【Congenital Section 및 논문작성법】

좌장: 이 철

Pulmonary Venous Abnormalities

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김 형 태

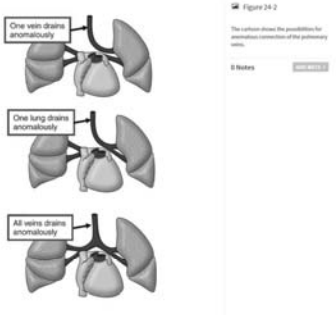
- The anomalous pulmonary venous connections are so commonly associated with isomerism of the atrial appendages

Totally anomalous pulmonary venous connection

- Incidence and aetiology
- Accounting for 1.5% of all patients with a cardiovascular malformation
- Being seen once in 14,700 live births
- Two-thirds with supracardiac and cardiac connections were males, while it was the infradiaphragmatic variant that showed an equal mix of genders
- One report suggesting autosomal dominant inheritance
- Identified a link between totally anomalous connection and paternal exposure to lead prior to conception

Totally anomalous pulmonary venous connection

- Anatomy

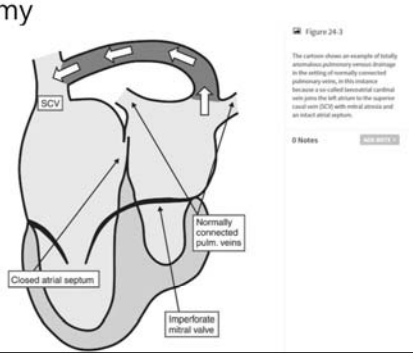


Totally anomalous pulmonary venous connection

- Anatomy
- Necessary to seek stenotic areas or regions along the route of anomalous drainage
- To establish whether the anomalous pulmonary venous connection is an isolated malformation, or part of a more complex anomaly
- Whether there are associated structural malformation of the pulmonary vasculature

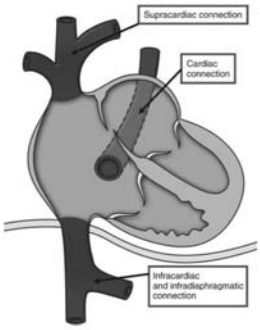
Totally anomalous pulmonary venous connection

- Anatomy



Totally anomalous pulmonary venous connection

- Anatomy
- The sites of anomalous connection are divided into supracardiac, cardiac, and infracardiac groups
- The first two, taken together, constitute supradiaphragmatic drainage, while infracardiac drainage is at the same time infradiaphragmatic



Totally anomalous pulmonary venous connection

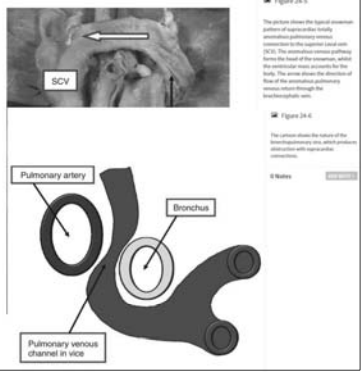
- Anatomy
- The commonest site for anomalous connection is supracadiac, accounting for nearly half of cases
- cardiac and intracardiac anomalous connections account for approximately one-quarter each of the total group

Totally anomalous pulmonary venous connection

- Anatomy
- Supracardiac connection can be to the left brachiocephalic vein, directly to the right superior caval vein, to the azygos system of veins, or to the left superior caval vein, albeit that when the left vein drains to the coronary sinus this is considered cardiac drainage
- In the most common pattern, the four pulmonary veins usually join in turn to a venous channel behind the left atrium

Totally anomalous pulmonary venous connection

- Anatomy
- If the vein passes anterior to the left pulmonary artery, then this course is not associated with obstruction
- Should the vein pass between the left pulmonary artery and the left bronchus, these two structures clasp the channel in the so-called bronchopulmonary vice



Totally anomalous pulmonary venous connection

- Anatomy
- Obstruction with this snowman pattern of anomalous connection can also occur, albeit rarely, at the opening of the brachiocephalic vein into the superior caval vein
- Supracardiac connection can also be found when the vertical vein joins directly with the right superior caval vein
- Obstruction may then occur between the right pulmonary artery and the carina

Totally anomalous pulmonary venous connection

- Anatomy

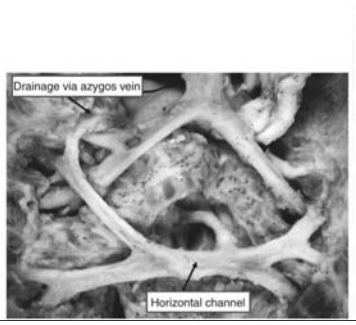


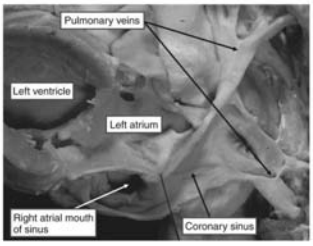
Figure 24-7

In this specimen, from a patient with isomeric right atrial appendages, the horizontal vein passes from left to right and ascends in the right paravertebral gutter, draining in supracardiac fashion through the azygos vein.

0 Notes

Totally anomalous pulmonary venous connection

- Anatomy
- When there is usual atrial arrangement, then almost always the cardiac form of anomalous connection is found when the pulmonary veins join the right atrium via the coronary sinus
- Obstruction is rare when the pulmonary veins drain through the coronary sinus, but can be produced by persistence of the Thebesian valve, or within the sinus when the individual veins connect in unusual fashion



Totally anomalous pulmonary venous connection

- Anatomy
- Direct connection of the pulmonary veins to the morphologically right atrium is exceedingly rare other than in the setting of isomerism of the right atrial appendages

Totally anomalous pulmonary venous connection

- Anatomy
- The final site of anomalous connection is both infracardiac and infradiaphragmatic
- The pulmonary veins join together, entering a descending vertical vein that passes into the abdomen through the oesophageal orifice of the diaphragm
- It then usually drains to the portal vein, or to one of its tributaries
- Drainage to the inferior caval vein is very rare

Totally anomalous pulmonary venous connection

- Anatomy
- When the inferior connection is to the portal venous system, obstruction is almost always present subsequent to closure of the venous duct
- Additional discrete stenosis can be found as the vertical vein passes through the diaphragm

Totally anomalous pulmonary venous connection

- Anatomy
- As discussed, it is also possible for different veins to terminate in different anomalous sites (mixed anomalous connection)

Totally anomalous pulmonary venous connection

- Anatomy
- A large proportion of the patients have significant associated malformations
- Even when the anomalous connection is isolated, there is almost always an interatrial communication present, so that venous blood is able to reach the left side of the heart

Totally anomalous pulmonary venous connection

- Anatomy
- At first sight, the left atrium and left ventricle seem small to the morphologist because of the disparate hyperplasia of the right atrium and right ventricle
- Measurements, however, show that the left-sided structures are usually of adequate dimensions

Totally anomalous pulmonary venous connection

- Morphogenesis
- Totally anomalous pulmonary venous connection is the consequence of failure of canalisation of the pulmonary venous channel in the mediastinum
- Initially, since the lung buds themselves are derived from the foregut, the intrapulmonary veins also have connections to the systemic venous system
- Should the pulmonary venous channel fail to develop, these anastomoses between pulmonary and systemic venous system persist and enlarge

Totally anomalous pulmonary venous connection

- Pathophysiology
- Shunt
- There is an obligatory left-to-right shunt, since pulmonary venous return is to the systemic veins or right atrium
- A systemic output can only be maintained if there is a right-to-left shunt, which is almost always at atrial level
- Exceptional cases have been described in which the atrial septum was intact
- In these patients, the right-to-left shunt occurred either at ventricular, or ductal level

Totally anomalous pulmonary venous connection

- Pathophysiology
- Obstruction to pulmonary venous return
- Obstruction to pulmonary venous return can occur at any of the anatomical sites documented above
- When there is definable obstruction, the right ventricular pressure is usually suprasystemic
- Almost all patients with pulmonary vascular obstruction also had pulmonary venous obstruction

Totally anomalous pulmonary venous connection

- Pathophysiology
- Consequences of pulmonary venous obstruction
- When pulmonary venous return is unobstructed, right ventricular diastolic pressure is low and right ventriclar compliance relatively high
- Since mixing of pulmonary and systemic venous blood is complete, apart from the minor degrees of streaming, right atrial and, therefore, systemic arterial blood is well oxygenated, with saturations of oxygen found in excess of 90%

Totally anomalous pulmonary venous connection

- Pathophysiology
- Consequences of pulmonary venous obstruction
- In the presence of pulmonary venous obstruction, in contrast, pulmonary venous pressure is raised
- The right ventricle becomes pressure rather than volume overloaded
- Systemic arterial oxygen saturation may then fall to values of 20% to 30%
- Results in tissue hypoxemia and metabolic acidosis

Totally anomalous pulmonary venous connection

- Presentation and symptoms
- The main determinant of the clinical picture was the presence of pulmonary venous obstruction
- Patients will be divided into those with and without pulmonary venous obstruction

Totally anomalous pulmonary venous connection

- Presentation and symptoms
- Patients with severe pulmonary venous obstruction present in the first week or two of life with obvious cyanosis and difficulties with feeding and respiration
- Patients without severe pulmonary venous obstruction tend to present in heart failure at 2 to 3 months of age
- They have a history of difficulties with feeding and, sometimes, chest infections
- Cyanosis is generally not a symptom

Totally anomalous pulmonary venous connection

- Presentation and symptoms
- Those with severe pulmonary venous obstruction are sick neonates with obvious or severe cyanosis
- Skin mottling is frequent, reflecting poor peripheral perfusion and metabolic acidosis
- Tachypnea is usually marked, though respiration is quiet
- Hepatomegaly is occasionally considerable, particularly when drainage is to the portal vein
- The peripheral pulses are often somewhat weak

Totally anomalous pulmonary venous connection

- Investigations
- Chest radiography
- Newborn with severe pulmonary venous obstruction have an extremely characteristic chest radiograph, with a small or normally sized heart framed by ground-glass lung fields

Totally anomalous pulmonary venous connection

- Investigations
- Chest radiography
- Patients without severe pulmonary venous obstruction have enlarged hearts because of the right ventricular volume overload, together with engorged lung fields
- The pulmonary trunk becomes prominent in older patients, as does the left vertical vein when this is the site of the anomalous venous connection -> the snowman appearance

Totally anomalous pulmonary venous connection

- Investigations
- Electrocardiography
- The electrocardiogram shows right-axis deviation with a clock wise frontal plane loop and right ventricular hypertrophy
- Disturbances of conduction are rare
- Patients with pulmonary venous obstruction, who present younger, are much less likely to have right atrial hypertrophy than those without pulmonary venous obstruction

Totally anomalous pulmonary venous connection

- Investigations
- Echocardiography
- Echocardiography is the definitive non-invasive method of diagnosis
- Exclusive right-to-left shunting at the atrial level through an atrial septal defect or patent oval foramen -> it should be assumed that any patient with this finding has totally anomalous pulmonary venous connection until proven otherwise

Totally anomalous pulmonary venous connection

- Investigatioins
- Echocardiography
- Other clues -> small left atrium, dilated superior caval vein, non-pulsatile caudally-directed flow seen below the level of the heart in subcostal imaging, or non-pulsatile cranially-directed flow seen above the level of the heart

Totally anomalous pulmonary venous connection

- Investigations
- Echocardiography
- When the pulmonary veins are connected anomalously to the coronary sinus, the collecting venous channel is the coronary sinus itself
- Great care must be taken to distinguish between enlargement of the coronary sinus owing to persistence of the left suprior caval vein and the pattern in which the pulmonary veins drain into it

Totally anomalous pulmonary venous connection

- Investigations
- Echocardiography
- A descending vein, as found in anomalous infradiaphragmatic connection, can sometimes be seen descending from the confluence from the suprasternal approach
- Pulsed Doppler ultrasound or colour Doppler can be used to show that the descending pulmonary vein contains non-pulsatile blood moving inferiorly, while the inferior caval vein contains blood moving superiorly

Totally anomalous pulmonary venous connection

- Investigations
- Echocardiography
- Anomalous connection to the right atrium can be diagnosed if there is no ascending or descending vein, the coronary sinus is of normal size and the pulmonary veins can be followed to their site of entry to the right atrium

Totally anomalous pulmonary venous connection

- Investigations
- Echocardiography
- The echocardiographer should consider measuring the diameter of all four pulmonary veins between hilum and confluence, as the sum of these diameters is a strong and independent predictor of surgical survival
- Sites of obstructioin along the pulmonary venous pathway can be demonstrated as points of turbulence, or even absent flow, both pre- and post- operatively
- In areas where colour Doppler suggests obstruction, pulsed wave Doppler offers an objective measure
- The presence of a focal increase in flow velocity with a continuous, non-phasic flow pattern distally is a characteristic finding

Totally anomalous pulmonary venous connection

- Investigations
- Echocardiography
- If the clinical and cross sectional echocardiographic findings do not fit the clinical situation, additional imaging should be performed without hesitation
- Fetal echocardiography

Totally anomalous pulmonary venous connection

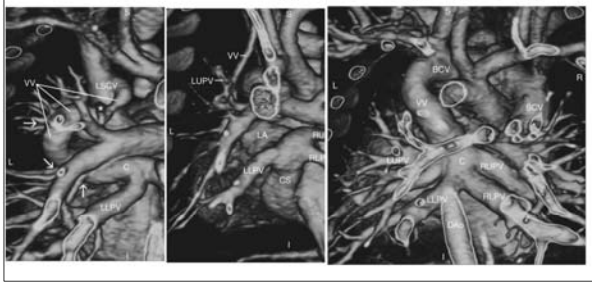
- Investigations
- Cardiac catheterisation
- The pulmonary venous anatomy can almost always be delineated non-invasively, and the clinical scenario of pulmonary venous obstruction can almost always be determined without invasive testing
- Pulmonary venous connections with a particularly tortuous course, as is often seen with infracardiac connection or drainage via the azygos system, can be difficult to follow by echocardiography

Totally anomalous pulmonary venous connection

- Investigations
- Computed tomographic angiography
- Technological advances in medical imaging have increased the utilisation of computed tomographic angiography in the evaluation of patients with anomalous pulmonary venous connection

Totally anomalous pulmonary venous connection

- Investigations
- Computed tomographic angiography



Totally anomalous pulmonary venous connection

- Differential diagnosis
- Unobstructed connection has to be distinguished from other conditions producing heart failure, mild cyanosis, and cardiomegaly with pulmonary plethora and right ventricular hypertrophy

Totally anomalous pulmonary venous connection

- Course and prognosis
- With medical treatment alone, three-quarters of all children with totally anomalous pulmonary connection uncomplicated by isomerism were dead or had undergone surgery by their first birthday
- The only place for medical treatment, therefore, is in resuscitation of the critically ill neonate

Totally anomalous pulmonary venous connection

- Course and prognosis
- Atrial septostomy – Sano and colleagues found that in no case did septostomy result in sufficient clinical improvement in critically ill patients to permit deferral of the operation
- In patients with severely obstructed pulmonary venous return, stent placement in the area of obstruction can be considered as a temporising measure if surgery cannot be performed in a timely manner

Totally anomalous pulmonary venous connection

- Management
- Medical treatment
- In the current era, medical management consists solely of supportive measures in preparation for surgical management

Totally anomalous pulmonary venous connection

- Management
- Surgery
- Operations at this time included those in which an anastomosis between the pulmonary venous confluence and the left atrium was created but (the interatrial communication was not closed; the common pulmonary vein, if obstructed, was not ligated)
- Because the left heart may have difficulty tolerating an acute increase in pulmonary venous return after surgery, resulting in low cardiac output, many surgeons leave the vertical vein intact after surgery

Totally anomalous pulmonary venous connection

- Management
- Surgery

TABLE 24-1 Results of Repair of Totally Anomalous Pulmonary Venous Connection in Infancy

Report	Date of Operation	Hospital Mortality (Number [%])
Katz et al[105]	1974–1977	4/19 (21%)
Wright et al[110]	1969–1976	3/23 (13%)
Hammon et al[25]	1969–1979	5/25 (20%)
Bove et al[116]	1971–1979	26/73 (36%)
Yee et al[120]	1975–1986	9/75 (11%)
Lamb et al[89]	1968–1985	14/80 (18%)
Lincoln et al[122]	1973–1986	12/83 (14%)
Sano et al[81]	1979–1987	1/44 (2%)
Raisher et al[97]	1983–1990	1/20 (5%)
Korbmacher et al[123]	1958–1992	18/52 (35%)
Lupinetti et al[91]	1985–1993	2/41 (5%)
Sinzobahamvya et al[93]	1977–1994	6/71 (8%)
Bando et al[87]	1966–1995	10/105 (10%)
Calderone et al[88]	1982–1996	19/126 (15%)
Bogers et al[85]	1973–1998	6/44 (14%)
Michielon et al[84]	1983–2001	11/89 (12%)
Hyde et al[83]	1988–1998	6/85 (7%)
Hancock Friesen et al[86]	1989–2000	10/84 (12%)

Totally anomalous pulmonary venous connection

- Management
- Surgery
- The post-operative course is frequently marked by pulmonary hypertensive crises
- Post-operative pulmonary hypertension in this population was tranditionally managed with 100% oxygen and epoprostenol (prostacyclin), but nitric oxide has shown promising results over the last 10 years

Totally anomalous pulmonary venous connection

- Results of surgery
- The late results of repair are, in general, excellent
- Nonetheless, late pulmonary venous obstruction is not uncommon
- It occurs in about 10% of all large surgical series
- Some authors have found it to be more common in patients with infracardiac or mixed drainage

Totally anomalous pulmonary venous connection

- Results of surgery
- In earlier studies, reoperation carried a high mortality and a strong chance of recurrence, whatever the nature of the obstruction
- In 1996, Lacour-Gayet and collegues, introduced a sutureless technique for reoperation using in situ pericardium with promising results

Totally anomalous pulmonary venous connection

- Results of surgery
- The diagnosis of restenosis, this will demonstrate a small anastomosis and/or a continuous, non-phasic relatively high-velocity Doppler flow signal and an enlarged right ventricle
- Computed tomographic angiography as the imaging modality used to clarify questionable echocardiography findings

Totally anomalous pulmonary venous connection

- Results of surgery
- The poor results of surgical relief of post-operative pulmonary venous obstruction have led to placement of stents across the stenoses either percutaneously or intraoperatively, but the results have either been disappointing, or else satisfactory over a very short term

Totally anomalous pulmonary venous connection

- Results of surgery
- A recent study by Kirshbom and colleagues evaluated long-term results of patients with totally anomalous pulmonary venous connection repaired between 1983 and 2005
- They reported an 84% 17-year survival rate, with most deaths occurring within a few months after surgery
- Over 90% of their patients reported excellent or good overall health, and school performance was average or better in 69% of subjects

Atresia of the common pulmonary vein

- Anatomy
- The essence of atresia of the common pulmonary vein is absence of functional connection between the pulmonary veins and the morphologically left atrium

Atresia of the common pulmonary vein

- Pathophysiology
- There is no direct route for blood to enter either the left atrium or any systemic vein and yet patients have lived for up to a month with this condition
- One suggested route is via bronchopulmonary venous anastomoses to the pleurohilar bronchial veins, which drain into the azygos, hemiazygos and brachiocephalic veins

Atresia of the common pulmonary vein

- Clinical presentation and investigation
- The age at presentation, clinical findings, electrocardiogram and chest radiograph are as for totally anomalous connection with severe pulmonary venous obstruction
- The diagnosis is difficult

Atresia of the common pulmonary vein

- Imaging
- Given the often small pulmonary venous confluence and severely obstructed flow through the pulmonary veins, this diagnosis can be very challenging to make using echocardiography
- Computed tomographic angiography can be attempted to define the anatomy

Atresia of the common pulmonary vein

- Management
- There is no medical treatment
- A few centers have reported success using aggressive haemodynamic stabilisation techniques, often including extracorporeal membrane oxygenation, and early surgical repair

Atrioventricular Septal Defect

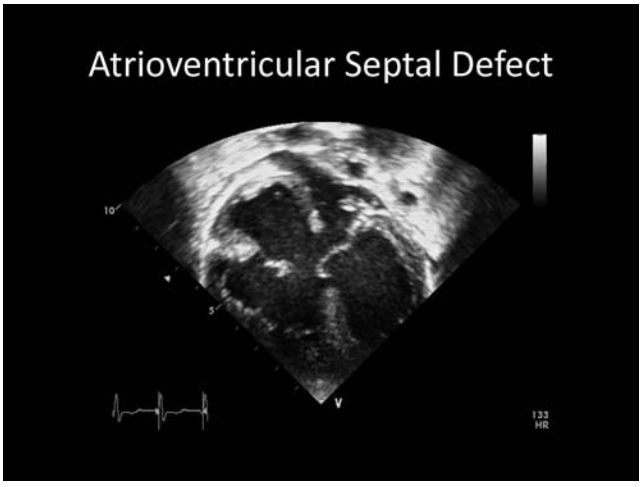
Pediatric and Congenital Cardiac Surgery, Seoul St. Mary's Hospital,
College of Medicine, The Catholic University of Korea

Cheul Lee, M.D.

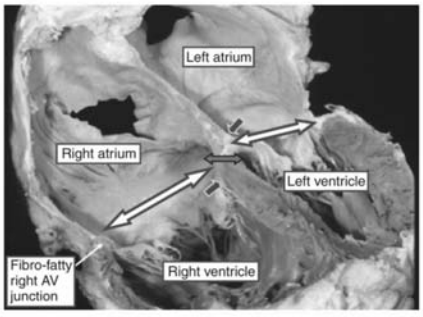
Atrioventricular Septal Defect

- A group of lesions unified by the anatomical hallmark of a common atrioventricular junction co-existing with deficient atrioventricular septation
- Synonyms
  - * Atrioventricular canal defect
  - * Endocardial cushion defect
- Approximately 4% of all congenital heart diseases

Atrioventricular Septal Defect

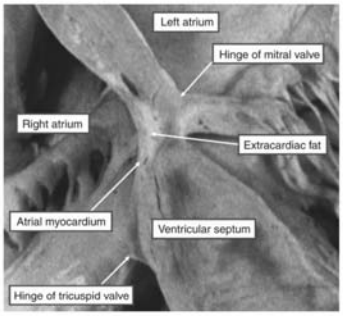


Normal Atrioventricular Junctions



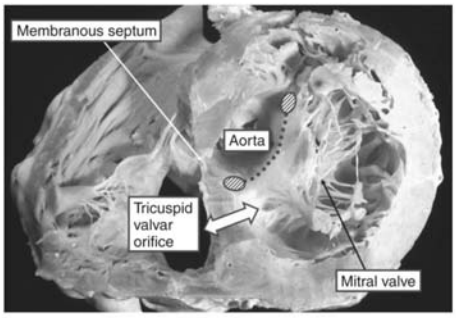
Anderson RH, et al. Paediatric Cardiology. 3rd ed.

Muscular Atrioventricular Sandwich



Anderson RH, et al. Paediatric Cardiology. 3rd ed.

Normal Atrioventricular Junctions



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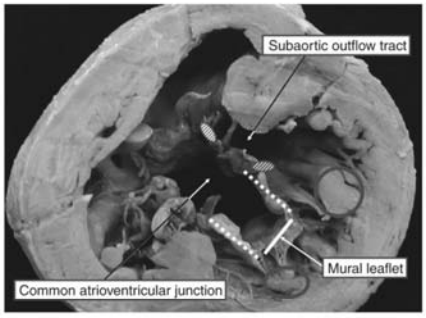
Common Atrioventricular Junction



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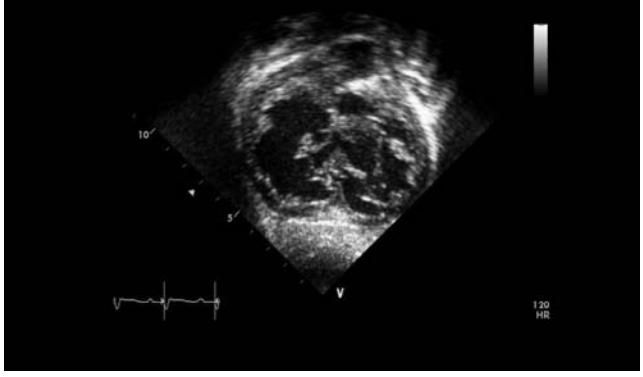
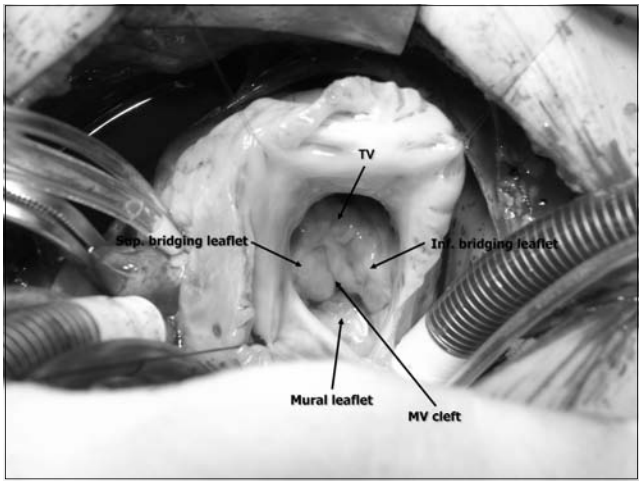
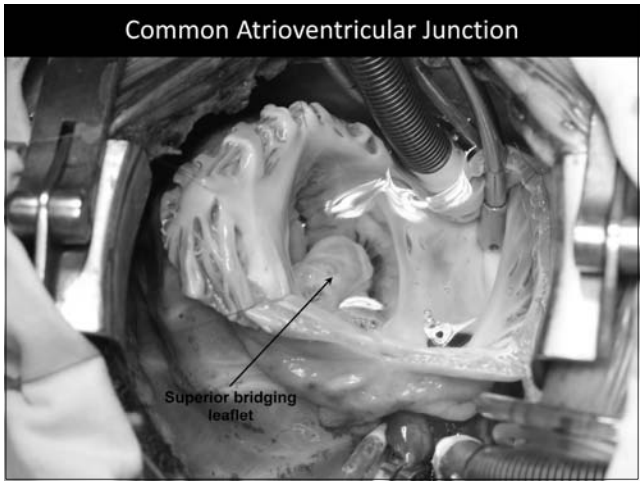
Common Atrioventricular Junction

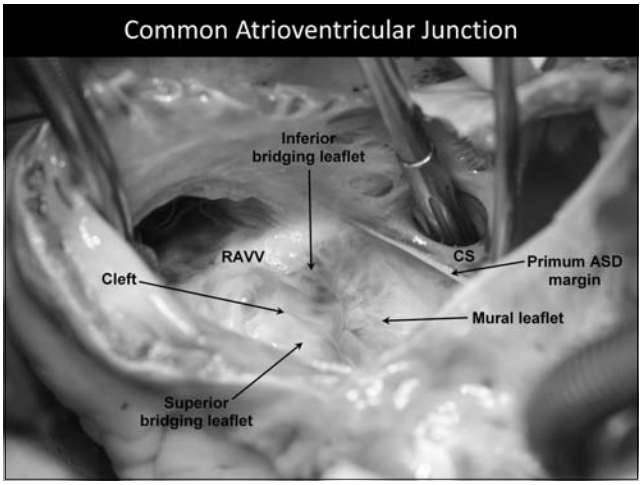




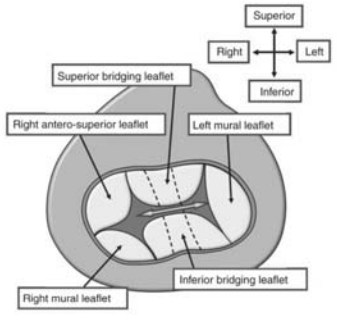
Common Atrioventricular Junction



Common Atrioventricular Junction

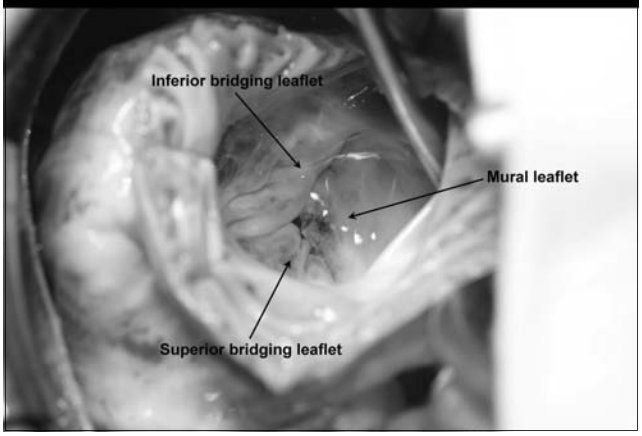


Atrioventricular Valve Leaflets

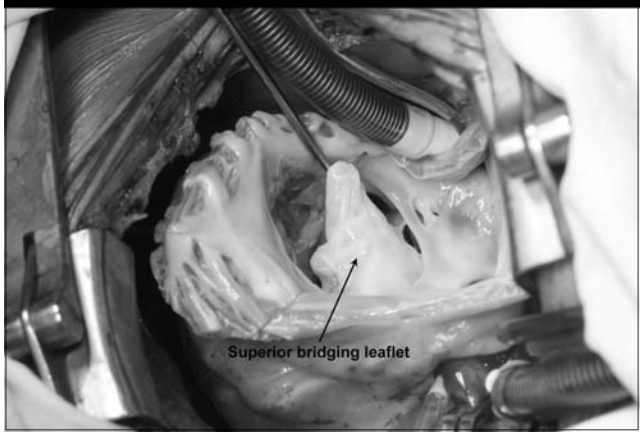


Anderson RH, et al. Paediatric Cardiology. 3rd ed.

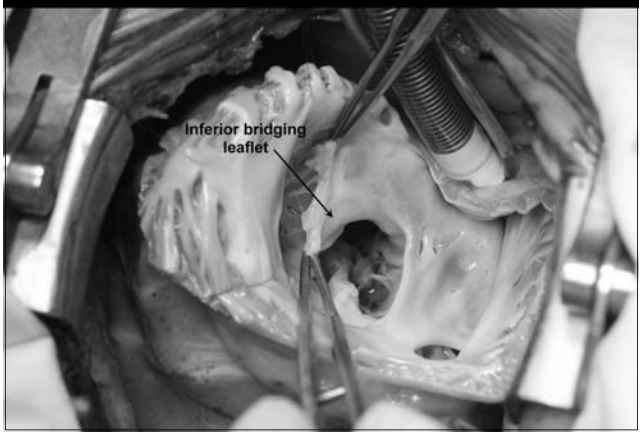
Left Atrioventricular Valve



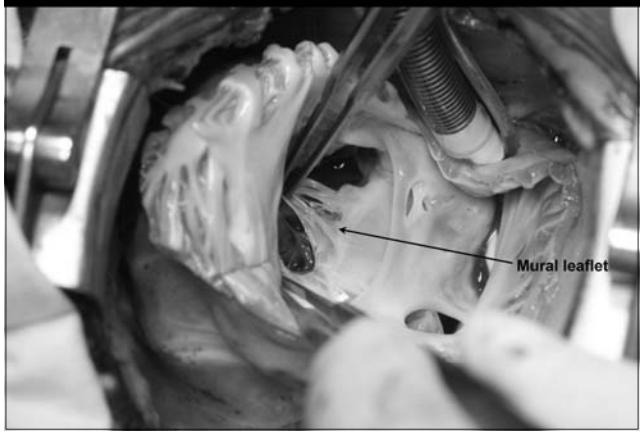
Superior Bridging Leaflet



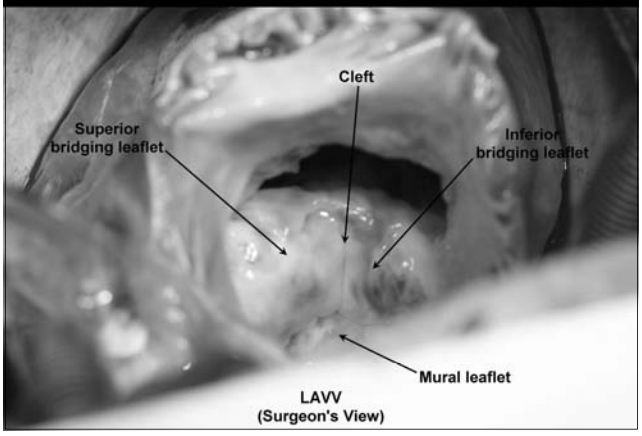
Inferior Bridging Leaflet

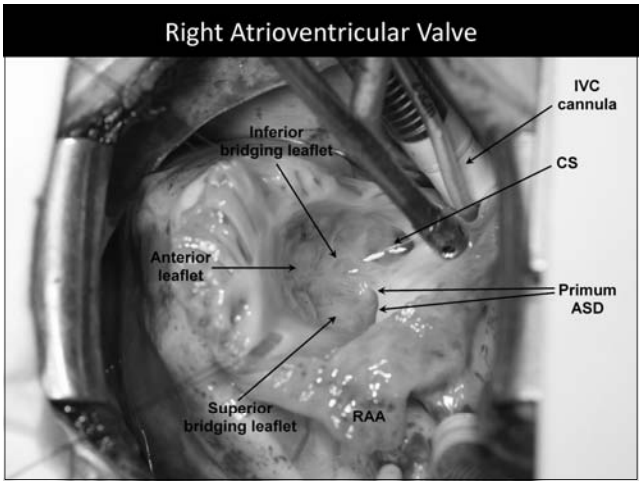


Left Mural Leaflet



Left Atrioventricular Valve



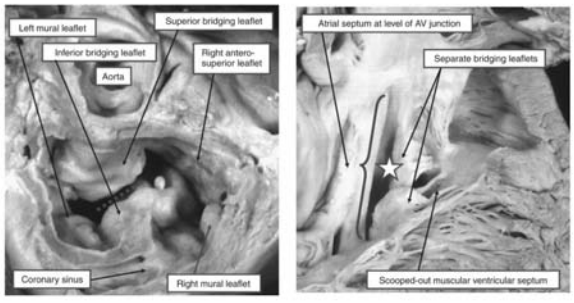


Congenital Heart Surgery Nomenclature and Database Project

- Partial (incomplete) AVSD
  = separate AV valve orifices + primum ASD
- Intermediate (transitional) AVSD
  = separate AV valve orifices + primum ASD + restrictive VSD
- Complete AVSD
  = common AV valve orifice + primum ASD + nonrestrictive VSD

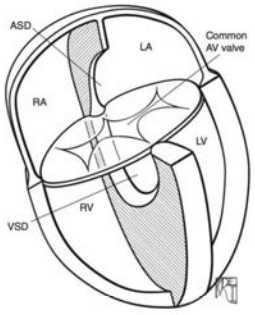
Ann Thorac Surg. 2000;69:S36-43.

Complete AVSD



Anderson RH, et al. Paediatric Cardiology. 3rd ed.

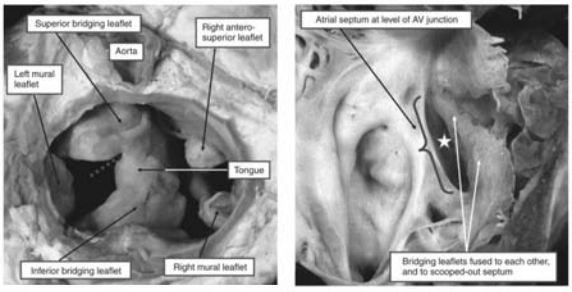
Complete AVSD



Mavroudis C, et al. Pediatric Cardiac Surgery. 4th ed.

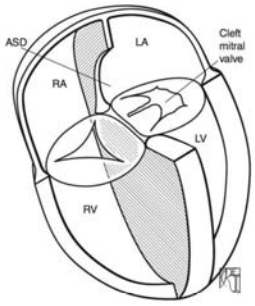
Complete AVSD

Partial AVSD



Anderson RH, et al. Paediatric Cardiology. 3rd ed.

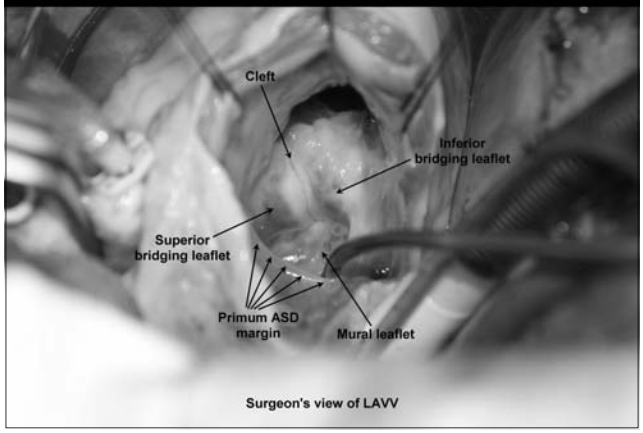
Partial AVSD



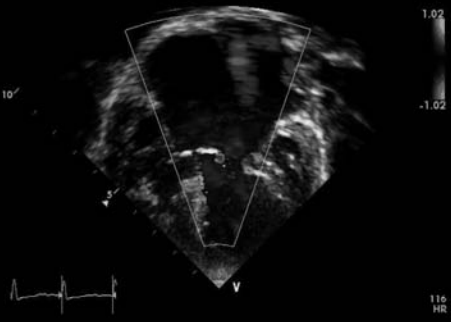
Mavroudis C, et al. Pediatric Cardiac Surgery. 4th ed.

Partial AVSD

Left Atrioventricular Valve Cleft

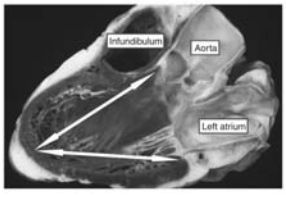


Atrioventricular Valve Regurgitation

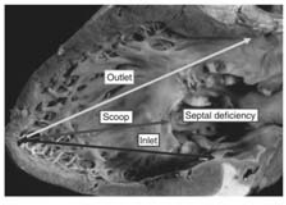


Inlet and Outlet Dimensions of the LV

Normal Heart

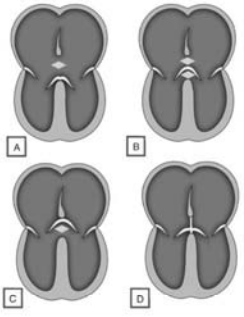


Atrioventricular Septal Defect



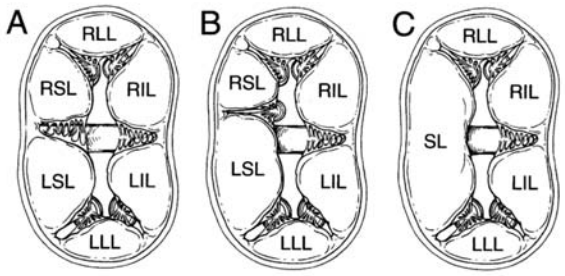
Anderson RH, et al. Paediatric Cardiology. 3rd ed.

Potential for Shunting



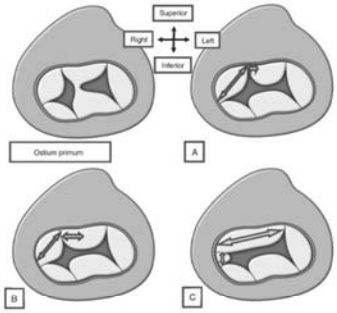
Anderson RH, et al. Paediatric Cardiology. 3rd ed.

Rastelli Classification



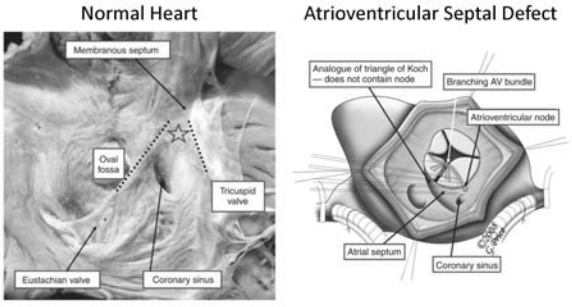
Ann Thorac Surg. 2000;69:S36-43.

Rastelli Classification



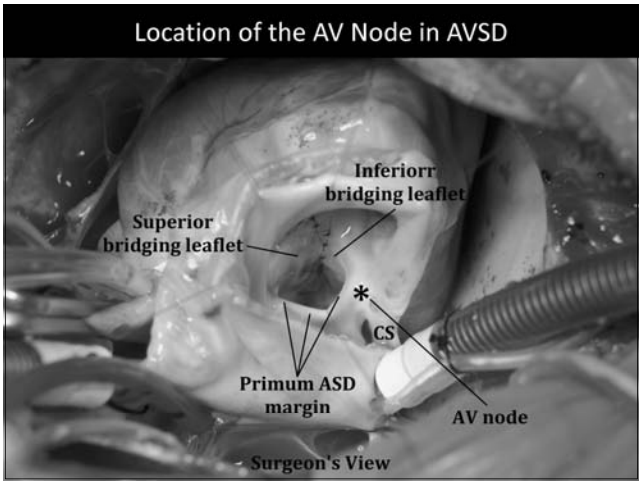
Anderson RH, et al. Paediatric Cardiology. 3rd ed.

Location of the AV Node



Anderson RH, et al. Paediatric Cardiology. 3rd ed.

Location of the AV Node in AVSD



Associated Cardiac Anomalies

- Patent ductus arteriosus
- Tetralogy of Fallot
- Completely unroofed coronary sinus with left SVC
- Heterotaxia
- Double outlet right ventricle
- Additional VSDs
- Total anomalous pulmonary venous connection
- Left ventricular outflow tract obstruction
- Transposition of the great arteries
- Etc.

Down Syndrome

- Rare in patients with partial AVSD
- Common in patients with complete AVSD (about 75%)
- More frequent advanced pulmonary vascular disease

Pathophysiology

- Left-to-right shunting is present unless severe pulmonary vascular disease has developed or important right ventricular outflow tract obstruction coexists.
- Partial AVSD: similar to that of an isolated ASD
- Complete AVSD
  * Large left-to-right shunt
  * Important elevation of PVR after age 6 to 12 months
- AV valve regurgitation: ventricular volume overload

AV Valve Regurgitation

- About 10-15% of patients with partial AVSD have important AV valve regurgitation.
- About 35% of patients with complete AVSD have important AV valve regurgitation.
- AV valve regurgitation may be more common in older patients with complete AVSD.

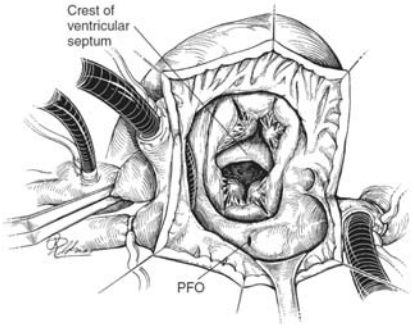
Timing of Surgery

- Asymptomatic partial AVSD: 1-3 years of age
- Partial AVSD with significant AVVR: earlier repair
- Complete AVSD: 3-6 months of age
- Symptomatic complete AVSD: earlier repair
- Role of pulmonary artery banding?

Goals of Surgery

1. Closing the interatrial communication
2. Closing the interventricular communication
3. Avoiding damage to the AV node and bundle of His
4. Maintaining or creating two competent, nonstenotic AV valves

Exposure

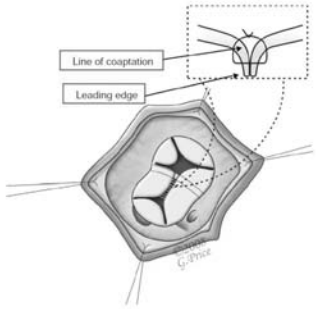


Mavroudis C, et al. Pediatric Cardiac Surgery. 4th ed.

Left AV Valve Cleft Repair

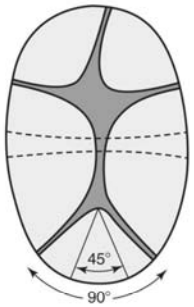
- Routine cleft repair is a current standard.
- The extent of cleft repair is determined by the position of the papillary muscles and the size of the left mural leaflet.
- When the papillary muscles are close together or a single papillary muscle is present, complete cleft repair can result in significant stenosis.

Left AV Valve Cleft Repair



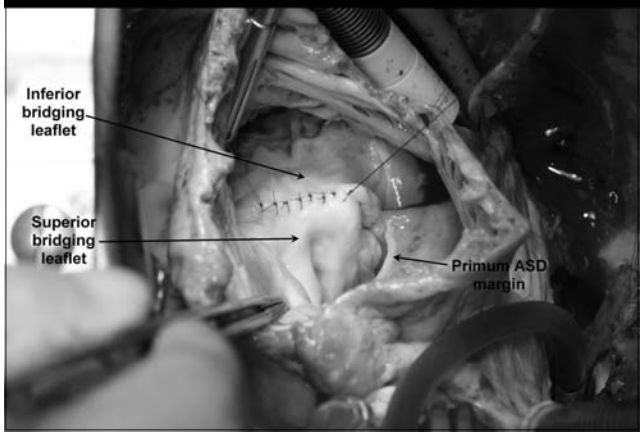
Anderson RH, et al. Paediatric Cardiology. 3rd ed.

Angular Size of the Left Mural Leaflet

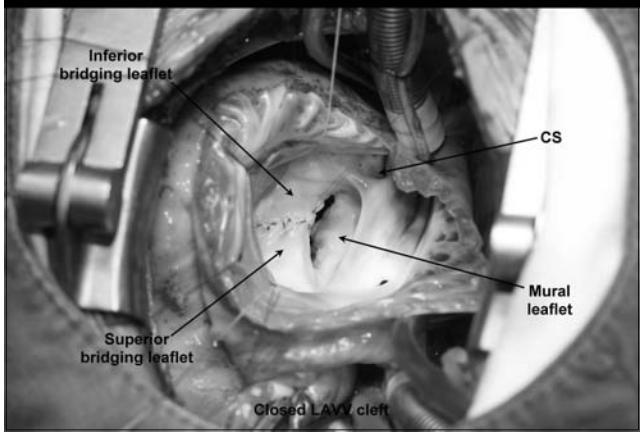


Anderson RH, et al. Paediatric Cardiology. 3rd ed.

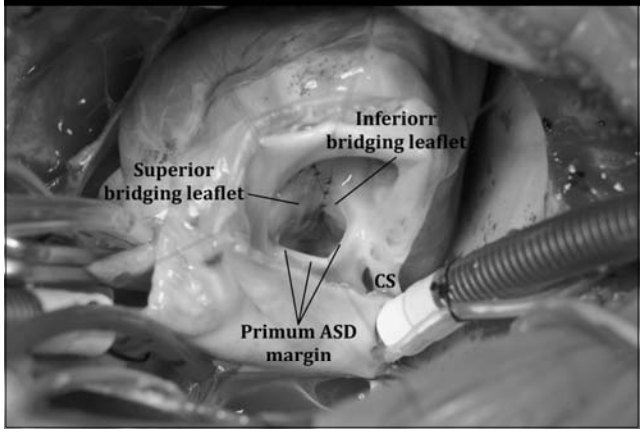
Repair of the Left AV Valve Cleft



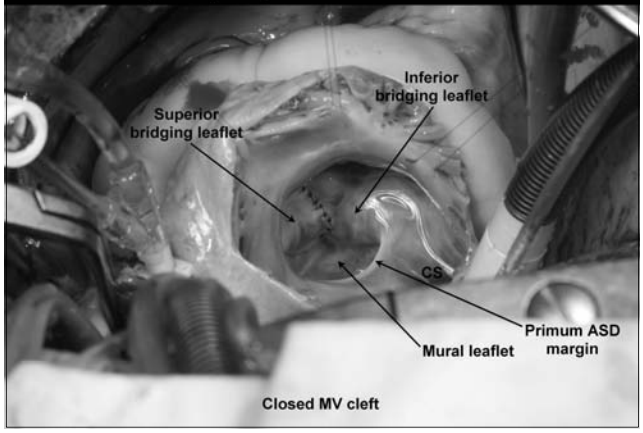
Completely Repaired Left AV Valve Cleft

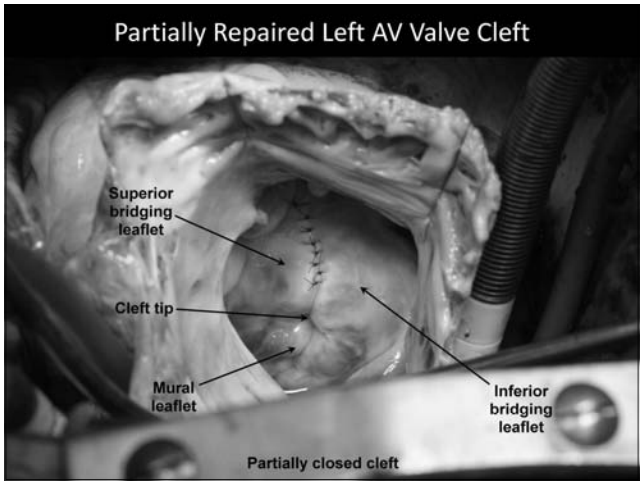


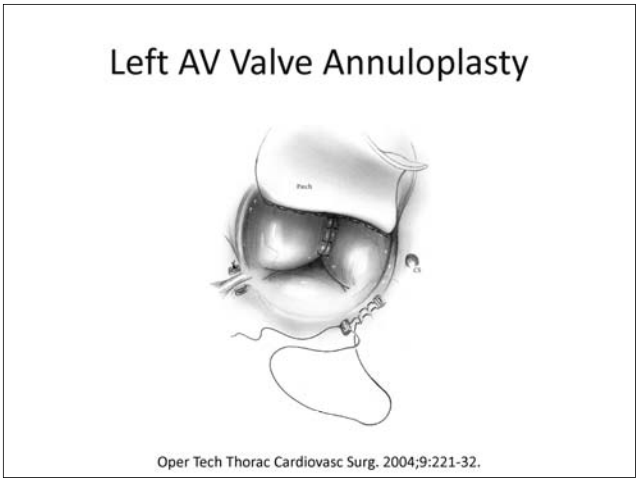
Completely Repaired Left AV Valve Cleft

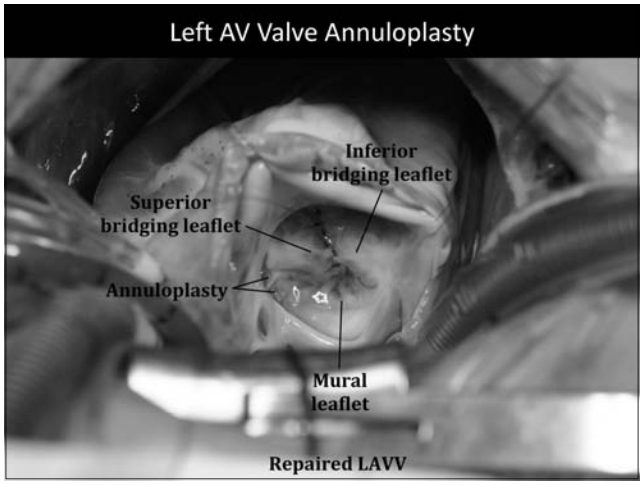


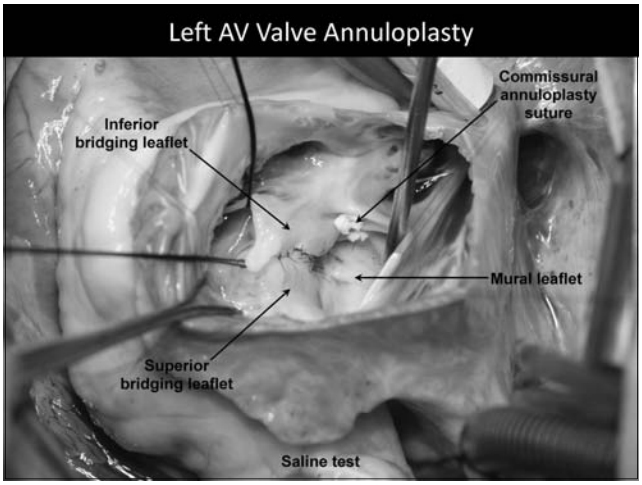
Completely Repaired Left AV Valve Cleft

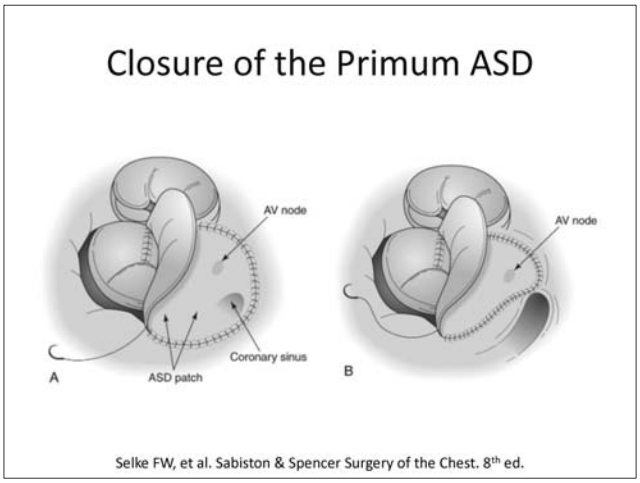


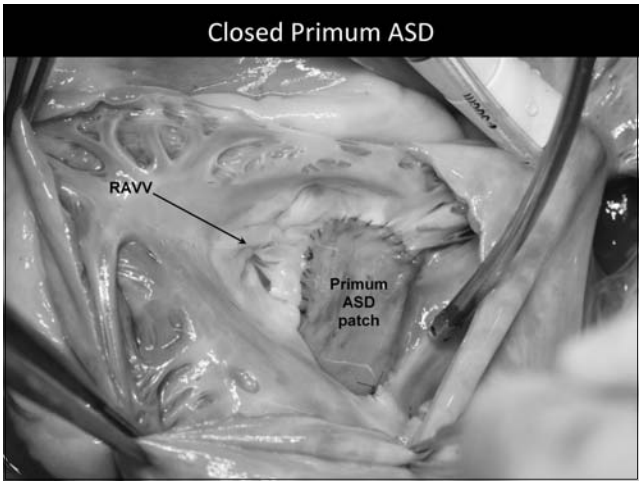

Partially Repaired Left AV Valve Cleft
Superior bridging leaflet
Cleft tip
Mural leaflet
Inferior bridging leaflet
Partially closed cleft


Left AV Valve Annuloplasty
Oper Tech Thorac Cardiovasc Surg. 2004;9:221-32.

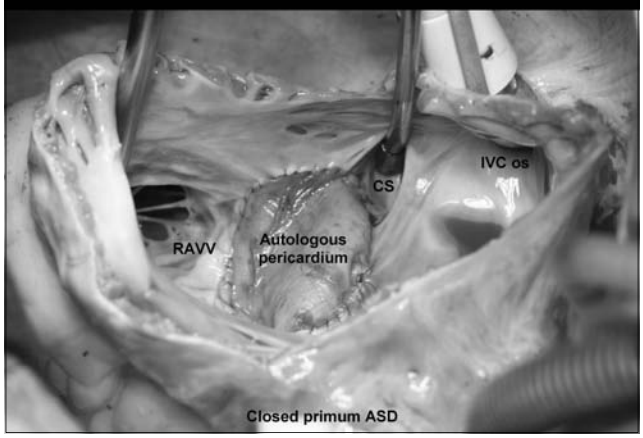

Left AV Valve Annuloplasty
Inferior bridging leaflet
Superior bridging leaflet
Annuloplasty
Mural leaflet
Repaired LAVV


Left AV Valve Annuloplasty
Commissural annuloplasty suture
Inferior bridging leaflet
Mural leaflet
Superior bridging leaflet
Saline test


Closure of the Primum ASD
AV node
Coronary sinus
A
ASD patch
AV node
B
Selke FW, et al. Sabiston & Spencer Surgery of the Chest. 8th ed.


Closed Primum ASD
RAVV
Primum ASD patch

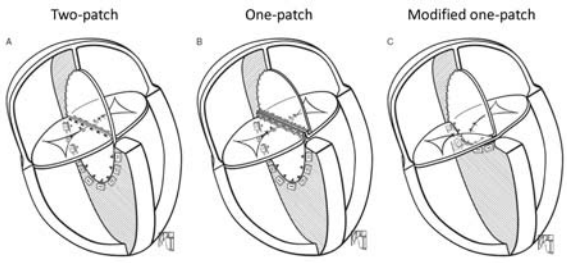
Closed Primum ASD



Repair Techniques for Complete AVSD

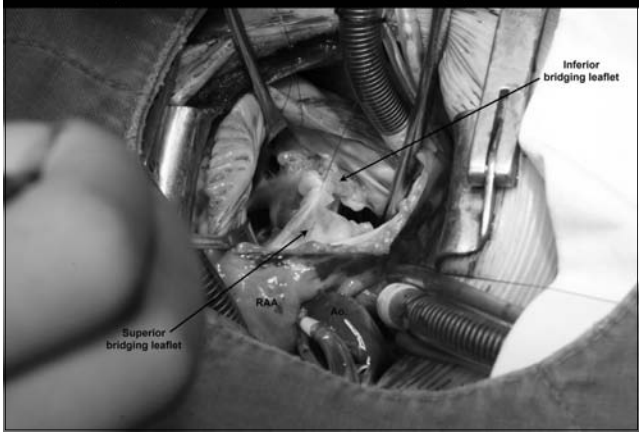
- One-patch technique
- Two-patch technique
- Modified one-patch technique

Repair Techniques for Complete AVSD

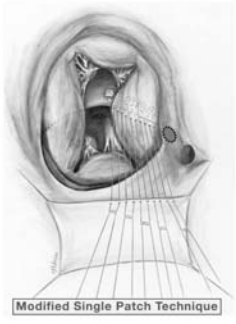


Mavroudis C, et al. Pediatric Cardiac Surgery. 4th ed.

Approximation of the Zone of Apposition

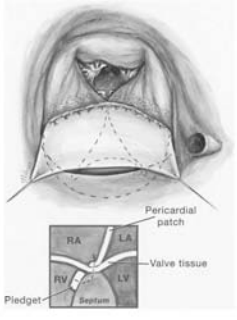


Modified One-Patch Technique

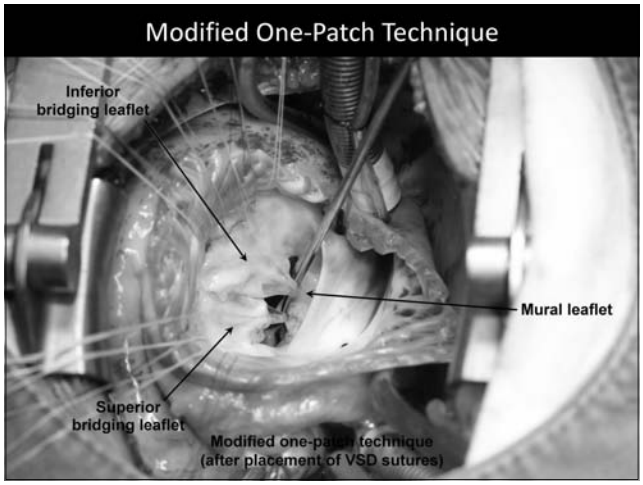


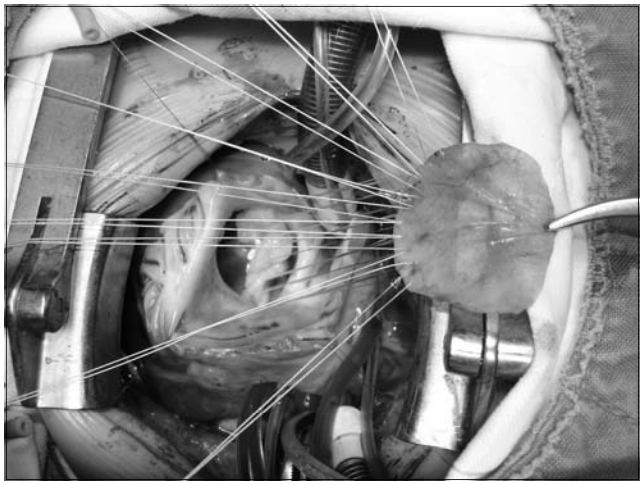
Ann Thorac Surg. 2007;84:2038-46.

Modified One-Patch Technique



Ann Thorac Surg. 2007;84:2038-46.





Contemporary outcomes of complete atrioventricular septal defect repair: Analysis of the Society of Thoracic Surgeons Congenital Heart Surgery Database

James D. St. Louis, MD,[a] Upinder Jodhka, MD, MHS,[b] Jeffrey P. Jacobs, MD,[c] Xia He, MS,[d] Kevin D. Hill, MD,[d] Sara K. Pasquali, MD, MHS,[c] and Marshall L. Jacobs, MD[c]

Objective: Contemporary outcomes data for complete atrioventricular septal defect (CAVSD) repair are limited. We sought to describe early outcomes of CAVSD repair across a large multicenter cohort, and explore potential associations with patient characteristics, including age, weight, and genetic syndromes.

Methods: Patients in the Society of Thoracic Surgeons Congenital Heart Surgery Database having repair of CAVSD (2008-2011) were included. Preoperative, operative, and outcomes data were described. Univariate associations between patient factors and outcomes were described.

Results: Of 2399 patients (101 centers), 78.4% had Down syndrome. Median age at surgery was 4.6 months (interquartile range, 3.5-6.1 months), with 11.8% (n = 284) aged ≤2.5 months. Median weight at surgery was 5.0 kg (interquartile range, 4.3-5.8 kg) with 6.3% (n = 151) < 3.5 kg. Pulmonary artery band removal at CAVSD repair was performed in 122 patients (4.6%). Major complications occurred in 9.8%, including permanent pacemaker implantation in 2.7%. Median postoperative length of stay (PLOS) was 8 days (interquartile range, 5-14 days). Overall hospital mortality was 3.0%. Weight < 3.5 kg and age ≤ 2.5 months were associated with higher mortality, longer PLOS, and increased frequency of major complications. Patients with Down syndrome had lower rates of mortality and morbidities than other patients; PLOS was similar.

Conclusions: In a contemporary multicenter cohort, most patients with CAVSD have repair early in the first year of life. Prior pulmonary artery band is rare. Hospital mortality is generally low, although patients at extremes of low weight and younger age have worse outcomes. Mortality and major complication rates are lower in patients with Down syndrome. (J Thorac Cardiovasc Surg 2014;148:2526-31)

Early Outcomes of Complete AVSD Repair STS Congenital Heart Surgery Database Study

- Down syndrome: 78%
- Medina age at surgery: 4.6 months
- Prior pulmonary artery banding: 4.6%
- Major complications: 9.8% (pacemaker 2.7%)
- Hospital mortality: 3.0%
- Risk factors for mortality and complications: weight < 3.5 kg, age < 2.5 months
- Down syndrome: lower rate of mortality and morbidities

J Thorac Cardiovasc Surg. 2014;148:2026-31.

Late Reoperation

- The most common cause of late reoperation after repair of AVSD is left AV valve regurgitation.
- The reoperation rate for left AV valve regurgitation is approximately 10%.

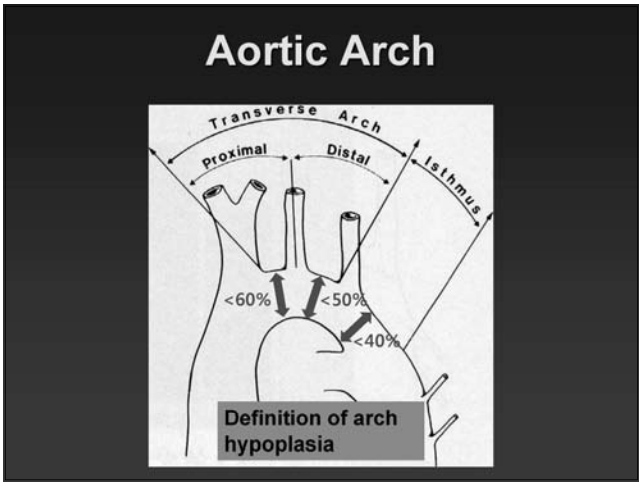
References

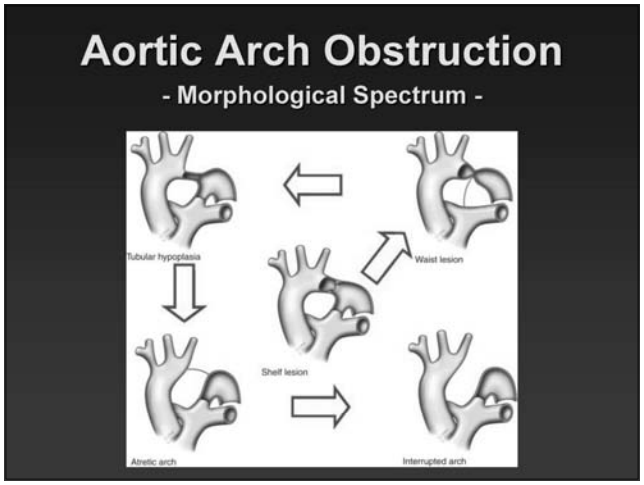
1. Anderson RH, et al. Paediatric Cardiology. 3rd ed.
2. Kouchoukos NT, et al. Kirklin/Barratt-Boyes Cardiac Surgery. 4th ed.
3. Mavroudis C, et al. Pediatric Cardiac Surgery. 4th ed.
4. Selke FW, et al. Sabiston & Spencer Surgery of the Chest. 8th ed.
5. 김용진, 외. 심장외과학. 1판

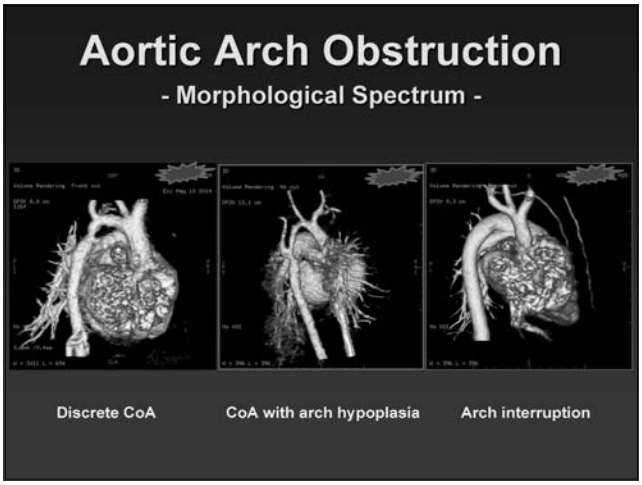
Arch Obstruction & LVOTO

서울아산병원 소아심장외과

박 천 수

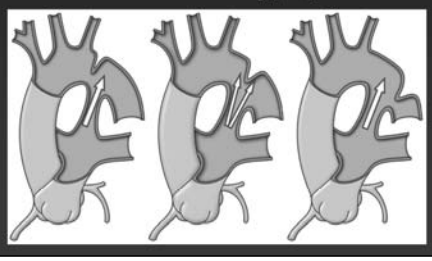






Aortic Arch Obstruction

- Coarctation of Aorta
  - ✓ Site of coarctation
  - ✓ Concomitant arch hypoplasia



Aortic Arch Obstruction

- Coarctation of Aorta

- Preductal
- Arch hypoplasia
- Infantile CoA

- Postductal
- Discrete
- Adult CoA

Aortic Arch Obstruction

- Interrupted aortic arch
  - ✓ Type A : isthmus
  - ✓ Type B : distal arch (↑aberrant SCA)
  - ✓ Type C : proximal arch

Presentation

- Heart failure
  - Mostly < 3months of life
  - A significant number < 1st week of life
- Circulatory collapse
  - Ductal closure: ↓ in lower body perfusion
  - Falling PVR: preferential flow of blood to the pulmonary circulation

→ development of acidosis and shock

Initial Management

- Stabilization
  - Maintain ductal patency : Prostaglandin E1
    - Maximal response: 15 minutes ~ 4 hours
    - Less effective: older or closed duct

    → Strongly suspected → Start PGE1!!

    → Antenatal transfer to tertiary center
  - Mechanical ventilator
    - Reduce the systemic O2 demand
    - Improve heart failure
    - Maneuvers to ↑ PVR: ↑ lower body perfusion

Surgical Correction

- Extent of arch obstruction
- Combined anomaly
  - Simple septal defects: VSD, ASD
  - Complex septal defect: CAVSD
  - Left heart anomaly: LVOTO, AS, MS, LV hypoplasia…
- Arch obstruction + simple septal defect

→ One-stage correction

Surgical Consideration
- Extent of Arch Surgery -

- End-to-End anastomosis
- End-to-Side anastomosis
  *Extended repair: proximal to 1st branch
- Subclavian flap; (reverse flap)
- Prosthetic patch
- Prosthetic interposition graft

Surgical Consideration
- DHCA vs. regional perfusion -

	DHCA	SCP
Advantage	• Clear operative field • More accurate correction especially in small babies • ↓ exposure to CPB	• Potentially neuroprotective
Disadvantage	• Poor neurodevelopmental outcome → Safe duration of circulatory arrest :???	• Crowded operative field • Technically demanding • Lack of randomized trial

Surgical Consideration
- DHCA vs. regional perfusion -

	DHCA	SCP
Advantage	• Clear operative field • More accurate correction especially in small babies • ↓ exposure to CPB	• Optimal perfusion flow: ? • Optimal perfusion pressure: ? • Is it really neuroprotective?
Disadvantage	• Poor neurodevelopmental outcome → Safe duration of circulatory arrest :???	• Crowded operative field • Technically demanding • Lack of randomized trial

Surgical Consideration
- DHCA vs. regional perfusion -

Perfusion
No perfusion

Surgical Consideration
- DHCA vs. regional perfusion -

Perfusion
is better !

Surgical Consideration
- Cerebral Protection -

- Selective cerebral perfusion
  - Our standard
  - Monitoring
    - Blood pressure
    - Flow rate : 50~70ml/kg/min (30~ 50%)
    - Near-infrared spectroscopy
    - Lactic acid

Surgical Consideration
- Cerebral Protection -

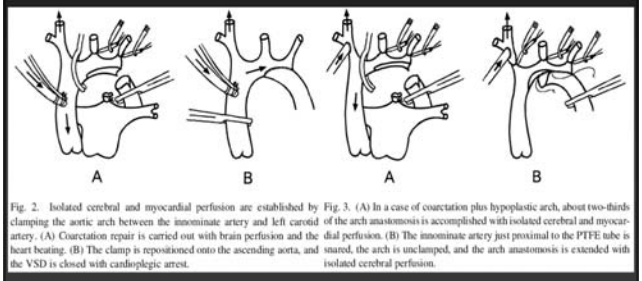


Fig. 2. Isolated cerebral and myocardial perfusion are established by clamping the aortic arch between the innominate artery and left carotid artery. (A) Coarctation repair is carried out with brain perfusion and the heart beating. (B) The clamp is repositioned onto the ascending aorta, and the VSD is closed with cardioplegic arrest.

Fig. 3. (A) In a case of coarctation plus hypoplastic arch, about two-thirds of the arch anastomosis is accomplished with isolated cerebral and myocardial perfusion. (B) The innominate artery just proximal to the PTFE tube is snared, the arch is unclamped, and the arch anastomosis is extended with isolated cerebral perfusion.

Ishino K et al. Eur J Cardiothorac Surg 2000;17:538-42.

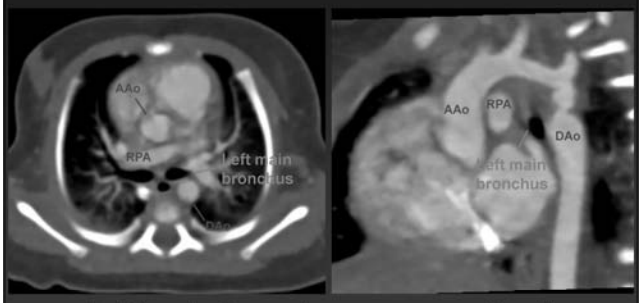
Surgical Consideration

- Selective cerebral perfusion
- Perfusion is better !

+ Selective myocardial perfusion

→ Selective C & M perfusion

Surgical Consideration
- Airway -

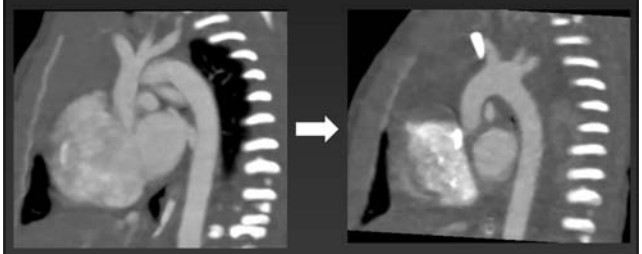


Left main bronchus compression!!

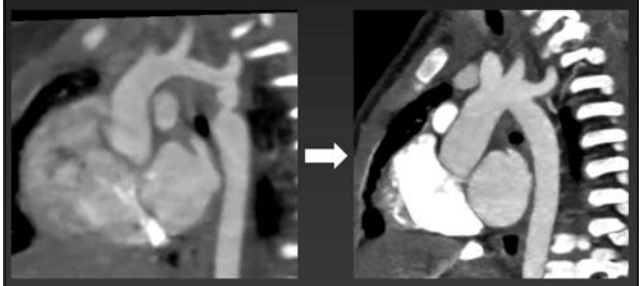
Surgical Consideration
- Airway -

- To avoid airway problem
  - ✓ extensive dissection of arch vessels and descending aorta
  - ✓ arch repair using autologous MPA patch
  - ✓ RPA anterior translocation

Surgical Consideration
- Arch repair using autologous MPA patch -



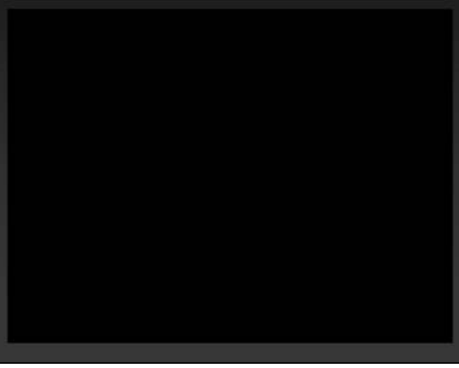
Surgical Consideration
- RPA anterior translocation -



Case 1
- Discrete CoA -

- M/ 4years
- Asymptomatic
- Murmur
- Prep. cuff blood pressure
  - ✓ UE: 105/65, LE: 97/66, PG 8
- EchoCG/ Heart CT

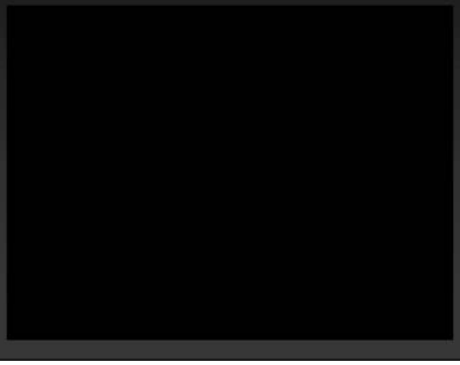
Case 1
- Discrete CoA -



Case 1
- Discrete CoA -

Case 1
- Discrete CoA -

Case 1
- Discrete CoA -



Case 2
- CoA with Arch Hypoplasia -

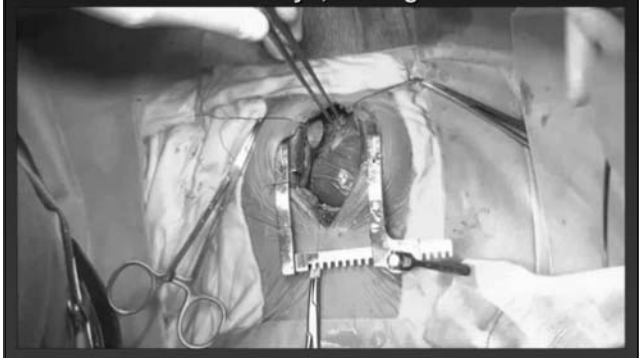
- Prenatal Dx. (+)
- GA 39+2wks, birth weight 3590 gm
  - → Admission to NICU
- E-glandin 0.004mcg/kg/min
- Mechanical ventilator (-)
- BNP 1724

Case 2
- CoA with Arch Hypoplasia -

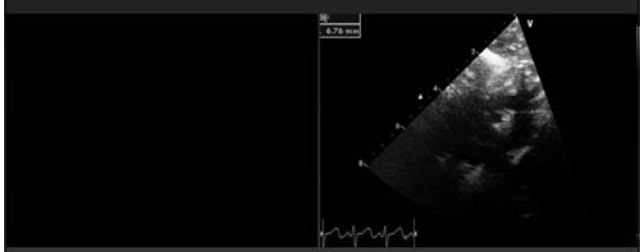
Case 2
- CoA with Arch Hypoplasia -

Case 2
- CoA with Arch Hypoplasia -

Case 2
- 14 days, 3.58 kg -



Case 2
- CoA with Arch Hypoplasia -



Case 2
- CoA with Arch Hypoplasia -

Case 2

- CoA with Arch Hypoplasia -

Complications

- Paradoxical hypertension
  - Correction of CoA (cause of HTN) → Hypertension ??
  - Postcoarctectomy syndrome
    : sudden ↑ of blood pressure → mesenteric arteritis → ischemia
    → Strict BP control, NPO for 1~2days

Complications

- Paraplegia
  - Related to
    - ✓ Prolonged distal clamp time
    - ✓ Intraoperative hyperthermia
    - ✓ Hypotension/ Acidosis
  - To avoid
    - ✓ Reducing clamp time (fast and perfect)
    - ✓ Local hypothermia
    - ✓ Hypertension

Complications

- Recoarctation
  - Can be avoided by
    - ✓ Using native tissue
    - ✓ Low tension anastomosis
    - ✓ Wide anastomosis
    - ✓ Completely removing ductal tissue

LVOTO

LVOTO

- Definition -

- Obstruction at various levels between LV and ascending aorta

Congenital Heart Surgery Database and Nomenclature Project: Aortic Valve Disease

(Ann Thorac Surg 2000;69:S118–31)

AS, NOS
AS, Valvar
AS, Supravalvar
AS, Subvalvar

LVOTO

- Valvar
- Subvalvar
  - ➢ Fixed subvalvar
    - ✓ Discrete
    - ✓ Diffuse (tunnel)
  - ➢ Hypertrophic CMP
- Supravalvar

Related to genetic disorder

LVOTO

- Valvar -

- Valvar AS
  - ➢ Incidence: 3~6% (~70% of LVOTO)
  - ➢ Male : female = 3~5 : 1
  - ➢ Associated anomalies
    - ✓ VSD
    - ✓ PDA
    - ✓ CoA
    - ✓ LV hypoplasia : 2V vs. 1V

LVOTO

- Valvar -

- Valvar AS
  - ➢ a wide spectrum

Mild AS
± bicuspid AoV

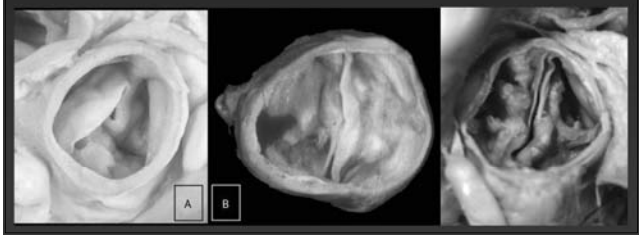
2V → 1V

Critical AS
Ductus dependent systemic circulation

LVOTO

- Valvar -

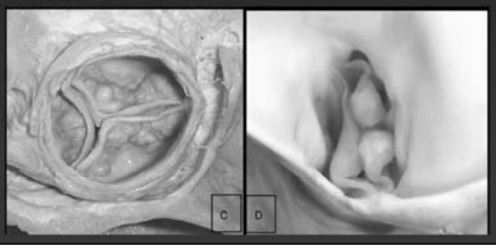
- Morphology of the valve
  - ➢ Bicuspid, dysplastic leaflet, fused commissures



LVOTO

- Valvar -

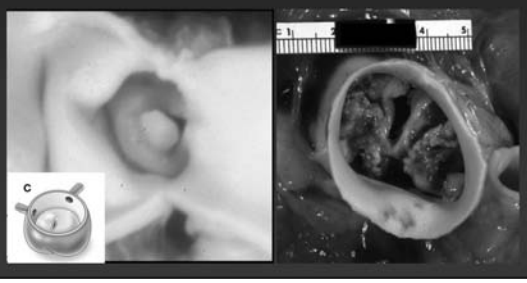
- Morphology of the valve
  - ➢ Tricuspid, dysplastic leaflet, fused commissures



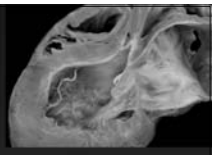
LVOTO

- Valvar -

- Morphology of the valve
  - ➢ Unicuspid



LVOTO
- Valvar -



- AS in neonate and infant
  - ➢ Pathophysiology (severe AS)
    - → ↑ afterload → ↑ wall tension & workload → hypertrophy → dysfunction
    - → PG at valve level → coronary/myocardial perfusion mismatch → myocardial ischemia (esp. subEndoC) → EFE → dysfunction

LVOTO
- Valvar -

- AS in neonate and infant
  - ➢ Postnatal course depends on
    - ✓ Severity of valvar obstruction
    - ✓ Degree of LV dysfu
    - ✓ Degree of LV hypoplasia
    - ✓ Shunt flow at atrial & ductal level
  - ➢ Symptoms: exertional chest pain, easy fatigability, syncope

R→ L (+adequate forward flow through AoV): differential cyanosis

LVOTO
- Valvar -

- ❖ Underestimated
  - ▪ ventricular dysfunction
  - ▪ R to L shunt through PDA
- ❖ Flow direction (PDA, arch, AAo.)
  - → 2V vs. 1V
    - ✓ Severity of stenosis (doppler)

LVOTO
- Valvar -

- AS in neonate and infant
  - ➢ Cardiac catheterization
    - ✓ Therapeutic >> Diagnostic

LVOTO
- Valvar -

- AS in neonate and infant
  - ➢ Indication for intervention
    - ✓ CHF
    - ✓ Ductal dependent circulation
    - ✓ Symptoms
    - ✓ Pressure gradient (P-P) > 50mmHg
  - → Left side structures: adequate for sustaining systemic circulation??

LVOTO
- Valvar -

- AS in neonate and infant

Borderline LV

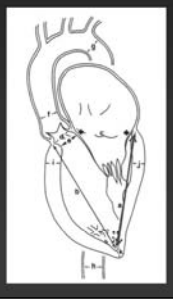
- ✓ Pressure gradient (P-P) > 50mmHg
- → Left side structures: adequate for sustaining systemic circulation??

Critical aortic stenosis in early infancy

Anatomic and echocardiographic substrates of successful open valvotomy

Maurice P. Leung, MBBS, MRCP,* Roxane McKay, BA, MD, FRCS, Audrey Smith, FIMLS, MPhil, PhD, Robert H. Anderson, BSc, MD, FRCPath,** and Robert Arnold, MB, ChB, FRCP, *Liverpool, England*

J Thorac Cardiovasc Surg 1991;101:526-535



- LV inflow dimension <25mm
- VA junction <5mm
- MV orifice <9mm

Echocardiographic Estimation of Critical Left Ventricular Size in Infants With Isolated Aortic Valve Stenosis

MARK K. PARSONS, MD, GORDON A. MOREAU, MD, THOMAS P. GRAHAM, JR., MD, FACC, JAMES A. JOHNS, MD, ROBERT J. BOUCEK, JR., MD
Nashville, Tennessee

J Am Coll Cardiol 1991;18:1049-1055

- LV cross-sectional area <2cm²
- LVEDD <13mm
- LVEDV < 20ml/m² (Cath)

Predictors of Survival in Neonates With Critical Aortic Stenosis

Larry A. Rhodes, MD; Steven D. Colan, MD; Stanton B. Perry, MD; Richard A. Jonas, MD; and Stephen P. Sanders, MD

Circulation 1991;84:2325-2335

- Threshold Score (Sum): <2 → 2V favor
  - ✓ LV to heart (long axis) ratio ≤ 0.8
  - ✓ Indexed aortic root diameter ≤ 3.5cm/m²
  - ✓ Indexed mitral valve area ≤ 4.75cm²/m²
  - ✓ LM mass index ≤ 35 g/m²

Predictors of Survival in Neonates With Critical Aortic Stenosis

Larry A. Rhodes, MD; Steven D. Colan, MD; Stanton B. Perry, MD; Richard A. Jonas, MD; and Stephen P. Sanders, MD

Circulation 1991;84:2325-2335

Rhodes score

$$\text{Score} = 14.0\,(\text{BSA}) + 0.943(\text{ROOT}_i) + 4.78\,(\text{LAR}) + 0.157\,(\text{MVA}_i) - 12.03$$

SV -0.35 BV

CRITICAL AORTIC STENOSIS IN THE NEONATE: A MULTI-INSTITUTIONAL STUDY OF MANAGEMENT, OUTCOMES, AND RISK FACTORS

Gary K. Lofland, MD[a]
Brian W. McCrindle, MD[b]
William G. Williams, MD[c]
Eugene H. Blackstone, MD[d]
Christo I. Tchervenkov, MD[e]
Rekwan Sittiwangkul, MD[b]
Richard A. Jonas, MD[f]
Congenital Heart Surgeons Society

J Thorac Cardiovasc Surg 2001;121:10-27

Table VI. *Independent factors predictive of percent survival benefit at 5 years after entry for Norwood procedure versus biventricular repair**

Variable	Parameter estimate (SE)	P value
Intercept	−86.47 (6.36)	
Higher grade of endocardial fibroelastosis	12.14 (0.96)	<.001
Lower z-score of aortic valve at the level of the sinuses of Valsalva	−6.20 (0.25)	<.001
Younger age at entry (d)†	30.55 (1.79)	<.001
Larger ascending aorta diameter (mm)‡	23.33 (2.24)	<.001
Absence of moderate or severe tricuspid regurgitation	−28.30 (2.60)	<.001
Lower z-score of the LV length	−0.70 (0.22)	.02

SE, Standard error.
*Adjusted for missing values for all variables; model $R^2 = 0.888$; root mean square error = 9.858.
†Inverse of (age at entry + 1) transformation.
‡Logarithmic transformation.

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Congenital Heart Surgeons Society

J Thorac Cardiovasc Surg 2001;121:10-27

CHSS score

Survival benefit = 30.55 (inverse of age at study entry [d] + 1)
− 6.20 (aortic root z-score)
+ 12.14 (echocardiographic grade of EFE)
+ 23.33 (logarithm of ascending aortic [mm])
− 28.30 (presence of moderate or severe tricuspid regurgitation)
− 0.70 (LV long-axis length z-score) − 86.47

- Positive value: SV favor
- Negative value: BV favor

Congenital Heart Disease

Validation and Re-Evaluation of a Discriminant Model Predicting Anatomic Suitability for Biventricular Repair in Neonates With Aortic Stenosis

Steven D. Colan, MD, Doff B. McElhinney, MD, Elizabeth C. Crawford, RDCS, John F. Keane, MD, James E. Lock, MD
Boston, Massachusetts

J Am Coll Cardiol 2006;47:1858-1865

- Colan Score = 10.98 (BSA) + 0.56 (aortic valve annulus z-score) + 5.89 (LAR) – 0.79 (presence of grade 2 or 3 EFE) – 6.78.
  → Cutoff : -0.65 (~90% predictive)
- Score (EFE omitted) = 12.16 (BSA) + 0.59 (aortic valve annulus z-score) + 5.73 (LAR) – 7.02 (→ Cutoff : -0.46)

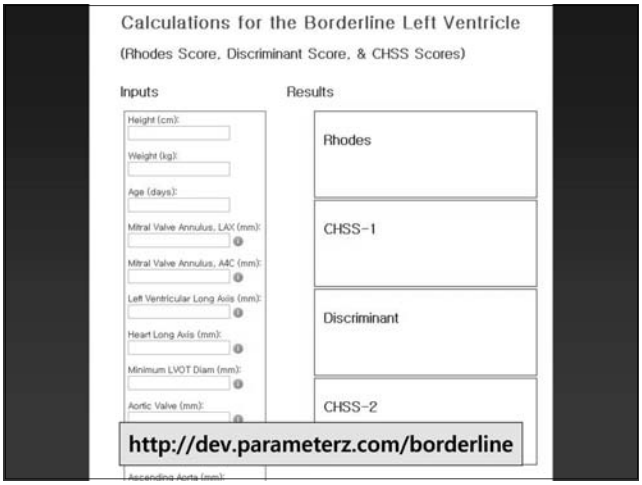
Critical left ventricular outflow tract obstruction: The disproportionate impact of biventricular repair in borderline cases

Edward J. Hickey, MD,[a] Christopher A. Caldarone, MD,[b,*] Eugene H. Blackstone, MD,[c] Gary K. Lofland, MD,[d] Thomas Yeh, Jr, MD,[e] Christian Pizarro, MD,[f] Christo I. Tchervenkov, MD,[g] Frank Pigula, MD,[h] David M. Overman, MD,[i] Marshall L. Jacobs, MD,[j] Brian W. McCrindle, MD,[b,*] and the Congenital Heart Surgeons' Society

J Thorac Cardiovasc Surg 2007;134:1429-1437

TABLE 1. Incremental risk factors for time-related death for patients who had an initial procedure indicating an intended biventricular repair pathway

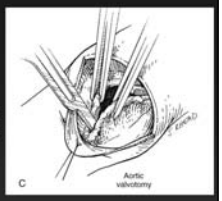
Covariate	Estimate	*P* value
Intercept	−.484	<.001
Presence of moderate or severe tricuspid regurgitation	−.279	<.001
Z-score of mitral valve annulus	+.030	<.001
Presence of large VSD	−.312	<.001
Length of apex-forming ventricle (cm)*	+.715	<.001
Minimum diameter of the LVOT (cm)†	+.892	<.001
Presence of left ventricular dysfunction‡	+.230	<.001
Grade of endocardial fibroelastosis§	+.165	<.001
Diameter of the mid-aortic arch (cm)‖	−.187	<.001



LVOTO
- Valvar -

- AS in neonate and infant
  - ➢ Treatment options
    - ✓ Percutaneous balloon valvuloplasty
    - ✓ Surgical valvotomy/ valvuloplasty
    - ✓ Aortic valve replacement with pulmonary autograft (Ross)
      : with or without annular enlargement

LVOTO
- Valvar -



- AS in neonate and infant
  - ➢ Surgical valvotomy
    - ✓ Do not reach aortic wall: even one millimeter enough to sufficiently enlarge aortic opening
    - ✓ Do not touch false raphe
    - ✓ As conservative as possible

** AR → ↑ probability of reoperation

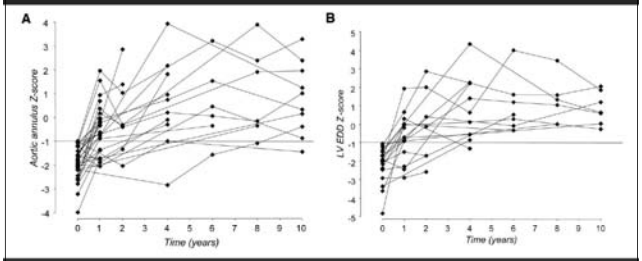
LVOTO
- Valvar -

- AS in neonate and infant
  - ➢ Outcomes
    - ✓ Balloon vs. surgical: similar in mortality and reintervention for AoV
    - ✓ ↑ AS in surgery vs. ↑ AR in balloon
    - ✓ Outcome improvement: importance of patient selection (borderline LV)
    - ✓ Catch-up growth of left heart structures

Left Heart Growth, Function, and Reintervention After Balloon Aortic Valvuloplasty for Neonatal Aortic Stenosis

Doff B. McElhinney, MD; James E. Lock, MD; John F. Keane, MD; Adrian M. Moran, MD; Steven D. Colan, MD

Circulation 2005;111:451-458

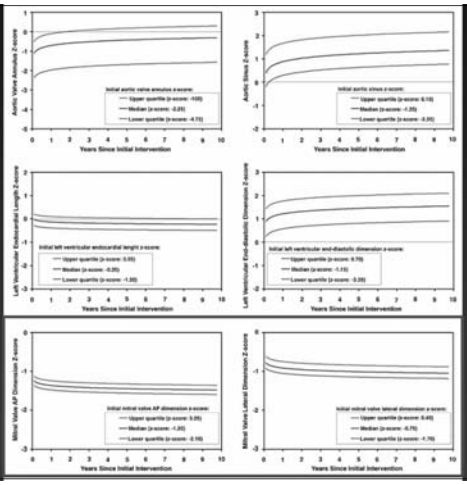


Congenital Heart Disease

Outcome and Growth Potential of Left Heart Structures After Neonatal Intervention for Aortic Valve Stenosis

Ra K. Han, MD, FRCPC,* Rebecca C. Gurofsky, BSc,* Kyong-Jin Lee, MD, FRCPC,* Anne I. Dipchand, MD, FRCPC,* William G. Williams, MD, FRCSC,† Jeffrey F. Smallhorn, MD, FRCPC,* Brian W. McCrindle, MD, MPH, FRCPC*
Toronto, Ontario, Canada

J Am Coll Cardiol 2007;50:2406-2414



LVOTO
- Valvar -

- AS in older children
  - ➢ Indication for intervention
    - ✓ Symptoms with PG >50mmHg
    - ✓ Asymptomatic but PG >70mmHg
    - ✓ Asymptomatic, PG 50~70mmHg
      - → controversial
      - → early intervention is beneficial

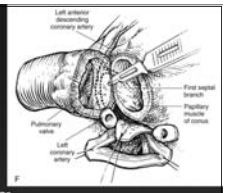
LVOTO
- Valvar -

- AS in older children
  - ➢ Treatment options
    - ✓ Percutaneous balloon valvuloplasty
    - ✓ Surgical valvotomy/ valvuloplasty
    - ✓ Aortic valve replacement with pulmonary autograft (Ross)
      : with or without annular enlargement

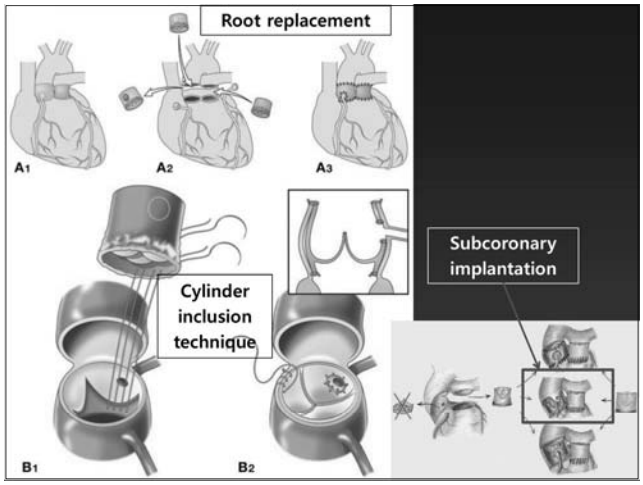
LVOTO
- Valvar -

- AS in older children
  - ➢ AVR
    - ✓ Significant No. need AVR, eventually.
    - ✓ Prosthetic AVR in the young
      - ❖ Limited size and lack of growth
      - ❖ Early degeneration in bio.
      - ❖ Life-long anticoagulation in mech.
      - → Pulmonary autograft (Ross)

LVOTO
- Valvar -



- Ross operation
  - ➢ Safe autograft harvesting
    - ✓ Avoiding damaging leaflet
    - ✓ Sufficient RVOT m. cuff
    - ✓ Avoiding injury to 1st septal perforator
  - ➢ Not an ideal option
    - ✓ Autograft function : dilatation and dysfxn
    - ✓ Reoperation for pulmonary valve



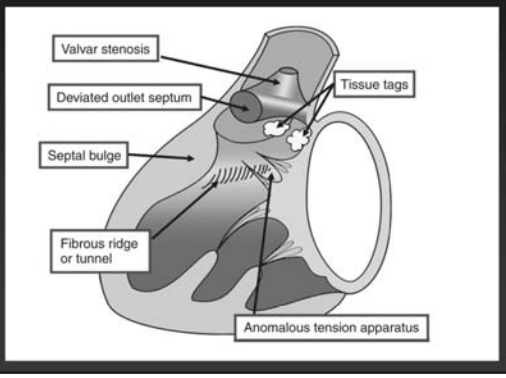
LVOTO
- Valvar -

- AS in older children
  - ➢ Outcomes
    - ✓ AVR (biologic/ mechanical)
      - ▪ Excellent (survival and durability)
    - ✓ Ross
      - ▪ Excellent early outcomes
      - ▪ Autograft failure (20~30% at 20 years)
        - ❖ Initial passive dilatation → late growth
      - ▪ RV-PA failure (20% at 20 years)

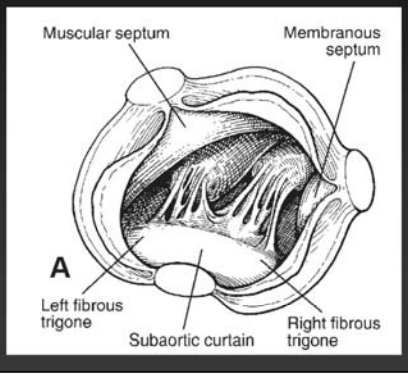
LVOTO
- Subvalvar -

- 15~20% of LVOTO
- Classification
  - ➢ Fixed SAS (70%)
    - ✓ Discrete
      - ▪ Membranous vs. fibromuscular
    - ✓ Diffuse
  - ➢ Hypertrophic CMP
  - ➢ Other SAS: MV mechanism associated, ALM hypertrophy, posteriorly deviated IS

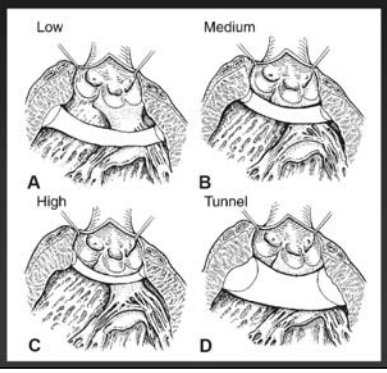
LVOTO
- Subvalvar -



LVOTO
- Subvalvar -



LVOTO
- Subvalvar -



LVOTO
- Fixed SAS -

- Pathophysiology: similar to valvar AS
- Aortic valve in SAS
  - Smaller than normal but usually normal morphology
  - Turbulence and jet damaging leaflets
  - → ↑ thickening or AoV
  - → ↓ mobility of AoV
  - → susceptible to infection

} ↑ AR

LVOTO
- Fixed SAS -

- Indication for surgery
  - Symptoms: shortness of breath, angina, syncope, exercise intolerance
  - Progressive decompensation
  - In asymptomatic patients
    - ✓ Peak PG >30mmHg in discrete SAS
    - ✓ Peak PG >50mmHg in diffuse SAS
  - Aortic insufficiency

LVOTO
- Fixed SAS -

- Surgery for fixed SAS
  - Discrete SAS
    - → Membrane or ridge excision ± myectomy

LVOTO
- Fixed SAS -

- Surgery for fixed SAS
  - Diffuse SAS (the adequacy of AoV)
    - ✓ Adequate AoV
      - → Modified Konno (septal ventriculoplasty)
    - ✓ Small or damaged AoV
      - → Konno (aortoventriculoplasty) + AVR

LVOTO
- HCMP -

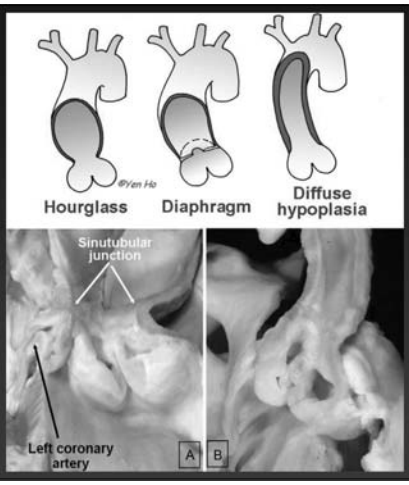
- Idiopathic Hypertrophic Subaortic Stenosis (IHSS)
  - ➢ Asymmetric ventricular septal hypertrophy
    - ✓ Hypertrophic septum: fixed stenosis
    - ✓ SAM of anterior mitral leaflet: dyanamic stenosis
  - ➢ Septal myectomy
    * Konno, MVR, …

LVOTO
- Supravalvar -

- Narrowing of the aortic lumen above the aortic valve
- 5~10% of the LVOTO
- Often part of Williams' syndrome
- Frequently branch PA involvement

LVOTO
- Supravalvar -

- Pathologic features
  - ➢ Great arteries
    - ✓ Localized (80%) vs. diffuse (20%)
    - ✓ Intimal hyperplasia, medial dysplasia,…
    - ✓ Pulmonary arterial involvement: lesser degree



LVOTO
- Supravalvar -

- Pathologic features
  - ➢ Coronary arteries
    - ✓ Markely dilated and tortous (↑ root pressure)
    - ✓ ST ridge thickening → coronary ostial narrowing
  - ➢ Valve abnormalities
    - ✓ AoV: morphologically normal in most cases
    - ✓ MV and subV apparatus: fibrous thickening

LVOTO
- Supravalvar -

- Pathophysiology
  - ➢ Difference from the other forms of LVOTO
    - ▪ coronary artery exposed to high systolic pressure
    - ▪ Premature coronary artery disease

    → Myocardial hypoperfusion → Vf and sudden death

LVOTO
- Supravalvar -

- Diagnosis
  - ➢ Williams' syndrome
    - ✓ Deletion on chromosome 7q11.23
    - → Affect the elastin gene
  - ➢ Non williams supravalvar AS
    - ✓ Loss-of-function of point mutation of the same elastin gene

LVOTO
- Supravalvar -

- Diagnosis
  - ➢ Echocardiography
  - ➢ Cardiac CT or MRI
  - ➢ Cardiac cath. and angiography

LVOTO
- Supravalvar -

- Indication for surgery
  - ➢ Symptoms
  - ➢ LVOT gradient >40~50mmHg
  - ➢ Early surgery
    - ✓ Progressive nature of disease
    - ✓ Detrimental effect on LV, aortic valve and coronary artery + myocardial hypoperfusion

LVOTO
- Supravalvar -

- Surgical treatment
  - ➢ Widening of obstructive segment
    - ✓ With vs. without patch
  - ➢ Adressing coronary arteries
    - ✓ Complete resection of abnormal tissue around coronary os.
    - ✓ Patch angioplasty or CABG

LVOTO
- Supravalvar -

- Surgery for localized disease
  - ➢ Single patch
    - ✓ One sinus vs. two sinuses
  - ➢ Separate multiple patches: Brom
  - ➢ No patch
    - ✓ Myer
    - ✓ Simple sliding

LVOTO
- Supravalvar -

- Surgery for diffuse disease
  - ➢ Extended patch aortoplasty
  - ➢ Perfusion strategy

양대혈관우심실 기시증

세브란스 심장혈관병원 심장혈관외과

신 홍 주

Definition of DORV

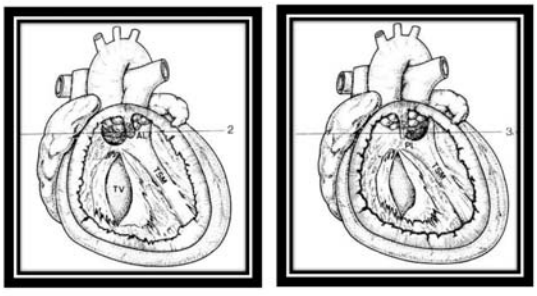
- A congenital anomaly in which both great arteries arise wholly or in large part from the right ventricle
- Presence of bilateral infundibulum
- Presence of atrioventricular valve-semilunar valve discontinuity (mitral aortic discontinuity)
- In the spectrum of TOF and TGA
- 50% rule: a heart is termed DORV if > 50% of both great arteries arise form the right ventricle

History of nomenclature

- 1898, Vierordt partial TGA
- 1923, Spitzer type II TGA (simple TGA)
- 1949, Taussig and Bing TGA with levoposition of PA
- 1950, Lev and Bolk Taussig-Bing heart
- 1952, Braun double outlet ventricle
- 1957, Witham DORV

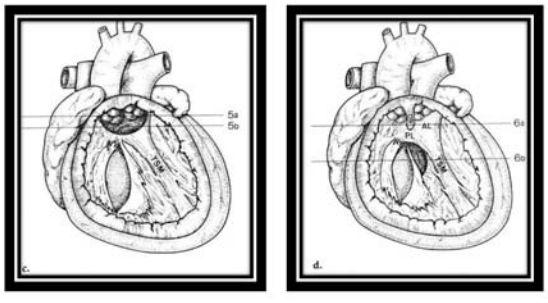
- 1957, Kirklin at Mayo Clinic 1st operation
- 1967, Kirklin successful repair of Taussig-Bing
- 1968, McGoon
- 1971, Kawashima

Classification by Lev (1972)



DORV with subaortic VSD DORV with subpumonic VSD

Classification by Lev (1972)



DORV with doubly committed VSD DORV with noncommitted VSD

CHSS classification

Congenital Heart Surgery Nomenclature and Database Project: Double Outlet Right Ventricle

Henry L. Walters III, MD, Constantine Mavroudis, MD, Christo I. Tchervenkov, MD, Jeffrey P. Jacobs, MD, François Lacour-Gayet, MD, and Marshall L. Jacobs, MD

Departments of Surgery, Wayne State University School of Medicine, Children's Hospital of Michigan, Detroit, Michigan; Northwestern University School of Medicine, Children's Memorial Hospital, Chicago, Illinois; McGill University, The Montreal Children's Hospital, Montreal, Quebec, Canada; University of South Florida School of Medicine, All Children's Hospital, St. Petersburg, Florida; Marie Lannelongue Hospital, Paris, France; and Hannenian University School of Medicine, St. Christopher's Children's Hospital, Philadelphia, Pennsylvania

Double outlet right ventricle (DORV) is a type of ventriculoarterial connection in which both great vessels arise entirely or predominantly from the right ventricle. Although the presence of aortic-mitral discontinuity and bilateral coni are important descriptors, they should not serve as absolute prerequisites for the diagnosis of DORV. The morphology of DORV is encompassed by a careful description of the ventricular septal defect (VSD) with its relationship to the semilunar valves, the great artery relationships to each other, the coronary artery anatomy, the presence or absence of pulmonary outflow tract obstruction (POTO) and aortic outflow tract obstruction (AOTO), the tricuspid-pulmonary annular distance, and the presence or absence of associated cardiac lesions. The preferred surgical treatment involves the connection of the left ventricle to the systemic circulation by an intraventricular tunnel repair connecting the VSD to the systemic semilunar valve. This ideal surgical therapy is not always possible due to the presence of confounding anatomical barriers. A multitude of alternative surgical procedures has been devised to accommodate these more complex situations. A framework for the development of the DORV module for a pediatric cardiac surgical database is proposed.

(Ann Thorac Surg 2000;69:S249–63)

CHSS classification of DORV

- DORV, VSD type
  - Subaortic or doubly committed, without RVOTO
- DORV, TOF type
  - Subaortic or doubly committed, with RVOTO
- DORV, TGA type
  - Subpulmonary without PS (Taussig-Bing) or with PS
- DORV, Remote type
  - Non committed, with or without RVOTO
- DORV, IVS

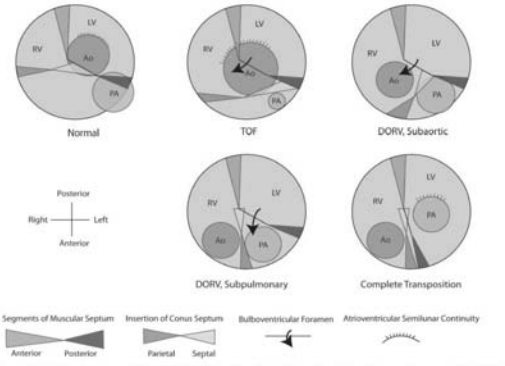
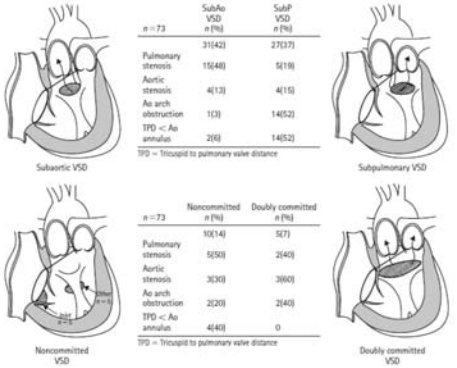


Figure 23-1. Diagrammatic representations of transverse sections of specimens that represent the spectrum of developmental abnormalities in hearts with abnormal ventriculoarterial connection. Ao, aortic PA, pulmonary artery



n = 73	SubAo VSD n (%)	SubP VSD n (%)
	31(42)	27(37)
Pulmonary stenosis	15(48)	5(19)
Aortic stenosis	4(13)	4(15)
Ao arch obstruction	1(3)	14(52)
TPD =< Ao annulus	2(6)	14(52)

TPD = Tricuspid to pulmonary valve distance

n = 73	Noncommitted n (%)	Doubly committed n (%)
	10(14)	5(7)
Pulmonary stenosis	5(50)	2(40)
Aortic stenosis	3(30)	3(60)
Ao arch obstruction	2(20)	2(40)
TPD =< Ao annulus	4(40)	0

TPD = Tricuspid to pulmonary valve distance

Figure 23.9 *Important anatomic features of VSD groups in a review of 73 patients who underwent biventricular repair of DORV between 1981 and 1991 at Children's Hospital Boston. (From Aoki et al. Results of biventricular repair for double outlet right ventricle. J Thorac Cardiovasc Surg, 1994; 107:340, with permission from Elsevier.)*

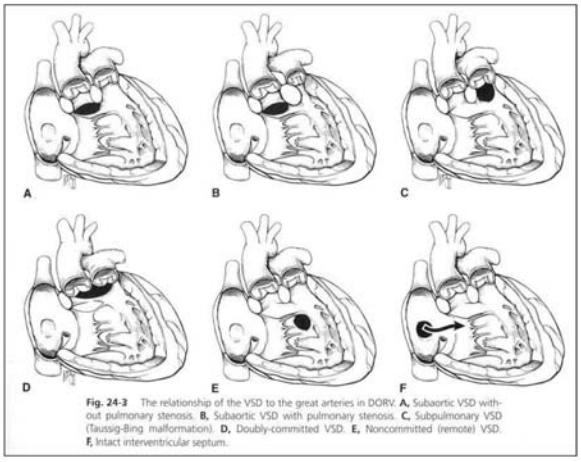


Fig. 24-3 The relationship of the VSD to the great arteries in DORV. **A,** Subaortic VSD without pulmonary stenosis. **B,** Subaortic VSD with pulmonary stenosis. **C,** Subpulmonary VSD (Taussig-Bing malformation). **D,** Doubly-committed VSD. **E,** Noncommitted (remote) VSD. **F,** Intact interventricular septum.

Figure 32.2

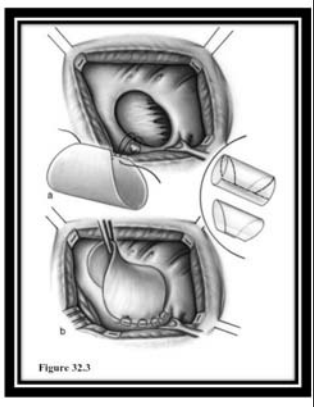


Figure 32.3

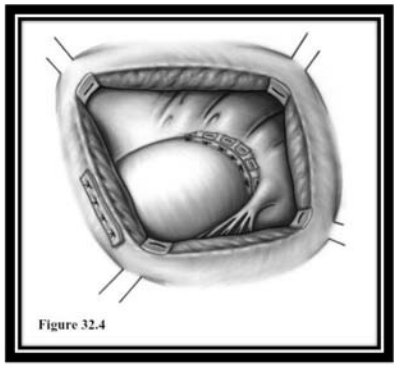


Figure 32.4

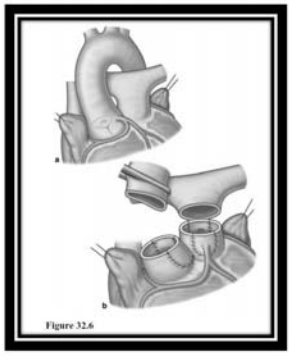


Figure 32.6


Figure 32.7

TV-PV distance

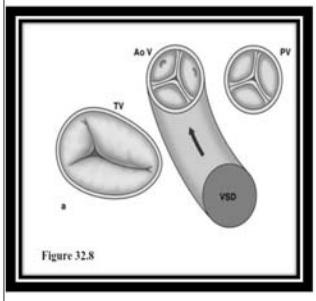
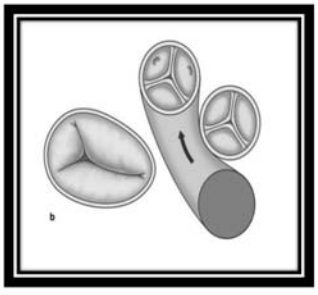


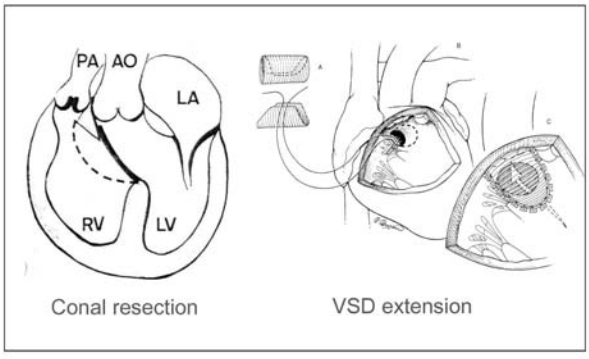
Figure 32.8



Surgery and timing for repair

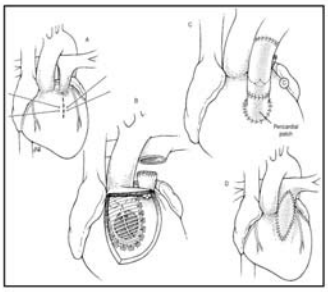
VSD type	About 3 months	Intraventricular repair (IVR)
TOF type	3 - 6 month	IVR + RVOT rec.
TGA type	Early and late infancy	•ASO + VSD tunnel •Senning/Mustard + VSD tunnel •DKS+VSD tunnel+RV-PA •REV •Kawashima •Nikaidoh
Remote VSD	Infancy? After palliation?	•Biventricular repair •Univentricular repair

Intraventricular repair

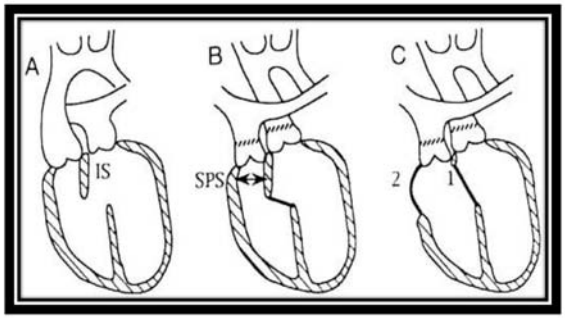


DORV with subaortic VSD, PS

- Valved conduit
  - Major coronary arteries crossing RV
  - High PVR or distal pulmonary obstruction
- Transannular patch



DORV, subpulmonic VSD (Taussig-Bing Anomaly)



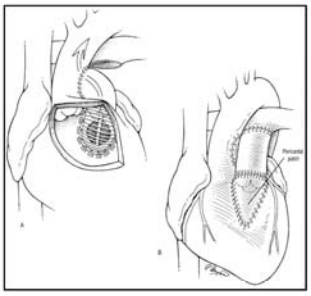
DORV, subpulmonic VSD (Taussig-Bing Anomaly)

Taussig-Bing 기형에서의 대혈관치환술은 완전대혈관전 위증과 비교하여 몇 가지 차이점이 있다.

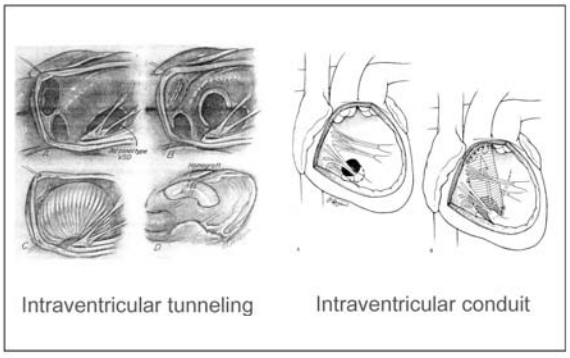
1) 관상동맥 전이 방법의 차이이다. 완전대혈관전위증의 경우 통상적인 관상동맥 배열이 흔한 반면, Taussig-Bing 기형의 경우 다 양하고 복잡한 형태의 관상동맥 배열 (single coronary artery, itramural coronary artery) 이 관찰된다
2) 둘째, Taussig-Bing 기형에서 대혈관의 배열이 다양한 데, 측측 배열의 대혈관에서 Lecompte 수기(maneuver)의 시행 여부이다
3) Taussig-Bing 기형에서 대동맥과 폐동맥의 심한 크기 차이를 보인다 상행대동맥이 폐동맥에 비해 심하게 작으며, 특히 대동맥궁협착이 있는 경우 차이는 더 심해진다
4) 대동맥하 협착, 대동맥 축착의 동반이 많다

Damus-Kaye-Stansel procedure, tunnel closure of VSD and RV-PA conduit

- Significant subaortic stenosis
- To risky to perform arterial switch (intramural coronary artery, single coronary artery)
- Aortic valve insufficiency - aortic valve should be closed



DORV with noncommitted VSD



Intraventricular tunneling Intraventricular conduit

DORV with noncommitted VSD

- Uni-ventricular repair

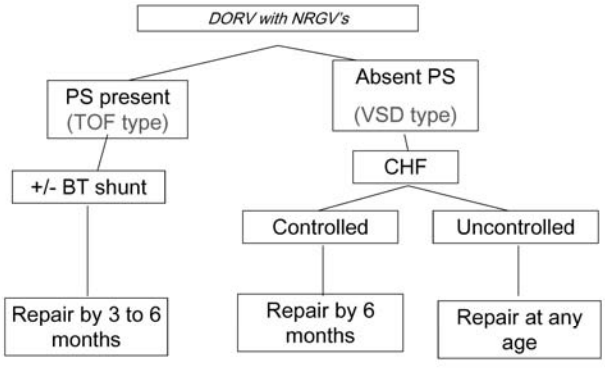
Anomalies of the atrioventricular valves

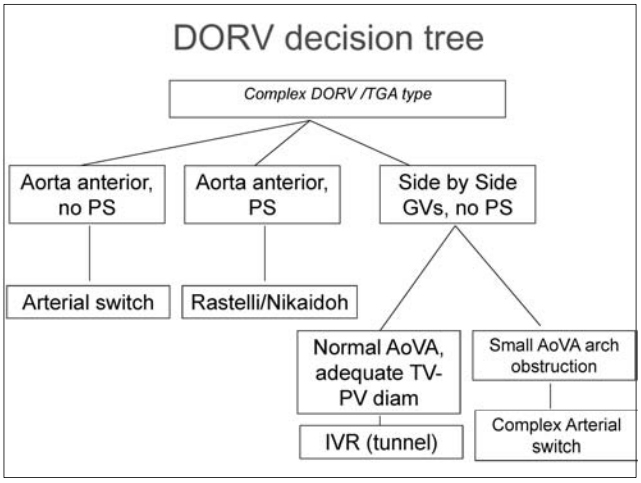
Multiple muscular VSDs

Inability to reliably channel the remote VSD to aorta

- Hypoplasia of the right or left ventricle

DORV decision tree





Complication

- Heart block
- Residual left-to-right shunt
- LVOT obstruction
  - Inadequate enlargement of VSD
  - Poor configuration of intraventricular tunnel patch
- RVOT obstruction
  - Obstructing muscle bundle or patch
- Myocardial dysfunction
- Coronary ischemia

Table 23-1. Summary of surgical treatment of remote DORV

Authors (year)	Time period of operations	No of patients	Previous palliations	Techniques of repair	Age at repair	Early death	Follow-up	Late death	Reoperation
Belli (1999)[66]	1987-1997	23	9 PAB (7) COA repair (5) BTS (2)	IVR 21 ASO 2	20mo (50d-10yr)	2 (9%)	58mo	No	8 (35%) Subaortic stenosis (6) TV repair + RVOTR(1) AVR (1)
Barbero-Marcial (1999)[68]	1987-1999	18	7 BTS (4) PAB (3)	IVR (Multiple patches)	4.7yr (2mo-13yr)	2 (11%)	2.7yr (1mo-12yr)	3 (16.6%)	MV repair (1)
Lacour-Gayet (2002)[77]	1998-2001	10	7 PAB	ASO	16mo (3wk-4.5yr)	1	20mo (4mo-4yr)	No	No
Artrip (2006)[52]	2000-2005	10	8 BTS (3) PAB (5) COA repair (2)	IVR 7 ASO 3	11mo (9d-4yr)	1	20mo	1	NA
Hu (2010)[78]	2006-2009	6	NA	Double-root translocation	*4yr (1-16yr)	No	*22mo (2-36mo)	없음	No

(ASO; arterial switch operation after LV–PA tunneling, AVR; aortic valve replacement, BTS; Blalock–Taussig shunt, COA; coarctation of the aorta, IVR; intraventricular rerouting, MV; mitral valve, PAB; pulmonary artery banding, TV; tricuspid valve)
NA; not available
* 4 patients with Taussig–Bing anomlay included

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- Stark J, et al. Surgery for congenital heart defects, 3rd edition. John Wiley & Sons, Ltd
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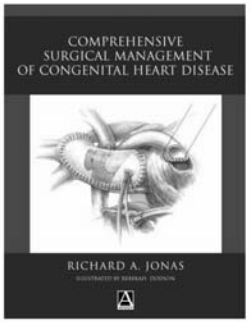

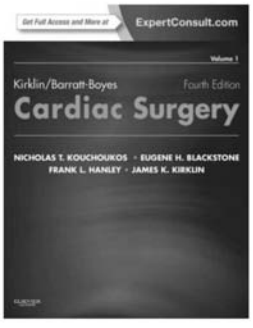

영문 의학논문 작성요령

서울대학교 의과대학

민 양 기

의학논문에서 사용하는 시제

[과거시제, 현재시제, 현재완료시제, 과거완료시제]

(1) 연구자의 업적을 언급할 때 주절의 동사는 현재완료시제 [또는 과거시제]를 사용하고 that절 안에서는 현재시제를 사용한다.

예) McClosky *et al.* [12] have reported [reported] that planets form first via the coagulation of dust grains into planetesimals, which are then assembled into planets with solid cores and in many cases of gaseous atmospheres.

(2) 현재완료를 사용하여 과거의 연구업적을 소개하였다가 같은 연구업적의 내용을 다시 언급할 때는 그 시기가 이미 알려있으므로 주절의 동사는 단순과거를 사용한다

예) Kovda *et al.* [3] have suggested that there are several oxides in this range of the O/U ratio. They also described [reported; mentioned; stated] that the limiting composition is related to the O/U ratio.

(3) 발생시기가 한정적으로 명기되어 있을 때 과거시제로 표현한다 [in 1975, later, ago, (at) first, originally, initially 등]

예) In 1975, Wilm *et al.* [8] suggested that CD4+ and CD8+ cells from HIV-I-infected subjects are apoptotic after 2 days' incubation.

☞ In 2004, ... 형태의 문장은 1회만 사용할 것

(4) Results부분에 해당하는 내용은 that절 안에서 과거시제를 사용한다

예) · Barber *et al.* [4] reported that the unsupported length of photomultiplier tube was 130 cm.

2

논문 Text 안에서 약어를 사용하는 방법

(1) 어떤 약어는 1개 이상의 **grammatical variants(명사형, 형용사형, 부사형 등)**의 의미를 갖는다. 다시 define할 필요 없다.
약어 **SEM**은 본문에서 **scanning electron microscopy [명사]와 scanning electron microscopic [형용사] scanning electron microscopically [부사]를 동시에 의미한다**.

(2) 마찬가지로 복수형일 때는 두 번 expand하지 않고, 어미 (s)를 붙임
wide-shallow beam**s** (WSB**s**) **WSBs** versus **WSB**
cross memory service**s** (CMS**s**)
☞소문자, 숫자는 apostrophe를 찍음: p's 5's and's

(3) 소유격으로 만든 약어도 주격일 때 다시 약어를 만들지 않음
The National Aeronautics and Space Administration's (**NASA's**) Implementation Plan for Space Shuttle Return to Space and Beyond was the **NASA** response to the Columbia disaster in 2003.

► 소제목 안에서는 약어를 만들지 않고, 본문에 처음 나올 때 만듬
(예) **National Institutes of Health [소제목]**
The National Institutes of Health (**NIH**) is the steward of medical and behavioral research for the United States.

3

비공인 약어(Nonstandard Abbreviation)의 사용법

① 여러 번(5**회** ??) 나오는 용어: abstract (3회 이상)와 text (5회 이상)

② 매우 긴 용어:
예) infrastructure for measurements of the European carbon cycle (IMECC)
complementary and alternative medicine (CAM)

☞ **grouping:**
[the experimental group vs the control group;
group A, B, C > I, II, III > 1, 2, 3]
→ PSR-352 increased the melting point in group 2 3 hours later.

► 약어는 full term (abbreviation)의 형태로 만든다

☞ **단축어(Contractions):** isn't→is not didn't→did not can't→**cannot**

4

숫자와 단위 쓰기

(1) 숫자와 단위 사이에 full space를 띄운다. 예) 23 mL
[예외] percent, 각도, ℃ 은 붙여 쓴다: 45% 45° 37.5℃
범위를 표시할 때 단위는 뒷 숫자에만 붙인다
예) **2-8 g** [예외] **2%-8%**

(2) **부호와 숫자를 함께 표현하는 방법 [필요에 따라 붙여 쓴다]**
27.6 ± 6.8 N = 35
• The mean concentration (±SD) of TP in group A specimens was 0.59 mg/L (±0.23; range, 0.117-1.44; n = 19).
[예외] **면적, 부피**, **배율**은 붙여 쓴다.
15x20 cm^2 20x13x12 cm^2 at x400 magnification

(3) **slash (/), ratio (:), range (-)**는 붙여 쓴다.
예) • 20 mg/kg s.c. daily
• an average ratio of 13:1
• 50%-70% of the cases in industrialized countries
▶ range는 전치사 "**to**"를 사용하여 표현할 수도 있다.
예) • The kappa coefficient was **-0.201 to -0.103**.
• The duration of eclipse in XTE J1710-281 is 400 **to** 430 s.

5

대문자 사용법(Capitalization)

Title과 **Subtitle**에서 단어의 첫 글자를 대문자로 표기하는 학술지가 많다.
이때 다음과 같은 단어는 대문자로 표기하지 않는다.

(1) **관사**(article): the, a, an
(2) **3글자 이하의 전치사**(preposition)
up, on, in, for, at, by, to, of, as, via, per
<cf> 4**글자 이상의 전치사:** Upon, Between, Concerning, **Plus**, **After**, Before, During, **With**, Without, Under, Over, Below
☞ 현재 **극소수의 학술지가 이 통일양식을 따르지 않고 있다.**
(3) **등위 접속사**(coordinating conjunction): and, but, or, for, nor
(4) **접두사와 접미사**
예) Intra-cluster Medium Anti-slide Piles
Extra-atmospheric Stellar Magnitude Intra-arc Regions
(5) Single word로 간주되는 복합어
예) X-ray Pulsars Follow-up Studies
Cost-effectiveness Analyses Long-term Treatment

[예문] • Dust Formation **Around** Evolved Stars
• Dust Grain-**Size** Distributions and Extinction in the Milky Way
• Time-**Dependent** Atmospheric Structure of 4 M-Type Model Series
• Characterization of Drying-**Induced** Deformation Behavior of Opalinus Clay in No-**Stress** Regime
• Pulse-**like** Character of Blackbody Radiation **From** Neutron Stars
* 관사, 전치사, 등위접속사도 문장 맨 앞에서는 물론 대문자로 쓴다

6

영문과학논문 작성을 위한 영문분석

☞ 과학영어와 일반영어는 다르다

7

비교문장의 병렬구조(Parallelism in Comparison)

than 다음에 **대명사**, 전치사, 대동사 혹은 조동사를 필요로 할 경우가 있으니 주의해야 한다.

The decrease in A was larger ***than*** ***that*** obtained for B.

Higher concentrations were found **in** substance W ***than*** ***in*** substance T.

Sugar **gave** a lower swelling temperature ***than*** **(did)** an equal quantity of compound A.

대비사상을 **simple word**로 ①주어 ②목적어 ③보어의 위치에 놓는다.

예) ① **The breath/length ratio of group A** was greater than that of group C. (X)

→ **The breath/length ratio** was greater in group A than in group C. (O)

② **The correlation between CP and AP** was stronger than that between CP and XP. (X)

→ **CP** more strongly correlated with AP than with XP. (O)

[특수구문] Blood flow to the thyroid gland is about 30% of the renal blood flow.(X)

→ Blood flow **to** the thyroid gland is about 30% of ***that to*** the kidney.(O)

8

형용사의 어순

순서	카테고리	예
class 1	관사, 소유격[Article]	a, an, the, this, my
class 2	수량 형용사 [Number]	three, 7, the 12th, many, few, multiple
class 3	대소 [Size]	small, big, little, great, giant, large
class 4	성질, 정도를 나타내는 형용사 [Shape]	careful, dangerous, heavy, rare, strong, useful, weak, healthy, helpful
class 5	신구[Age]	young, old, acute, chronic
class 6	색깔[Color]	white, red, black, gray

these 3 small expensive new black Italian cars

예) 1. different 2 systems (X) → 2 different systems (O)
2. internal multiple foci (X) → **multiple** internal foci (O)
3. a safe effective treatment (X) → a **safe and effective** treatment (O)

a safe effective and convenient treatment (X) →
a **safe, effective, convenient** treatment (O)

[Class가 같은 형용사가 여러 개 있을 때는 **짧은 어구가 앞에 온다**]

☞ 형용사의 **affinity for noun:** asymptotic **giant branch stars**
new **large Magellanic cloud**

☞ **opinion adjective + fact adjective:** effective and **basic processes**
delicious and **hot coffee**

9

불가산명사(Uncountable)/가산명사(Countable Noun)

한국어에 없는 **불가산명사(Uncountable Noun): 고유/추상/물질명사**

(1) **복수형으로 쓸 수 없다.**

(2) **few, many 대신에 little, much로 수식한다.**

information *n.*[U] 정보, data, literature, knowledge, percent, research, evidence, permission, childhood 등

예) **Little** data **was** available. 2 pieces of evidence (2개의 증거);

plasma *n.*[U] land *n.* [U] eclipse *n.*[C] convection *n.*[U,C]

☞ 단어의 의미에 따라 uncountable noun일 수도 있고, countable noun일 수도 있다. ▶ hair *n.*[U,C] clover *n.*[U,C]

disease *n.*[U,C] cancer *n.*[U,C] carcinoma *n.*[C]

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영어문장 안에서 명사의 사용법

영어는 한 문장 안에서 같은 명사가 중복하여 두번 사용할 수 없다.

Table 1 and Table 3 → **Tables** 1 and 3
Figure 1 and Figure 2 → **Figures** 1 and 2
Fig. 2 and Fig. 5 → **Figs.** 2 and 5

► **Fig. 2A Fig. 3, A and C Fig. 4; A, B and E Fig. 5, A and D to F**

- between the control and experimental group**s** ***n.*[C]**
- between the first and **the** third incubation ***n.*[U]**

11

동사(Verb)

- **수동태(Passive Voice)를 잘못 사용한 문장**

(1) Similar changes were occurred in other disorders. (X)
[수정] were occurred → **occurred**
(2) Their ages ***were ranged*** from 25 to 62 **(years)**. (X)
[수정] were ranged → **ranged [이 문장에서 years는 대개 생략함]**

(3) All tissues of the body ***are originated*** from the germ cell of the female. (X)
[수정] are originated → **originate**
(4) Subjects ***were consisted*** of 25 healthy mice varying in age from 20 to 29 **months**. (X)
[수정] were consisted → **consisted**
(5) Of the ***remained*** 6 rats with papillomas involving the soft palate, 2 rats required multiple excisions. (X)
[수정] remained → **remaining**

- 긴 문장에서 동사를 끝에 놓지 않는다. 동작명사 (**Action in the verb**)를 동사로 표현한다.
Injection of Tris solution was **done** (0점)
Tris solution was **injected**. (100점)

12

의인법 문장

사물, 사상을 주어로 하는 의인법을 사용하면 세련된 영어 표현이 된다.

(1) By MTT assays, we identified the grade as 61% of NASCETs.

→ MTT assays **revealed** that the grade was identified as 61% of NASCETs.

(2) Recombination of these electrons and holes **produces** thermoluminescence.

(3) Adoption of this average value **introduces** no significant error in the resulting calculated critical mass.

(4) Knowledge of this value **enables** us to calculate the remaining unknowns.

(5) The **necessity** [**call**] for efficient reactor operation at high temperatures has recently **raised** interest in the study of refractory compounds.

(6) Therefore, complicated competition occurs around 1.0 MeV.

→ This **causes** complicated competition around 1.0 MeV.

(7) Gather et al. have measured this fast neutron spectrum and found the currently well-known 2.3 keV scattering resonance dip.

→ …, **which led to the finding of** the ….

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부정관사의 용법

『정관사와 부정관사의 사용구분은 (1) (우리 모두가 알고 있는 바로 그) **특정한 것**인가[the *N*]? (아무거나 하나) **불특정**한 것인가[a *N*]?에 따라 (2) **독자**들이 **이미 알고 있는 것**인가?에 따라 결정된다.』

(1) 대상 사물이 그 논문에 처음 등장

- In ***a*** previous report, the authors pointed out that ….
- ***An*** experimental study was performed on ….

(2) 저자가 임의로 결정한 사항

- ***A*** distance of 7.3 cm was maintained between the poles.
  [a/an + 명사 + of + 숫자]

(3) 'one'을 뜻한다.

- The measurements were made at **a single** institution.
  a single investigator (D.S.C.) 여기서 **single**은 **부정관사를 강조**한다.

(4) 배분단수 (distributive singular): 배분적인 뜻 을 갖는다.

- All subjects have **a** nose.
- samples with **central defects** vs. samples with **a central defect**

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정관사의 용법

(1) 대개 정관사가 필요한 경우: **the+ tech nique, method, maneuver, test, procedure, approach/ scale, score, ratio, rate/ classification, system, assay/theory, hypothesis/ effect, response, process, pathway** [독자들이 이미 알고 있는 사상]

예) Non-contrast and contrast-enhanced T1-weighted images of the orbit were acquired using **the** fat-suppression MR technique.

(2) 신체의 부분, 장기(organ) 이름 앞에서 사용합니다.(이 때 두 번째부터 the를 생략)

예) The aforementioned physical factors exert adverse effects in **the** liver, spleen, and stomach

(3) 잡지이름, 신문이름

예) ***The*** *Nature* ***The*** *New England Journal of Astronomy and Astrophysics*

(4) 형용사 entire, final, last, present, same, whole, only, chief, very, following 앞에 정관사 the를 붙인다.

예) • A combination of tidal shocks and ram pressure swept away ***the*** entire gas content of such progenitors about 10 billion years ago.
• The primary galaxy can transform rotationally supported systems into those dominated by random motions in ***the*** same manner as in dwarf spheroidals.

15

고유명사의 소유격 vs 형용사 역할을 하는 고유명사

인명이 소유격으로 사용될 때는 고유명사로서 무관사가 된다.

The diffusion coefficient is estimated from (—) **Gilliland's** equation.

Valsalva's maneuver　　the **Toynbee** maneuver

Dalton's law　　the **Henry** law

[예] In the rationalized MKS system, **the Maxwell** equations are $y = Ax + B$, $z = Mx - N$ and (—) **Ohm's** law.

여기서 Maxwell은 형용사 역할을 하므로 정관사 the가 붙는다. Ohm's은 인명의 소유격이기 때문에 관사가 붙지 않는다.

☞ **의학논문에서는 technique, method, maneuver, test, procedure, approach, scale, score, ratio, rate, classification, system, assay/theory, hypothesis, effect, response, process, pathway 앞에 고유명사가 자주 사용된다**

16

약어(Abbreviation, Acronym) 앞에 사용하는 부정관사 a/an

· 3글자 까지는 the first letter 가 발음되는 소리에 따라 a/an을 붙인다

(예) **an** FAC **an** HOT an SCI an MD an MRI
an SBP of 120 **mm Hg** **a** DBP of 80 **mm Hg**

· 4 글자 이상 일 때는 단어 (word)로 읽어서 첫소리가 자음으로 발음되면 a를 붙이고, 모음으로 발음되면 an을 붙인다

(예) **a** FACH **a SCIE**

☞ **There is no general rule without some exceptions.**
예) **an FRCT** **an SPSS**

17

부정문(Negative Sentence)를 만들 때 주의사항

(1) **부분 부정문과 완전부정문**을 구별하여 사용해야 한다.
예) 부분 부정문: **All** fluconazole-susceptible isolates have **no** V404I mutation.
완전 부정문: **None of the** fluconazole-susceptible isolates have V404I mutation
예) 부분 부정문: Immunosuppressant was **not** used in **all** animals.
완전 부정문: Immunosuppressant was **not** used in **any** animals.
예) 부분 부정문: There was **no** class III/III homozygote in **all** subjects.
완전 부정문: There was **no** class III/III homozygote in **any** subjects.

(2) **이중 부정(double negative)**은 가급적 사용하지 않는다.
예) **not abnormal**[→ **normal**].
예) Our result is **not inconsistent** [→ **consistent**] with the previous hypothesis.
예) Rheumatologic symptoms were **not uncommon** [→ **common**].
☞ **이중부정은 한국 연구자와 일본 연구자의 심각한 증상이다. [negative thinking]**
"ABC test를 시행해야 한다. [positive thinking]

(3) 단어 **and**를 부정문에 **사용할 수 없다.**
예) The methylation cycle did not correlate with age and sex. (X)
→ The methylation cycle did not correlate with age or sex. (O)

(4) 단어 **also**는 **부정문에 사용할 수 없다.**
예) **No** expression of IL-8 was **also** detected. (X)
→ **No** expression of IL-8 was detected **either**. (O)

(5) **결과**를 기술할 때 **"~할 수 없었다"** 대신 **"~하지 못했다"**로 표현한다.
예) We **could not observe** the enzyme.(X)
We **did not [failed to] observe** the enzyme.(O)

18

숫자 풀어쓰기(Spelling Out Numbers)

의학 논문에서는 모두 **아라비아 숫자**로 표기하는 것이 원칙이나, 다음과 같은 예외에서는 **단어**로 풀어 쓴다

(1) sentence, title, subtitle **의 문두**

Three specimens were identified: 2 were in the oxidized state and 1 was in the reduced state.

(2) **분수** (common fraction)

We require a **two-thirds** majority for consensus.

▶ [예외: mixed fraction (혼합분수) The experiment lasted for **3⅓** hours.

(3) 숙어, 관용적 표현(idiomatic expressions)

- Please include **one or two** of the following scales.
- During **one of the** laboratory runs, it was observed that samples from cases 3 and 9 had faint electrophoretic bands due to suboptimal DNA quality.

Cf> in 1 of (the) 17 samples.

(4) first 부터 ninth까지의 서수사: The **third** specimen was not available for reevaluation.

(5) consecutive numerical expressions; 수가 연속될 때 앞의 것을 풀어 쓴다

- The envelope contained 3 copies of the manuscript and **one** 3.5-in diskette.

▶ [예외] 9 이하와 10 이상이 섞여 있을 때

The samples obtained on the **5th** and **11th** days were included in the experimental study.

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구두점(Punctuation) 사용법

[1] Semicolon: 등위접속사(**and, but, for**) 대용으로 쓰인다.

예) For the GAMMA transformation, the default value is $\gamma = 0.7$; for the LOG scaling, the exponent default value is 2.

[2] Colon: 앞 내용을 구체적으로 **예시**하는 경우와 논문의 **title과 subtitle사이에서** 사용된다.

(1) The conditions for obtaining the maximal production of the enzyme depend on 2 factors: the system and the source of the enzyme.

(2) Weil sequences: A family of binary sequences with good correlation properties.

[3] Forward slash (Virgule): equivalence 또는 duality를 표현할 때 사용한다

(1) If the approval process raises concerns among the researchers or the ethics/IRB members, authors may want to explain the resolution of these issues.

(2) This aspiration method technique is one that any investigator can master whether or not **he/she** has technical expertise.

☞ any investigators ~ ~ they ~ ~.

(3) relationships between A and **B/C** [← relationships between A and B, and between A and C]

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동의어(Synonym)와 유사어(Analogue) 의 구별

21

§ 전치사 Above/Below, Over/Under, Beyond/Within

Above this line, the water level will not rise.

Below 95℃, the water temperature begins to saturate.

(상하, 고저의 관계를 나타냄)

Over [**More than**] 7,500 km of railroad have so far been electrified.

Under [**Less than**] 150 nuclear power reactors are in operation today.

(초과, 미만을 나타냄)

Beyond 4 seconds, the fuel will melt under this condition.

Within 4 seconds, the fuel will not melt under this condition.

(**수평**으로 그려진 **선**상에서[시간은 그래프의 가로축의 개념으로 받아들여진다] 한 점을 초과)

22

§ 장소전치사 at on in

(1)어디에 (2)어디로부터 분리되어 (3)어디로 이동하여

지점: (1) at a single institution
(2) (away) from the port
(3) A thermometer was attached to the flask.

선, 평면: (1) on the vessel wall
(2) off the bottom of the beaker
(3) onto a glass filer paper

공간: (1) in a convection oven
(2) out of the furnace
(3) The contents of the flask were poured into a test tube.

[Quiz 1] KTX trains stop ( ) Daejon City. We live ( ) Sunwha-Dong.
[Quiz 2] This study was conducted ( ) the biochemistry laboratory ( ) the Institute of Michigan between January 2011 and March 2012.

23

§ Determine, Investigate, Examine, Assess, Evaluate/Rate, Grade

Determine, Investigate, Examine, Assess, Evaluate
사람과 사물의 **특성**이나 성질 또는 **가치**나 **효과**를 평가 • 조사할 때 사용한다.

⊙ The objective of this study is to **determine** the evolution of the binary orbits.
⊙ Here we **investigate** how molecular lines can be used to deduce the magnetic and thermal structure of sunspots, starspots, and cool stars.
⊙ We exhibit the complexity of the supermembrane ground state and **examine** various truncations of these models.
⊙ The U-disequilibrium method was utilized to **evaluate** [**assess**] the alteration of rocks in the Corumbataí River basin, São Paulo state, Brazil.

Rate, Grade
정해진 **척도**에 의해 **평가**하거나 **점수(score)**를 매기는 경우에 사용한다.

⊙ We **rated** [**graded**] the distance in the simulation on a 5-point scale.

24

§ Exist와 Present

Exist: 어떤 현상, 법칙, 논쟁, 사물이 우주에 존재한다는 의미이다

⊙ Considerable [Continuing] **controversy exists** regarding the usefulness of molecular dynamics simulations in evaluating free energy differences.

⊙ We attempted to explain why intrusions, such as stocks and batholiths, **exist**.

Present: 과학연구를 위한 실험 중에 나타나는 물질, 증상, 징후 같은 data에 대해서는 present를 사용한다. 명사형 presence와 existence도 같은 nuance를 가진다

⊙ If **shock** is **present**, suitable measures to combat it should be instituted immediately.

☞ 강조의 정도에 따라 **be present < be situated < be located**

One of the roots is **present [situated; located]** on the imaginary axis, while others are present [situated; located] at symmetrical points on both sides thereof.

⊙ The analysis revealed the **presence** of **GM-CSF**.

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영문 교정

26

의학논문에서 사용하지 않는 어휘들[1]

1. a lot of → many, numerous, much
2. about [부사]→ approximately
3. and so on, and so forth, etc. → such as, including, and other~
4. any more → further [혹은 redunt하므로 삭제]
5. around → near, in the vicinity [neighborhood] of
6. not anymore → no longer
7. besides → [전치사] in addition to, [부사] in addition

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의학논문에서 사용하지 않는 어휘들[2]

8. deal with → treat, apply, analyze, consider, study, investigate
9. have to do with (~와 관계가 있다) → involve, be related to, have a relation to, have a connection with
10. hint → information
11. just → simply/only/merely, precisely/exactly/identically, recently
12. nowadays → now, today, at the present time, at this time, currently, presently
13. maybe → probably, possibly, perhaps
14. really → actually, truly, certainly, undoubtedly, indeed, in fact, generally, greatly, considerably, extensively, to a great extent

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게르만계 단어[구어체] 보다 라틴계 단어[문어체]가 더 좋다

ask	inquire 묻다
build	construct 세우다
buy	purchase 구매하다
dead	deceased 사망한
give	provide 주다
last	final 최후의
live	inhabit 서식하다
try	attempt 시도하다
say	state 언급하다
seem	appear …같다
way	method 방법
write	describe 기술하다

의학논문에서 단어수(Word Count) 규정

[1] Manuscript word count: 3500-5000 words

Introduction부터 Conclusion까지 count한다.

⇒ title, abstract, acknowledgments, references, tables, figure legends는 포함하지 않는다.

[2] Abstract:

200-350 words for Original Article, Review Article, and Meta-analysis.

Objective, Methods, Results, Conclusion을 count한다.

⇒ Key word는 포함하지 않는다..

☞ Title: 150 characters for Original Article and Review Article
100 characters for Editorias, Commentary, and Letter to Editor

30

(1) The symptoms of syringomyelia **were similar to the** myofascial pain syndrome with referred pain of extensor digitorum longus m..

⇒ The symptoms of syringomyelia **are similar to those of** the myofascial pain syndrome with referred pain **to the** extensor digitorum longus m.

[주: [시제], 비교구문, 대명사, 관사, 전치사, 마침표]

(2) 6 of **particular 17** items in STR recommendation were described **at table 3**.

⇒ ***Six*** of **the 17 particular** items in STR recommendation **are** described **in** Table 3.

[주: 두음법칙, 형용사의 어순, 시제, 영문 의학 논문의 format]

(3) **In** the other hand, there was **significant** difference **with** the average JAD score **among** studies in the journals **registered in** SCI (**p=0.0360**).

⇒ **On** the other hand, there was **a** significant difference **in** the average JAD score **between the** studies **published in the SCI journals** (***P***= 0.036).

[주: 전치사, 관사, 동사, *P* value 표기]

31

(4) After we **checked for no leakage** of the balloon, the suction line was inserted to **a 11-Fr** Foley catheter.

⇒ After we **checked for leakage** of the balloon, the suction line was inserted to **an 11-Fr** Foley catheter. [주: positive thinking; 발음을 해볼 것, an 11-Fr]

(5) Of the 8 peaks, **7 peaks** were identified; **remained peaks** were very low.

⇒ Of the 8 peaks, 7 have been identified; **the remaining** was very low.

[주: remain은 자동사이다. "나머지"의 표현; 남아 있는 수가 몇 개인지 확인해야 한다]

(6) **Any** unsafe condition was **not** detected throughout the experiment.

⇒ **No** unsafe condition was **(ever)** detected throughout the experiment.

[주: any + not의 어순은 문법에 어긋난다.]

(7) **Photograph 2 and 3** show the microstructures in the **region** of the large and small particles, located near the cladding of the irradiated specimen.

⇒ **Photographs** 2 and 3 show the microstructures in **the regions** of the large and small particles, located near the cladding of the irradiated specimen, **respectively**.

[주: 복수형 어미 –s, 1:1의 대응관계에는 respectively가 필요]

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(8) Data are analyzed using **the SPSS 10.5** for Windows**(SPSS Inc. U.S.A**) by **the Student's t-test**.

⇒ Data **were** analyzed using SPSS 10.5 for Windows **(SPSS** Inc, **Chicago**, **IL**, **USA**) with **Student's *t*** test.

[주: 시제, 괄호 앞 띄어쓰기, 통계검사명, 재료·시약의 표기법, 정관사의 용법]

(9) **Despite of many** countries such as China **performed many** acupuncture clinical trials, **little western medical doctors trusted in** the effect of traditional Chinese medicine.

⇒ **Despite the fact that** many countries such as China **have** performed **[many삭제]**acupuncture clinical trials, **few Western physicians have trusted** the efficacy of traditional Chinese medicine.

[주: 종속**절**, 시제, 형용사, 철자법, 단수·복수형, 타동사, 의학논문 영어]

(10) We divided the subjects **to** 3 groups **such as** no treatment **group**, muscle packing **group &** fibrin adhesion **group**.

⇒ We divided the subjects **into** 3 groups: **the** no treatment, muscle packing **and** fibrin adhesion **groups**.

33

[주: 전치사, such as의 용법, 기호, 중복명사의 표현]

English-Language Editing for Non-English Speaking Researchers

[1차 교정] Linguistic Editing

Corrections for grammar, spelling, and typographical errors **(문장, 문단)**

[2차 교정] Scientific Editing

Manuscript preparation according to the biomedical manuscript format (논문의 내용과 구성): 의학논문은 format과 문법이 문과논문과 다르다.

▶ **Manuscripts to be edited:**

(1) Manuscripts submitted **SCI journals** (2) **Thesis**

(3) Abstracts and **Posters** for international congresses

(4) **English presentation** at international congresses (**presentation script**)

☞ **검증된(evidence-based), 정평 있는(recognized) on-line editing service에 의뢰하기**

[Korea] 서울영어논문컨설팅 www.seoulmpc.com

[USA] Textcheck www.textcheck.com

[USA] Boston BioEdit www.bostonbioedit.com

34

【Coronary Section 및 인문학 강의】

좌장: 성기익

Echo in VHD

서울아산병원 심장내과

김 대 희

The Prosthetic Heart Valve

Department of Thoracic and Cardiovascular Surgery,
Chuncheon Sacred Heart Hospital, Kangwon, Korea

Kilsoo Yie, M.D.

"Not all innovations represent progress"
The feasibility of an operation is not the best indication for its performance.

2

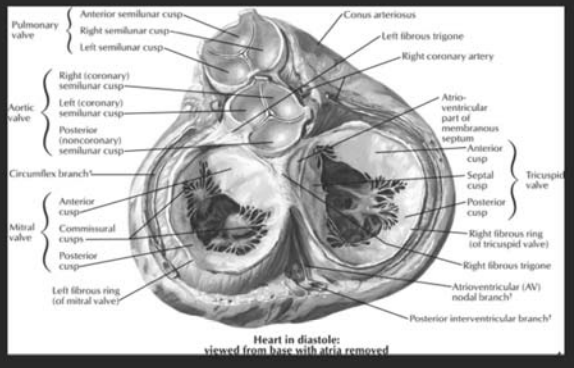
BACKGROUNDS

Trends of Valvular Heart Surgery

Increased total number of VHD & VHS(intervention)
Decreased rheumatic VHD
Increased degerative VHD
Extended application of valve repair
Minimally invasive valve surgery

3

Normal Cardiac Valves



Heart in diastole: viewed from base with atria removed

BACKGROUNDS

Ideal Artificial Heart Valve

✓Hemophilic (anti-thrombogenic)
✓duration
✓non-toxic
✓less traumatic
✓Hemodynamic profiles

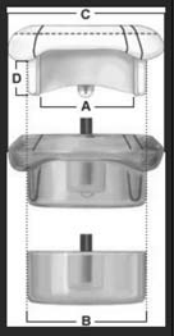
5

Terminology

Device Parameters

Size	25 mm	27 mm	29 mm	31 mm	33 mm
A	25	27	29	31	31
B	28	29.5	31.5	33.5	33.5
C	36	38	40	42	44
D	7	7.5	8	8.5	8.5

A	IOD, Stent diameter
B	Tissue annulus diameter (TAD)
C	External sewing ring diameter (ESRD)
D	Anterior effective profile



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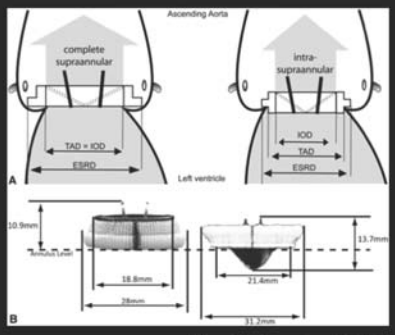
Terminology

Device Parameters



J Thorac Cardiovasc. Surg. 2008;136:462-471.

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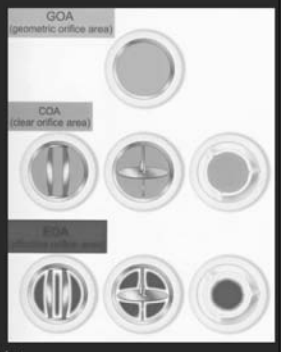
Terminology

Effective Orifice Area (EOA)

- the most important parameter.
- Both mechanical and tissue valve

- EOA, the blood really flows.
- Indexed EOA (IEOA) : EOA related to 1m² of pt's BSA.



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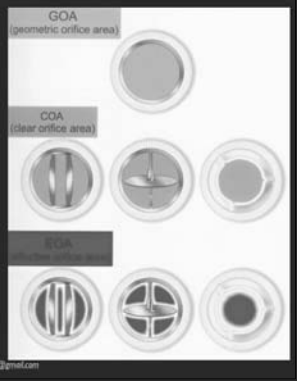
Terminology

Effective Orifice Area (EOA)

For preventing PPM

IEOA should be greater than

- 0.85 cm^2/m^2 in aortic position
- 1.2 cm^2/m^2 in mitral position



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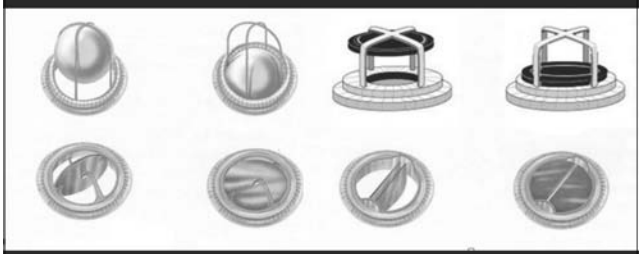
Various type of Artificial Heart Valve

Mechanical valve



10

Various type of Artificial Heart Valve

Mechanical valve (bileaflet valves)

Valve	Material	Position	Radiographic Characteristics	FDA Approval
The Medtronic-Hall® Prosthesis	Housing: Titanium Disc: Pyrolytic carbon Sewing Ring: Knitted PTFE, standard	Aortic and Mitral	Housing is radiopaque; disc is radiolucent	2002
The Sorin Allcarbon® tilting disc	Housing: Stellite 25, a chrome alloy Disc: Pyrolytic carbon over a graphite substrate Sewing Ring: Teflon	Aortic and Mitral	Disc has a tantalum wire that is radiopaque	—
ATS open pivot® bileaflet (Standard Series)	Orifice Ring: Pyrolytic carbon Leaflets: Pyrolytic carbon over graphite substrate Sewing Ring: Dacron	Aortic and Mitral	Titanium ring is radiopaque; leaflets are visible due to high tungsten content	2000
Edwards Mira® Valve	Orifice Ring: Pyrolytic carbon Leaflets: Pyrolytic carbon over graphite substrate Sewing Ring: Dacron	Aortic and Mitral	Titanium ring is completely radiopaque; leaflets impregnated with tungsten	—
The MCRI On-X	Orifice Ring: On-X carbon Leaflets: On-X carbon over graphite substrate Sewing Ring: PTFE	Aortic and Mitral	Leaflets impregnated with tungsten	2001 (aortic) 2002 (mitral)

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Various type of Artificial Heart Valve

Mechanical valve (bileaflet valves)

The Sorin Bicarbon® mechanical valve	Housing: Titanium Leaflets: Pyrolytic carbon Sewing Ring: PTFE	Aortic and Mitral	Leaflets and housing are radiopaque	—
The St. Jude Medical (SJM) Standard® bileaflet valve	Housing: Graphite coated with pyrolytic carbon Leaflets: Graphite coated with pyrolytic carbon Sewing Ring: Polyester, PET, or PTFE	Aortic and Mitral	Leaflets impregnated with tungsten	1977
SJM Regent® bileaflet valve	Housing: Graphite coated with pyrolytic carbon Leaflets: Graphite coated with pyrolytic carbon Sewing Ring: Polyester, PET, or PTFE	Aortic and Mitral	Leaflets impregnated with tungsten	2002
SJM Masters® with Silzone coating	Cage Material: Pyrolytic carbon over graphite substrate Leaflets: Pyrolytic carbon with graphite substrate Sewing Ring: PET polyester	Aortic and Mitral	Leaflets impregnated with tungsten	Withdrawn January 2000
Standard Sulzer® Carbomedics Valve	Housing: Pyrolytic carbon Leaflets: Pyrolytic carbon-coated Sewing Ring: Dacron	Aortic and Mitral	The titanium ring surrounding the housing and leaflets is radiopaque	1993

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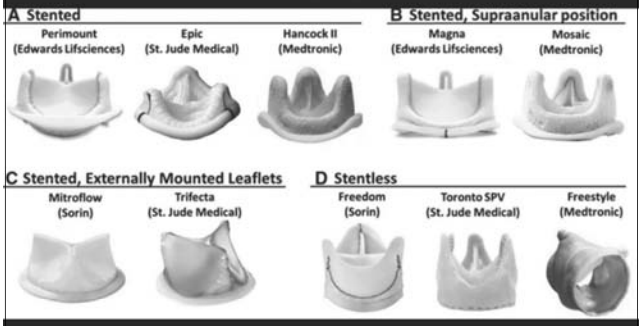
Various type of Artificial Heart Valve

Tissue Valve



13

Ulberchit JS et al. Clin Infect Dis. 2004;39:S73-82

Various type of Artificial Heart Valve

Tissue Valve

Valve	Tissue	Material	Location	Radiographic Characteristics	FDA Approval
CE porcine®	Porcine	Sewing ring: molded silicone rubber covered by PTFE cloth Stent material: PTFE cloth Stent: Elgiloy	Aortic or Mitral	Elgiloy® stent is radiopaque	1976
CE SAV®	Porcine	Sewing ring: molded silicone rubber covered by PTFE cloth Stent material: PTFE cloth Stent: Elgiloy	Aortic	Elgiloy® stent is radiopaque	2002
Hancock MO® stented	Porcine	Sewing ring: Dacron Stent: polypropylene	Aortic	Haynes® alloy ring at the annulus	1978
Hancock II® stented porcine	Porcine	Porcine valve Stent: acetyl homopolymer	Aortic, Mitral	Haynes® alloy, scalloped stent, metal ring and eyelets	1999
CE PERIMOUNT®	Bovine Pericardium	Sewing ring: silicone rubber with nonwoven polyester Stent material: woven polyester Stent: Elgiloy	Aortic or Mitral	Elgiloy® stent is radiopaque	1991 (aortic) 2000 (mitral)
Freestyle®	Porcine	Polyester cloth covering a porcine valve	Aortic	—	1997
T-SPV®	Porcine	Polyester cloth covering a porcine valve	Aortic	—	1997
St. Jude Medical Biocor®	Porcine	Sewing ring: Dacron Stent material: polyester Stent: acetal copolymer	Aortic and Mitral	Contains wire in sewing ring	2005

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Mechanical vs. Biological

Major Problems

Mechanical valve	Biological valve
Thrombosis	SVD (Calcification, Cusp tear)
pannus formation	Dehiscence
paravalvular leak	infection
infection	pannus
bleeding	paravalvular leak

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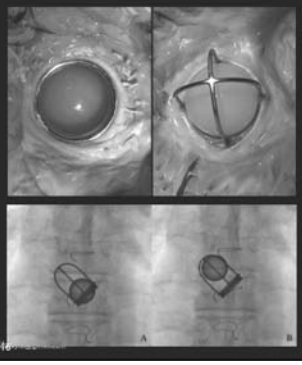
Mechanical Heart Valve

Caged Ball valve

- 1960, first clinical use in mitral replacement.
- No central blood flow
- Increased work-load
- Blood cell damage
- Thromboembolism



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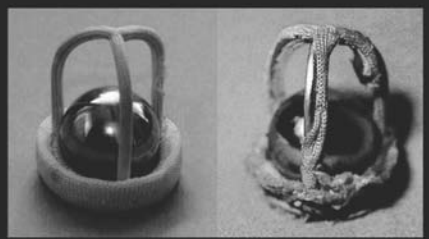
Mechanical Heart Valve

Caged Ball valve

- Cloth-covered developed, but tearing occurred



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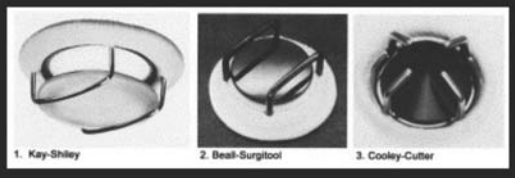
Mechanical Heart Valve

Non-Tilting Disc valve

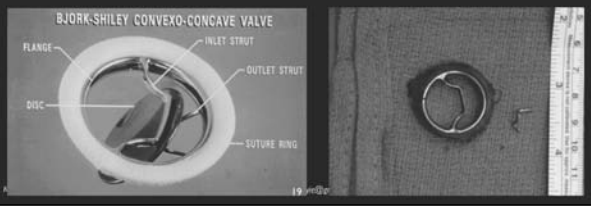
- Low profile design, easy implantation, little opening resistance, short closure delay time (low AR or MR).
- But, higher flow gradient, significant turbulence, hemolysis, thromboembolic complications.



Mechanical Heart Valve

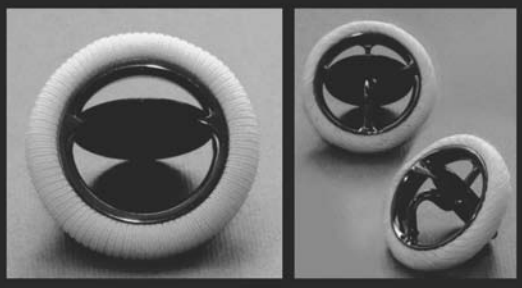
Tilting mono Disc valve (Bjork-Shiley)

- First model in 1969, most-often implanted valves in the 1970s and 1980s
- Carbon flat disc tilting up to 60°-70°
- Standart type → convex concave type → monostrut type
- But, inflow bar broken and disc escape !! (2% / year)



Mechanical Heart Valve

Tilting mono Disc valve (Omniscience, Medtronic Hall)



Mechanical Heart Valve

Bileaflet Valves : SJM (1977)

- Different tilting angle, pivot design, sewing ring design.
- Open up to 85°, close at 30°
- SJM HP (1992) and SJM Regent (1998) : reduced sewing ring and enlarged EOA.

standard SJM 21mm	EOA 1.51cm^2
SJM HP	EOA 2.03cm^2
SJM Regent	EOA 2.47cm^2

** Regent 19mm EOA 1.51
(sufficient to prevent significant PPM with BSA of 2m^2)

Mechanical Heart Valve

Bileaflet Valves : Bicarbon-Sorin (1990)

- Second most commonly implanted bileaflet valve
- Convex–concave shaped leaflet and tilt up to 80° and close at 20°
- a : Fitline or Slimline (suitable for small annuli)
- b: Overline (for supraannular implant)
- The same mechanism, but a different sewing cuff material, is typical for the Edwards MIRA valve (since 1997)

Mechanical Heart Valve

Bileaflet Valves : Carbomedics (1986)

- Standard : leaflets tilt up to 78° and close at 25°, tilting range of 53°
- R : response to the problem of a small aortic annulus
- Top Hat : Totally supra annular implantation

Mechanical Heart Valve

Bileaflet Valves : Carbomedics (1986)

- Orbis : Universal Aortic and Mitral Valve: Enabling implantation of the same valve either to the aortic or mitral position

Mechanical Heart Valve

Bileaflet Valves : ATS (1992)

- Standard Type and AP type (Advanced Performance) for small Annuli

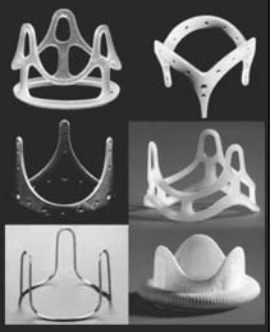
Case

	Edward Magna	Trifecta	
Leaflet	Bovine Pericaridum		
sewing ring	Silicon rubber	Silicon rubber	
Stent	Cobalt-chronmium	Titanium	
Fabric ecovoering stent	polyester cloth	polyester cloth	

Biological Heart Valve

General

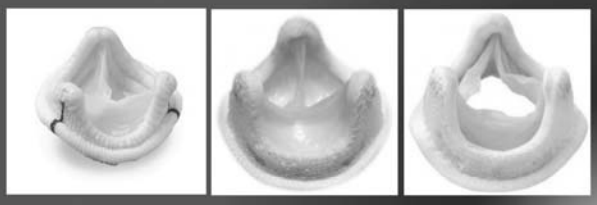
- xenografts that are mounted on a cloth-covered stent, which is manufactured from stellite, titanium, or plastic.
- Slight flexibility, helps to absorb stress load and thereby prolong the durability.
- The stent is covered with Teflon or polypropylene.
- Either a porcine aortic valve or a valve assembled from bovine pericardium.
- detoxification (anticalcification, antidegenerative, antimineralization) treatment incorporated into the processing and storage of tissue valves



Biological Heart Valve

Porcine valve

- St Jude Epic®, Hancock II®, Medtronic-Mosaic®



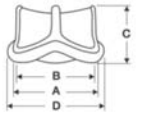
Biological Heart Valve

Bovine Pericardial valve

- Sorin Soprano®, C-E Perimount Magna®
- St Jude Trifecta®, Sorin Mitroflow®

Edward Magna®

Specifications



Model 3000/ 3000TFX

Size	19 mm	21 mm	23 mm	25 mm	27 mm	29 mm
A. Stent Diameter (TAD)	19	21	23	25	27	29
B. Internal Diameter (Stent I.D.)	18	20	22	24	26	28
C. Profile Height	14	15	16	17	18	19
D. External Sewing Ring Diameter	24	26	28	30	32	34

Significant dimensions in millimeters (nominal values)

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St Jude Epic Supra®

Epic™ Supra Stented Tissue Valve with Linx™ AC Technology
Ordering Information View Catalog

Contents: Aortic Supra-Annular Stented Tissue Valve (1 unit per box)

Reorder Number	Valve Size (mm)	Tissue Annulus Diameter (mm)	Internal Diameter (mm)	Aortic Protrusion (mm)	Total Height (mm)
ESP100-19	19	19	19	11	14
ESP100-21	21	21	21	11	15
ESP100-23	23	23	23	13	16
ESP100-25	25	25	25	13	17
ESP100-27	27	27	27	14	19
ESP100-29	29	29	29	15	20

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Trifecta®

19 mm Valves

Figure 1. Mean Pressure Gradient (mmHg)

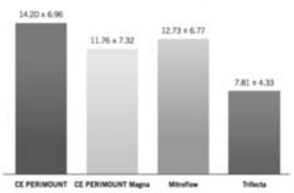
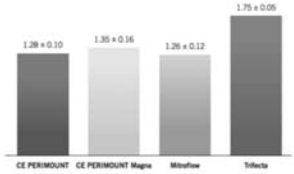


Figure 4. Effective Orifice Area (cm^2)



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Trifecta®

25 mm Valves

Figure 2. Mean Pressure Gradient (mmHg)

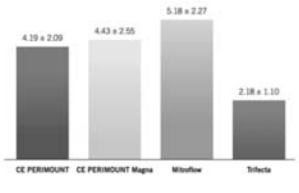
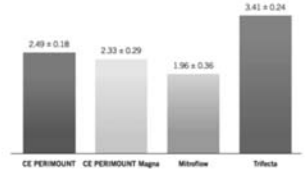


Figure 5. Effective Orifice Area (cm^2)



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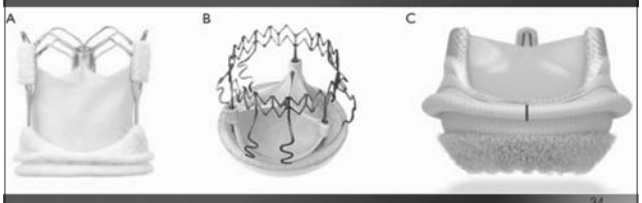
Biological Heart Valve

Sutureless valve

- Medtronic 3F Enable®, Sorin Percival®, Edward Intuity®



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Biological Heart Valve

Medtronic 3F Enable®

- CE approved in 2010
- Nitinol stent.
- Equine pericardial valve leaflets
- fixed with glutaraldehyde, incorporated within a self-expanding Nitinol frame.
- without needing the placement and tying of sutures.

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Biological Heart Valve

Sorin Percival®

- CE approved in 2011
- bovine pericardium incorporated in a nitinol-cage
- The metal-cage : anchoring the prosthesis to the aortic root.

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Biological Heart Valve

Edward Intuity®

- CE approved in 2012, based on the PERIMOUNT valve
- balloon expandable stainless steel cloth-covered frame
- implanted with the aid of a delivery system.
- reduces the number of sutures required to secure the valve.

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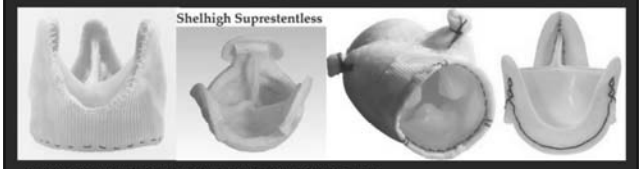
Biological Heart Valve

Stentless valve

- Toronto SPV, 1988 by T. David, Edward prima, shelhigh superstentles, Medtronic Freestyle, Sorin Freedom
- Neither stent nor sewing ring,
- larger EOA and lower transvalvular pressure gradient.
- But, superiority in long-term data ? (vs. supraannular)
- More technical demanding and time-consuming.



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Choice of Artificial Valve

Age

- Tissue valve should be preferred over 70 years in aortic and mitral position.
- But reoperation really risky ???
- Or, life expectancy would be longer than present ???

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Choice of Artificial Valve

Anticoagulation therapy

- Contra-indication for anticoagulation ? alcoholism, under-developing country, intolerance…

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Choice of Artificial Valve

Annular size and Quality

- For heavily calcified, rigid, rough annulus it is advantageous to choose the valve with wide and soft sewing ring.
- Damaged annulus such as endocarditis, allograft or stentless biopresthesis are preferred.
- Small annulus 19mm tissue valve vs. mechanical valve

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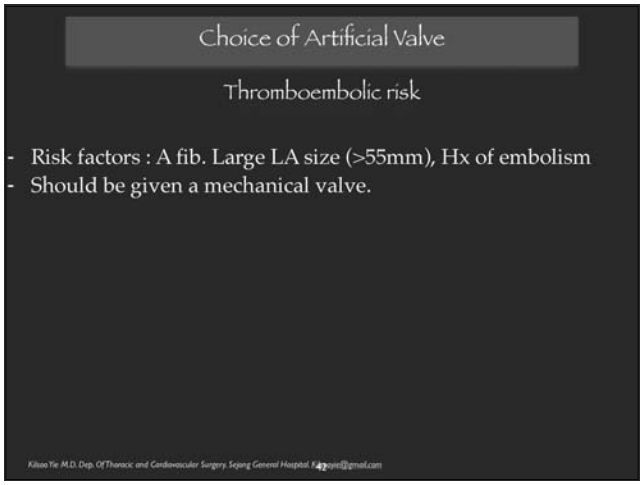
Choice of Artificial Valve
Thromboembolic risk
- Risk factors : A fib. Large LA size (>55mm), Hx of embolism
- Should be given a mechanical valve.
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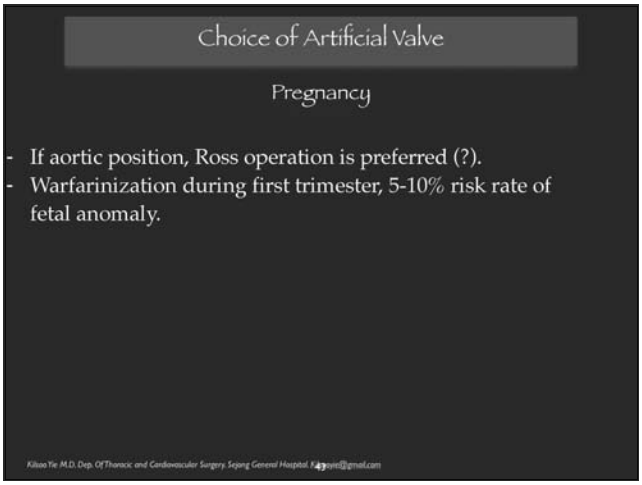
Choice of Artificial Valve
Pregnancy
- If aortic position, Ross operation is preferred (?).
- Warfarinization during first trimester, 5-10% risk rate of fetal anomaly.
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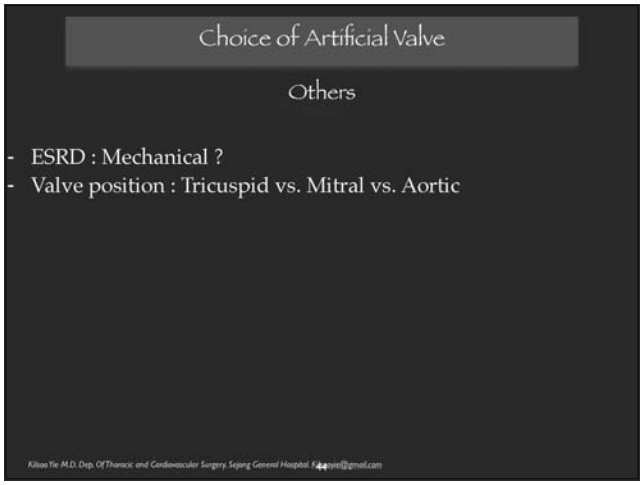

Choice of Artificial Valve
Others
- ESRD : Mechanical ?
- Valve position : Tricuspid vs. Mitral vs. Aortic
Kilsoo Yie M.D. Dep. Of Thoracic and Cardiovascular Surgery. Sejong General Hospital
44

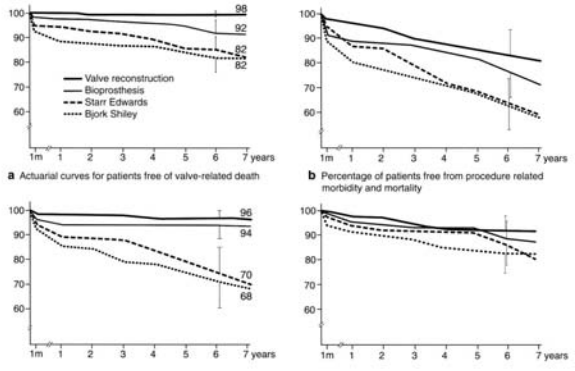
Valve Repair

경북대학교 의과대학 흉부외과학교실

김 근 직

Introduction

- 1960s Congenital malformation
  Rheumatic valvular disease
  → Palliative valve repair/valve replacement
- 1970s Rheumatic valvular disease
  → valve replacement(Mechanical, tissue, repair)
- 1980s Degenerative valvular disease(Echocardiography)
  → Functional valve analysis
  Reconstructive valve surgery
- 1990s Ischemic/cardiomyopathy
  (Tx of Atrial fibrillation:Maze opertion)
  → Nonthrombogenic valve surgery



a Actuarial curves for patients free of valve-related death

b Percentage of patients free from procedure related morbidity and mortality

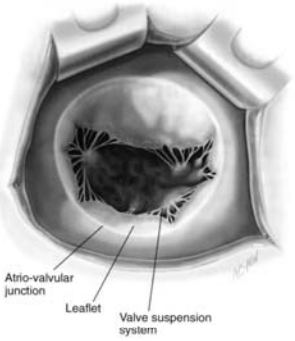
Reconstructive Valve Surgery
Three Fundamental Principles

- Preserve or restore full leaflet motion
- Create large surface of coaptation
- Remodel the annulus

A. Carpentier. JTCS 1983;86(3):323-37

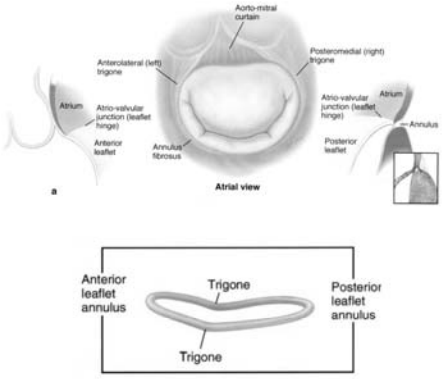
Mitral valve repair

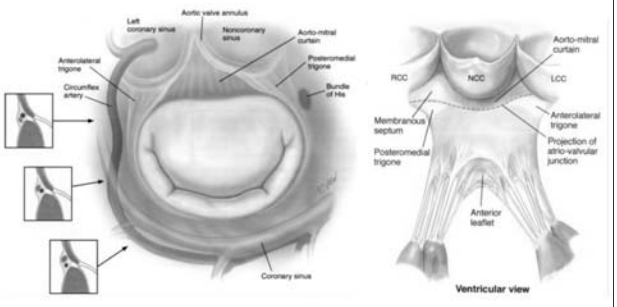
Anatomy of mitral valve



- Atrio-valvular junction
- Leaflet
- Valve suspension system
  - Chordae
  - Papillary muscle

Annulus

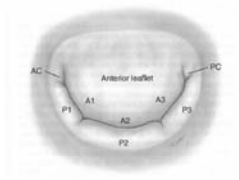




Leaflet

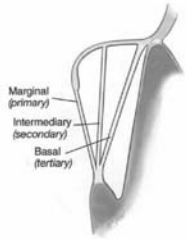
- **Anterior leaflet** : triangular – A1, A2, A3
- **Posterior leaflet**(indentation)
  – P1, P2, P3

- AL commissure
- PM commissure



Chordae

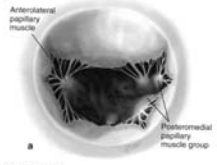
- **Marginal(primary)**
  : prevent eversion
- **Intermediary(secondary)**
  : prevent doming
- **Basal(tertiary)**
  : maintain geometery

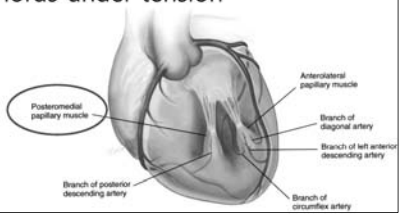


Papillary muscle

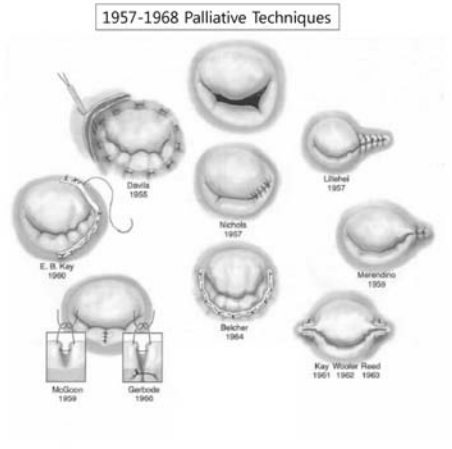
- Anterolateral PM
- Posteromedial PM

→ Keeping the chords under tension





Mitral regurgitation



Etiology

- **Primary MR**
  - Degenerative
    - Fibroelastic deficiency(FED)
    - Barlow ds(billowing valve)
    - Marfan syndrome
  - Endocarditis
  - Rheumatic
  - Calcified valve
- **Secondary MR** : problem of LV
  - Ischemic
  - DCMP

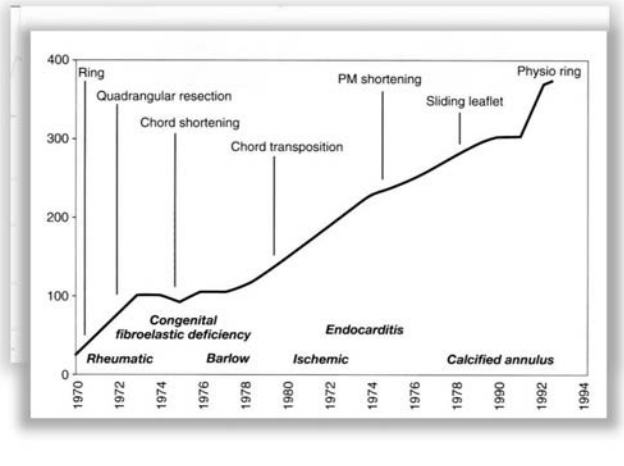
Natural course of MR

- Annual mortality of asymptomatic MR
  - 6.3%/yr
  - After 10yr : 90% died
- Occult LV dysfunction
  : frequently predates symptoms in severe MR
- Medical Tx can produce
  - Congestive heart failure
  - Atrial fibrillation

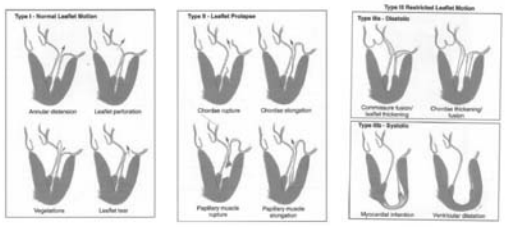
Benefits of MV repair

- Preservation of own valve within heart
- No need of anticoagulation
- Lower risk of prosthetic infection
- Lower risk of LV rupture
  : fatal complication of MV replacement
  - Resection of subvalvular structure during MVR

J Heart Valve Dis 2008;17:42-47

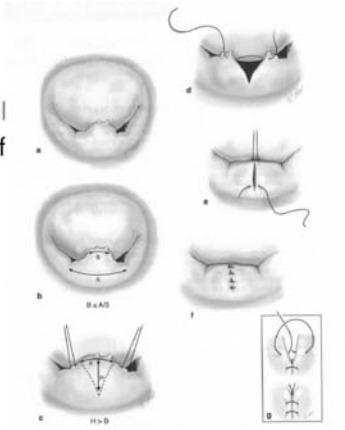


Carpentier's Classification



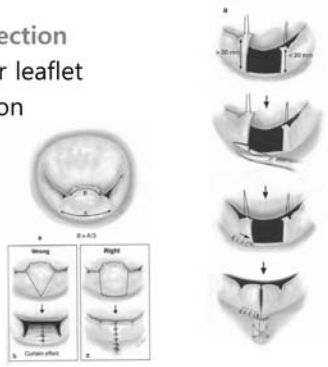
- Type I : normal leaflet motion, annular dilatation, leaflet perforation
- Type II : leaflet prolapse, papillary or chordae rupture, leaflet redundancy
- Type IIIa : restricted leaflet opening, restricted leaflet during cardiac cycle d/t rheumatic change
- Type IIIb : restricted leaflet closure, restricted leaflet during systolic phase d/t papillary muscle displacement

- Triangul
  : <1/3 of



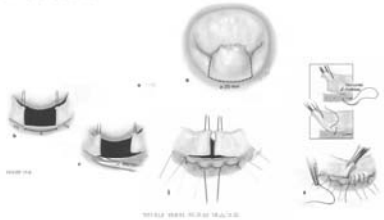
Posterior prolapse

- **Quadrangular resection**
  : >1/3 of posterior leaflet
  Annular plication



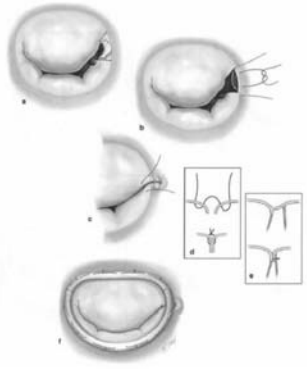
Posterior prolapse

- **Quadrangular resection+sliding annuloplasty**
  : >30mm
  Prevent SAM
  Compression suture



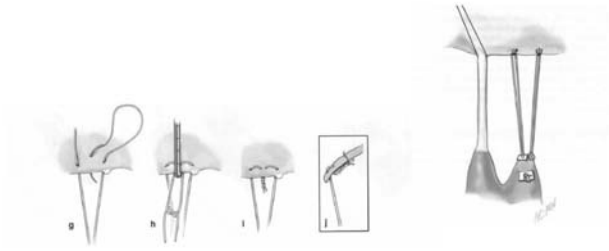
Commissural prolapse

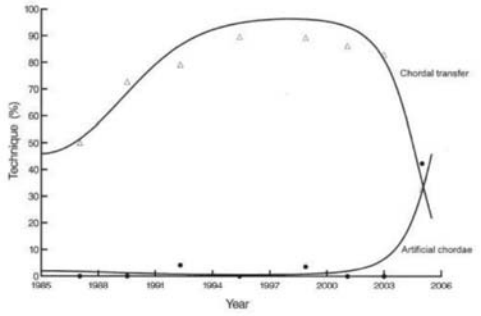
- Commissural plication
- Triangular resection



Anterior prolapse

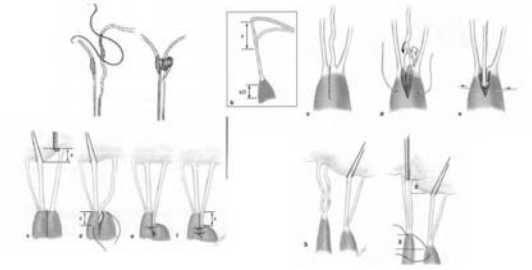
- Long-term results : posterior>>anterior
- **Artificial chorda implantation**





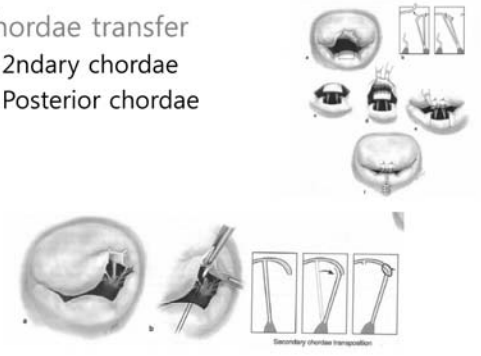
Anterior prolapse

- Chordae shortening
- Papillary muscle sliding plasty



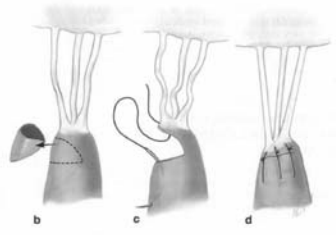
Anterior prolapse

- Chordae transfer
  - 2ndary chordae
  - Posterior chordae



Anterior prolapse

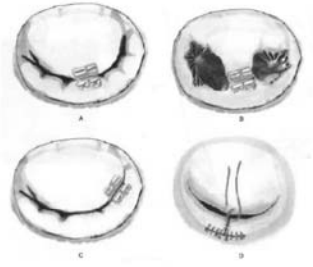
- Papillary mucle shortening



Gillinov et al. ATS 2008;86:708-17

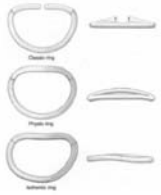
Anterior prolapse

- Alfieri(double orifice) technique
  : not to make stenosis



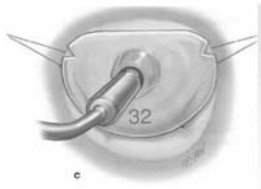
Annuloplasty ring

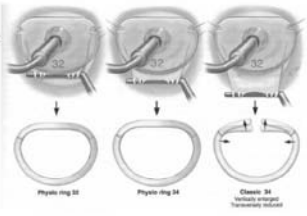
- Complete vs incomplete
  - Incomplete
    - Usually posterior annular dilatation
    - Leaflet repair itself reduce annular circumference
    - Difficult visualization of anterior annulus
  - Complete
    - Functional MR(to reduce annular circumference)
- Rigid, Semi-rigid, Flexible
  - Flexible ring
    - Physiologic movement of MV annulus
    - Valve distorsion or orifice narrowing
  - Rigid ring : more prone to produce SAM
- Adjustable vs fixed



Ring sizing

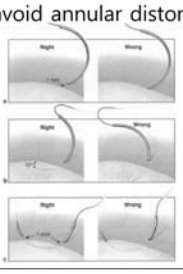
- Measurement of anterior leaflet
- Commissure to commissure
- Height of anterior leaflet : partial ring?

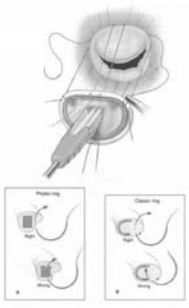




Annuloplasty suture

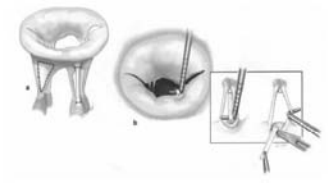
- Suture within the annulus fibrosus
  - to avoid ring dehiscence
- Not to suture metallic core of ring
  - to avoid annular distorsion

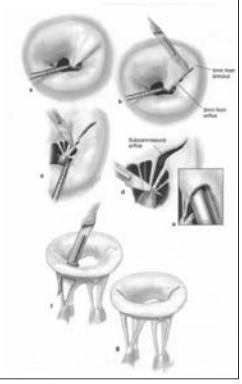




Rheumatic MV disease

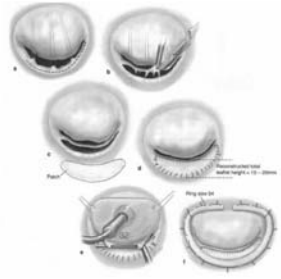
- Commissurotomy
- 2ndary chordae resection
- Not good result
  in severe deformity valve

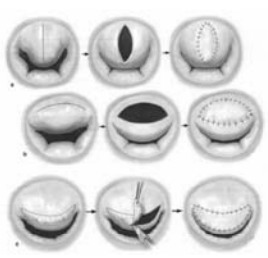




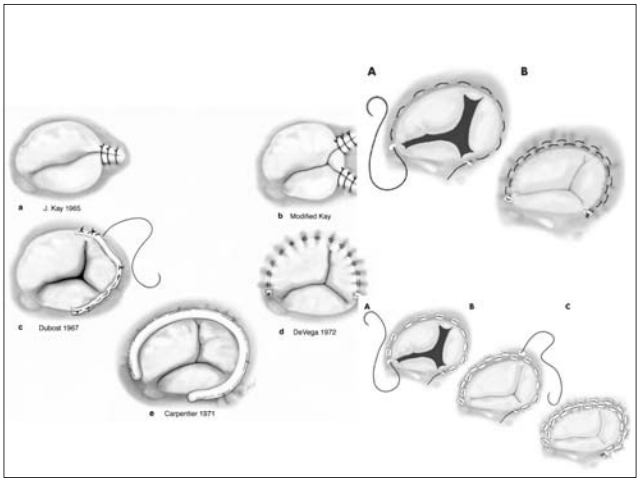
Rheumatic MV disease

- Leaflet extension : pericardium

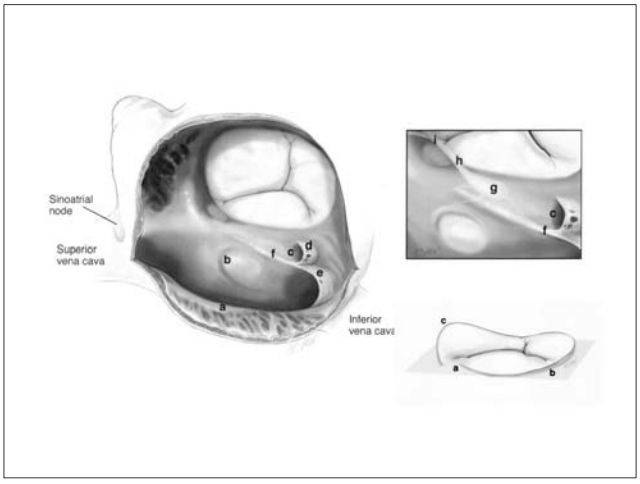




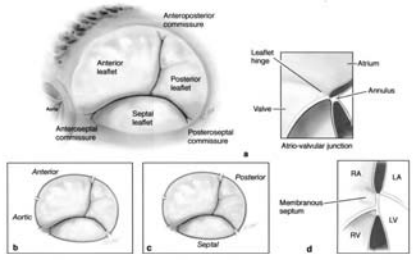
Tricuspid valve repair

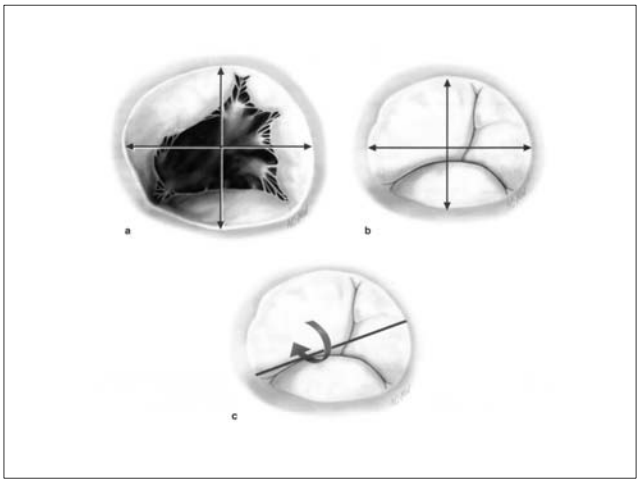


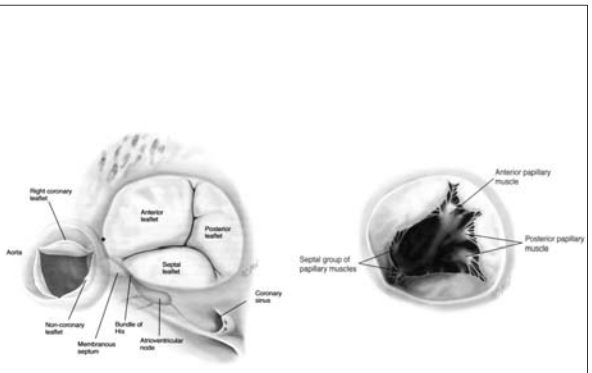
Anatomy of Tricuspid valve



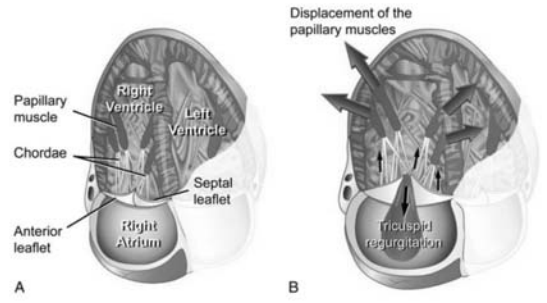
Annulus





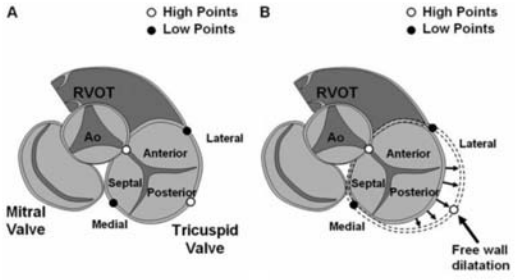


Functional TR



Mascherbauer J, EHJ;2010;31:2841–2843

Functional TR



Ton-Nu T et al. Circulation. 2006;114:143-9

Ring annuloplasty

- **Differential Annulus Dilatation**
  : Dilatation of the annulus does not affect all leaflets the same
  - Posterior leaflet can increase up to 80%
  - Anterior leaflet can increase up to 40%
  - Septal leaflet can increase up to 10%

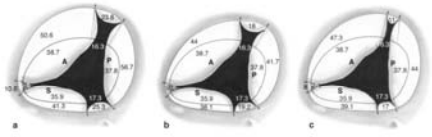


Table 2. Comparison of Selected Annuloplasty Approaches for Functional TR

	Bicuspidization	Classic De Vega	Flexible Band	Rigid Ring
Simplicity	Yes	Yes	No	No
Added time	<5 min	<10 min	10-20 min	15-20 min
Reproducibility	Low	Moderate	High	Very high
Annular stabilization	Posterior	Anterior/posterior	Anterior/posterior	Septal/anterior/posterior
Risk of heart block	None	Minimal	Minimal	Low
Residual TR	High	Moderate	Low	Low
Recurrent TR	High	Moderate	Low	Low
Cost	Cheap	Cheap	Expensive	Expensive

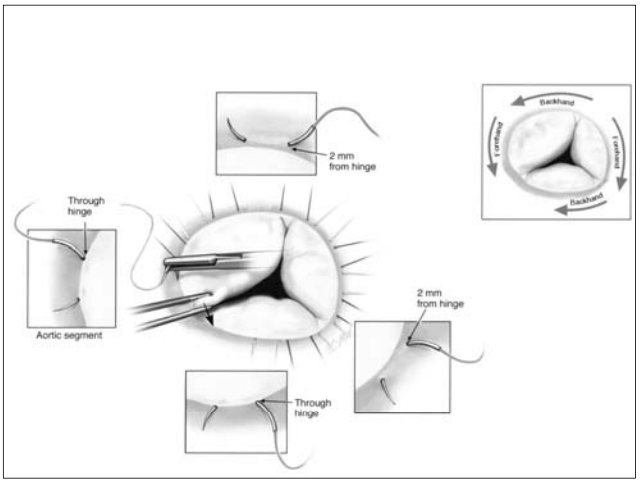
This assumes techniques are applied by general cardiac surgeons without specific expertise in either repair technique.
TR, tricuspid regurgitation.

Chikwe J, Anyanwu AC. Semin Thoracic Surg 22:90-96.

Table 1. Commonly Used Rings and Bands for the Treatment of Functional Tricuspid Regurgitation

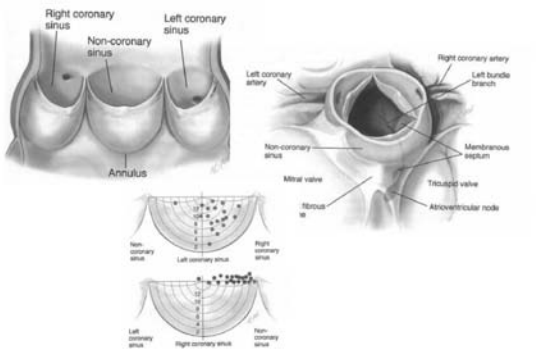
Name	Manufacturer	Rigid or Flexible	Size and Shape (Closed or Open)	Comments
Carpentier-Edwards	Edwards Lifesciences	Rigid Ring	26-36 mm open	Dedicated tricuspid, planar
Cosgrove-Edwards	Edwards Lifesciences	Flexible band	26-38 mm open	Mitral or tricuspid
MC3	Edwards Lifesciences	Rigid titanium Ring	26-36 mm open 3D	Dedicated tricuspid, 3D conformation
Duran AnCore	Medtronic	Flexible ring or band	25-35 mm closed or open	Mitral or tricuspid
Tailor	St. Jude Medical	Flexible ring or band	Closed or open	Mitral or tricuspid
Annuloflex	CarboMedics	Flexible ring or band	26-36 mm convertible closed or open	Mitral or tricuspid
Simulus	ATS Medical	Flexible ring or band	23-35 mm closed or open	Mitral or tricuspid

Rogers JH, Bolling SF, et al. Semin Thoracic Surg 22:84-89.

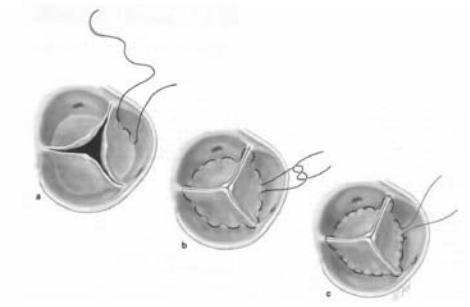


Aortic valve repair

Anatomy of aortic valve

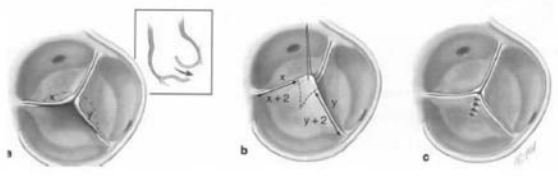


Annular dilatation

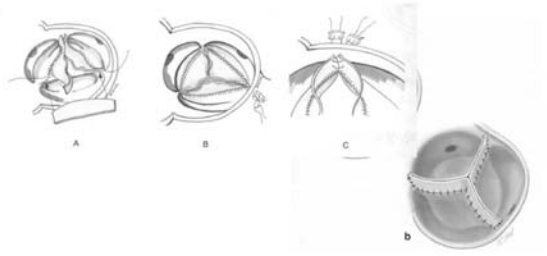


Leaflet perforation

Leaflet Prolapse



Leaflet extension



Summary

- Adequate knowledge for Valve
- Adequate ring annuloplasty(MV, TV).
- Artificial chordae(MV)
- One lesion one technique principle(MV)

AntiAF Surgery

Department of Thoracic & Cardiovascular Surgery,
Sungkyunkwan University School of Medicine

Kiick Sung, M.D., Ph.D.

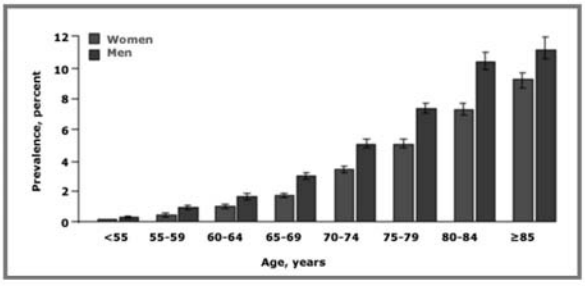
2015 Arrhythmia Surgery

Prevalence of AF

- AF is the most common cardiac dysrhythmia treated in clinical practice:
  - 1~2% of all population
- Increasing with advancing age
  - from ,0.5% at 40-50 years, to 5-15% at 80 years
- Its prevalence continues to increase at a rapid rate
  - at least 2.5 folds in the next 50 years

2015 Arrhythmia Surgery

Prevalence of AF



2015 Arrhythmia Surgery

AF with Mitral Valve Disease

- Incidence: 50%
- MV surgery alone: remain 70 ~ 80%
- Survival benefit: JAMA 2005;294:2323-9
- Freedom from AF after Maze op: increase but sinus rhythm restoration rate:46-95%
- LA alone vs biatrial:
  - LA alone: paroxismal AF, no need for RA incision
  - Results ?

2015 Arrhythmia Surgery

Consequences of AF

- Morbidity and Mortality
  - 2-fold increase in risk of mortality
  - 5-fold increase in risk of stroke
    associated with more severe stroke
  - increase hospitalization
  - promotes heart failure (due to LV dysfunction)
    worsen a patient's overall prognosis
- Quality of Life
  - QoL may be considerably impaired due to risk of exacerbation of symptoms

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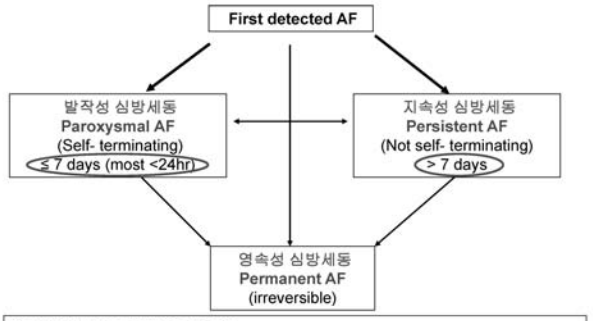
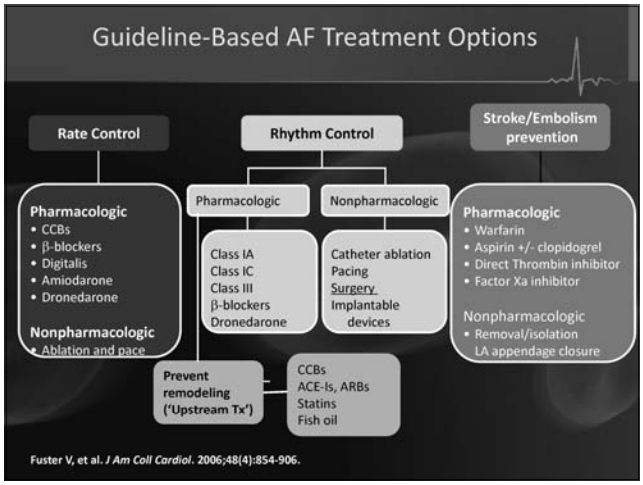
Classification of AF



Recurrent : two or more episode
Longstanding persistent AF: continuous AF of greater than one-year duration

Guideline-Based AF Treatment Options



Fuster V, et al. *J Am Coll Cardiol*. 2006;48(4):854-906.

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Rate Control vs Rhythm Control

- AF-CHF trial: no difference

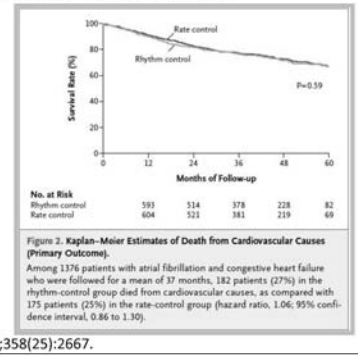

Figure 2. **Kaplan–Meier Estimates of Death from Cardiovascular Causes (Primary Outcome).**
Among 1376 patients with atrial fibrillation and congestive heart failure who were followed for a mean of 37 months, 182 patients (27%) in the rhythm-control group died from cardiovascular causes, as compared with 175 patients (25%) in the rate-control group (hazard ratio, 1.06; 95% confidence interval, 0.86 to 1.30).

N Engl J Med. 2008;358(25):2667.

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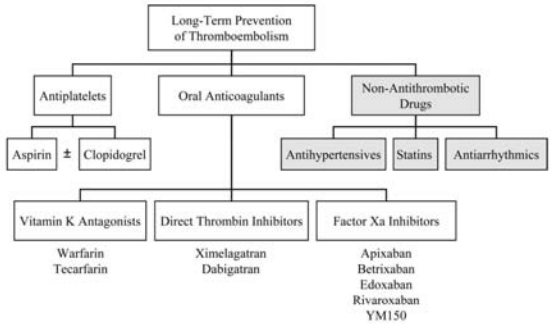
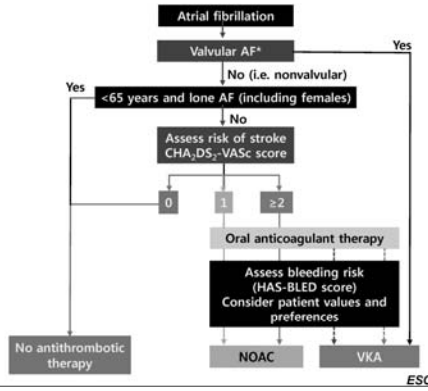
Prevention of Thromboembolism



Choice of Anticoagulant



ESC guideline, 2012

CHA_2DS_2VASc score for further refinement

'Major' risk factors	'Clinically relevant non-major' risk factors
Previous stroke, TIA, or systemic embolism Age ≥75 years	Heart failure or moderate to severe LV systolic dysfunction (e.g. LV EF ≤40%) Hypertension - Diabetes mellitus Female sex - Age 65–74 years Vascular disease[a]

CHA_2DS_2-VASc score	Patients (n=7329)	Adjusted stroke rate (%/year)[b]
0	1	0%
1	422	1.3%
2	1230	2.2%
3	1730	3.2%
4	1718	4.0%
5	1159	6.7%
6	679	9.8%
7	294	9.6%
8	82	6.7%
9	14	15.2%

Risk factor	Score
Congestive heart failure/LV dysfunction	1
Hypertension	1
Age ≥75	2
Diabetes mellitus	1
Stroke/TIA/thrombo-embolism	2
Vascular disease[a]	1
Age 65–74	1
Sex category (i.e. female sex)	1
Maximum score	**9**

CHA_2DS_2VASc score and antithrombotics

Risk category	CHA_2DS_2-VASc score	Recommended antithrombotic therapy
One 'major' risk factor or ≥2 'clinically relevant non-major' risk factors	≥ 2	OAC[a]
One 'clinically relevant non-major' risk factor	1	Either OAC[a] or aspirin 75–325 mg daily. Preferred: OAC rather than aspirin.
No risk factors	0	Either aspirin 75–325 mg daily or no antithrombotic therapy. Preferred: no antithrombotic therapy rather than aspirin.

HAS-BLED bleeding risk score

Letter	Clinical characteristic	Points awarded
H	Hypertension	1
A	Abnormal renal and liver function (1 point each)	1 or 2
S	Stroke	1
B	Bleeding	1
L	Labile INRs	1
E	Elderly (e.g. age >65 years)	1
D	Drugs or alcohol (1 point each)	1 or 2
		Maximum 9 points

* a score of ≥3 indicates 'high risk

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Pathophysiology 1

- Triggers: initiation of AF
  - Pulmonary veins and left atrium
    - 94% of paroxymal Af (Haissaguerre et al.)
    - Two types with different electric properties are juxtaposed.
  - Posterior wall of left atrium
  - SVC, Marshall vein and coronary sinus

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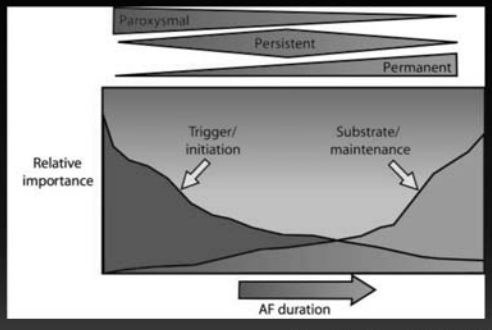
Pathophysiology 2

- Substrate: maintenance of AF
  - Structural abnormalities
    - Atrial dilatation
    - Lower mean atrial voltage
  - Conduction abnormalities
    - Prolongation of conduction times
    - Longer P wave duration and slow conduction
  - Impaired sinus node

Persistent AF: Different disease from PAF



Mayo Clin Proc. 2009 July;84(7):643-662.

SAMSUNG MEDICAL CENTER

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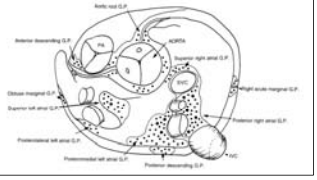
Pathophysiology 3

- Modulating factors
  - Inflammation
    - C-reactive protein (CRP)
    - Equivocal and limited
  - Parasympathetic nerves
  - Sympathetic nerves
    - Pulmonary veins are primary location for entry of vagal nerves into the LA
  - Ganglionated plexus



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Surgical vs Catheter

- Controversial
- Surgical >> Catheter ?
- Surgical indication
  - Symptomatic AF patients undergoing cardiac surgery (IIA-A)
  - Asymptomatic AF patients undergoing cardiac surgery in whom the ablation can be performed with minimal risk (IIB-C)
  - Stand-alone AF who have failed catheter ablation in whom minimally invasive surgical ablation is feasible (IIB-C)
  - Adult congenital reoperation for TGA
  - MV disease

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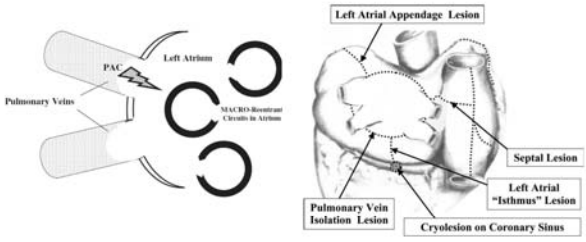
Maze Operation

- The first curative approach to AF
- Atrial segmentation impeding deployment of reentant waves



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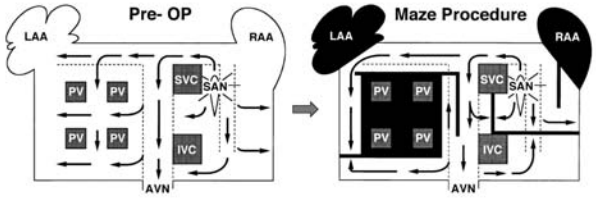
Concept of Maze Op.



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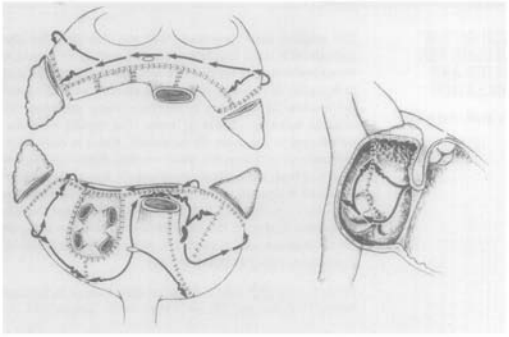
Maze I

- Sinus node dysfunction



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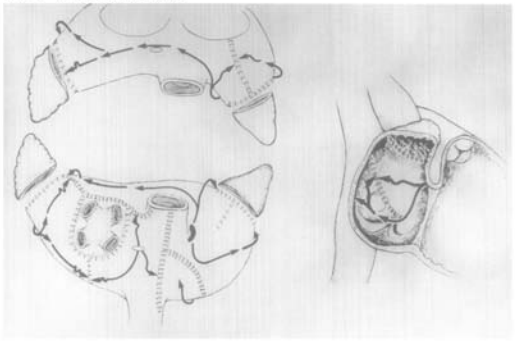
Maze II

- SVC transsection



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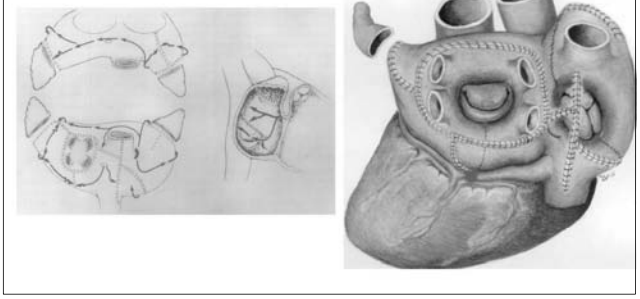
Maze III

- Gold standard, cut-and-saw



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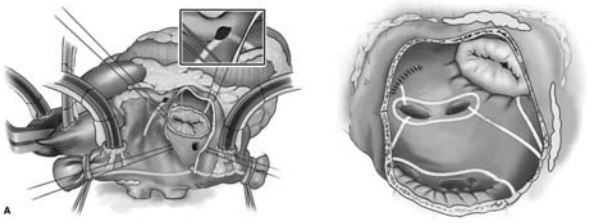
Maze IV

- Simplified ablation assisted procedure



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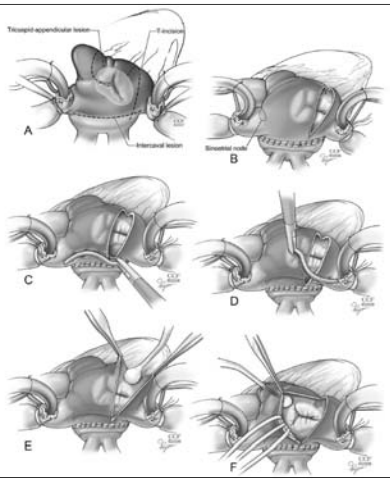
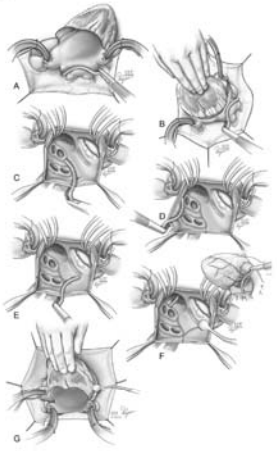


2015 Arrhythmia Surger



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Choice of Lesion Set

Type of surgery	Paroxysmal AF	Nonparoxysmal AF
Aortic valve surgery	Left sided ablation (1 or 2)	Biatrial ablation (1 + 3 or 2 + 3)
Coronary artery surgery		
Other open heart surgery without left atriotomy		
Mitral valve surgery	Left sided ablation (1)	Biatrial ablation (1 + 3)
Atrial septal defect surgery	Biatrial ablation (1 + 3)	Biatrial ablation (1 + 3)

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Alternative Energy source

- Transmurality vs collateral injury
  - Heat sink or cooling sink
- Cryo
- Radiofrequency
  - Uni
  - Bi
  - Irrigated
- Microwave
- Laser
- Focused US

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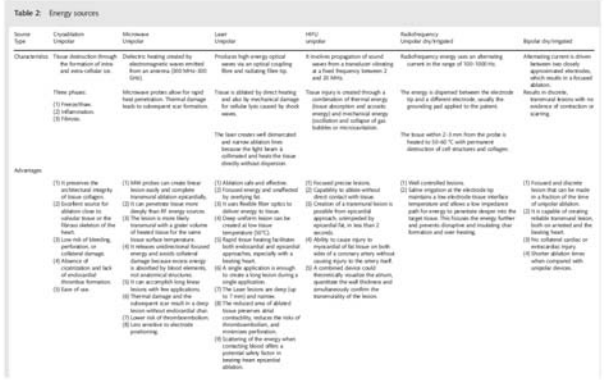

Table 2: Energy sources

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Table 2: Continued

Source Type	Cryoablation Unipolar	Microwave Unipolar	Laser Unipolar	HIFU unipolar	Radiofrequency Unipolar dry/irrigated	Bipolar dry/irrigated
Disadvantages	(1) Long time necessary to create an ablation (2 - 3 min). (2) Probes rigid and large - not suitable for minimally invasive procedures. (3) Difficulty in creating lesions in the beating heart because of the heat sink of the circulating blood volume. (4) Coronary artery stenosis. (5) Oesophageal lesions.	(1) It is unfocused heat energy. (2) There is no way to judge transmurality of ablation during surgery. (3) Potential collateral injury (circumflex artery. (4) It is not capable of creating epicardial lesions on the beating heart.	(1) The deliver is unconfined and thus could cause collateral damage. (2) There is no way to judge transmurality of ablation during procedures. (3) Crater formation and even perforation at high energy can occur*. (4) Poor visualization can make precise application difficult.	(1) If the power of the source is too high, excessive mechanical shear can disrupt adjacent tissue and cause collateral or target tissue damage. (2) Its safety profile needs to be clarified. (3) Fixed depth of penetration, which may be problematic because of the pathological variability in atrial wall thickness.	(1) It is incapable of creating epicardial transmural lesion on the beating heart. (2) It radiates unfocused heat, and this may cause collateral injury if not used carefully. (3) It is thrombogenic. (4) Pulmonary vein stenosis. (5) Damage to the circumflex coronary artery. (6) Atrio-esophageal fistula.	(1) Difficult to maintain constant and firm tissue-electrode surface contact on beating heart. (2) Limited manoeuvrability can hamper the orientation of the probe and constrain the variety of achievable lesion set. (3) It can only ablate tissue that can be clamped within the jaws of the device.

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Minimally Invasive Technique

- Beating heart (without CPB), epicardial
  - Robotic
  - Throacoscopic
  - Mini-thoracotomy
- Hybrid: epicardial surgcial ablation + endocardial catheter ablation
- Mini-maze:
  - PVI + LA isthmus & coronary sinus + RA isthmus
- PVI, LA appendage resection

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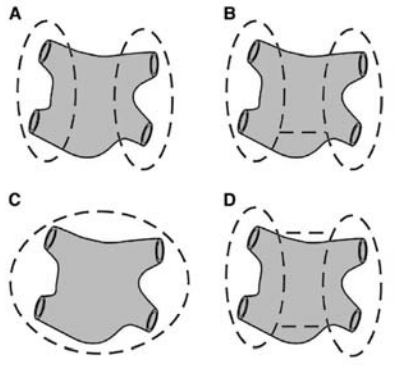
PVI



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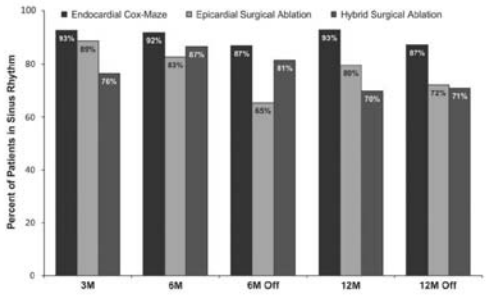
Freedom From AF



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Other AF Surgery

- Historical
  - Left atrial isolation: 1980, Williams et al
  - Corrido technique: 1985, Guiraudon et al
  - Mini-maze:
  - PVI
  - Radial approach: experimental

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Results

- Success rate: about 90%
- When ?
  - Last rhythm
  - At 6m, 1yr, etc
  - Time related event
- With AAD or not
- Without AF or resortration of sinus rhythm
- 24hr holter or long-term monitoring or EKG only

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Risk Factors for Recurrence

- Huge LA
- Fine fibrillation wave
- Duration of AF
- Old age
- Fibrosis
- Recurrence of MV disease

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Comments

- Without AF ≠ restoration of atrial activity
- Survival benefit ?
- Risk of thromboembolism ?

당신이 기적의 주인공이다

권영찬닷컴

권 영 찬


당신이 가족의 주인공이다!

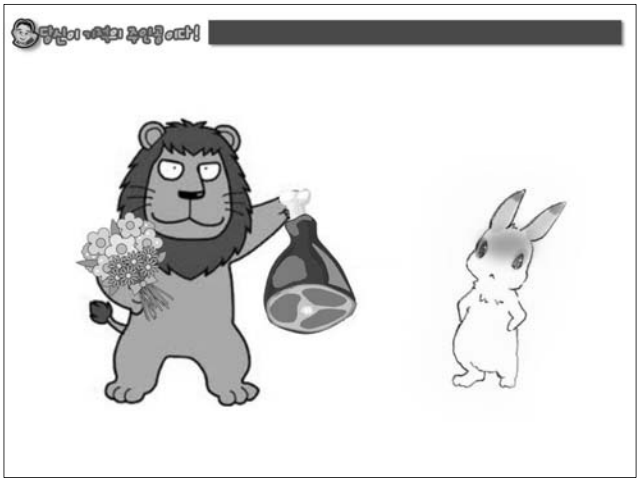

당신이 가족의 주인공이다!

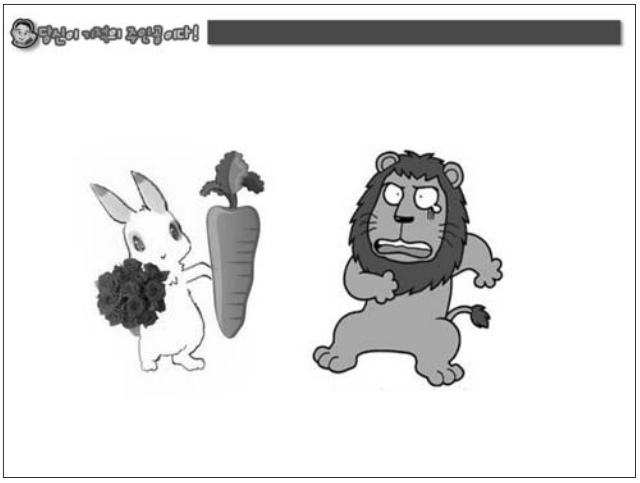

당신이 가족의 주인공이다!
TOYOTA


당신이 가족의 주인공이다!
TOYOTA


당신이 가족의 주인공이다!


당신이 가족의 주인공이다!
1991년 KBS 공채 ->
1997년에 강남에 아파트 구입 ->
2005년 연봉 5억 ->
2005년 구속(자살 생각) ->
2007년 12월 추락 ->
2012년 7억~8억원의 연봉





일반대화와 코칭대화 비교

일반대화	코칭대화
자신이 이야기한다	상대의 이야기를 듣는다
일방적으로 말한다	상대를 대화로 끌어들인다
상대의 이야기를 끊는다	상대의 이야기를 끌어낸다
재촉한다	기다린다
(자신이)평가한다	(상대에게)평가하게 한다
관찰하지 않는다	관찰한다
한가지 패턴의 질문	다양한 패턴의 질문
논리에 치우친다	감정을 존중한다
전부 알고 있는 척 한다	알아도 모르는 척 한다

일반대화와 코칭대화 비교

일반대화	코칭대화
답을 준다	힌트를 준다
자신의 생각에 집착한다	자신의 생각에 집착하지 않는다
말로만 끝낸다	행동까지 지원한다
YOU를 강조한다("당신은")	WE를 강조한다("우리가")
WHY를 강조한다("당신 왜 그래?")	HOW를 강조한다("우리 어떻게 할까?")
인정하지 않고 인정해도 전하지 않는다	인정하고 전달한다
약점을 지적한다	강점을 지적한다
상대의 실수를 질책하는 기회로 삼는다	상대의 실수를 성장의 기회로 삼는다

마음 챙김 – 명상

- ▸존 카밧진 박사가 의료에 접목
- ▸ 1979년부터 미국에서 시작
- ▸ 현대인의 병 – 70%이상이 스트레스
- ▸ 치유가 아닌 치료의 개념
- ▸ 카톨릭대학교 의료대학등에서 국내 적용

용서하기

프레드 레스킨 교수
(스텐포드의대)

▸ 용서하는법

첫째, 당신에게 일부러 상처주려는 사람은 없다.

둘째, 화가나면 숨을 깊게 쉬고 사랑하는 사람을 떠올려라

셋째, 모든것은 나에게 달려있다.

당신이 가족의 주인공이다!

Comedy
- 삶을 낙관적으로 보는 인생대본. 즉, 인생은 신선한 것
: 삶의 문제들을 늘 단순화 하고 최소화하며,
다른 사람들과 따뜻하고 사랑스런 관계를 추구한다.
(Happy ending: Cinderella story)

Romance
- 삶에 있어서 늘 모험과 정복을 추구: 정열적 인생관
: 모험심과 적극성으로 삶의 장애를 이겨냄
: 승리자와 영웅추구: 변화와 적응, 전진추구
: 낙관적 승리 기대

Tragedy
- 모든것은 다 죽는다. 자신을 삶의 희생자라 생각
: 이 세상은 기쁨과 슬픔, 행복과 불행이 뒤섞여
마침내 죽음과 파열로 끝나고 만다. 이 세상을 믿지마라

Irony
- 인생은 수수께끼: 값싼 영웅주의 배제
인생은 쉽게 풀리는 게임이 아니다.
삶의 모호성을 강조: 그저 최선을 다할뿐!

당신이 가족의 주인공이다!

생각에 따라서 행복과 불행

당신이 가족의 주인공이다!

유 머 스 피 치 란 ?

당신이 가족의 주인공이다!

도전은 해봤니?

받고 싶으면 먼저 줘라!

당신이 가족의 주인공이다!

고객은 나의 스폰서이다!

당신이 가족의 주인공이다!

당신의 네비게이션의 위치는?

당신이 쓰는 네비게이션은?

기본만 제대로 해도 웃는다!

당신이 기적의 주인공이다!

◈ 한국남자의 웃음량

*세계 평균 웃음량
-남자 하루에 5회 ,
여자 하루에 8회

*한국 성인 남녀 평균 웃음량--
남자 한 주에 0.1회,
여자 하루에 3회

*한국 남자가 10주에 한번 웃는 경우:

술에 만취했을 때,
예쁜 여성을 발견했을 때

당신이 기적의 주인공이다!

웃어본 사람이 웃을 수 있다.

당신이 기적의 주인공이다!

◈ 유머스피치 표현법

당신이 기적의 주인공이다!

우리가 생각하는 행복이란 무엇일까?

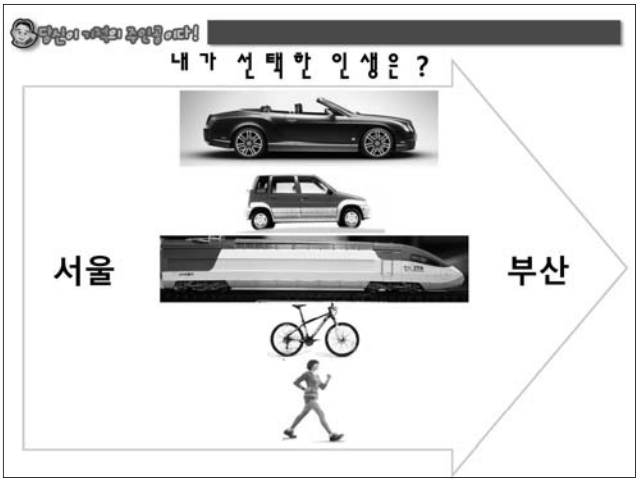
당신이 기적의 주인공이다!

성공하면 내 탓, 실패하면 남의 탓!

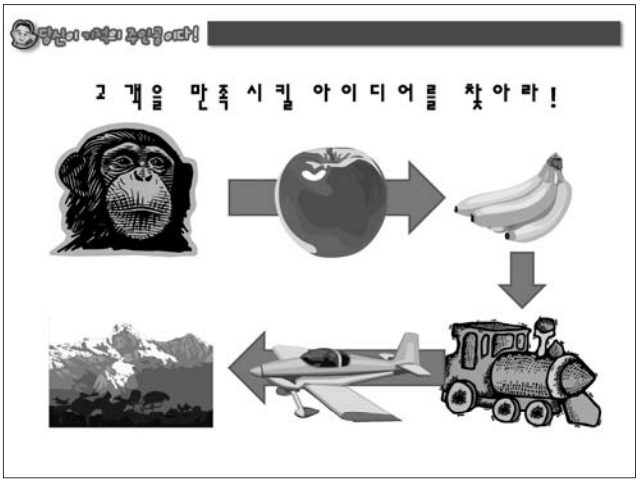
당신이 기적의 주인공이다!

칭찬은 고래도 춤추게 한다


당신이 가장 중요한 존재입니다!
내가 가장 잘 할 수 있는 방법을 찾아라!


당신이 가장 중요한 존재입니다!
내가 선택한 인생은?
서울
부산


당신이 가장 중요한 존재입니다!
호기심을 가져라!

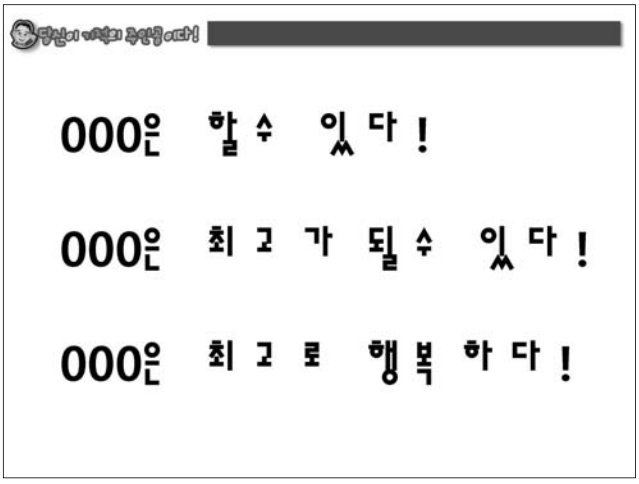

당신이 가장 중요한 존재입니다!
고객을 만족시킬 아이디어를 찾아라!


당신이 가장 중요한 존재입니다!
당신의 고객은 당신의 종교이다?


당신이 가장 중요한 존재입니다!
불행은 불행으로 끝나는 것이 아니라
또 다른 행복의 시작


당신이 기적의 주인공이다!


당신이 기적의 주인공이다!
1만원짜리 칼이 1억원짜리 명검으로


당신이 기적의 주인공이다!
000은 할 수 있다!
000은 최고가 될 수 있다!
000은 최고로 행복하다!

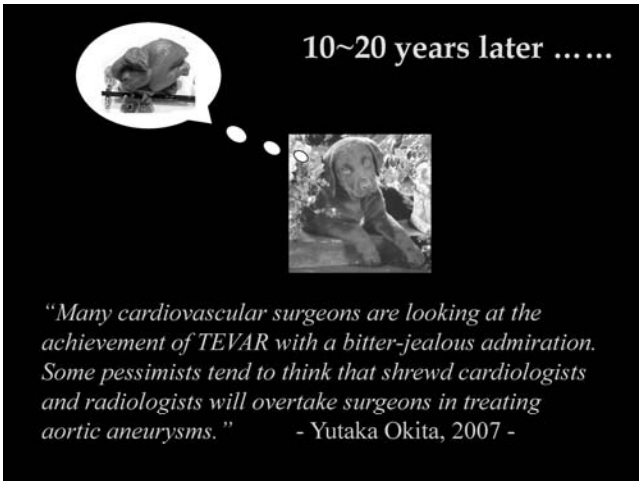
【혈관 파트】

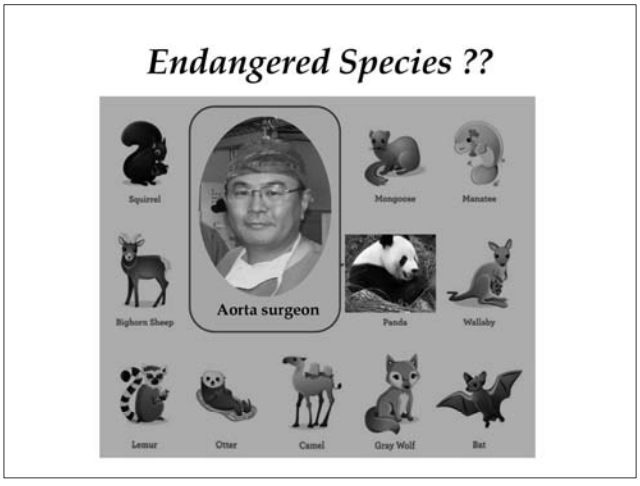
좌장: 박계현

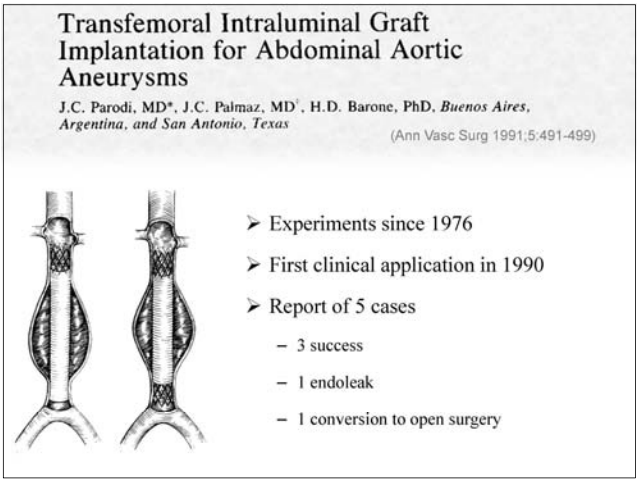
Endovascular Aortic Repair

Department of Thoracic and Cardiovascular Surgery,
Seoul National University Bundang Hospital

Kay-Hyun Park








The New England
Journal of Medicine
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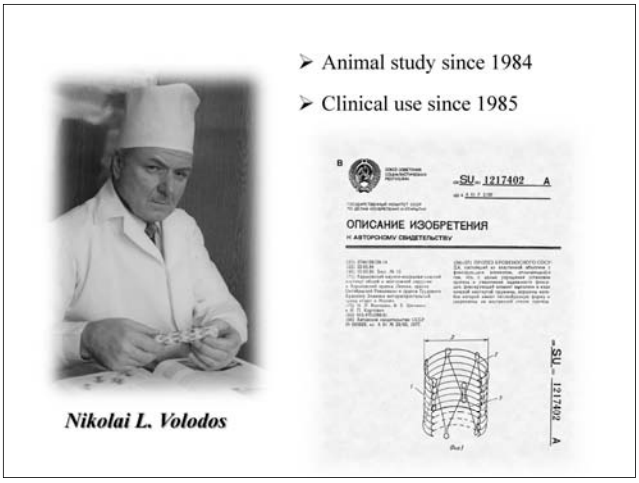
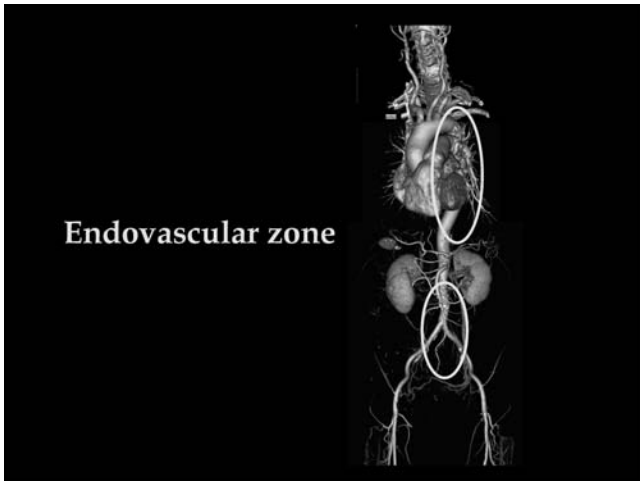
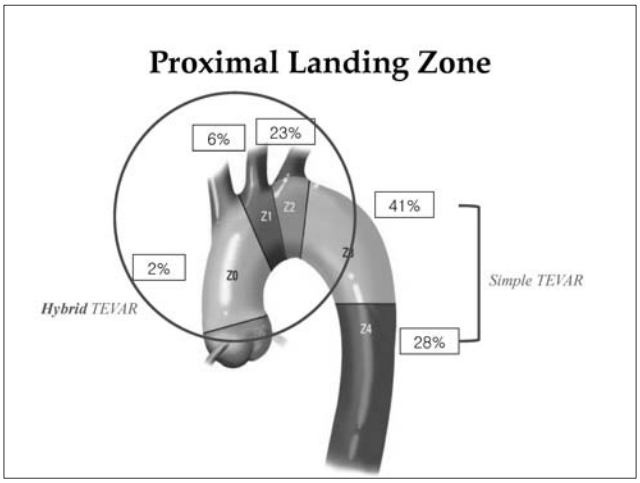
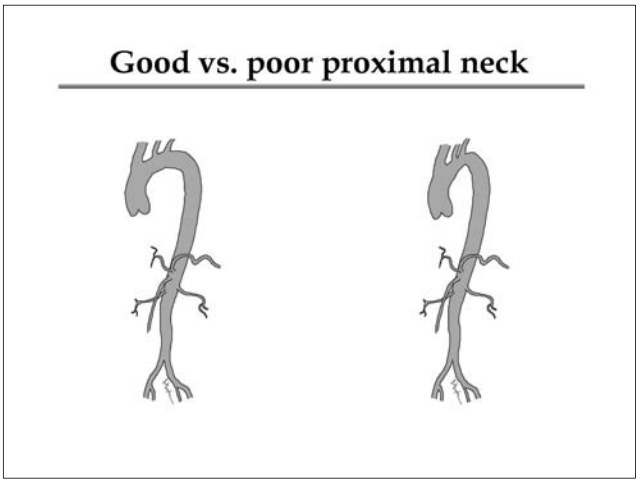
Volume 331 DECEMBER 29, 1994 Number 26
TRANSLUMINAL PLACEMENT OF ENDOVASCULAR STENT-GRAFTS FOR THE TREATMENT OF DESCENDING THORACIC AORTIC ANEURYSMS
Michael D. Dake, M.D., D. Craig Miller, M.D., Charles P. Semba, M.D., R. Scott Mitchell, M.D., Philip J. Walker, M.B., B.S., and Robert P. Liddell, B.A.
First clinical application in 1992
13 patients

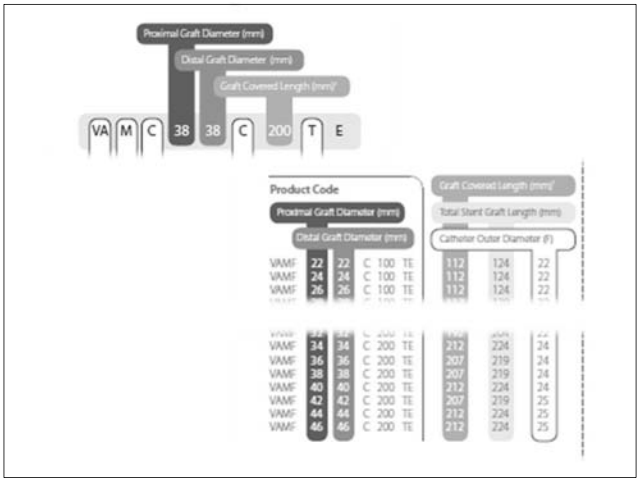

Animal study since 1984
Clinical use since 1985
Nikolai L. Volodos
SU- 1217402 A
ОПИСАНИЕ ИЗОБРЕТЕНИЯ

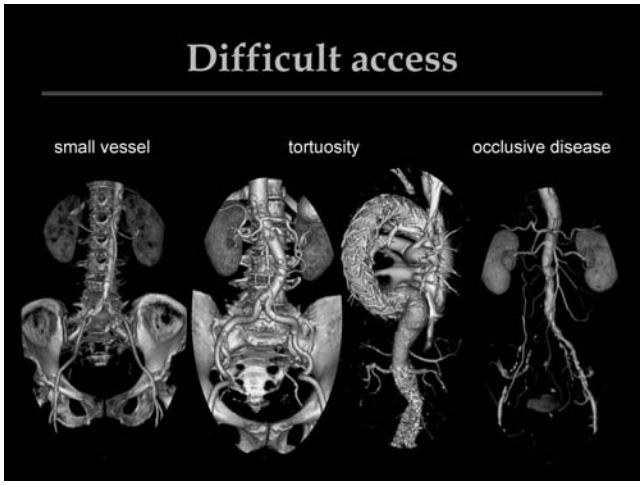

Endovascular zone

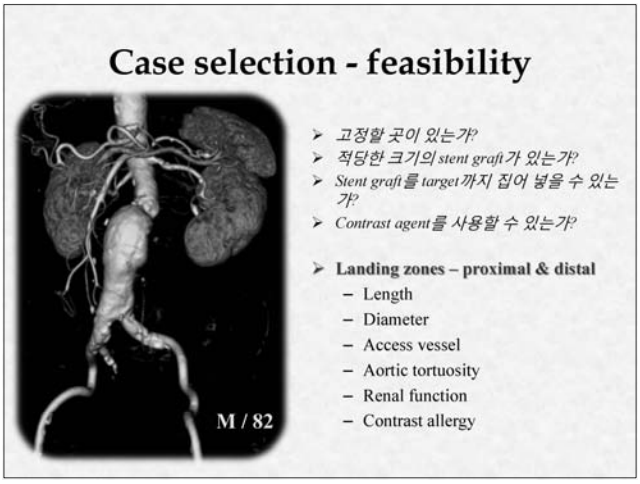

Case selection - feasibility
F / 75
고정할 곳이 있는가?
적당한 크기의 stent graft가 있는가?
Stent graft를 target까지 집어 넣을 수 있는가?
Contrast agent를 사용할 수 있는가?
Landing zones – proximal & distal
Length : ≥ 2cm, the longer the better
Diameter
Access vessel size & tortuosity
Renal function
Contrast allergy

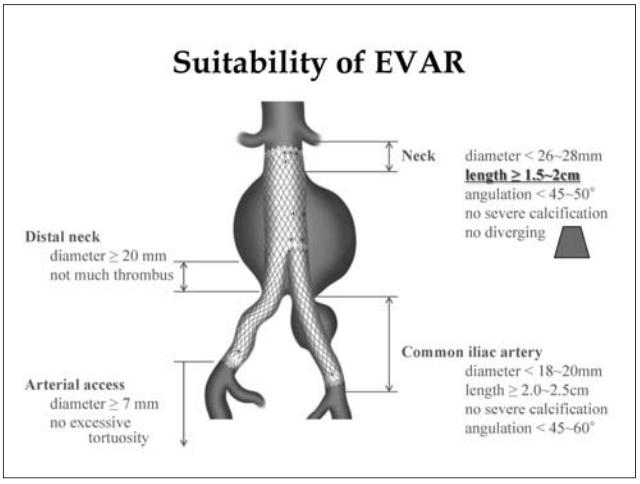

Proximal Landing Zone
6%
23%
41%
2%
28%
Z0
Z1
Z2
Z3
Z4
Hybrid TEVAR
Simple TEVAR

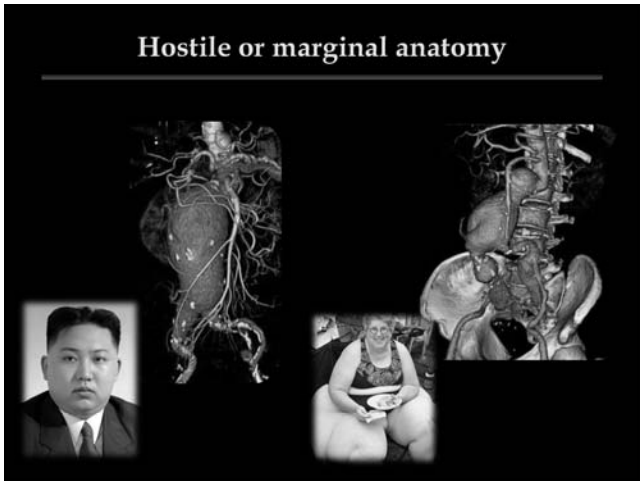

Good vs. poor proximal neck

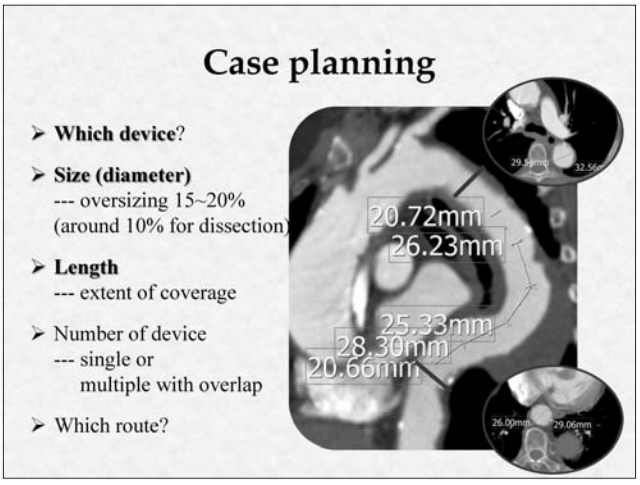

Proximal Graft Diameter (mm)
Distal Graft Diameter (mm)
Graft Covered Length (mm)
VA M C 38 38 C 200 T E
Product Code
Proximal Graft Diameter (mm)
Distal Graft Diameter (mm)
Graft Covered Length (mm)
Total Stent Graft Length (mm)
Catheter Outer Diameter (F)


Difficult access
small vessel
tortuosity
occlusive disease


Case selection - feasibility
M / 82
고정할 곳이 있는가?
적당한 크기의 stent graft가 있는가?
Stent graft를 target까지 집어 넣을 수 있는가?
Contrast agent를 사용할 수 있는가?
Landing zones – proximal & distal
Length
Diameter
Access vessel
Aortic tortuosity
Renal function
Contrast allergy


Suitability of EVAR
Neck
diameter < 26~28mm
length ≥ 1.5~2cm
angulation < 45~50°
no severe calcification
no diverging
Distal neck
diameter ≥ 20 mm
not much thrombus
Common iliac artery
diameter < 18~20mm
length ≥ 2.0~2.5cm
no severe calcification
angulation < 45~60°
Arterial access
diameter ≥ 7 mm
no excessive tortuosity

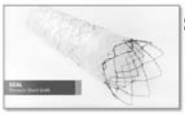

Hostile or marginal anatomy


Case planning
Which device?
Size (diameter)
--- oversizing 15~20%
(around 10% for dissection)
Length
--- extent of coverage
Number of device
--- single or
multiple with overlap
Which route?
20.72mm
26.23mm
25.33mm
28.30mm
20.66mm

Thoracic EndoVascular Aortic Repair

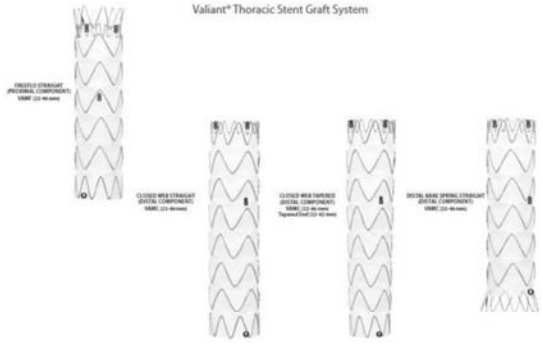

Cook TX2


Gore TAG


S&G Seal


Medtronic Captivia

18



Procedure

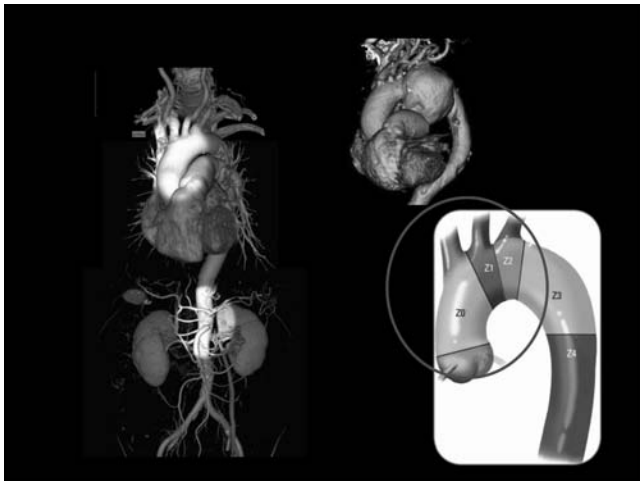
- Imaging
  --- fluoroscopy, screen, table
- Puncture kit
- Guidewire
- Catheter
- Sheath
- Dilator
- Balloon
- stent

Qualifications for credentialing of cardiothoracic surgeons to perform endovascular stent-grafting of the thoracic aorta

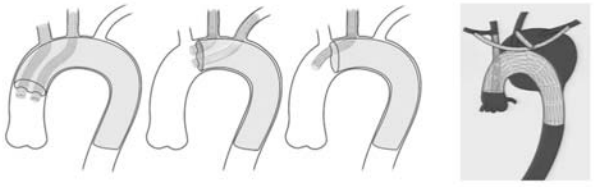
- STS / AATS Position Statement, 2006 -

Knowledge	**Technical expertise**	**Training**
broad understanding of disease entity	*all therapeutic options (conventional & new)*	*specific to endo-vascular approach*

- Experience with 10 open surgical procedures
- Minimum of 25 wire/catheter placements
- Participation in 10 abdominal or 5 thoracic aortic EVSG
- Experience with large-bore femoral sheath cannulation
- Experience with retroperitoneal exposure of the iliac arteries



Chimney technique



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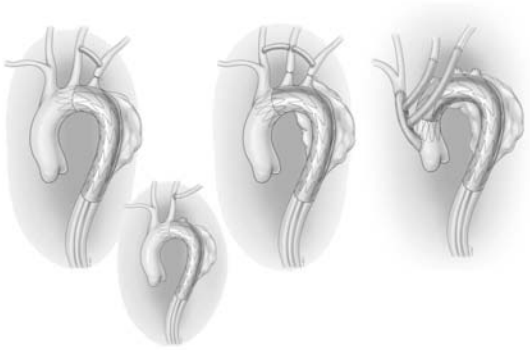
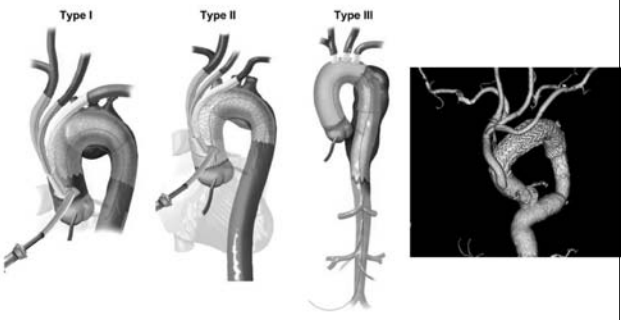
Hybrid TEVAR with arch debranching

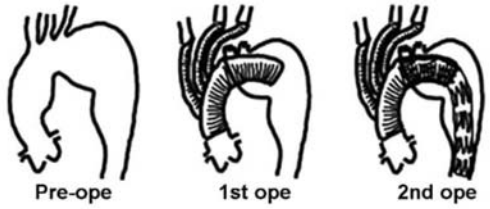


Zone 0 option

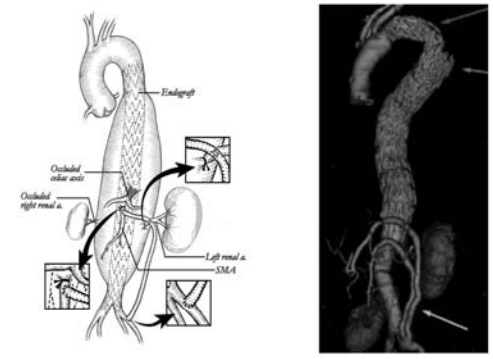


Elephant Trunk + TEVAR

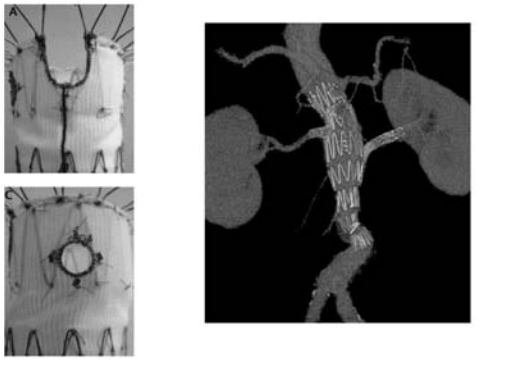
- Conventional total arch replacement with Elephant Trunk
- Second stage TEVAR instead of DTA replacement surgery



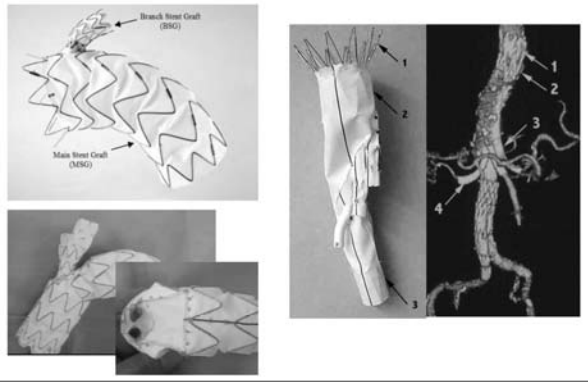
Hybrid repair of thoracoabdominal aneurysm



Fenestrated stent graft



Branch stent graft



Questions to be answered

- **Is endovascular repair**
  - able to treat all lesions?
  - safer than open repair for all patients?
  - as durable as open repair?
  - equally available as open repair?
  - less costly than open repair?

30

Indication of endovascular repair in thoracic aorta : established

- thoracic aneurysm with good landing zones
  - 'neck' length ≥ 2cm, ideally ≥ 4~5cm
  - +/- sacrifice of left subclavian/celiac a.
- traumatic (isthmic) rupture
- post-surgical anastomotic pseudoaneurysm
- penetrating atherosclerotic ulcer with IMH, false aneurysm, or pain
- complicated acute type B dissection

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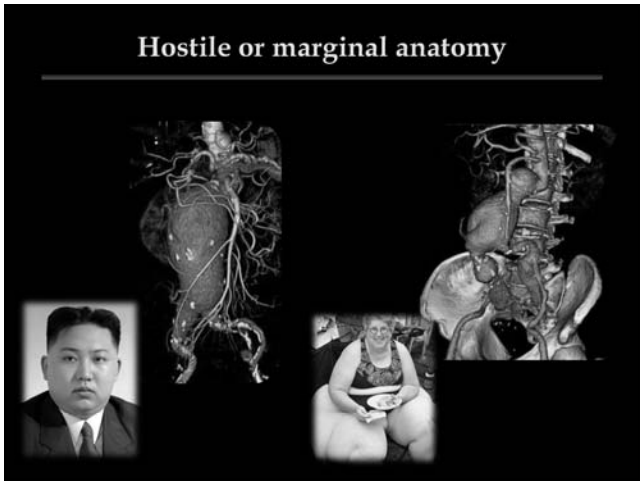
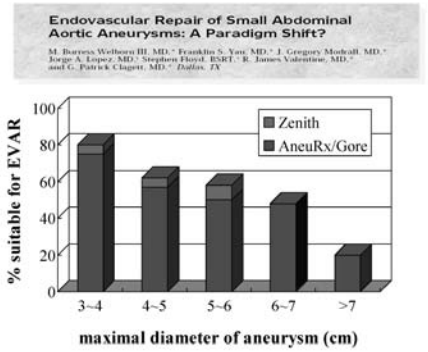
Hostile or marginal anatomy

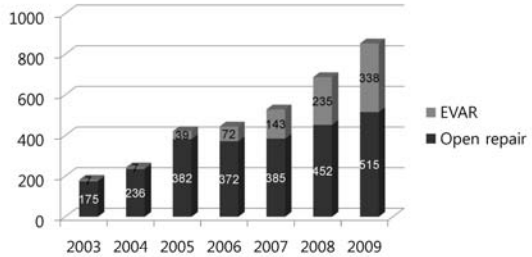


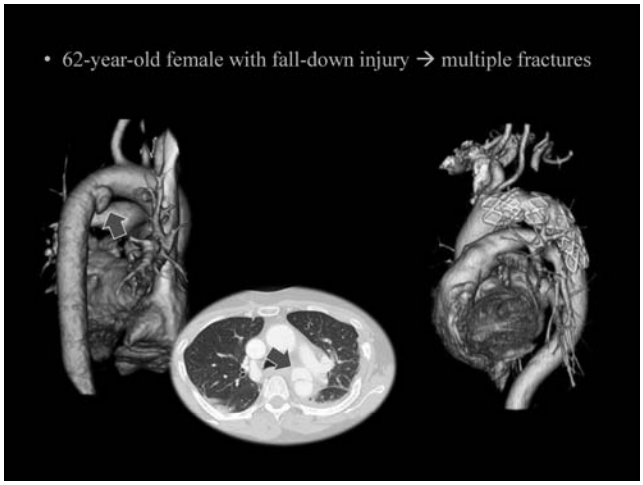
How many AAA can be treated with EVAR?

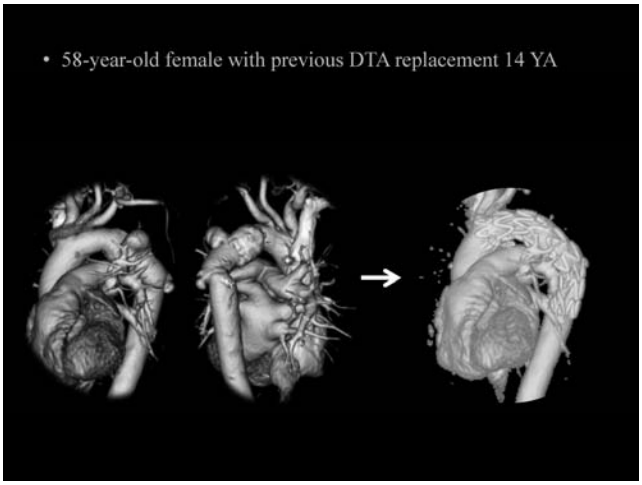


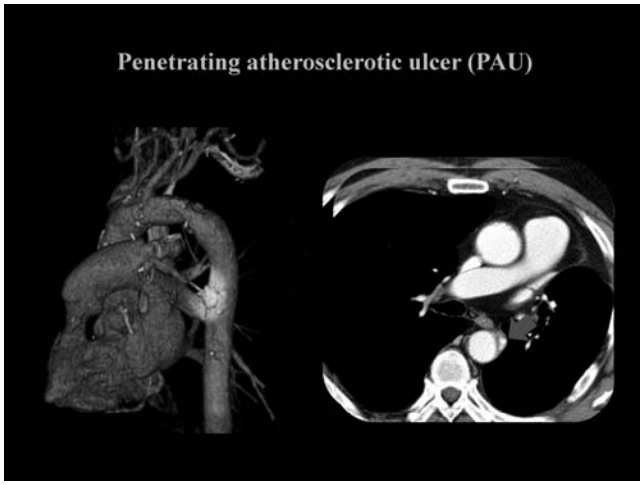
Annual number of AAA treated in Korea

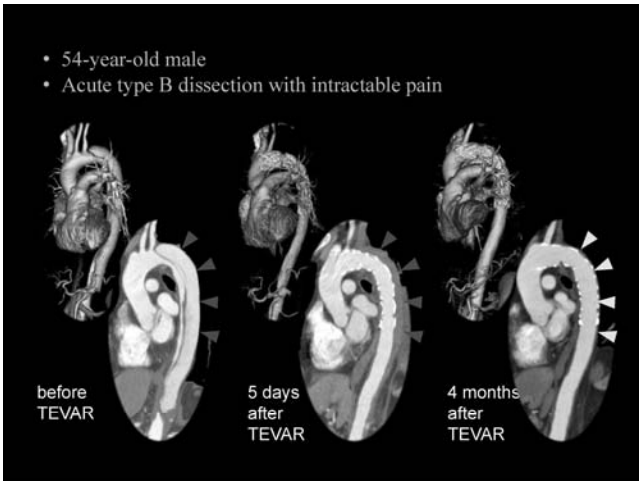
Data from HIRA

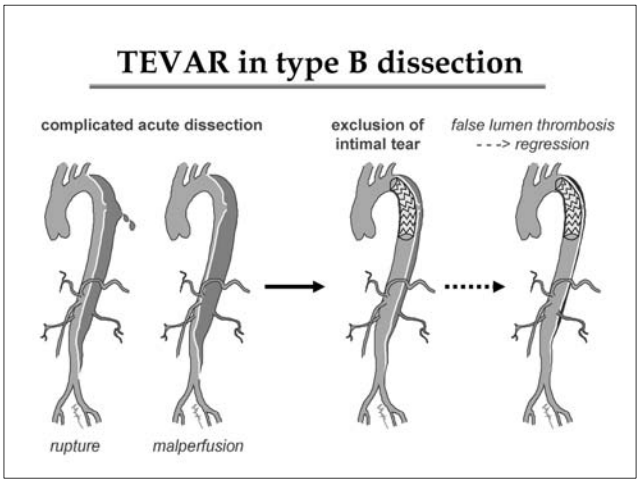








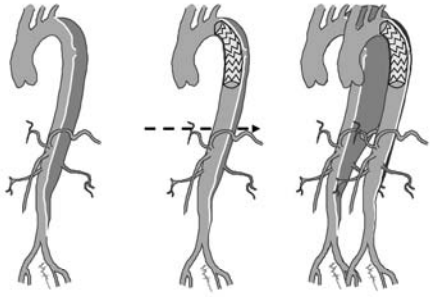




Indication of endovascular repair in thoracic aorta : controversial or undetermined

- retrograde type A dissection
  (primary tear in the descending aorta)
- infectious/mycotic aneurysm
- uncomplicated acute type B dissection
- chronic type B dissection
- inadequate landing zones necessitating
  - 'debranching/rerouting' procedures
  - adjunct procedures, e.g., chimney
  - new generation devices (fenestrated, branched)

Rationale of TEVAR in uncomplicated dissection

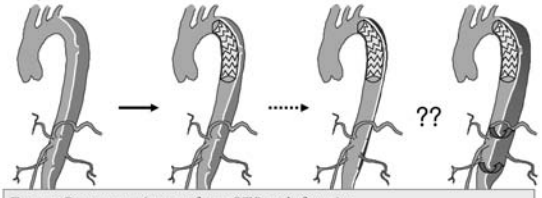


However, the reality is that

Most dissections have distal re-entry tears, especially in chronic stage.

TEVAR

≤ 80% in acute
≤ 50% in chronic



Expert Consensus (report from STS task force) :
"*Neither open surgery nor stent-graft reverses the natural history of aortic dissection unless the entire extent of dissection is either resected or excluded, and that can be achieved only by surgical intervention*"

44

courtesy of Taek Yeon Lee, MD

- **F / 56, Marfan**
- **s/p TEVAR for type B dissection**

December 2009 June 2011 November 2011

EVAR trial

Lancet 2004;364:843-8

- Randomization of elective **AAA** patients fit for open surgery
  - endovascular stent-grafting (n=543) vs. open surgery (n=539)

	EVAR	open repair
• median length of operation :	180min	200min
• 30-day mortality :	1.7%	4.7%
• median length of admission :	7 days	12 days
• conversion to open repair	1.8%	-----
• correction of endoleak	3.3%	-----
• re-exploration	-----	2.8%

1st-generation stent-grafts in thoracic aorta

Demers P, Craig Miller D, et al. J Thorac Cardiovasc Surg 2004;127:664-73

- 103 patients between 1992~1997, mean follow-up for 4.5 years
  - 62 patients were '*unsuitable for conventional open repair*'.
- **mortality : 9%, paraplegia : 3%**
- **actuarial freedom from treatment failure : 67%/1-year, 56%/5-year**

Stent-grafting of thoracic aorta in France

Ricco JB, et al. J Thorac Cardiovasc Surg 2006;131:131-7

- Nationwide result of 166 patients in France between 1999 ~ 2001
- **in-hospital mortality : 10%**
- **49 complications in 34 patients (20.5%)**
  - *endoleak : 16.3%, other serious complications : **12.7%***

Secondary procedures after TEVAR

- **Talent registry** (*J Thorac Cardiovasc Surg 2006;132:332-9*)
  - 457 patients, 2nd procedure = 19% / 3 years, 30% / 5 years
- **Heidelberg** (*J Vasc Surg 2011*)
  - 47 patients of hybrid TEVAR (1997~2009)
  - 27.6% 2nd procedure, 6.3% open conversion
- **U Penn** (*J Thorac Cardiovasc Surg 2013;145:S165-70*)
  - 680 TEVAR (2000~2011) → 60 2nd TEVAR + 20 surgery
- **Kobe** (*Ann Thorac Surg 2013;95:1584-90*)
  - 147 TEVAR (2000~2011) → 10 2nd TEVAR + 9 surgery

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Systematic review of clinical outcomes in hybrid procedures for aortic arch dissections and other arch diseases

Piergiorgio Cao, MD, FRCS,[a] Paola De Rango, MD, PhD,[b] Martin Czerny, MD,[c] Arturo Evangelista, MD,[d] Rossella Fattori, MD,[e] Christoph Nienaber, MD,[f] Hervè Rousseau, MD,[g] and Marc Schepens, MD[h]

J Thorac Cardiovasc Surg 2012;144:1286-1300

➢ **Conclusion**

- Hybrid arch repair present a persistent high risk of mortality and neurologic morbidity, comparable with open repair.
- Mortality was not affected by center volume or time of experience.
- Zone 0 deployment present 3 times higher mortality than zone 1 repair.
- No reliable long-term data exist to ascertain the durability.

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Endovascular repair of thoracoabdominal aneurysms: design options, device construct, patient selection and complications

L. M. REILLY, T. A. M. CHUTER

J Cardiovasc Surg 2009;50:447-60

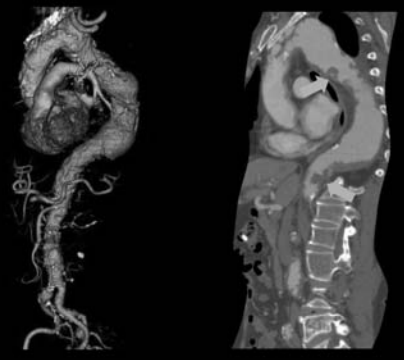
• Total number of pooled cases	287	• Renal failure	9.8%
• Follow-up < 18 months		• Hemodialysis	5.1%
• Early mortality	6.9%	• Early re-intervention	8.9%
• Late mortality	13.6%	• Late re-intervention	11.1%
• Spinal cord ischemia			
paraplegia	8.2%	• Early endoleak	16.2%
paraparesis	6.7%	• Late endoleak	14.3%
permanent	6.7%	• Branch occlusion	3.5%
temporary	10.0%		

49

Problems/complications of TEVAR

◆ Mortality	1.5~6.5%
◆ Renal failure	5.2~13%
◆ Vascular access problems	
➢ need of iliac conduit	up to 40%
➢ serious injury to iliofemoral arteries	1.4~14%
◆ Neurological complications	
➢ stroke	2.9~11%
➢ paraplegia	2~5%
◆ Procedural failure	1~5%
◆ Retrograde type A dissection	2~6%
◆ Endoleak	0~45%
◆ Late mechanical failure (fracture/breakage/wear)	up to 9%
◆ Prosthesis infection	???

Shaggy aorta – risk factor for both open repair and TEVAR



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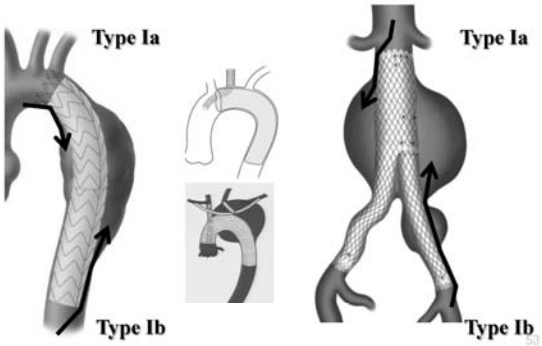
Endoleak – type I



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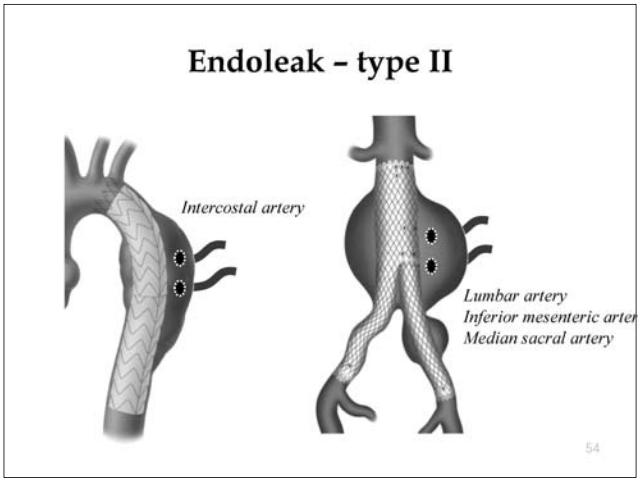

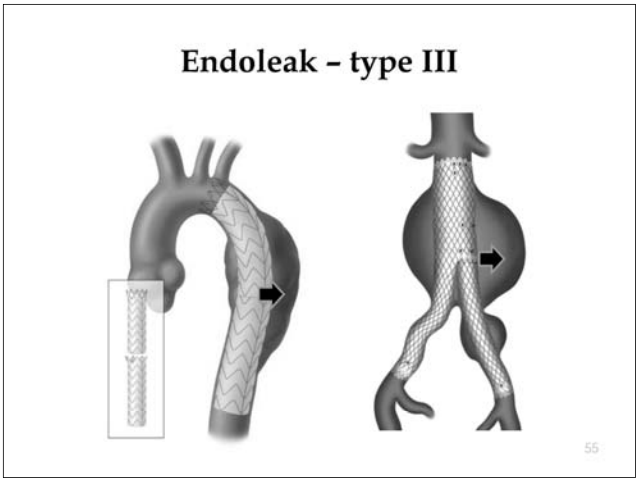

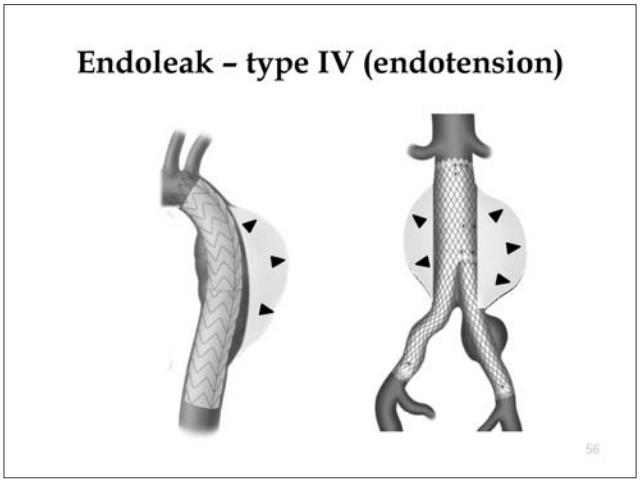

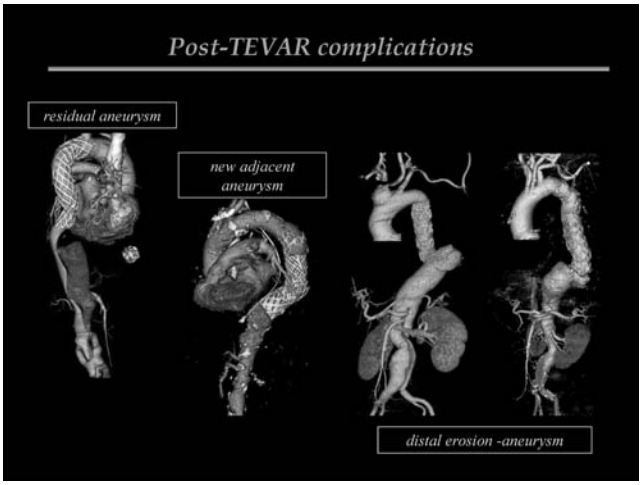

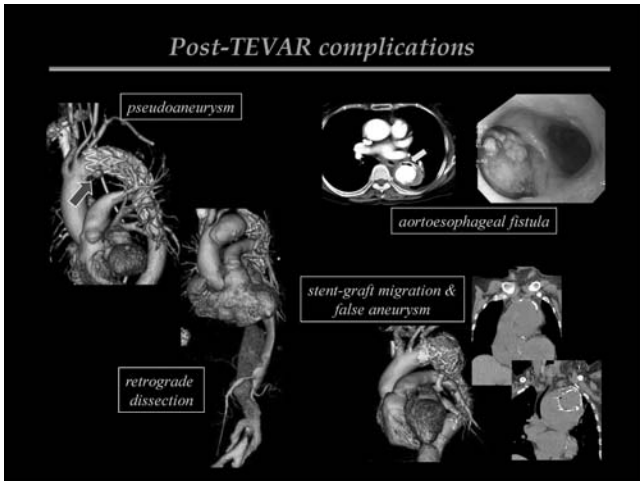

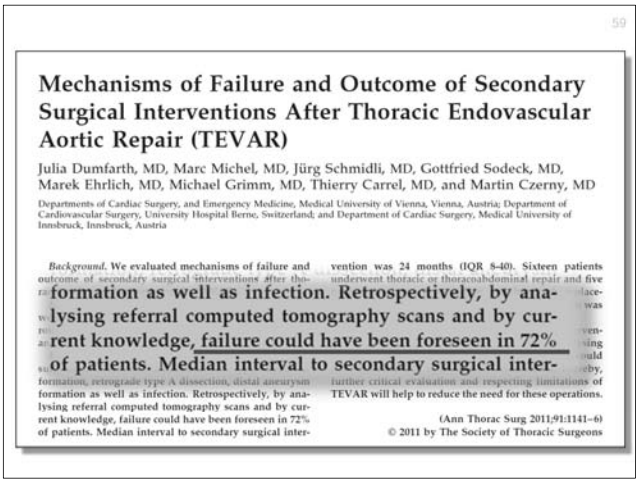
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Mechanisms of Failure and Outcome of Secondary Surgical Interventions After Thoracic Endovascular Aortic Repair (TEVAR)

Julia Dumfarth, MD, Marc Michel, MD, Jürg Schmidli, MD, Gottfried Sodeck, MD, Marek Ehrlich, MD, Michael Grimm, MD, Thierry Carrel, MD, and Martin Czerny, MD

Departments of Cardiac Surgery, and Emergency Medicine, Medical University of Vienna, Vienna, Austria; Department of Cardiovascular Surgery, University Hospital Berne, Switzerland; and Department of Cardiac Surgery, Medical University of Innsbruck, Innsbruck, Austria

Background. We evaluated mechanisms of failure and outcome of secondary surgical interventions after tho- vention was 24 months (IQR 8-40). Sixteen patients underwent thoracic or thoracoabdominal repair and five

formation as well as infection. Retrospectively, by ana- lysing referral computed tomography scans and by cur- rent knowledge, failure could have been foreseen in 72% of patients. Median interval to secondary surgical inter-

formation, retrograde type A dissection, distal aneurysm formation as well as infection. Retrospectively, by analysing referral computed tomography scans and by current knowledge, failure could have been foreseen in 72% of patients. Median interval to secondary surgical inter- further critical evaluation and respecting limitations of TEVAR will help to reduce the need for these operations.

(Ann Thorac Surg 2011;91:1141–6)

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Lessons

- 2nd procedure is not rare after TEVAR, ≥20% of them should be open surgery.
  - *Causative factors for early failure*
    - *off-label use for unfavorable anatomy*
    - *wrong indication, e.g., Marfan, infection*
    - *inadequate landing zone*

- Procedural / early success
  ≠ clinical / long-lasting stabilization
  because of late endoleak, adjacent aneurysm, infection, erosion (fistula), etc.

- The best countermeasure to complication is prevention. Best outcome can be achieved by selecting appropriate procedures to appropriate patients.
  It is why we need a real '***bivascular***' team that is good at both open surgery and endovascular procedure.

Questions to be answered

- **Is endovascular repair**
  - safer than open repair for all patients?
    mostly but not always
  - as durable as open repair?
    questionable
  - able to treat all lesions?
    maybe in the future, not in my life
  - equally available as open repair?
    doubtful, probably not
  - less or more costly than open repair?
    Newer devices will be too expensive for wide use

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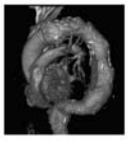
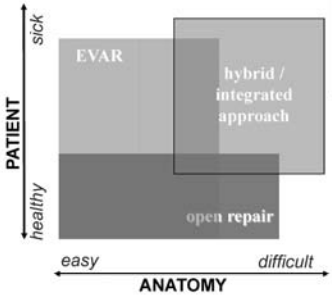
"…… it is not prudent to offer endovascular stent graft repair to younger patients who do not have major contraindications to open surgical repair……careful selection is key with particular emphasis on favorable anatomic targets……"

- Demers P, Craig Miller D, et al. JTCS 2004;127:664-73 -

"The gold standard for treatment of the standard patient still is the conventional open procedure in the hands of excellence. Unfit for surgery is a term steeply increasing in the literature and sometimes seems to be occupied as license to stent in cases that could easily be handled in a specialized surgical centers" *– Sunder-Plassmann L. J Cardiovasc Surg 2005;46:121-30 -*

complement *rather than* **competition**





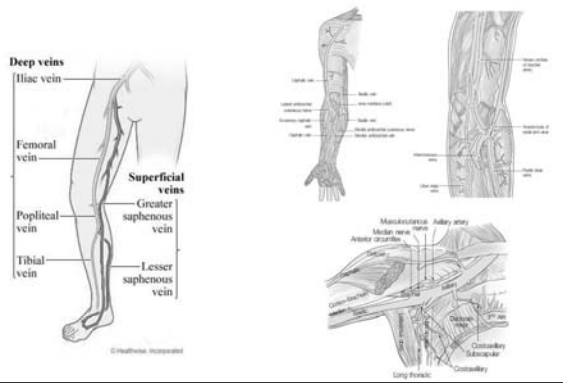
Deep Vein Thrombosis & Pulmonary Embolism: Overview & Treatment

Department of Thoracic and Cardiovascular Surgery,
Kangbuk Samsung Medical Center, Sungkyunkwan University, School of Medicine

Joon Hyuk Kong

Anatomy

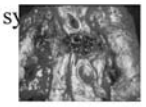
Venous System



Pathophysiology

Venous Thromboembolic Disorder

- **Deep Vein thrombosis / Pulmonary embolism**
  - Traveler's thrombosis (Economy class sy
  - Chronic venous insufficiency



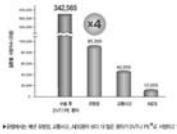
- Other forms of venous thrombosis
  - Superficial thrombophlebitis
  - Axillary-Subclavian thrombosis
  - Mesenteric venous thrombosis

Superficial Thrombophlebitis

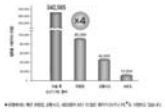
- Cause ; Spontaneous, Trauma, Varicose vein, Buerger's disease, Malignancy, Hypercoagulability
- Not related with bacterial infection, except caused by recent iv catheterization
- Symptoms ; localized pain, erythema, warmth, tenderness, swelling, palpable cord
- **Asymptomatic Synchronous DVT(+) in 35%** => Check venous duplex study!
- Indication for treatment
  - Isolated superficial thrombophlebitis with encroachment on the S-F junction
  - Purulent infection
  - >5cm involvement: 45 days LMWH

Venous Thromboembolic Disorder

- Deep Vein thrombosis / Pulmonary embolism
  - Possible cause of mortality
    - First year mortality of acute DVT ; 19-21%
    - PE death; 15% hospital death, 150,000-200,000 death/year in USA
  - Significant morbidity due to progression to chronic venous insufficiency



Venous Thromboembolic Disorder



- Incidence of acute DVT
  - Autopsy cases ; 35-52%
  - Community-based, venography, symptomatic ; 1.6 /1000 residents, yearly
  - Postoperative DVT; GS(19%), NS(24%), hip fracture(48%), hip arthroplasty(51%), knee arthroplasty(61%)
  - Trauma; autopsied casualties(62%), venography(58%) -- duplex(4-20%)

Epidemiology and Natural history

- The incidence of **recurrent, fatal, and non fatal VTE** has been estimated to exceed 900,000 cases annually in the united state alone.
- In the United States of America, 200,000 new cases of **pulmonary embolism(PE)** occur each year, and 50,000 of these result in death.
- **VTE** kills four to five more people annually than dose breast cancer or acquired Immunodeficiency syndrome.
- **PE** is the third most common fatal vascular disorder following coronary artery disease (CAD) and cerebrovascular accident (CVA).
- The in-hospital mortality rate is 12%, and it is thus the number one preventable death in hospitalized patients.

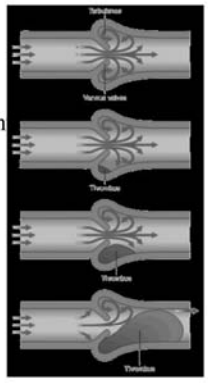
*(*Rutherford's Vascular Surgery 7th edition, section 7 venous disease, chapter 48, p 736, chapter 50 , p 770, Saunders 2010)*

Isolated calf vein thrombosis

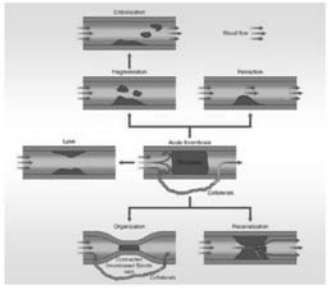
- Differences in
  - Rates of PE / post-thrombotic complications
- **Recanalize more rapidly**
- Lower reflux in involved calf vein segments
- Lower long term complication
  - PE : 10%, 33% by V/Q scan
  - PTS: 23% at 1yr (vs 54% in proximal DVT)
- Proximal propagation : 15% to 23%
  - in the absence of treatment
    - 1/4 - 1/3 by Kearon
- **However, Need anticoagulation !!!**

Pathophysiology

- Virchow's triad
  - Endothelial abnormality
  - Stasis of blood flow (predominan
  - Hypercoagulability of blood



Pathophysiological consequences



Clinical spectrum of acute DVT

1. Asymtomatic calf vein thrombosis
2. Symptomatic calf vein thrombosis
3. Femoropopliteal DVT
4. Phlegmasia Alba Dolens
5. Phlegmasia Cerulea Dolens
6. Venous gangrene

Clinical Course

- Acute (<2wks)
  - Flow void, low echogenic thrombus, venous distension, loss of compression
- Subacute (2-4wks)
  - Increased echogenecity, decreased venous size, resumption of flow
- Chronic (>4wks)
  - Echogenic thrombus, wall irregularity, valve abnormality, collateral veins

Clincal Course

- Acute DVT
  - Symptomless, warmness, redness, pain, swelling
- Phlegmasia alba dolens (=milk leg, white leg)
  - Increased tissue pressure exceeds the capillary perfusion pressure, causing pallor
- Phlegmasia cerulea dolens(=blue leg)
  - Deoxyhemoglobin in stagnnat vein imparts a cyanotic hue to the limb

Phlegmasia alba dolens (=white leg)

Phlegmasia cerulea dolens(=blue leg)

Risk Factors

Risk factors- hypercoagulable status

Inherited	Acquired
Common	Age
Factor V Leiden	Surgery and trauma
Prothrombin gene mutation (G20110A)	Immobilization
Homozygous C677T mutation in methylene	Malignant disease
Tetrahydrofolate reductase gene	Previous venous thromboembolism
	Pregnancy and puerperium
	Oral contraceptive
	Hormone replacement therapy
	Antiphospholipid antibodies
Rare	**Unknown (probably multifactorial)**
Antithrombin deficiency	Elevated levels of factor VIII, IX, and XI and fibrinogen
Protein S deficiency	
Protein C deficiency	
Dysfibrinogenemia	
Homozygous homocystinuria	

Acquired Risk Factors - Surgery

	Calf DVT	Proximal DVT	Fatal PE
High risk	**40-80%**	**10-30%**	**>1%**
• Surgical patients with history of venous thromboembolism			
• Major pelvic or abdominal surgery for malignancy			
• Major trauma			
• Major lower limb orthopedic surgery			
Moderate risk	**10-40%**	**1-10%**	**0.1-1%**
• Geberak surgery in patients >40 years			
• Patients on oral contraception			
• Neurosurgical patients			
Low risk	**<10%**	**<1%**	**<0.1%**
• Uncomplicated surgery in patients <40 years without any other risk factors			
• Minor surgery in patients >40 years without any other risk factors			

Acquired Risk Factors

- **Old age**
  - a major risk factor of VTE
- **Prior venous thromboembolism**
  - independent risk factor for future VTE / adequate prophylaxis
- **Immobilization**
  - 60% of the paralyzed limb / 7% contralateral normal control leg
  - air travel
- **Malignancy**
  - resulting rom activation of the cogulation cascade?
- **Superficial thrombophlebitis**
  - an independent risk factor for VTE
- **Antiphospholipid antibody syndrome**
  - anticardiolipin antibody / lupus anticoagulant antibody
  - 2% of population / 30-50% of patients with SLE
  - 50% frequency of DVT/ half having PE

Inherited Thrombophilia

- Epidemiology

Thrombophilia	General population (%)	Patients with VTE (%)
Factor V Leiden*	5	20
Prothrombin G20210A	3	7
Elevated factor VIII**	6-8	10-15
Protein C deficiency	0.2-0.5	3
Protein S deficiency	0.2-0.5	3
Antithrombin deficiency	0.02	1
Hyperhomocysteinemia**	5	10

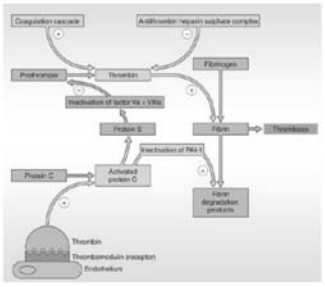
*Rare in the Asian and African populations

**Likely to be multifactorial

- Diagnosis of inherited thrombophilia
  - Should be considered in **any patient with VTE**

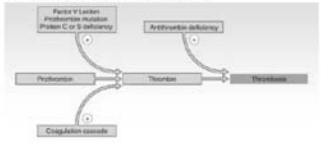
Inherited Thrombophilia

- Regulation of coagulation pathway



Inherited Thrombophilia

- Mechanism of thrombosis

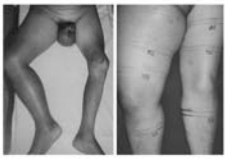


- Investigation for suspected inherited thrombophilia
  - age less than 45 years
  - recurrent episodes of VTE
  - Family history of VTE
  - thrombosis at unusual venous sites such as dural sinuses
  - recurrent miscarriages

Clinical Features

Clinical Features – L/E DVT

- Mostly asymptomatic
- Pain, Edema
  - due to vein obstruction, inflammation of perivascular tissue, lymphatic obstruction
- Distention of superficial veins
- Cutaneous erythema
- Homan's sign
  - pain in calf with forced dorsiflexion of foot



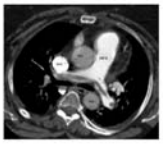
Clinical Features – U/E DVT

- **Less common (2-5% of population)**
- Indwelling mechanical devices
  - pacer lead, central venous catheters
  - 30-40% of cases
- Conditions of venous compression
  - lymphadenopathy, tumors
- Paget-Schroetter sndrome
- 10-30% risk for **PE** (**similar to leg DVT**)

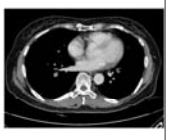
Clinical Features – PE

- Classification of PE

Pulmonary embolism	History	Pathophysiology	Therapy
Acute massive	Acute	Circulatory collapse	Thrombolysis, thrombectomy
Acute submassive	Acute	Stable, echocardio-graphic signs of RV overload	Thrombolysis?, heparin
Acute nonmassive	Acute	Stable	Heparin
CTEPH (Chronic thromboembolic pulmonary Hypertension)	Chronic	RV overload	Medical or elective thromboendartectomy



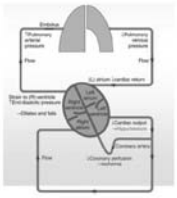
- **Acute massive**: >50% PA occlusion
  - sudden death in 10%, within 1 hr,
  - severe acute dyspnea, syncope
- **Acute submassive**
- **Acute nonmassive:** <50% PA occlusion
  - asymptomatic or tachypnea, dyspnea, pleuritic pain



Complication

Complications (I)

- **Pulmonary Embolism**
  - most devastating complication
    - obstruction of blood flow distal to the clot
    - rapid increase in pulmonary arterial and right heart pressure



Complications (II)

- **Pulmonary Embolism**
  - Inadequate tx. of proximal venous thrombosis
    - 20% to 50% risk of significant recurrent VTE
    - 90% of thromboemboli arising from L/Ex veins
  - Sx PE: 7% to 17% of proximal U/Ex thrombi
  - Lung scan: + in 25- 51% of Asx patients
  - Autopsy : [DVT + PE] = [1.8 X DVT alone]
  - PE contributes to **approx. 15% of hospital deaths**
  - 1-week survival rate after a PE : 71%
  - 25% of PE manifest as sudden death
  - Mortality in adequate Dx. and Tx.: 8% to 9%

Complications (III)

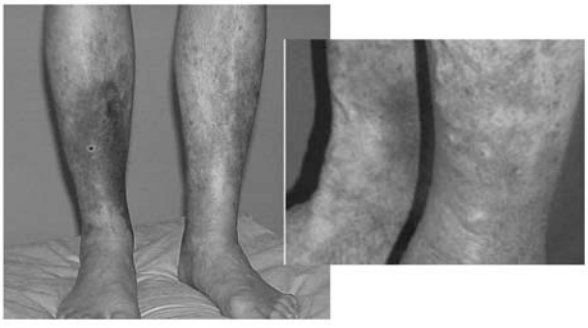
- **Post-thrombotic Syndrome**
  - less dramatic than PE
  - greater degree of chronic socioeconomic morbidity
  - 29% to 79% of patients
    - pain, edema, hyperpigmentation, or ulceration
  - Severe manifestations
  - ambulatory venous hypertension
    - valvular reflux / persistent venous obstruction / anatomic distribution of these abnormalities
  - X6 risk of post-thrombotic syndrome with recurrent DVT

Post-Thrombotic Syndrome (PTS)

- Painfula heavy leg
- Cramps
- Paresthesia
- Prutitus
- Formation of varicosities
- Edema
- Hyperpigmentation of the skin

=> **Reduced quality of life (QoL)**

PTS



Diagnosis

Diagnosis of DVT

- **D-dimer** ; cross-linked degradation product of fibrin.
  - Sensitivity 44-72%, specificity 44-70%
  - High negative predictive value; 97-99%
- **Duplex USG** ; test of choice (Accuracy >95%)
- **CT venography** ; pelvic vein evaluation, PE study

- Impedence phlethysmography
- Ascending venography
- MR Venography
- Lung ventilation & perfusion scan

DVT ; Diagnosis

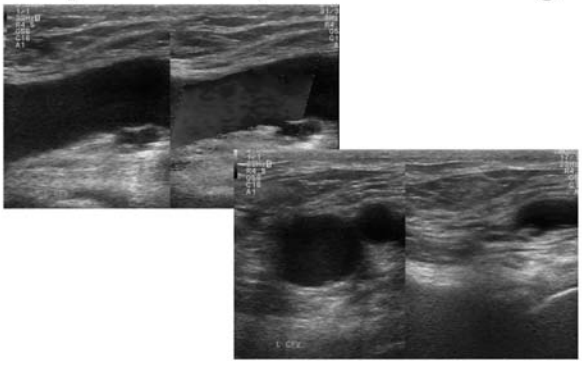
- **Before anticoagulation,** Check coagulation profiles **!**
  - CBC ; Hb, Hct, platelet
  - BT / PT / aPTT
  - AT-III, protein C, protein S
  - Coagulation factors VIII, IX, XI
  - Fibrinogen, FDP, D-dimer, homocysteine
  - Lupus anticoagulant, anticardiolipin Ab, antiphospholipid Ab
- **Family study in hereditary or familiar tendency**
  - Factor V Leiden, Prothrombin gene mutation ; rare in KOREA

Duplex criteria for DVT

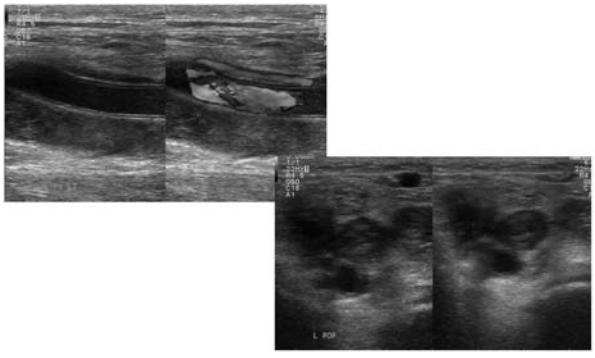
- Negative for DVT
  - Complete approximation of the vein wall during compression
  - Complete color filling of the lumen without any defect
- **Positive** for DVT
  - Partially compressible or noncompressible vein
  - **Echogenic material** within the vein
  - **Filling defect** on color imaging
  - Absence of doppler signal

Mansour & Labropoulos: Vascular Dlagnosis(2005)

Duplex USG ; normal finding



Duplex USG ; abnormal finding



Conditions that may mimic acute DVT

Muscle strain or blunt trauma
Ruptured muscle with subfascial hematoma
Spontaneous hemorrhage or hematoma
Ruptured synovial cysts (Baker's cysts)
Arthritis, synovitis, or myositis
Cellulitis, lymphangitis, or inflammatory lymphedema
Superficial thrombophlebitis
Arterial insufficiency
Pregnancy or oral contraceptive use
Lymphedema
Lipedema
Chronic venous insufficiency or venous reflux syndromes
Extrinsic venous compression: lymphadenopathy, tumors, lymphomas, hematomas, abscesses, right iliac artery
Systemic edema: congestive heart failure, metabolic, nephrotic syndrome, post–arterial reconstruction
Dependency or leg immobilization (casts)
Arteriovenous fistula

Diagnostic strategies for DVT

- Assessment of risk of venous thrombosis; Modified Wells Criteria

Criteria	Score
Active cancer (receiving treatment within previous 6 months or receiving palliative treatment)	1
Paralysis, paresis, or recent immobilization of lower extremity	1
Recently bedridden for ≥ 3 days, or major surgery within 12 weeks requiring any type anesthesia	1
Localized tenderness along distribution of deep venous system	1
Entire leg swollen	1
Calf swelling ≥ 3cm increased compared to asymptomatic leg (measured 10cm below tibial tuberosity)	1
Pitting edema confined to symptomatic leg	1
Collateral superficial veins (nonvaricose)	1
Previously documented DVT	1
Alternative diagnosis at least as likely as DVT	-2

Risk Assessment	Score
Low risk	≤ 0
Intermediate risk	1-2
Likely	>2

Diagnostic strategies for DVT

Annal Int Med 2003

Summary of Pathophysiology

- Deep vein thrombosis (DVT) and pulmonary embolism (PE) are a single clinicopathological entity
  - > venous thromboembolic disease, VTE
- The incidence: 1 (DVT) and 0.5 (PE) cases per **1000 population per year** in the **Western world**
- In a hospital setting, 15% of medical and 30-50% of surgical patients develop VTE if no prophylaxis is initiated
- Clinical feature: nonspecific and inaccurate
- Serious complications; ***30-40% mortality*** in **untreated PE**, ***~50% PTS*** in **DVT**
- Clinical risk assessment and plasma D-dimer testing with duplex study and pulmonary CT angiography

Treatment

Concerns in a patients with DVT

- Pulmonary embolism
- Symptoms
- Extension of thrombosis
- Recurrence
- Post-thrombotic syndrome

=> Aim of DVT treatment

Goals of DVT Therapy

- **Diminish the severity and duration of lower extremity symptoms**
- **Prevent Pulmonary embolism**
- **Minimize the risk of recurrent venous thrombosis**
- **Prevent the postthrombotic syndrome (PTS)**

Overview of Treatment

1. **Systemic Anticoagulation**
2. **Systemic Thrombolysis**
3. Surgical Thrombectomy
4. **IVC filter**
5. **Catheter Directed Thrombolysis (CDT)**
6. **Percuataneous Mechanical Thrombectomy (PMT?)**
7. **PharmacoMechanical Thrombolysis (PMT)**
8. **Adjuvant Venous Angioplasty and Stenting**

DVT: Treatment options

- Anticoagulants
- Thrombolytic therapy

- Pharmacomechanical thrombectomy
- Surgical thrombectomy

- Vena cava filter
- Conservative treatment

DVT: Treatment options

Goal	Caval filter	Anti-Coagulation	Thrombolytic Therapy	Venous Thrombectomy
reduce PE	+	+	+	+
prevent thrombus extension		+	+	+/-
reduce DVT recurrence		+	+	+/-
restore venous patency			+	+
restore venous valve			+	+
reduce chronic venous insufficiency		+/-	+	+

Treatment

- **Conservative Treatment**

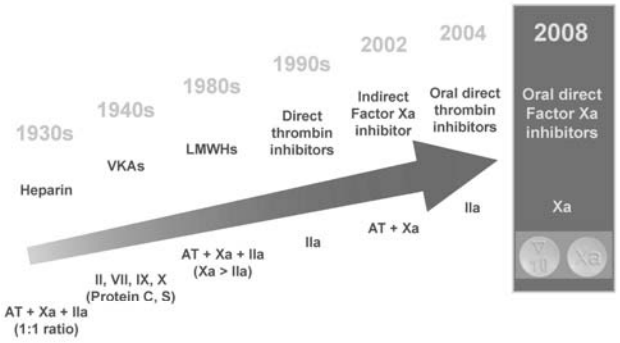
Conservative Treatment

- **Bed rest** and **leg elevation**
  - 1289 prospective cohort study
  - Bed rest does not prevent PE
  - LMWH + early ambulation + compression bandage or ES, faster improvement of pain and swelling w/o increasing risk of PE, decreased PTS
    - Partsch H, JVS 2002
- Graduated **compression stocking**
  - Graduated compression stocking for 24 months post-5 yr cumulative data of incidence of PTS 26% vs. 49%
    - Prandoni P et al, Ann Int Med 2004
- Below-the-knee stocking is equivalent to the thigh one

Treatment

- **Anticoagulation**

The evolution of anticoagulant drugs



Outpatient Anticoagulation Therapy: Relative CIx

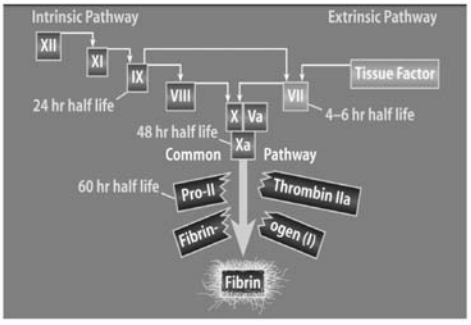
- PE with hemodynamic or respiratory instability
- Extensive iliofemoral thrombus
- Known potential for non-compliance
- Active bleeding
- Severe hypertension (HTN)
- Renal clearance <30 mL/min or SCr >2.5 mg/dL
- Thrombocytopenia <100,000
- History of heparin-induced thrombocytopenia

Michigan Quality Improvement Consortium (MQIC) guidelines 2011

Anticoagulants

- UFH (Unfractionated heparin)
- LMWH (low molecular weight heparin)
- Fondaparinux
- Vitamin K antagonist
- Direct thrombin inhibitor
- Factor Xa inhibitor

Clotting Cascade



Heparin (UFH)

- **Heterogenous mixture** of polysaccharide fragments w/ molecular weight 12,000~15,000
- **Bind to** the antithrombin, results **conformational change of AT**, thereby enhance AT's inhibitory effect on thrombin and other coagulation factors esp., Xa
- Drawbacks of unfractionated heparin (UFH)
  - Need to administer heparin by continuous IV infusion
  - Unpredictable activity, requiring laboratory monitoring
  - Heparin induced thrombocytopenia (HIT)

Low Molecular Weight Heparin (LMWH)

- Obtained by various fractionation or depolymerisation of polymeric heparin
- Molecular weight < 8000
- Various activity to the **AT and Xa**
- Constant release → predictable effect, do not need monitoring

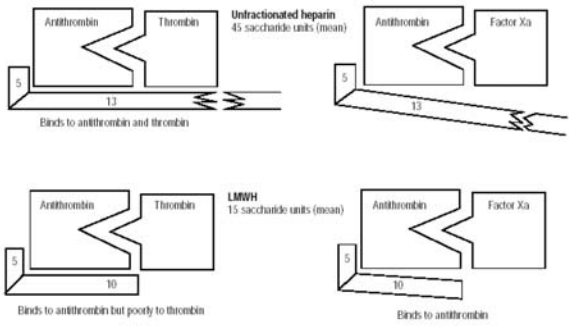
Low Molecular Weight Heparin (LMWH)

Agent	Trade Name	Mean MW	Anti-Xa:Anti-Iia Ratio
UFH	-	12,000~15,000	1
Ardeparin	Normiflo	6,000	1.9
Dalteparin	Fragmin	6,000	2.7
Enoxaparin	Clexane	4,200	3.8
Nadroparin	Fraxiparin	4,500	3.6
Reviparin	Clivarine	4,000	3.5
Tinzaparin	Innohep	4,500	1.9

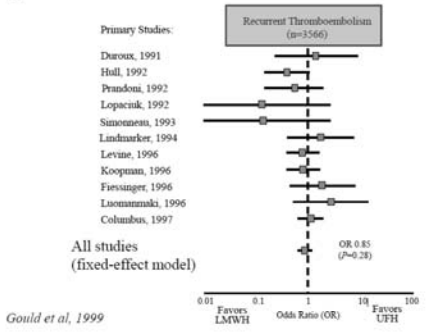
Advantages of LMWH

Pharmacokinetic Characteristic	Clinical advantage
Reduced protein binding	Good bioavailability
	Predictable dose response
	Resistance not encountered
Predictable dose response	Fixed or wt-based dosing possible
	Monitoring not required
Longer plasma half-life	Once- or twice-daily dose possible
Smaller molecule	Improved subcutaneous absorption
Less effect on platelets and endothelium	Reduced incidence of HIT and, possibly, bleeding

Heparin vs. LMWH



Meta-Analysis LMWH vs Heparin for Treatment of DVT



Gould et al, 1999

Fondaparinux

- Synthetic pentasaccharide
- Factor Xa inhibitor
- For injection
- Fondaparinux vs enoxaparin in hip/knee surgery
  - More effective at preventing VTE
  - No difference in major bleeding
- no report of HIT

UFH vs LMWH vs Fondaparinux

	UFH	LMWH	Fondaparinux
Mechanism	Enhances AT effects on Xa & thrombin	Enhances AT effects more selectively on Xa than on thrombin	Enhances anti-Xa activity of AT
Half-life	1-2 hr	4.5-7hr	17-21 hr
Dosing	Continuous drip	BID or once daily	Once daily
Reversal agents	Protamin sulfate 1mg neutralizes 100u of heparin	Protamin sulfate neutralizes 60% of activity	Not reversible by protamin
Monitoring	aPTT, heparin assays	none	none
Clearance	Hepatic & RES, No renal adjustments	Renal Adjust for CrCl<30mL/min	Renal contraindicated in CrCL<30mL/min
Cause HIT	yes	yes	no

LMWH vs. UF Heparin

Recurrences rate	Enoxaparin	UF Heparin	RR (>0.75)
Vein thrombosis event	4.5 %	5.7 %	0.81
DVT	3.1 %	4.4 %	0.79
PE	0.95 %	1.8 %	0.63

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LMWH vs. UF Heparin

Complication (%)		Enoxaparin	UF Heparin	RR (> 0.75)
Major bleeding	10days	2.2 %	2.0 %	NS
	30days	2.9 %	4.3 %	0.74 (28%)
Death		3.3 %	5.8 %	NS
Mortality				0.69 (31%)

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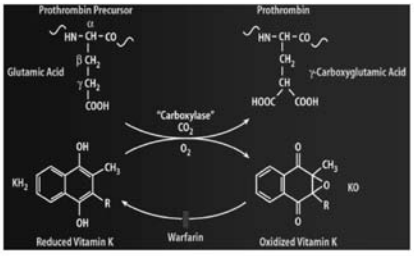
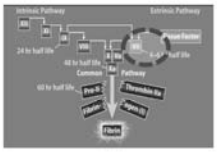
Warfarin : Mechanism of Action



- Inhibit carboxylation of coagulation factor II, VII, IX, X in the liver
- Also inhibits natural anticoagulant protein C/S

VKA should be given with heparin at the begining

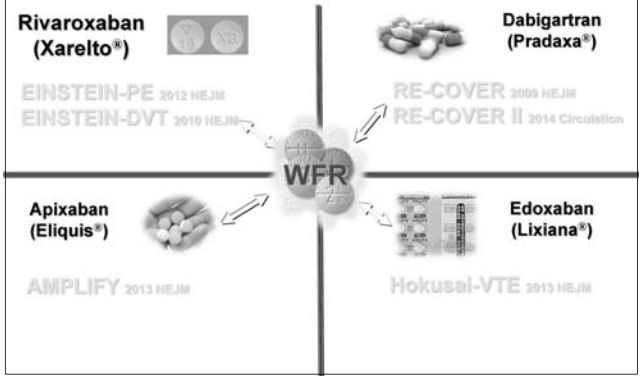
- Slow action of VKA
- Relatively hypercoagulable state due to short half life of natural anticoagulants (protein C/S)
- Very short half life of factor VII → initial INR may not reflect effect of VKA



New Oral Anticoagulants (NOACs)

- Factor Xa inhibitors
  - Rivaroxaban
  - Apixaban
  - Edoxaban
- Direct thrombin inhibitors
  - Dabigatran

New ERA of NOAC in VTE treatment



Pharmacokinetics of NOACs

	Dabigatran	Rivaroxaban	Apixaban
Administration	bid	QD	bid
Bioavailability	6.50%	80%	66%
Tmax	1.25-3 h	2-4 h	1-3 h
Half life	12.14 h	5-13 h	8-15 h
Renal excretion	80%	66%	25%
Plasma protein binding	35%	>90%	87%
Dialysability	Yes	Not expected	Unlikely

Anticoagulant therapy: Contraindication

- Active bleeding
- Recent CNS surgery : 2 mo
- Recent major surgery : 2 wk
- Recent hemorrhagic stroke 2 mo
- Severe uncontrolled hypertension
- Severe renal and/or hepatic dysfunction

Optimal Duration of Anticoagulant Therapy for Symptomatic Venous Thrombosis

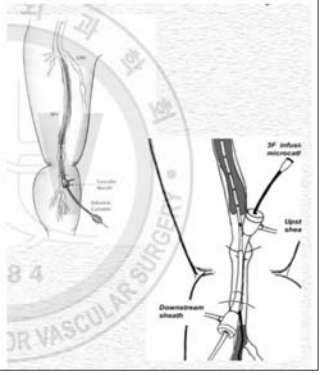
Indication	Duration
DVT with provocative events	3 months
DVT without proviocative cause	6 months to > 1 year
DVT with malignancy	until resolution of malignancy
Hypercoagulable state	life long
Recurrent DVT	life long

Treatment

- **Catheter Directed Thrombolysis (CDT)**

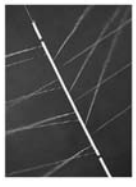
Catheter directed thrombolytic therapy (CDT)

- **Access**
  - Ipsilateral Popliteal vein
  - Contralateral Femoral vein
  - Internal Jugular vein
- **6-F sheath : Heparin**
- **5F multi-sideportcatheter : UK**
  - Heparin 500 unit/hr
  - Urokinase30~100 x 103IU/hr



Catheter directed thrombolytic therapy (CDT)

- Delivery of thrombolytics into the thrombus
- Popliteal approach
- Urokinase>>streptokinase, rtPA – more bleeding
- Pulsed spray catheter



National Multicenter Registry
Radiology 1999

- 287 patients
  - Acute 188, 45 chronic, 54 acute on chronic
- Results
  - Complete lysis 31%, significant(50-99%) 52%, incomplete(<50%) 17%
  - 7.8 million U of UK during 53.4 hrs
  - Higher complete lysis rate in patients with symptoms of less than 10days
  - Major non-fatal bleeding complication 11%
  - Pulmonary embolism in 6 patients, 1 death
  - Overall mortality 0.4%
  - Improved 1 yr patency in treated w/ stent(74%) than w/o stent(53%)

Limitations of CDT

- Time to lysis
- Need to hospitalization and intensive monitoring
- Risk of hemorrhage
- Cost

Treatment

- **PharmacoMechanical Thrombolysis (PMT)**

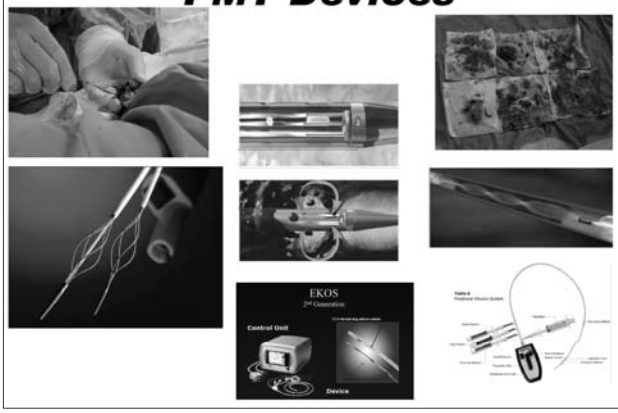
Pharmacomechanical thrombectomy(PMT)

- Reduce dosage of thrombolytic Tx
- Reduce treatment time
- Increase safety
  - narrows contraindications
  - decrease complications
- Reduced cost

PMT Devices

- Aspiration thrombectomy device
- Rotational device
  - Arrow PTD
- Rheolytic thrombectomy
  - angiojet, oasis, hydrolyser
- Isolated PMT
  - trellis
- Ultrasound accelerated thrombolysis
  - Ekos

PMT Devices



CDT vs. PMT

	complete thrombus remove	partial thrombus remove	angioplasty & stenting
CDT	70 %	30 %	78 %
PMT	75 %	25 %	82 %

Lin PH et al. Am J Surg 2006

❖ Compared to CDT, it provided similar treatment success, with reduced ICU, total hospital length of stay, and hospital costs

Treatment

- **Adjuvant Venous Angioplasty and Stenting**

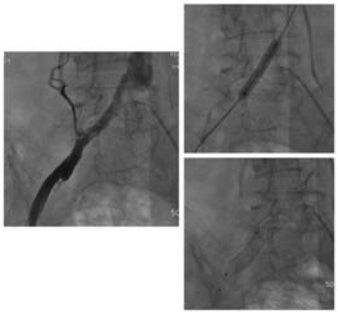
May-Thurner Syndrome

- Iliac vein compression syndrome
  - Compression of the left common iliac vein by the overlying right common iliac artery

• 김창원, 부산대

Adjuvant Venoplasty & Stenting

- **Technique**
  - Popliteal vein approach
  - Venoplasty balloon (8~10 mm)
  - Self-expanding stents (10~16 mm)
  - After the procedure, oral warfarin for 6 months



Balloon angioplasty & Stent insertion

Balloon angioplasty & Stent insertion

Author (year)	N	Success rate	Primary patency				Sx resolution	Complication
			6 mos	1 yr	2 yrs	4 yrs		
O'Sullivan GJ (2000)	39	87%		92% (A) 94% (C)			85%	17%
Hurst DR (2001)	18		89%	79%				
Kwak HS (2005)	22	96%		95%	95%			9%
Husmann MJ (2007)	11	100%		90%	82%		90%	
Oguzkurt L (2008)	36	94%		85%		80%	85% (A) 25% (C)	3%

Treatment

- **Surgical Thrombecotmy**

Venous Thrombectomy

- Revival of thrombectomy in the management of acute iliofemoral venous thrombosis.
  - 230 thrombectomy
  - No fatal PE
  - 1 operative mortality
  - Early & long-term patency 80% vs 30% of anticoagulated pts
    - Eklof B, Contemp Surg 1992

Venous Thrombectomy

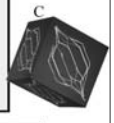
- AVF treatment guidelines for acute DVT
  - Accurate definition preoperatively of the extent of thrombosis, including routine contralateral iliocavography
  - Completion phlebography after thrombectomy to insure the adequacy of thrombectomy & examine residual venous lumen
  - Construction of a small arteriovenous fistula to increase velocity through a thrombogenic iliofemoral venous segment which assists in maintaining patency
  - Immediate & prolonged anticoagulation

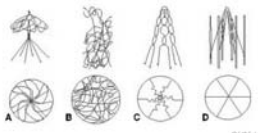
Treatment

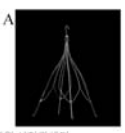
- **IVC filter**

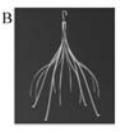
Inferior Vena Cava Filters

Permanent filter	Optional retrievable filter
Simon Nitinol (A) Bird's Nest (B) Greenfield (C) VenaTech (D) TrapEase	Gunther Tulip (A) Cook Celect Filter (B) OptEase (C) Recovery Filter









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Permanent IVC filter Indication

- Contraindication to anticoagulation
- Patients who experience a complication to anticoagulation treatment
- Recurrent PE
- DVT pts who have cancer, burns
- DVT during Pregnant
- High-risk surgical and trauma patients with a contraindication for anticoagulation

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Inferior Vena Cava Filter

- **Absolute** Indication
  - Contraindications to anticoagulation
  - Recurrent thromboembolism despite adequate anticoagulation
  - Complications of anticoagulations that have to be forced the therapy to be discontinued
  - Immediately after pulmonary embolectomy
  - Failure of another form of caval interruption, demonstrated by recurrent thromboembolism

Inferior Vena Cava Filter

- **Relative** indications
  - A large free-floating iliofemoral thrombus demonstrated on venography in a high-risk patient
  - Propagating ilio-femoral thrombus despite adequate anticoagulation
  - Chronic pulmonary embolism in a patient with pulmonary hypertension and cor pulmonale
  - Occlusion of more than 50% of pulmonary bed and would not be tolerate any additional thrombus
  - Recurrent septic embolism

Summary

- **IVC filters**
  - are *not considered* indicated for thrombolysis,
  - **strongly considered**
    - in case of loose (free-floating) thrombi or patients with poor cardiopulmonary reserve, **filter placement before thrombolysis or mechanical thrombectomy** should be strongly considered.

* Optimal or **retrievable filters** should be considered for this purpose.

Summary (cont'd)

- **CDT** for lower extremity DVT
  - are ***not esblished***,
  - **seriously considered**
    - patients with iliac and proximal femoral vein thrombosis, especially who are younger,
    - patients with thrombosis of short duration (less than 10 – 14 days)

Summary (cont'd)

- **Mechanical thrombectomy**
  - may turn out to shorten the treatment time
  - possibly decrease the risk of complications, but this remains to be proved
- **Endovascular stents**
  - are used almost only in the iliac veins

Highlights in Thrombolytic Management of DVT

- WHAT'S IN?
  - **Cather-directed thrombolysis**: **good effect** and **low rate of bleeding** complications
- WHATS'S OUT?
  - **Systemic thrombolysis**: because of **a high rate of bleeding complications**

Highlights in Thrombolytic Management of DVT

- WHAT'S NEW?
  - Pharmacomechanical thrombolysis:
    - is associated with **reduced thrombolysis time**
    - allows **aggressive treatment of underlying pathology**
- WHATS'S CONTROVERSIAL?
  - **Aggressive thrombolysis** combined with **immediate treatment of underlying obstructions or other causes**

Calf Vein Thrombosis (CVT)

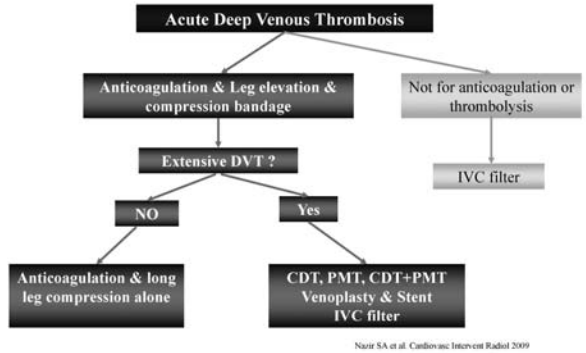
Calf Vein Thrombosis (CVT)

- CVT usually do not cause major sequelae & high risk of PE
- But CVT can embolize, propagation to large veins substantially increases the risk of PE & post-thrombotic syndrome
- Propagation rate : 6-30%
- If not treated, recurrent VTE occurred in 30% of pts.
- 29% recurrent VTE in pts treated w/ 5 days IV heparin vs. no recurrence in pts receiving 3 mo of anticoagulation

Lagerstedt CI, Lancet 1985

Guideline

DVT treatment algorithm.



Nazir SA et al. Cardiovasc Intervent Radiol 2009

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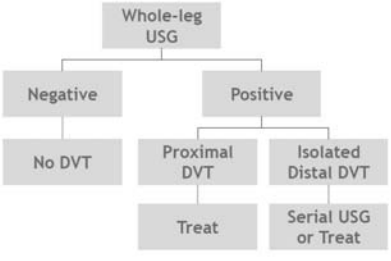
ACCP Antithrombotic Guidelines, 9th ed



Pregnancy

DVT in pregnancy

- Increased risk of VTE in pregnancy
- Warfarin – teratogenic
- LMWH until delivery

Malignancy

Anticoagulant therapy in pts with malignancy

- Risk of VTE : 11%, 2nd leading cause of death in pt w/ overt malignancy
- Recurrence rate is higher in pts w/ malignancy than without malignancy
- Bleeding complication is higher in pts c malignancy than without malignancy

- Anticoagulant therapy LMWH>VKA
- NOAC – no data availble
- Extended anticoagulation

Anticoagulant therapy in pts with brain tumors

- High risk of VTE : 7.5~25%
  - esp., age≥60 years, glioblastoma, large tumor size, subtotal resection, use of chemotherapy, neurosurgery ≤ 2 mo, leg paresis
- Risk of bleeding: 2~4% in pts w/ glioma,
  - esp., pituitary adenoma, metastatic tumor from melanoma, choriocarcinoma, thyroid ca., renal cell ca.
- Anticoagulant therapy LMWH>VKA

Prophylaxis

DVT: Prophylaxis

	Calf DVT	Proximal DVT	Fatal PE
High risk	**40-80%**	**10-30%**	**>1%**
• Surgical patients with history of venous thromboembolism			
• Major pelvic or abdominal surgery for malignancy			
• Major trauma			
• Major lower limb orthopedic surgery			
Moderate risk	**10-40%**	**1-10%**	**0.1-1%**
• Geberak surgery in patients >40 years			
• Patients on oral contraception			
• Neurosurgical patients			
Low risk	**<10%**	**<1%**	**<0.1%**
• Uncomplicated surgery in patients <40 years without any other risk factors			
• Minor surgery in patients >40 years without any other risk factors			

DVT: Prophylaxis

- **Pharmacologic**
  - UFH
  - LMWH
  - Fondaparinux
  - Oral direct thrombin inhibitor
  - Factor Xa inhibitor
  - VKA
  - Aspirin
- **Mechanical**
  - Intermittent pneumatic compression

Venous Diseases

김창수.수 흉부외과

김 창 수

Anatomy

- 3 system
  - Superficial
  - Deep
  - Perforating
- 2 compartment
  - Superfitial
  - Deep

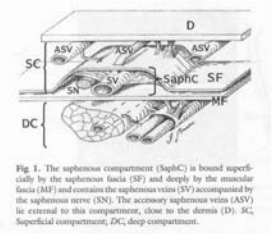


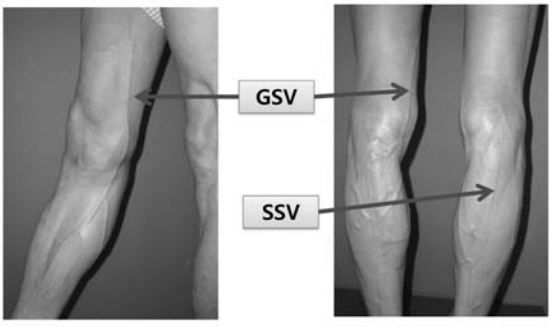
Fig. 1. The saphenous compartment (SaphC) is bound superficially by the saphenous fascia (SF) and deeply by the muscular fascia (MF) and contains the saphenous veins (SV) accompanied by the saphenous nerve (SN). The accessory saphenous veins (ASV) lie external to this compartment, close to the dermis (D). *SC*, Superficial compartment; *DC*, deep compartment.

- Communicating vein ; interconnection with other veins of the same system

Superficial venous system

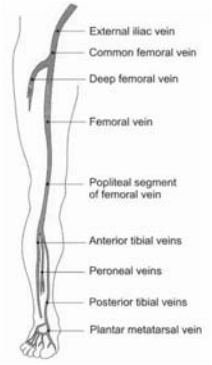
- **GSV (Great saphenous vein)**
  - SFJ 에 5개의 branch
    ; epigastric, circumflex iliac, external pudendal, ant.& post accessory V.
  - Below knee ; anterial, posterior accessory V.
- **SSV (Small saphenous vein)**

Normal veins



Normal valve movement

Deep venous systems



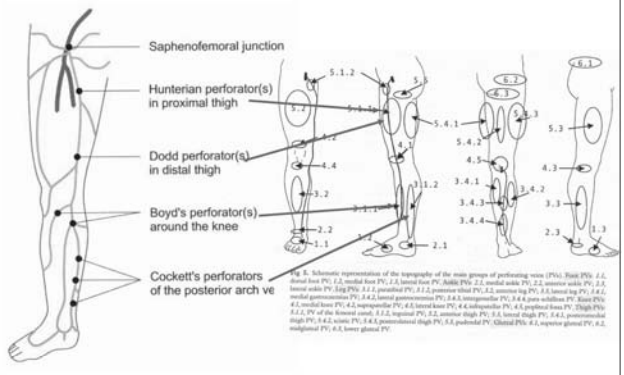
Perforating veins

Gluteal
Thigh
Knee
Leg
Ankle
Foot

⟷

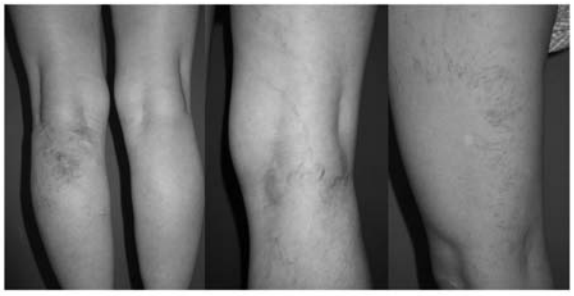
Medial
Anterior
Lateral
Posterior

J Vasc Surg 2002;36:416-22



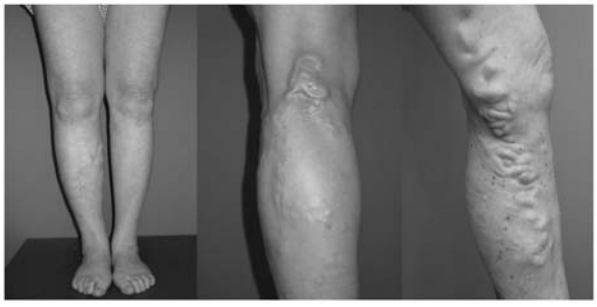
Clinical classification

- C0 ; No visible or palpable signs
- C1 ; Telangiectasia or reticular veins
- C2 ; Varicose veins - C1/C2 cut off diameter = 3mm
- C3 ; Edema - Corona phlebectasia는 논의중
- C4 ; Skin change
  C4a ; pigmentation – eczema
  C4b ; lipodermatosclerosis – white atrophy
- C5 ; as C4 with healed ulceration
- C6 ; as C4 with active ulceration



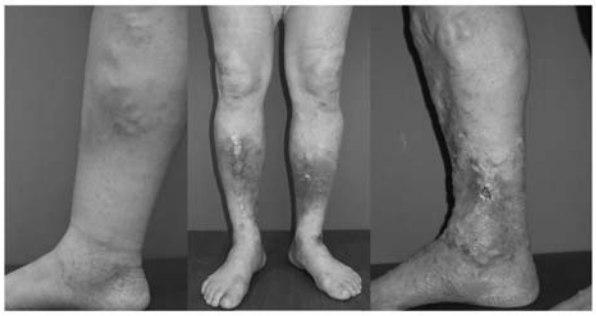
Reticular and Spider veins

(CEAP C1)



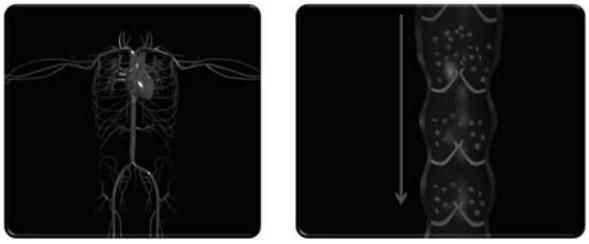
Varicose veins

(CEAP C 2,3)



Complicated varicose veins
(CEAP C4,5,6)

판막의 역류가 원인



정상 비정상

Symptoms

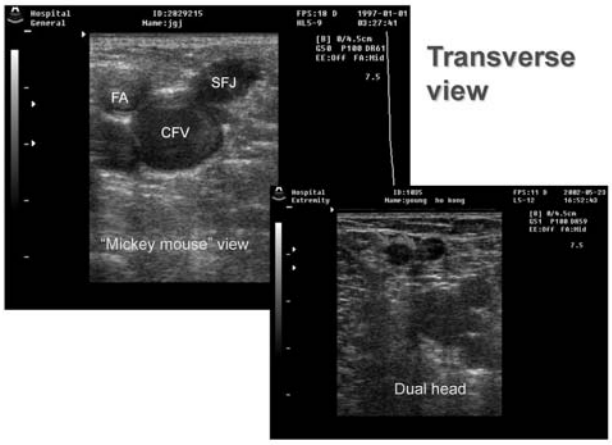
- Aching ; 77%, F>M
- Heaviness
- Itching
- Night cramp, tiredness ; 10-15%
- Swelling

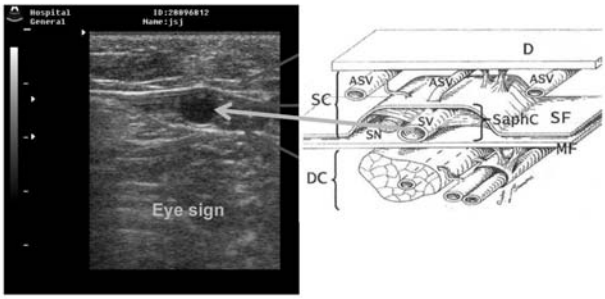
Thrombophlebitis

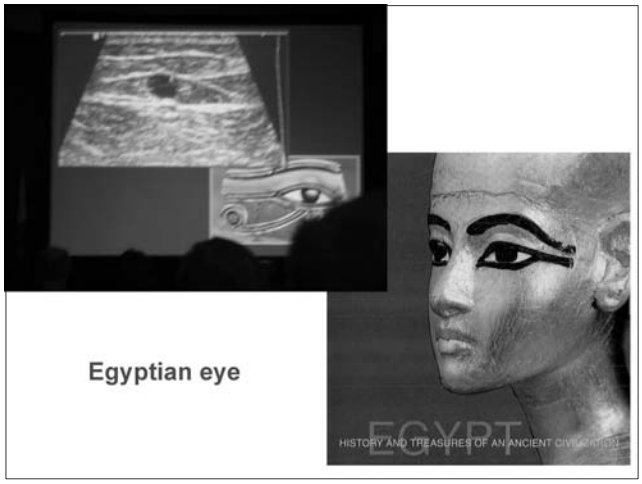
Duplex scan(혈관초음파)

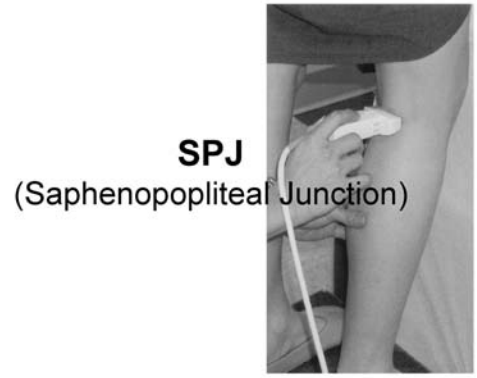
- B-mode + continuous wave Doppler
- Color flow image : triplex
- Erect position에서 시행.
- 특별한 경우에 supine position에서 시행 (secondary varicose vein, DVT)
- Probe position : longitudinal, transverse
- Reflux augmentation : Valsalva maneuver
  calf / foot compression and release

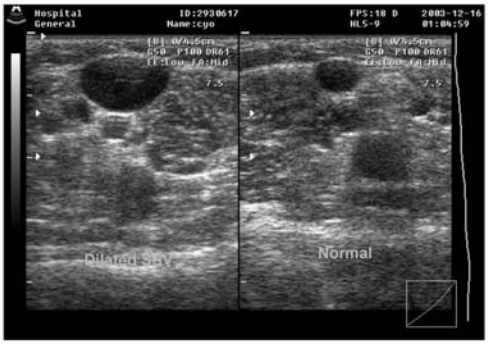
SFJ
(Saphenofemoral junction)



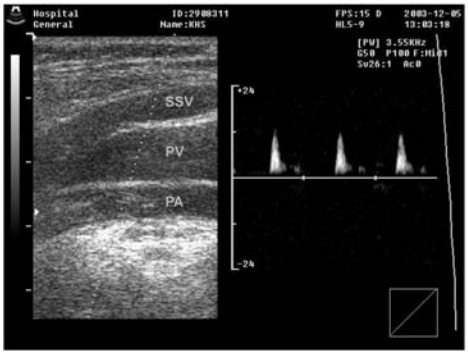




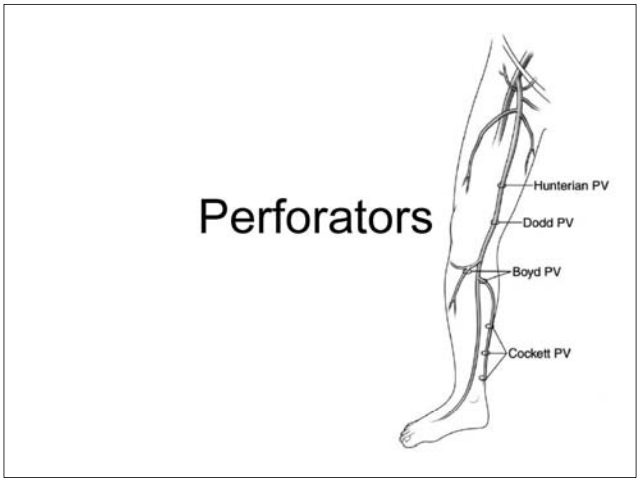


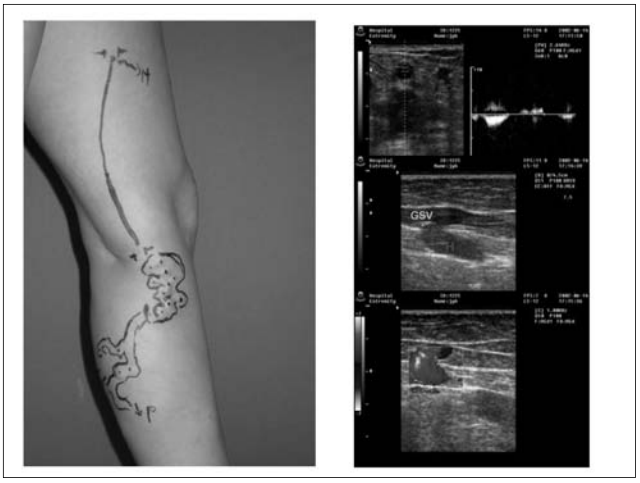


Popliteal fossa transverse view



Popliteal fossa longitudinal view





Current Tx. Strategies

- **Ablation**
  - 1) **Endovenous Thermal ablation(EVTA)**
    - * Radiofrequency (Venefit, RFITT, Fcare sys.)
    - * LASER (810, 940, 980, 1320, 1470, 1520nm)
    - * Steam
  - 2) Chemical ablation
    - * Foam sclerotherapy
    - * MOCA(mechanochemical ablation)
    - * Glu(cyanoacrylate) embolization
    - * V block
- **Surgical stripping :** high ligation and stripping, cryostripping
- **Saphenous preservation :** CHIVA, ASVAL

High ligation and stripping

Endovenous laser ablation (EVLA)

Goal : transmural **vein wall** destruction
→ irreversible **obliteration**

EHIT

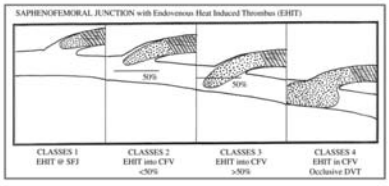
(Endovenous Heat induced thrombosis)

Table II. Summary of the incidence of endovenous heat-induced thrombosis in various series by type of thermal ablation

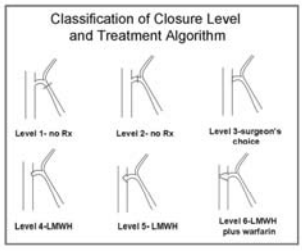
Author	*Year*	*Procedure*	*Duplex FU (days)*	*Complication rates*
Welch[19]	2006	RFA	7	0
Vasquez et al[20]	2007	RFA	4	0.2%
Passman et al[21]	2007	RFA	NA	0.8%
Ravi et al[22]	2006	EVLT/RFA	14	0.1%
Merchant et al[23]	2002	RFA	NA	0.4%
Nicolaides[24]	2000	RFA	NA	1.9%
Weiss and Weiss[25]	2002	RFA	7	0
Gradman[26]	2007	EVLT: 10,290 RFA: 6275	NA	0.15%
Knipp et al[27]	2008	EVLT	NA	DVT: 34%; PE, 2% DVT: 2.2%; Thrombus extension: 7.8%
Hingorani et al[12]	2004	RFA	10 (mean)	16%
Mozes et al[28]	2005	EVLT	7 (mean)	2.3%

EVLT, Endovenous laser treatment; *FU*, follow-up; *NA*, no regular duplex follow-up, *PE*, pulmonary embolism; *RFA*, radiofrequency ablation.

Kabnick classificiation (2006)



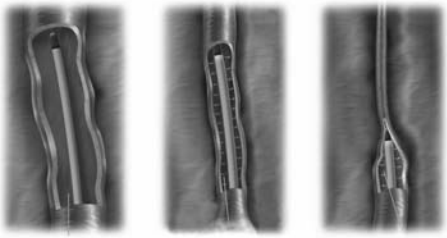
Lawrence classification (2010)



EHIT 예방

- Catheter position :
  Deep vein junction으로부터 2 - 2.5cm
- Early Postop Duplex scanning & proper Mx.
- Early ambulation : Local rather than general anesthesia

Radiofrequency ablation(RFA)



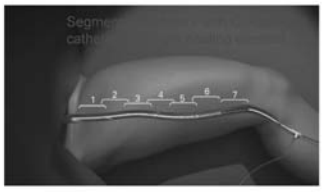
Disposable catheter inserted into vein

Vein heats and collapses

Catheter withdrawn, closing vein

Segmental Ablation

20 sec treatment at 120 degrees Celsius



Images courtesy of Antonios Gasparis, MD

Foam Sclerotherapy

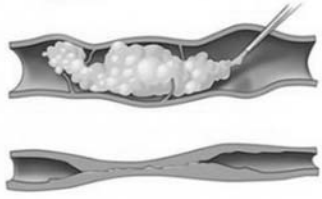


Table 2: Sclerosing agents

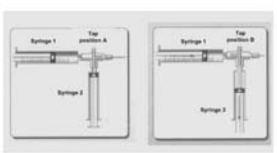
- Detergents: Disrupt vein cellular membrane
  - Sodium tetradecyl sulfate (Sotradecol)
  - Polidocanol (Aethoxysclerol)
  - Sodium morrhuate (Scleromate)
  - Ethanolamine oleate (Ethamolin)
- Osmotic agents: Damage the cell by shifting the water balance
  - Hypertonic sodium chloride solution
  - Sodium chloride solution with dextrose (Sclerodex)
- Chemical irritants: Damage the cell wall
  - Chromated glycerin (Scleremo)
  - Polyiodinated iodine (Sclerodine)
  - Alcoholic solution of zein (Ethibloc)
  - OK 432 (Picibanil)
  - Bleomycin

Indications

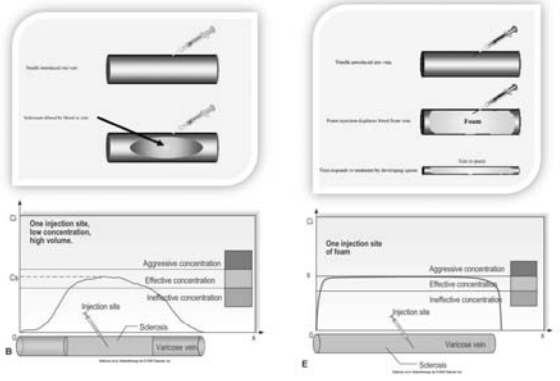
- In principle all types of varicose veins are amenable to foam sclerotherapy. In particular:
  - Saphenous veins (great saphenous vein (GSV) and short saphenous vein (SSV))
  - Accessory veins
  - Varicose veins associated with perforator incompetence
  - Reticular varicose veins
  - (Spider veins, Telangiectasias)
  - Residual and recurrent varicose veins after treatment
  - Pudendal and genital varicose veins
  - Peri-ulcerous veins
  - Venous malformations

Foam perparations

- Tessari's method
- 1 part STS or POL + 4 or 5 part of air
- Two syringe and 3 way tap
- Increase the efficacy and safety of treatment



Liquid Vs. Foam



Foam sclerotherapy 장점

- Increased volume injected for an identical amount of agent
- Less dilution in blood, sclerosing capacity ↑
- Obliteration of the entire cross section of vein
- Persistence of the sclerosing agent - intima contact
- Easy echo verification in view of the particular echogenicity of foam
- Safety of injection

김창수수 흉부외과의원

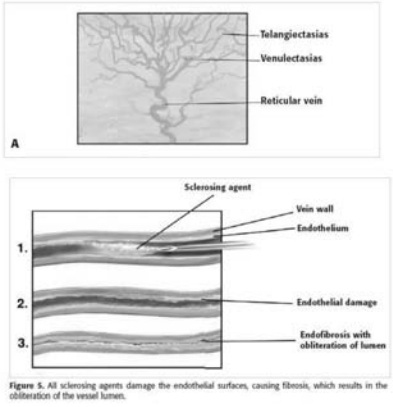


Figure 5. All sclerosing agents damage the endothelial surfaces, causing fibrosis, which results in the obliteration of the vessel lumen.

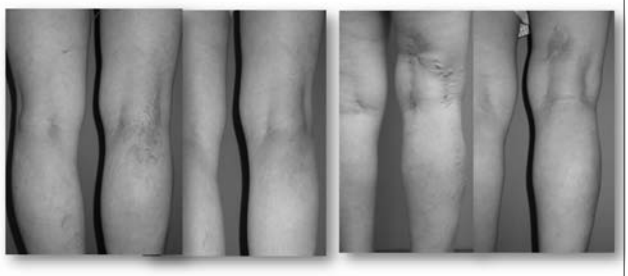
Maximal foam volumes

- **The recommended maximum foam volume per leg and session is 10 ml.**
- When treating large-caliber varicose veins, the foam sclerosant should be as viscous as possible.

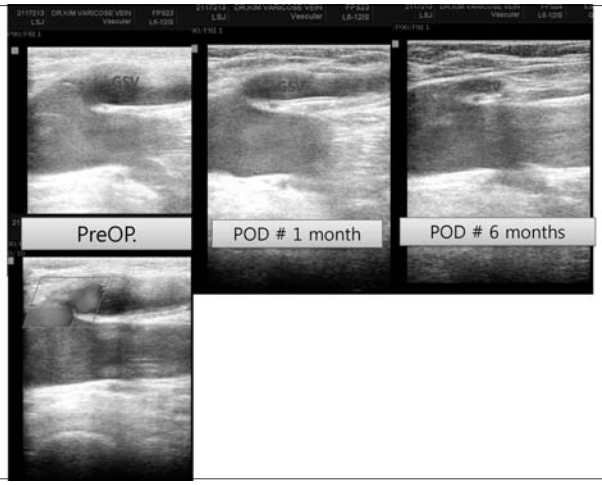
PostSCT. management

- Compression cotton ball
- Class II compression stocking
- 10-30min activity
- 3일 후부터는 stocking 만 착용(3 ~ 6주)
- 2nd session은 2 ~ 4주 뒤에 시행

혈관경화요법 후 6 개월



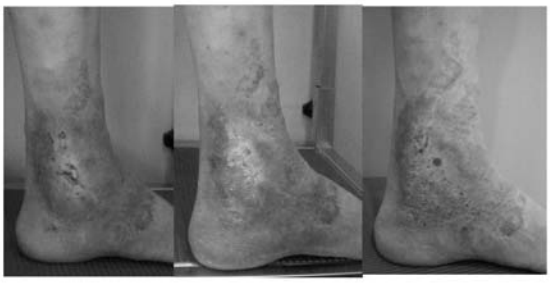
Pre/post OP



수술후 2주

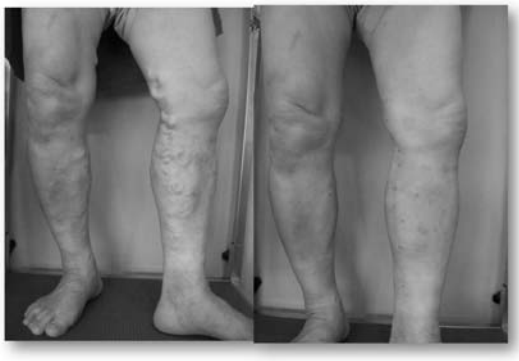
수술전 하지궤양 합병증 동반

수술후 1개월



수술전 2주일 1개월

수술후 1개월



수술 후 6개월사진

감사합니다.

혈액투석을 위한 동정맥루(Vascular Access for Hemodialysis)

순천향대학교 부천병원 흉부심장혈관외과

허 균

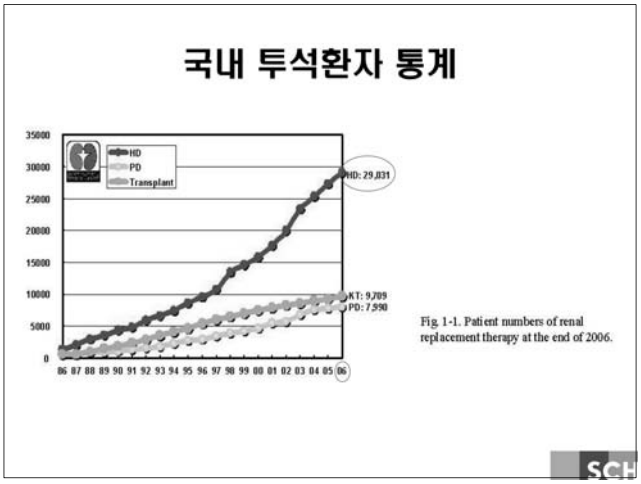


Fig. 1-1. Patient numbers of renal replacement therapy at the end of 2006.

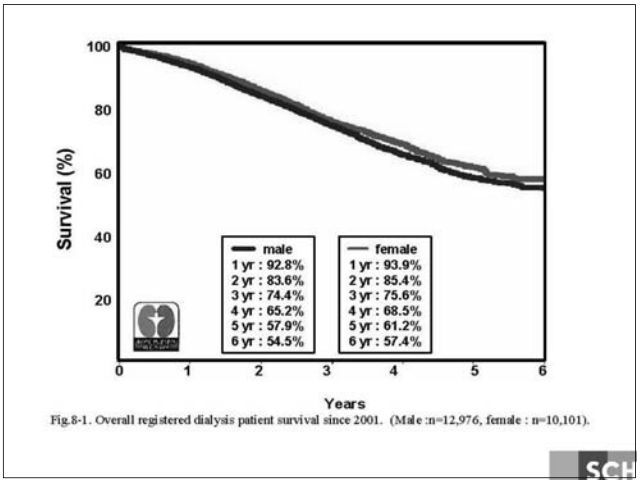


Fig.8-1. Overall registered dialysis patient survival since 2001. (Male :n=12,976, female : n=10,101).

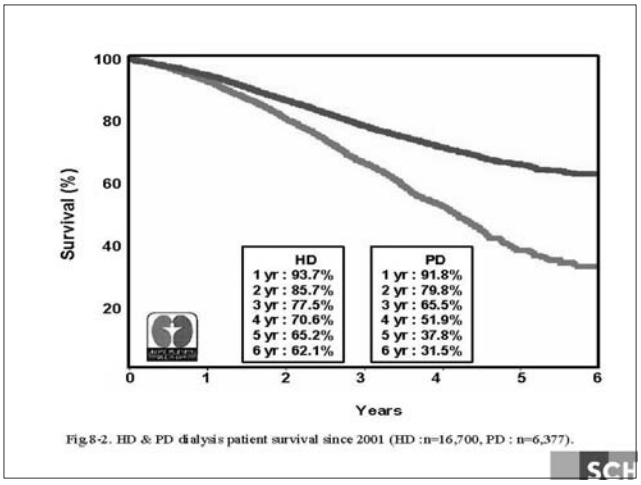


Fig.8-2. HD & PD dialysis patient survival since 2001 (HD :n=16,700, PD : n=6,377).

"투석환자들에게
혈관접근(vascular access)은
생명선(lifeline)이다"

Vascular access on ESRD

- AV Fistula
- AV Graft
- Central catheter

Vascular access on ESRD

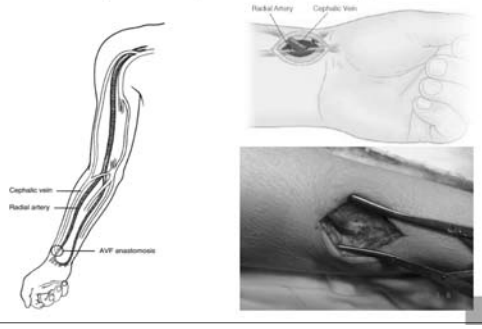
- The access should be placed distally and in the upper extremities whenever possible
- Options for fistula placement should be considered first, followed by prosthetic grafts if fistula placement is not possible
- Catheters should be avoided for HD and used only when other options listed are not available

AV Fistula

- 자신의 정맥을 이용하여 주위 동맥과 연결
- 정맥의 상태가 매우 중요
- Preferred: Fistulae (DOQI)
  - A wrist (radiocephalic) primary fistula
  - An elbow (brachiocephalic) primary fistula
  - A transposed brachial basilic vein fistula

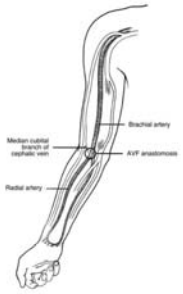
AV Fistula

– A wrist (radiocephalic) primary fistula



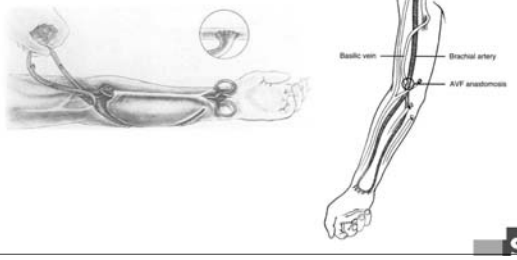
AV Fistula

- An elbow (brachiocephalic) primary fistula



AV Fistula

- A transposed brachial basilic vein fistula



AV Fistula

- The wrist fistula (radiocephalic) is the first choice of access type because of the following advantages:
  - It is relatively simple to create
  - It preserves more proximal vessels for future access placement
  - It has few complications. Specifically, the incidence of vascular steal is low, and in mature fistulae, thrombosis and infection rates are low

AV Fistula

- The major disadvantage of the wrist fistula is
  - lower blood flow rate
  - Comparatively long maturation times (1 to 4 months) must elapse after creation of these fistulae before they can be used
  - relatively high primary failure rate (15%)
  - moderate secondary patency rate at 1 year (62%).

AV Fistula

- The elbow (brachiocephalic) primary fistula is the second choice for initial placement of an access. Its advantages include the following:
  - It has a higher blood flow compared with the wrist fistula.
  - The cephalic vein in the upper arm usually is comparatively easier to cannulate and is easily covered, providing a potential cosmetic benefit.

AV Fistula

- The disadvantages of the elbow primary fistula include the following:
  - It is slightly more difficult to create surgically than a radiocephalic fistula.
  - It may result in more arm swelling than a radiocephalic fistula.
  - It is associated with an increased incidence of steal compared with a radiocephalic fistula.
  - It is associated with a greater incidence of cephalic arch stenosis than a forearm radiocephalic fistula

AV Graft

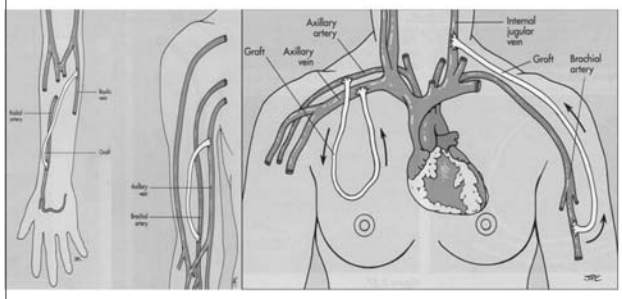
- Acceptable: AVG of synthetic or biological material, such as:
  - Forearm loop graft, preferable to a straight configuration.
  - Upper-arm graft
  - Chest wall or "necklace" prosthetic graft or lower-extremity fistula or graft; all upper-arm sites should be exhausted

AV Graft

Forearm loop graft

AV Graft

- **Others**



AV Graft

- **AVGs have the following advantages:**
  - **A large surface area for cannulation initially**
  - **They are technically easy to cannulate**
  - **The lag-time from insertion to maturation is short. For PTFE-derived grafts, it is recommended that not less than 14 days should elapse before cannulation to allow healing and incorporation of the graft into local tissues, although ideally, 3 to 6 weeks are recommended**

AV Graft

- **AVGs have the following advantages:**
  - **Multiple insertion sites are available**
  - **A variety of shapes and configurations is available to facilitate placement**
  - **It is easy for the surgeon to handle, implant, and construct the vascular anastomosis**
  - **The graft is comparatively easy to repair either surgically or endovascularly**
- **A synthetic dialysis AVG is expected to last 3 to 5 years**

Central catheter

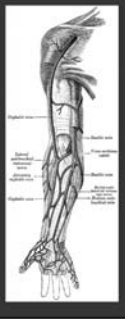
For AV access formation

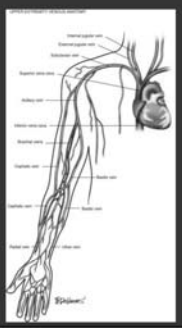
환자의 혈관 상태 파악

AV fistula or AV graft

환자의 혈관상태

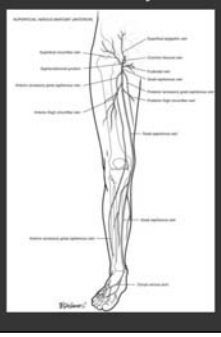
▣ Vein anatomy- 상지





환자의 혈관상태

- Vein anatomy- 하지



환자의 혈관상태

- Sonography
- Venography
- CT angiography
- MR angiography
- Manual examination : 촉진, 타진

Example of preoperative venogram : normal findings

Sonography 유용성

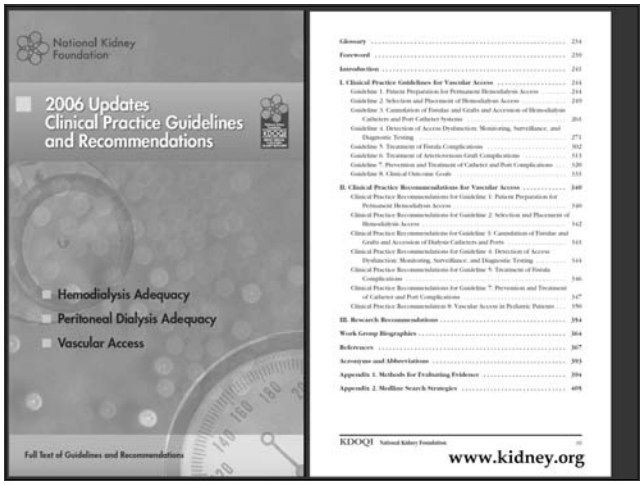
- Cephalic vein 의 크기, 위치 및 상태
- Antecubital vein 및 brachial vein 상태
- Axillary vein
- Venous mapping
- Radial artery, brachial artery
- Central vein stenosis 유무를 알수 없다

- DOQI(Dialysis Outcomes Quality Initiative) Guideline

미국 국립신장기금에서 지원을 받아 투석을 위한 혈관 접근로와 관련된 시행 기준을 제시한 것으로 투석치료에 종사하는 의료진들은 이 기준을 따름 [1997]

NKF-KDOQI Guideline Update 2006

- 기존 38개 지침(guideline)을 8개 지침으로 바꾸어 정리
- 8개의 지침은 다시
  ①증거를 근거로 하는 진료지침
  (clinical practice guideline)
  ②임상진료에 대한 권장사항
  (clinical practice recommendations)
  ③향후 연구방향(research recommendations)으로
  나누어 정리함



Principles of hemodialysis access surgery

- *As far distally in the extremity as possible*
- *Autogenous preferred*
- *Evaluation of arterial inflow and venous outflow*
- *Upper extremity over lower extremity*
- *Nondominant arm over dominant arm*
- *Forearm over upper arm*
- *Types of prosthetic graft material*
- *Cuffed venous catheters discouraged*

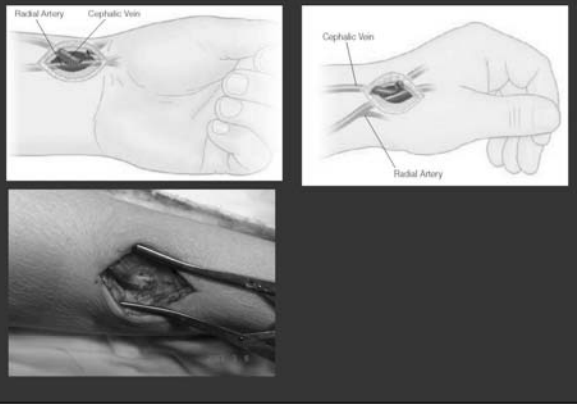
What is the best access for hemodialysis?

- 35 years after initial description of the AV fistula, it still remains the best access for hemodialysis.

AV fistula(AVF)

Arterial diameter > 1.6 mm
Venous diameter > 2.0-2.5 mm
Continuity with the proximal central veins absence of obstruction
Vein condition

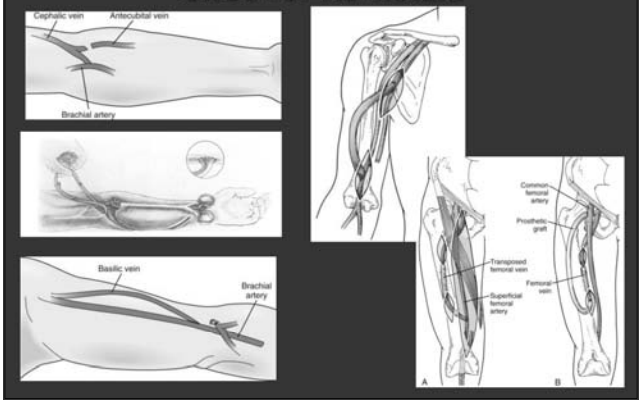
→ Wrist or Forearm Radio-Cephalic AVF (RCAVF)



Sites for AV fistula

- 2.1.1 Preferred: Fistulae. (B)
  - 2.1.1.1 A wrist (radiocephalic) primary fistula. (A)
  - 2.1.1.2 An elbow (brachiocephalic) primary fistula. (A)
  - 2.1.1.3 A transposed brachial basilic vein fistula: (B)

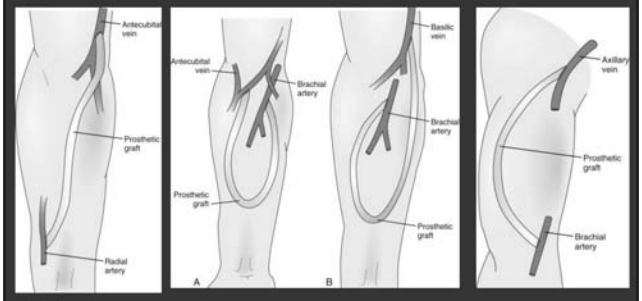
Sites for AV fistula



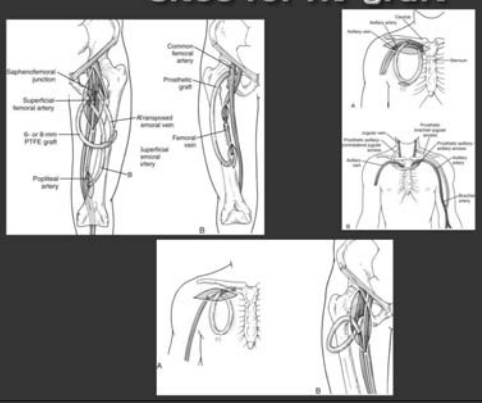
AV graft(AVG)

- 2.1.2 Acceptable: AVG of synthetic or biological material, such as: (B)
  - 2.1.2.1 A forearm loop graft, preferable to a straight configuration.
  - 2.1.2.2 Upper-arm graft.
  - 2.1.2.3 Chest wall or "necklace" prosthetic graft or lower-extremity fistula or graft; all upper-arm sites should be exhausted.

Sites for AV graft



Sites for AV graft



Monitoring and surveillance

- ***정기진찰(monitoring)***
  - The examination and evaluation of access by P/Ex
  - 시진상 이상소견, 부종 및 주사침 삽입부의 지속적인 출혈
  - 촉진상 진전(thrill)의 감소/소실 혹은 맥박(pulse)로의 변환
  - 청진상 문합부 잡음(bruise)의 감소 내지는 소실
- ***정기검사(surveillance)***
  - The evaluation of access by special instrumentation

Table 7. Flow Methods in Dialysis Access

Duplex Doppler Ultrasound (Quantitative color velocity imaging: **[DDU]**
Magnetic Resonance Angiography: **[MRA]**
Variable Flow Doppler Ultrasound (Specs USA):**[VFDU]**
Ultrasound dilution (Transonics):**[UDT]**
Crit-Line III (optodilution by ultrafiltration;HemaMetrics): **[OABF]**
CritLine III direct transcutaneous (HemaMetrics): **[TQA]**
Glucose pump infusion technique **[GPT]**
Urea dilution **[UreaD]**
Differential Conductivity (GAMBRO): **[HDM]**
In Line Dialysance (Fresenius) **[DD]**

Monitoring and surveillance

Table 9. Criteria for Intervention

Degree of Stenosis	Access Pressure Ratio					
	Graft			Fistula		
	Arterial Segment		Venous Segment	Arterial Segment		Venous Segment
<50% of diameter	0.35-0.74		0.15-0.49	0.13-0.43		0.08-0.34
>50% of diameter						
Venous outlet	>0.75	or	>0.5	>0.43	or	>0.35
Intra-access	≥0.65	**and**	<0.5	>0.43	**and**	≤0.35
Arterial inflow	<0.3		Clinical findings	<0.13 + clinical findings		Clinical findings

Table 10. Access Flow Protocol Surveillance

Access flow measured by ultrasound dilution, conductance dilution, thermal dilution, Doppler or other technique should be performed monthly. The assessment of flow should be performed during the first 1.5 hr of the treatment to eliminate error caused by decreases in cardiac output or blood pressure related to ultrafiltration/hypotension. The mean value of 2 separate determinations (within 10% of each other) performed at a single treatment should be considered the access flow.

Graft

If access flow is <600 mL/min in a graft, the patient should be referred for fistulogram.
If access flow 1,000 mL/min that has decreased by more than 25% over 4 mo, the patient should be referred for fistulogram.

SCHBC practices

For AV access formation

↓

외래에서 초음파시행;양팔

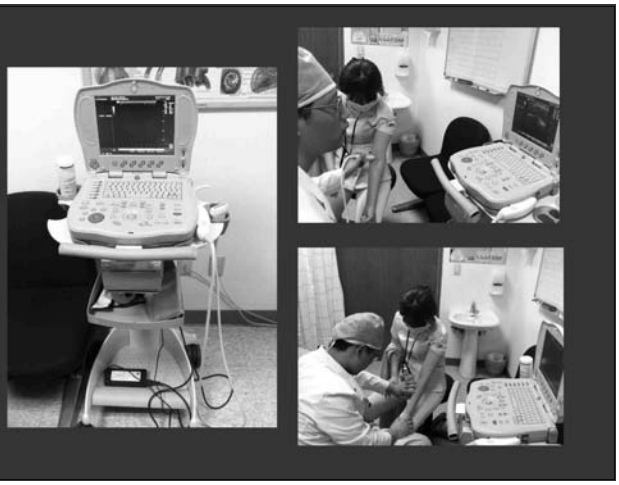
↓

Cephalic vein 의 위치, 상태

/ \

Cephalic vein을 이용하여 AVF wrist, Lt or Rt

Antecubital vein or brachial vein 을 이용하여 AVG forearm, Lt. or Rt



Cephalic vein을 이용한 wrist AVF

Local anesthesia

Incision : between RA and CV

CV dissection and dilatation

CV 의 dorsal branches 보다 proximal 부위를 이용

Arteriotomy : 8-11mm

8-0 prolene, continuous running suture

Post anastomosis dilatation : manual method, branch ligation

Antecubital vein or brachial vein 을 이용한 AVG forearm

Local anesthesia

Incision : between BA and antecubital vein at cubital fossa

Graft : ePTFE 4-6mm tapered size, thin wall, thick wall

Venotomy and vein anastomosis 7-0

Arteriotomy and artery anastomosis 7-0

Post anastomosis dilatation : manual method

수술 후 추적관찰

수술 2주후 외래 F/U

초음파를 이용하여 AV access 상태 확인

AVF : mid-forearm size, Velocity, color doppler 등을 확인

AVG : velocity, color doppler, vein anastomosis 부위등을 확인

3개월뒤 투석실에서 access flow 확인

Complex AV access

Complicated AV access

Hemodialysis access: Complex

- Patients who have "outlived" the AV access option in the upper extremity
- Nearly 7% of access placements were located at a site other than the upper extremity
- Complex: become necessary when options in the upper extremity are extended

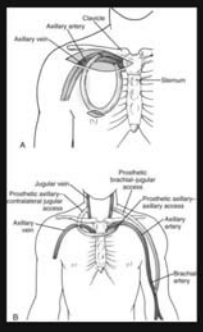
Complex access site selection

Table 73-1 – Major Complex Access Procedures: Indications, Relative Contraindications, and Anatomic Requirements

Access Procedure	Specific Anatomic Requirements	Ideal Clinical Situation	Relative Contraindications
Autogenous femoral vein transposition	Patent femoral vein >3 mm in diameter Patent, noncalcific superficial femoropopliteal artery	Pediatric or young, healthy patients Patients who are hypercoagulable with no other autogenous access options Patients at high risk for infection (poor hygiene, immunosuppressed, multiple previous access infections)	Significant obesity of the thigh Patients who are elderly or "medically fragile" Access sites for temporary catheter placement not readily available Patients at high risk for access-related ischemia of the lower extremity
Prosthetic midthigh loop femorofemoral access Prosthetic loop femorofemoral access	Patent femoral or common femoral vein Patent, noncalcific superficial femoral artery (midthigh access) or common femoral artery	Patients who are elderly or have significant medical co-morbidities	Patients at high risk for infection (poor hygiene, immunosuppressed, multiple previous access infections) Patients who are morbidly obese
Prosthetic chest wall access	Patent axillosubclavian artery and vein Patent central vein	Patients who are morbidly obese Patients at high risk for access-related limb ischemia	Patients who are reasonable candidates for autogenous or prosthetic thigh access procedures
Tunneled cuff dialysis catheter	Patent central vein	Patients who are "medically fragile" or have limited life expectancy (<6 mo) Patients in whom all alternative access procedures have been expended	Patients who are candidates for an alternative complex access procedure (autogenous or prosthetic thigh or chest wall access)

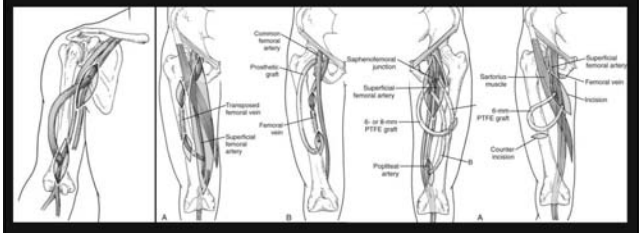
Chest wall access

- Exhaustion of all access possibilities in both arms with a patent superior vena cava, subclavian, and brachiocephalic veins
- In case of unilateral central venous stenosis or obstruction with complete exhaustion of all other access possibilities on the contralateral side
- The reasonable patency and minimal complications



Rutherford's vascular surgery, 7th

Lower-extremity vascular access



Rutherford's vascular surgery, 7th

Lower-extremity vascular access

- Acceptable results in terms of patency
  - femoral vein transposition > femoral grafts.
- Autologous access
  - less infective
  - increased ischemic complications
- Further research with randomized trials is required to assess the outcomes of lower-extremity vascular access.
- Obese : abdominal pan-nus -> mid thigh loop

Complications

- Stenotic
  - stenotic or obstructed access
  - Central vein stenosis
  - Primary failure : failure to mature
- Nonstenotic
  - Infection
  - Pseudoaneurysm
  - Arterial steal syndrome
  - Neuropathy
  - Cardiopulmonary complications

Thrombotic occlusion of AV graft

- Initial thrombectomy success rates
  - Endovascular : 79%
  - Surgical : 77%
- Graft patency at 30 and 90 days
  - Endovascular : 79% and 75%
  - Surgical : 73% and 68%
- Endovascular Tx
  - tissue plasma activator (tPA), potent thrombolytic agent
  - newer thrombectomy devices
- Open surgical thrombectomy alone is not typically adequate
  - Graft revision with patch angioplasty or graft interposition,

Access thrombotic occlusion

Endovascular Tx. **Surgical Tx.**

Hybrid technique

Hybrid technique

- Removal of thrombus is achieved by open balloon catheter thrombectomy
- Once the clot is removed, intra-operative angiography from the arterial inflow to the superior vena cava can be performed
- Cause of access failure
  - Balloon angioplasty
  - Surgical revision with patch angioplasty or graft interposition

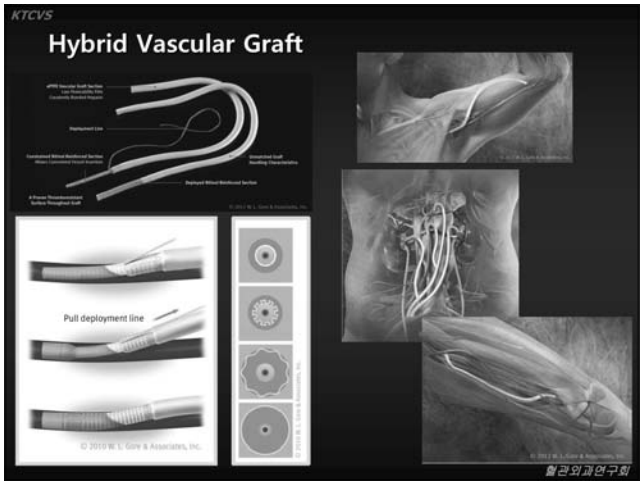
Hybrid technique

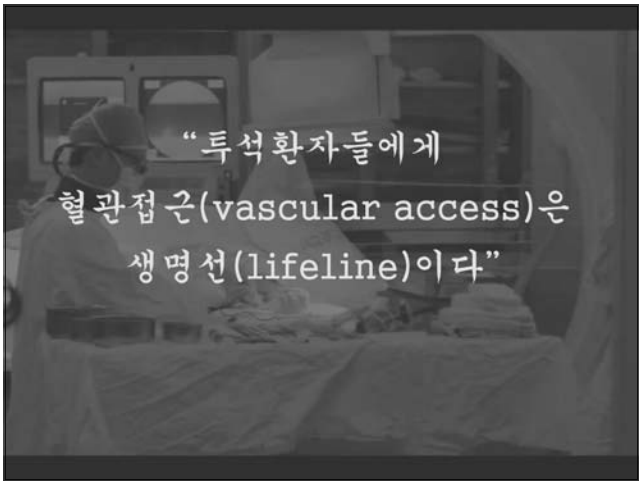
Hybrid technique for thrombectomy and angioplasty. A, Through a small arteriotomy near the venous end, balloon catheters are passed proximally and distally. B, Conventional balloon catheters are used for thrombectomy. C, A sheath is then placed through the arteriotomy for fistulography and possible intervention.

AV graft infection

Segmental bypass and partial graft excision

순천향대학교 부천병원
흉부외과 허균


KTCVS
Hybrid Vascular Graft
Pull deployment line
© 2010 W. L. Gore & Associates, Inc.
혈관외과연구회


"투석환자들에게
혈관접근(vascular access)은
생명선(lifeline)이다"

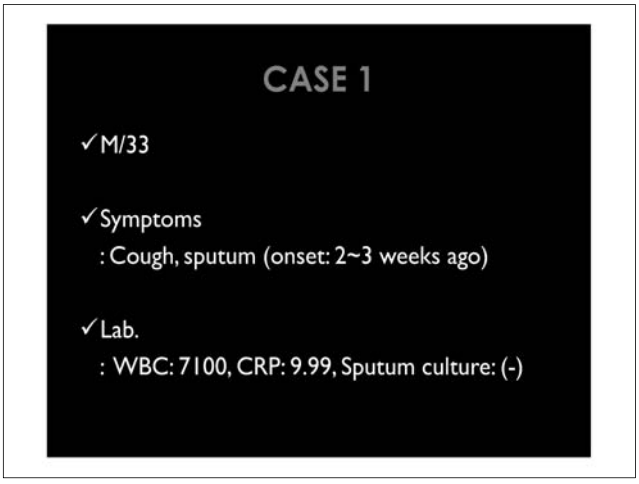
【Thoracic Section】

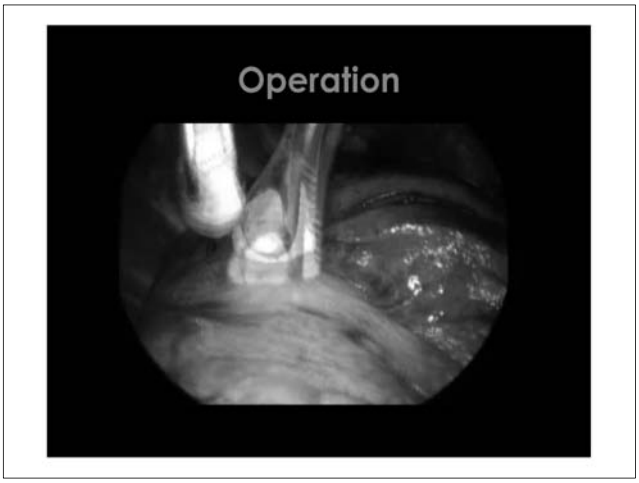
좌장: 금동윤

Surgery for Congenital Anomalies and Benign Tumors of the Lung

고려대학교 의과대학 구로병원

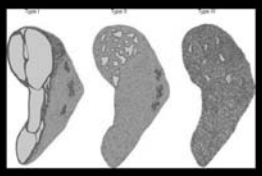
김 현 구





Congenital Cystic Adenomatoid Malformation (CCAM)

- Segmental bronchial atresia during fetal lung bud development



Stocker's classification of congenital cystic adenomatoid malformation. Type I typically has one or more large cysts. (55% of cases). Type II has numerous small cysts (<20mm). Type III is essentially a solid mass of tissue.

- Equally affected at both lungs, commonly in lower lobes
- Size of lesion: primary determinant of prognosis

- Symptoms
  1. Cough and recurrent pulmonary infection in older children
  2. Asymtomatic: incidentally noted in chest x-ray
- Regression: first few months after birth
  → For asymptomatic patients, observation for 1 year is appropriate
- Surgical resection
  1. At the onset of respiratory symptoms
  2. No evidence of regression
- Reasons for early resection
  1. Malignant potential: pleuropulmonary blastoma, rhabdomyosarcoma, BAC (M/C in type I)
  2. Expecting compensatory lung growth after resection

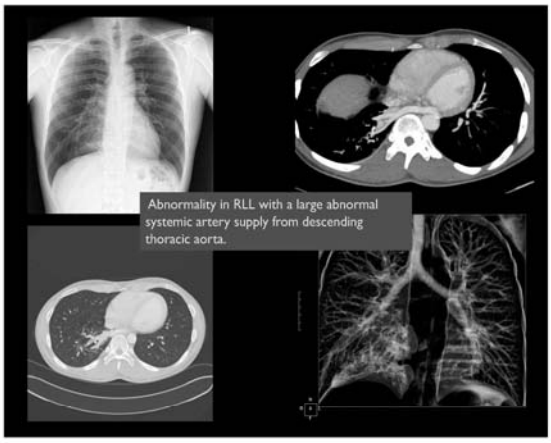
CASE 2

✓ M/25

✓ Symptoms
: Dyspnea (onset: 3~4 weeks ago)

✓ Past Hx.
: 2년 전 건강검진에서 흉부 X-ray상 이상 소견 발견

✓ Lab.
: WBC, ABGA: within normal limit

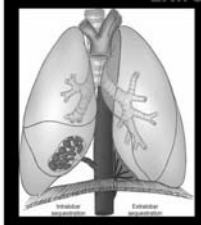


Operation

Pulmonary Sequestration

- Absence of communication with the tracheobronchial tree and pulmonary arteries
- Blood supply: systemic artery
  drainage: pulmonary or systemic veins
- Symptoms
  1. Hemodynamic changes, audible continuous murmur
  2. Respiratory difficulties in an infant
  3. Chronic pulmonary infection in older ages and teenagers
  4. Asymptomatic mass in an adult

Extra / Intralobar type



Extralobar

- Charateristics
  1. Completely separate from the remaining lung
  2. Has its own pleural investment
  3. Usually located in the inferior portion of the thoracic cavity but, anywhere from the neck to just below the diaphragm
- Blood supply
  - Artery: descending aorta, abdominal aorta, subclavian, intercostal
  - Vein: azygos, hemiazygos, subclavian, portal vein
- May be connected with esophagus
- 3-D CT for finding systemic artery
- Asssocaited congenital anomaly: Diaphragmatic hernia, pericardial defect, anomalous pulmonary venous drainage
- Surgery
  - Resection soon after making diagnosis
  - Resection lesion itself without any accompanying lung tissue

Intralobar

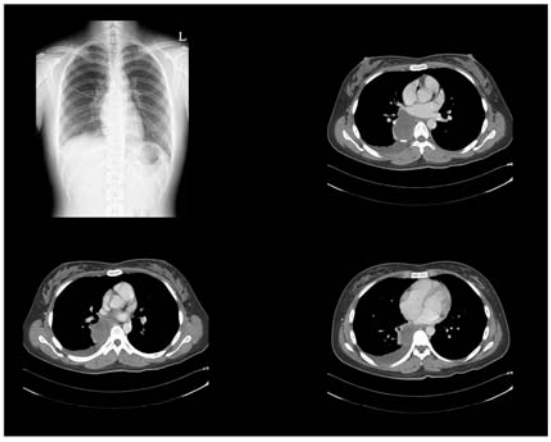
- Characteristics
  1. Congenital, possibly acquired resulting from chronic infection
  2. Surrounded normal lung tissue without separate pleural investment
  3. Located in lower lobe in all cases
- Blood supply
  - Artery: descending thoracic aorta, variable branches of aorta
  - Vein: inferior pulmonary vein, systemic vein
- Recurrent infection
- Surgery
  - Resection soon after diagnosis
  - Removal of the entire lobe including normal lung tissue

CASE 3

✓F/27

✓Symptoms
: right chest pain (onset: 5 days ago)

✓Lab.
:WBC, ABGA, Culture: within normal limit



Operation

Bronchogenic Cyst

- Type according to the location

1. Mediastinal
   - 2/3 of patients
   - Paratracheal, carinal, hilar
2. Parenchymal
   - may communicate with bronchus
3. Others: Inferior pulmonary ligament, retroperitoneal, neck

- Solitary cyst filled with fluid or mucus
- Symptoms
  - Compression of air way
    : wheezing, stridor, shortness of breath, pneumonia, emphysema
  - 1/3 of patients
    : incidental on imaging in asymptomatic child or adult

➢Surgery
- Soon after diagnosis because of high likelihood of symptoms developing
- Simple resection for mediastinal location
- Extensive resection for parenchymal location

Congenital Abnormalities of Lung

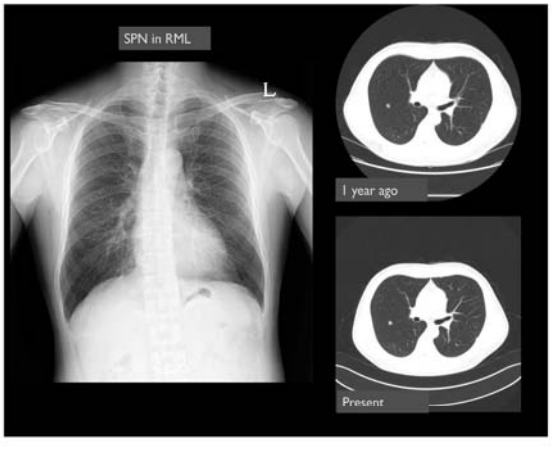
Lesion	Location	Radiologic Findings	M:F	Symptoms	Vasculature
Lobar emphysema	LUL 40%	Hyperlucent lobe	2.5 : 1	Tachypnea, respiratory distress	Normal
	RML 35%	Mediastinal shift			
	RUL 20%			Wheezing	
CCAM	Equal all lobes	Type I—single cyst	1 : 1	Respiratory distress	Normal
		Type II—many small cysts			
		Type III—solid mass			
Sequestration					
Extralobar	Basilar, left 80%	Wedge-shaped mass	2 : 1	Usually none	Arterial—descending aorta
					Venous—hemiazygos
Intralobar	Posterior basal, left 60%	Cyst or solid	1 : 1	None or infection	Arterial—descending aorta
					Venous—Pulmonary vein
Bronchogenic cyst					
Mediastinal	Pericarinal	Round mass	1 : 1	None or wheezing	Normal
Parenchymal	Lower lobes	May contain air	1 : 1	Infection, wheezing	Normal

Benign Tumors of the Lung

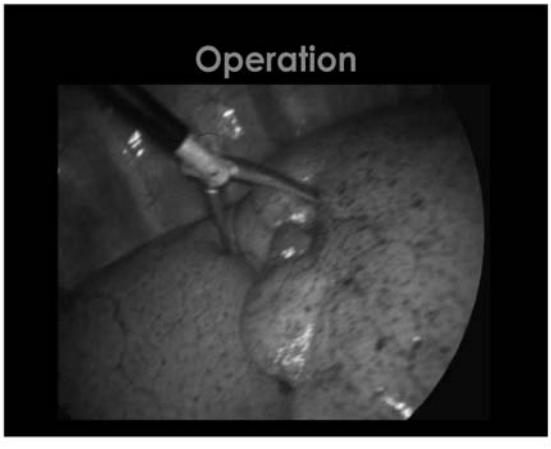
CASE 4

✓M/53

✓Symptoms
- 1년 전 건강검진상 SPN발견



Operation



Harmatoma

➢ Prevalence
- M/C benign tumor: 4~8% of pulmonary neoplasm
- Half: chromosomal abnormality (12q14-15)
- Male dominant (2:1 or 3:1)
- Age: 30~60 years

➢ Radiologic findings
- Composed of mainly of cartilage and gland-like formation with significant amount of fat, connective tissue, smooth muscle
- M/C in peripheral area
- Endobronchial lesion in 3~20%
- Well-circumscribed lesion
- Mean size: 1.8cm in diameter (0.2~5cm)
- Popcorn calcification: presence of fat density (up to 50%)

➢ Symptoms
- Asymptomatic
- Must differenciated from carcinoma on chest X-ray
- Needle aspiration biopsy: diagnostic yield in 85%

➢ Fate
- Slow growth
- Tumor growth was observed in 48% for 4.1 years (3.2+-2.6mm/year)
- Reasonable to watch these lesions
- Malignancy is rare.

➢ Treatment
- If biopsy has not been confirmed, Surgery is an acceptable approach
- If the mass is >2.5cm, Remove it.
- Preoperative marking under CT guidance is recommended.
- Enucleation or wedge resection, segmentectomy, or lobectomy

➢ Malignant associated with Hamartoma
- Adenocarcinoma, or sarcoma might have been developed from hamartoma
- Bronchial carcinoma was identified 6.3~6.6 times more often with a hamatoma.

CASE 5

✓F/54

✓PHx.
: 3년 전 rectal cancer로 수술 받음

✓C.C.
: CT F-up중 multiple GGO lesion발견

Operation

AAH

➢ Nomenclature
- *Atypical adenomatous hyperplasia*
- *Aveolar cell hyperplasia*
- *Atypical alveolar hyperplasia, bronchioloalveolar cell adenoma*

➢ Pathology
- One or more small, asymptomatic ground-glass opacity in the peripheral lung
- Proliferation of minimally atypical cuboidal type II pneumocytes
- 1~10mm in size (majority <5mm)
- Any lesion >5mm: probable carninomatous tumor
- Premalignant lesion to adenocarcinoma

➢ Fate
- Size of tumors grew to 0.2 cm or more, AAH to BAC
  0.3 cm or more to minimally invasive adenocarcinoma
  1.0 cm or more to overtly invasive adenocarcinoma
  2.0 cm or more to overtly invasive adenocarcinoma with LN metastasis

➢ Incidence
- 12 to 23% in resected materials and 3% in autopsy materials.
- Usually found in the upper lobe of the lung and occurs most frequently in patients with adenocarcinoma
- Multiple AAH lesions reportedly show a significantly higher frequency of preceding malignancies

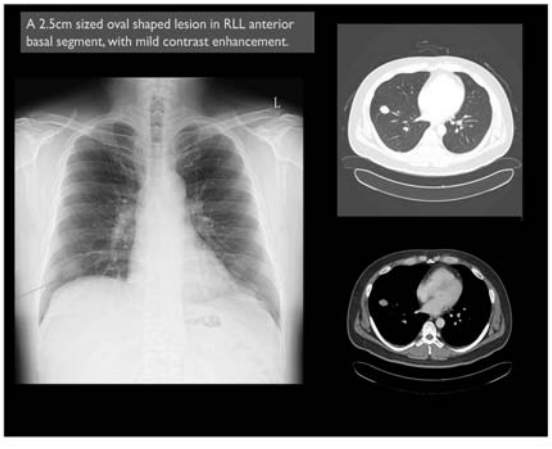
➢ Management
- Clinical differentiation between BAC and AAH by needle aspiraiton is essentially impossible
- If GGO is resected and found to represent
  AAH → nothing more than wedge resection
  BAC → wedge resection, segmentectomy, or lobectomy

CASE 6

✓M/41

✓C.C.
: 건강검진상 SPN발견

A 2.5cm sized oval shaped lesion in RLL anterior basal segment, with mild contrast enhancement.



Operation

Leiomyoma

➢ Prevalence
- Rare (2%), but M/C soft tissue tumor of lung
- 2/3 in women
- Mean age: 35 years old

➢ Symptom and Sign
- Asymptomatic
- Found incidentally on chest X-ray or CT
- Endobronchial symptoms in few

➢ Pathology
- Composed of smooth muscle fiber
- Origin
  Bronchial smooth muscle or wall of bronchial artery
  Metastatic myomas of uterine origin

➢ Treatment
- Surgical resection is treatment of choice

Benign Tumors of the Lung

Origin Unknown
- Hamartoma
- Clear cell (sugar) tumor
- Teratoma

Epithelial Tumors
- Papilloma
- Polyps
- Atypical adenomatous hyperplasia

Mesodermal Tumors
- Fibroma
- Lipoma
- Leiomyoma
- Chondroma
- Granular cell tumor
- Sclerosing hemangioma (alveolar pneumocytoma)

Other
- Inflammatory myofibroblastic tumor
- Xanthoma
- Amyloid
- Mucosa-associated lymphoid tumor

Occurrence (%)
Hamartoma (76.9)
Benign mesothelioma (12.3)
Xanthomatous and inflammatory pseudotumors (5.4)
Lipoma (1.5)
Leiomyoma (1.5)
Hemangioma (0.8)
Adenoma of mucous glands (0.8)
Mixed tumor (0.8)

Thank you !

Inflammatory Lung Disease

부산대학교 의과대학 흉부외과학교실

조 정 수

contents

- Bacterial infections of the lungs and Bronchial compressive disorder
- Pulmonary tuberculosis and other Mycobacterial disease of the lung
- Mycotic and Actinomycotic infections of the lung
- Surgical outcome of infectious lung disease
- Pulmonary paragonimiasis, Pleuropulmonary Amebiasis, Hydatid disease of the lung

Bacterial infections of the lungs and Bronchial compressive disorder

Surgical spectrum of bacterial infection of the lung and bronchial compressive disease

Spectrum of surgical infectious disease

- Bronchiectasis
- Lung abscess
- Organizing pneumonia
- Pulmonary infection in granulomatous disease of childhood
- Tuberculosis and fungal disease
- Thoracic empyema

Bronchial compressive pulmonary disorders

- Right middle lobe syndrome
- Bronchiolithiasis
- Inflammatory lymphadenopathy
- Congenital processes
- Sclerosing mediastinitis
- Cardiovascular disease

Bacterial infections of the lungs and Bronchial compressive disorder

- **Bronchiectasis**
  - Abnormal permanent dilatation of subsegmental airways
  - Etiology
    - **Congenital** - Congenital cystic bronchiectasis, Selective immunoglobulin A deficiency, Primary hypogammaglobulinemia, Cystic fibrosis, α1-antitrypsin deficiency, Kartagener's syndrome, Congenital deficiency of bronchial cartilage, Bronchopulmonary sequestration
    - **Acquired** – Infection, Bronchial obstruction(Intrinsic: tumor, foreign body Extrinsic: enlarged lymph nodes), Middle lobe syndrome, Scarring secondary to tuberculosis, acquired hypogamma globulinemia

Bacterial infections of the lungs and Bronchial compressive disorder

- Classification of Bronchiectasis
  - Saccular bronchiectasis
  - Cylindrical bronchiectasis
  - Pseudobronchiectasis
  - Post-tuberculosis bronchiectasis
  - Genetic-related bronchiectasis

Bilateral saccular bronchiectasis, Characteristic of the preantibiotic era, involving the lower lobes, lingula, and RML.

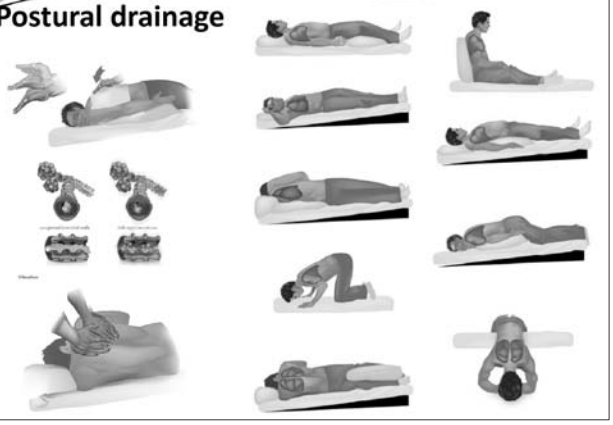
Bacterial infections of the lungs and Bronchial compressive disorder

- Anatomic Distribution of Bronchiectasis in Order of Frequency
  - **Left lung** more often than right lung(9:7)
  - **Left lower lobe**, most frequently involved
  - **Right middle lobe and lingula**, next most frequently involved
  - Total left bronchiectasis, fourth most commonly involved
  - Right lower and total right are less often involved
  - Right upper lobe is involved more often than **left upper lobe**(4:1)

Bacterial infections of the lungs and Bronchial compressive disorder

- Treatment of Bronchiectasis
  - Medical
    - Prevention and control
    - Antibiotics
    - Postural drainage
  - Surgical
    - Unilateral, segmental, or lobar distribution
    - Persistent, recurrent symptoms when medication is discontinued
    - Recurrent infection and hemoptysis
  - Transplantation

Postural drainage



Bacterial infections of the lungs and Bronchial compressive disorder

- **Lung abscess**
  - Sub acute pulmonary infection in which the chest radiograph shows a cavity within the pulmonary parenchyma
- Classification of Lung abscess

Primary lung abscess (acute or chronic)
Related to anaerobic aspiration
Related to specific pneumonia
Secondary lung abscess
With existing lung disease
Metastatic from extrathoracic source
Obstructing bronchial carcinoma
Bronchoesophageal fistula
Foreign body inhalation
Pulmonary infarction
Bullous emphysema

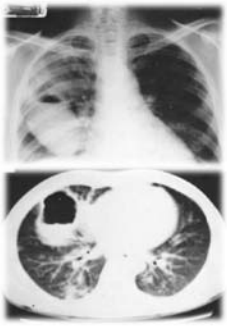
Bacterial infections of the lungs and Bronchial compressive disorder

- Contributing Factors to Lung Abscess

Dental and periodontal disease
Anesthesia
Alcohol abuse
Seizure disorders
Immunosuppression
Neuromuscular disorders with bulbar dysfunction
Esophageal motor disorders
Bronchial obstruction

Lung abscess

- Axillary sub-segment of the posterior segment at the upper lobe and superior segment of the lower lobe.
  A: Right lung. B: Left lung.



A: AP view of a patient with a large aspiration abscess of the RML
B: CT examination

Differential diagnosis of cavitary lung lesions

1. Cavitating carcinoma, generally squamous cell
2. Tuberculous or other fungal diseases
3. Pyogenic lung abscess
4. Empyema with bronchopleural fistula.

- Patient's history is important.
- Absence of fever, lack of purulent sputum, and anormal white blood cell count should raise strong suspicion of an underlying neoplasm.

Bacterial infections of the lungs and Bronchial compressive disorder

- Principles of Therapy for Lung Abscess

Identification of etiologic organism
Prolonged antimicrobial therapy
Adequate drainage in acute stage
Chest physiotherapy
Bronchoscopy
Percutaneous catheter drainage
Emergency surgical treatment
Specific indication
External drainage (only in emergent situation)

Bacterial infections of the lungs and Bronchial compressive disorder

- Indications for Surgery in Lung Abscess

Acute stage (emergency)
Complications
- Bronchopleural fistula
- Empyema
- Bleeding

Chronic stage (definitive)
Persistent symptoms and signs
Recurrent complications (empyema, bronchopleural fistula)
Suspicion of carcinoma
Persistence of lung abscess larger than 6cm after 8weeks of treatment

Surgical intervention is now required in only about 10% of patients with lung abscess.

Bacterial infections of the lungs and Bronchial compressive disorder

- **Organizing pneumonia**
  - An occasional patient with pneumonitis, even with appropriate antibiotic therapy, does not follow the usual predictable course and develops an organized pneumonic process.
  - This also is seen in some patients who receive little or no therapy.
  - The course varies considerably, but the infectious process resolves into a protracted chronic course, and little or no resolution is seen on chest radiography.
  - Regardless of its cause, the area of organized pneumonia should be resected.
  - Outcome is satisfactory.

Pulmonary tuberculosis and other Mycobacterial disease of the lung

- Diagnosis of infection
  - Targeted tuberculin skin testing(TST)
  - Whole blood interferon-gamma release assays(IGRA)
- Diagnosis of active tuberculosis
  - Epidemiologic risk for infection
  - Clinical and radiographic presentation
  - Results of tuberculin skin testing
  - Results of microbiologic evaluation

Pulmonary tuberculosis and other Mycobacterial disease of the lung

Reported Sensitiviti Tuberculosis
Test
AFB smear
Culture of pleural fluid
Adenosine deaminase (>
INF gamma
Pleural biopsy AFB smea
Pleural biopsy culture
Pleural biopsy PCR
Pleural fluid PCR

Findings of Diagnostic Studies in Pleural Tuberculosis

Test	*Typical findings*[a]
Pleural fluid	
pH	7.30–7.40 (if lower, consider empyema)
Total protein	>3 g/dL
Cell count	>1,000/mm^3
Differential: Lymphocytes	>80% if subacute/chronic; PMN predominance if very early/acute
Cholesterol	Elevated if chronic, with milky appearance to fluid
Glucose	60–100 mg/dL (if lower, consider TB empyema)
LDH	>500 IU/L
Sputum AFB	More likely positive if parenchymal disease is present. However, up to 55% of patients with isolated pleural TB (otherwise clear CXR) may have positive induced sputum cultures.[6]
PPD	Up to one-third initially false negative, but on repeat testing 2 months after diagnosis, almost all have positive PPD[c]

Pulmonary tuberculosis and other Mycobacterial disease of the lung

- Principles of therapy for active pulmonary tuberculosis
  - Use **multiple drugs** to which the organism is susceptible
  - Choice of initial therapy should be guided by local resistance patterns and modified by in vitro drug susceptibility tests when available
  - Drug therapy should be for a **sufficiently long period** of time (in most cases at least 6months) to provide durable cure of disease
  - Always **add more than one** drug to which the organism is believed sensitive to a potentially failing regimen
  - Use **directly observed therapy** whenever possible to reduce the chances for nonadherence
  - Promptly report each case to the local public health department

Pulmonary tuberculosis and other Mycobacterial disease of the lung

- Recommended regimens (1st line agents)

Regimen	Drugs	Initiation phase(doses)	Drugs	Continuation phase(doses)
1	I,R,P,E	$8(I_7P_7E_7R_7)$	I,R	$18(I_1R_1)$
		$8(I_5P_5E_5R_5)$		$18(I_5R_5)$
				$18(I_3R_3)$
2	I,R,P,E	$2(I_7R_7P_7E_7)$ then $6(I_2R_2P_2E_2)$	I,R	$18(I_2R_2P_2E_2)$
3	I,R,P,E	$8(I_3P_3R_3E_3)$	I,R	$18(I_3R_3)$
4	I,R,E	$8(I_7R_7E_7)$	I,R	$28(I_7R_7)$
		$8(I_5R_5E_5)$		$28(I_5R_5)$

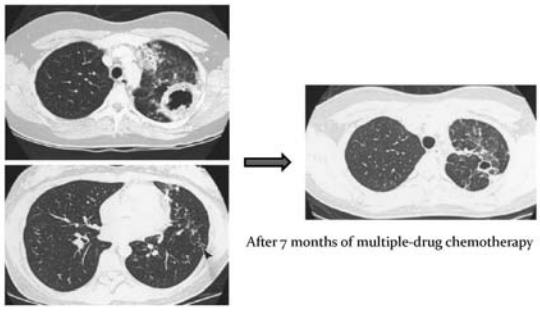
2HERZ/4HER(or 7HER)

Pulmonary tuberculosis and other Mycobacterial disease of the lung

- Definition of multidrug-resistant(MDR) TB
  - Resistance to at least **isoniazid** and **rifampin**
  - Recommended regimens for MDR (2nd line agents)
    - **p-Aminosalicylicacid** (8–12g)
    - **Ethionamide** (15–20mg/kg)
    - **Cycloserine** (10–15mg/kg)
    - **Ofloxacin,** levofloxacin (400mg), Moxifloxacin (400mg)
    - Capreomycin (15–20mL/kg), **Streptomycin,** Kanamycin (15–30mg/kg)
    - Thiacetazone (150mg)
- Definition of extensively drug resistant(XDR) TB
  - MDR strains resistant to any fluoroquinolone and to at least one second-line injectable drug(amikacin, capreomycin, or kanamycin)

Pulmonary tuberculosis and other Mycobacterial disease of the lung

- Radiographic imaging



After 7 months of multiple-drug chemotherapy

Surgical role in the treatment of patients with TB

- Another treatment option for **MDR or XDR TB** that is anatomically localized, particularly in the face of limited medical therapy options, is **resectional surgery**
  - However, **no randomized studies** looking at the role of surgery in MDR TB.
  - Retrospective cohort studies have demonstrated success, both within developed and resource-poor countries.
  - If surgery is considered for a patient with MDR TB, it should ideally be performed only **after several months of chemotherapy** and should be followed by up to 18 months of chemotherapy

Surgical role in the treatment of patients with TB

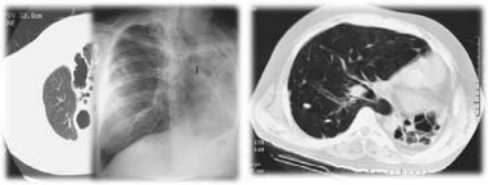
Indications for Surgery in Drug-Resistant Tuberculosis[a]

- Persistently positive AFB smear or sputum culture despite aggressive chemotherapy [65,66]
- High risk of relapse (based on drug resistance profile and radiological findings)[65,66]
- Localized lesion [65,66]
- Complications of tuberculosis including bronchiectasis, empyema, hemoptysis[65]
- Sufficient drug treatment available (to reduce bacterial burden and allow healing of bronchial stump

Grand Round Calling the Surgeon: The Role of Surgery in the Treatment of Drug-Resistant Tuberculosis ***Lancet Infect Dis. 2012 February ; 12(2): 157–166.***

Surgical role in the treatment of patients with TB

- Surgery plays a role in the treatment of patients with TB.
  - Patients with lungs destroyed by MDR(XDR) TB or cavitary disease with or without positive sputum smears.

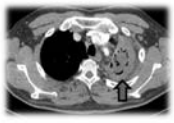


Surgical role in the treatment of patients with TB

- Decortication alone for management of a trapped lung is sometimes indicated.

Surgical role in the treatment of patients with TB

- Mycotic infection and life-threatening hemoptysis in patients with tuberculosis



- Tuberculous bronchial stricture

cough and exertional dyspnea

Bronchial stricture due to endobronchial tuberculosis

Environmental Mycobacterial infection (Nontuberculous Mycobacteria, NTM) of the lung

- Environmental mycobacteria (EM) are found free in water and soil.
- EM infections seem to be increasing in absolute numbers as well as in recognition as a major cause of pulmonary disease.
- Most frequently, EM infects patients with previously diseased lungs, and the infection has a more indolent course than in patients infected with M. tuberculosis.
- Lung damage due to previous TB, bronchiectasis, and chest irradiation is found in many patients with EM infections..
- EM infections, unlike TB, are not transmitted from person to person

Environmental Mycobacterial infection (Nontuberculous Mycobacteria, NTM) of the lung

- The most common EM infection is caused by the M. avium complex(MAC, M. avium and M. intracellulare).
- MAC is widespread and infection usually advances slowly
- Slow growing EM infections are caused by M. kansasii, M. xenopi, M. malmoense, and M. simiae.
- Rapid growing EM producing significant lung pathology includes M. abscessus and M.chelonae
- Patients infected with rapid growers are more difficult to treat because of poor bacteriocidal antibiotic effectiveness against these organisms.

Environmental Mycobacterial infection (Nontuberculous Mycobacteria, NTM) of the lung

Sheilds 7th chapter 83

Diagnostic Criteria for Pulmonary Disease Involving Nontuberculous Mycobacteria (NTM)[a,c]

Clinical	*Microbiologic*
Pulmonary symptoms consistent with NTM Nodular or cavitary opacities on chest radiograph **AND/OR** HRCT with multifocal bronchiectasis with multiple small nodules **AND** Exclusion of other diagnoses	Positive culture from at least two separate sputum samples[b,c] **OR** Positive culture (≥1) from at least one bronchial wash or lavage[b] **OR** Transbronchial or other biopsy with granulomatous inflammation or AFB Positive culture (≥1) for NTM by sputum or bronchial wash or lavage[b]

[a]Patients suspected of having NTM pulmonary disease who do not meet the above criteria should be followed until the diagnosis is excluded or firmly established.
[b]Expert consultation should be sought with identification of infrequently encountered or suspected environmental contamination.
[c]The treatment of NTM pulmonary disease should be based on the risks and benefits of therapy.
[d]Sputum should be collected from three early morning samples before more invasive methods.
Source: Adapted from Diagnosis, treatment, and prevention of nontuberculous mycobacterial diseases. An official statement of the ATS/IDSA. *Am J Respir Crit Care Med* 2007;175:367–416. With permission.

Environmental Mycobacterial infection (Nontuberculous Mycobacteria, NTM) of the lung

- The medical treatment of EM infections, as with TB, is a multi-drug regimen based on specific culture data. Resistance and intolerance to antimycobacterial drugs are high.
- EM infections to involve the lingula, middle lobe, or both of slender older women.

Environmental Mycobacterial infection (Nontuberculous Mycobacteria, NTM) of the lung

- Surgical intervention fo
  patients with MDR TB.
- After appropriate antibi
  destroyed lung, extensiv
  middle lobe or lingula.

Table 1 Indications fo
statement)

A poor response to drug
The development of ma
The presence of signific
hemoptysis

Table 2 Indications for NTM lung disease surgery (JST guidelines)

(1) When sources of bacterial discharge or major lesions being sources of bacterial discharge are clearly noted and, in addition, one of the following disease conditions is observed
- a. Chemotherapy has failed to stop bacterial discharge
- b. Bacteriological relapse is noted
- c. Radiographically enlarged lesions or tendencies of lesion enlargement are either revealed or predicted
- d. Even though bacterial discharge has been stopped, cavitary lesions or bronchiectatic lesions remain, suggesting that relapse or reactivation may occur
- e. Acute exacerbation has repeatedly occurred due to lesions that are sources of massive bacterial discharge, leading to the rapid progression of disease

(2) In patients with hemoptysis, repeated airway infection or comorbid aspergillosis, responsible lesions are subject to resection irrespective of the status of bacterial discharge

Mycotic and Actinomycotic infections of the lung

- Mycotic infection
  - Fungal infections of the lungs have traditionally represented a very small component of the practice of most thoracic surgeons.
  - Most fungal pathogens are opportunistic, causing clinically significant infection only in the presence of **impaired host defenses**.
    - Histoplasmosis, Blastomycosis, Coccidioidomycosis, Aspergillosis, **Aspergilloma**,
    - Zycomycosis, Cryptococcosis, Candidiasis
- Actinomycotic infection
  - Actinomycosis is caused by the facultative an aerobic bacterium Actinomyces.
  - The pulmonary form is rare, making up 15% of reported disease and usually occurring as a secondary infection of a previously existing cavity or bronchiectasis.

Surgical outcome of inflammatory lung diseases

- Thoracoscpoic Lobectomy and Segmentectomy for Infectous Lung Disease. *Ann Thorac Surg 2012;93:1033– 40*

Table 2. Microbiology in 171 Patients With Chronic Bronchiectasis or Cavitary Lung Di

Organism
Mycobacterium avium complex (MAC)
Mycobacterium abscessus
Mycobacterium fortuitum
Mycobacterium simiae
Mycobacterium kansasii
Pseudomonas aeruginosa
Aspergillus/Scedosporium
Haemophilus influenzae
MRSA

MRSA = methicillin-resistant *Staphylococcus aureus*.

Table 4. Morbidity and Mortality After Thoracoscopic Lobectomy or Segmentectomy

Complication	n	%
Operative mortality	0	(0%)
Operative morbidity	19	(8.9%)
Prolonged air leak	12	(5.6%)
Atrial fibrillation	3	(1.4%)
Bronchial injury	1	(0.5%)
Pneumonia	1	(0.5%)
Wound infection	1	(0.5%)
Atelectasis	1	(0.5%)
Pleural effusion	1	(0.5%)

- Results of Surgical Resection for Bronchiectasis

Author	Patients	Mortality(%)	Morbidity(%)
Sealy,etal.(1966)	140	1.4	3
Sanderson,etal.(1974)	242	0.4	33
Annest,etal.(1982)	24	8.3	13
Dogan(1989)	487	3.5	11

Sheilds 7th chapter 83

Author	Patients	Mortality(%)	Morbidity(%)
Kutlay H. et al (2002)	166	1.7	10.5
Eren S. et al (2007)	143	1.3	23.0
Zhang P, et al.(2010)	790	1.1	16.2
Caylak H. et al (2012)	339	0.6	12.7

Various articles

- Results of Surgical Resection for drug resistant pulmonary tuberculosis

Case studies of drug resistant pulmonary tuberculosis patients undergoing surgical resection along with medical treatment

Author	Country	Years	Cohort size	Age*	MDR/ XDR	Perioperative Complication/ Mortality (%)	Post-op Treatment Duration (months)†	Perioperative culture-negative rate (%)	Favorable Outcome Rate
Kim 2010[18]	Korea	1996–2008	72	31	46/26	17%/1.4%	~(18-24)	78%	86%‡
Shiraishi 2009[19]	Japan	2000–2007	36	46	36/0	19%/0	18 (8-46)	100%	83%‡
Dauriante 2008[20]	Latvia	1998–2005	17	42	9/17	18%/0	14.5 (7-28)	47%	47%‡
Park 2009[21]	Korea	1998–2004	19	31	17/2	0/0	12~	95%	79%‡
Ohki 2009[22]	Turkey	1997–2005	55	34	55.6‡	29%/1.8%	24~	93%	85%‡
Wang 2008[23]	China	1995–2008	50	29	50.8‡	25%/0	12 (6-18)	95%	75%‡
Shiraishi 2004[24]	Japan	2000–2008	5	41	0/5	0/0	18~	100%	100%‡
Mehtem 2009[25]	Egypt	1995–2005	23	24	23.1‡	35%/4.3%	~(18-24)	100%	91%‡
Naidoo 2007[26]	South Africa	1997–2005	27	34	27.1‡	29%/0	18~	93%	93%‡
Ke 2006[27]	Turkey	1993–2005	79	38	79.1‡	30%/2.5%		94%	95%‡
Kim 2006[28]	Korea	1991–2001	39	28	30/18	23%/2.5%	18 (8-48)	72%	77%‡
Santocteriat 2006[29]	Peru	1999–2004	113	27	113/-	23%/3%	12/2~	78%	63%‡
Takeda 2003[30]	Japan	1998–2003	28	48	28.6‡	21%/3.8%	~(18-24)	93%	89%‡
Park 2002[31]	Korea	1995–1999	40	33	40/-	10%/0	18~24~	94%	90%‡
Chang 2001[32]	Taiwan	1990–1999	27	41	26/1	11%/4%	15 (8-24)	92%	89%‡
Pomerantz 2001[33]	USA	1983–2000	172	35	172.1‡	12%/3.5%	24~	98%	100%‡
Venkatesan 1997[34]	South Africa	1990–1995	82	34	82.1‡	23%/1.6%	9 (6-24)	88%	86%‡
Iseman 1993[35]	USA	1984–1993	19	30	19.1‡	21%/0		88%	88%‡

Grand Round Calling the Surgeon: The Role of Surgery in the Treatment of Drug-Resistant Tuberculosis ***Lancet Infect Dis. 2012 February ; 12(2): 157–166.***

- Results of Surgical Resection for pulmonary NTM

Table 2 Outcome of surgical treatment for pulmonary NTM disease in previous reports

Publication author, year, reference	Patients n	Predominant species	Sputum culture conversion rate %	Long-term relapse rate %
Corpe et al. 1981[12]	124	*M. avium* complex	93	5
Moran et al. 1983[13]	37	*M. intracellulare*	94	5
Pomerantz et al. 1991[14]	38	*M. avium* complex*	84	0
Ono et al. 1997[15]	8	*M. avium* complex	100	13
Shiraishi et al. 1998[16]	33	*M. avium* complex	94	6
Nelson et al. 1998[17]	28	*M. avium* complex	90	4
Lang-Lazdunski et al. 2001[18]	18	*M. xenopi*	89	0
Shiraishi et al. 2002[19]	21	*M. avium* complex	100	10
Shiraishi et al. 2004[20]	11	*M. avium* complex*	100	9
Sherwood et al. 2005[21]	26	*M. avium* complex*	82	0
Watanabe et al. 2006[22]	22	*M. avium* complex	100	5
Mitchell et al. 2008[7]	236	*M. avium* complex*	100	0

Surgical treatment of non-tuberculous mycobacterial lung disease: strike in time *INT J TUBERC LUNG DIS 2010, 14(1):99–105*

- Results of Surgical Resection for pulmonary Aspergilloma

Variable	Results: Simple (n = 13)	Complex (n = 47)	p Value	All (n = 60)
Postoperative complications, n (%)	3 (23.1)	15 (31.9)	0.736	18 (30.0)
Prolonged air leak	1 (7.7)	8 (17.0)	0.668	9 (15.0)
Prolonged ventilation (>48 h)	0 (0)	5 (10.6)	0.575	5 (8.3)
Pneumothorax	1 (7.7)	3 (6.4)	1.000	4 (6.7)
BPF	0 (0)	4 (8.5)	0.568	4 (6.7)
Pneumonia	1 (7.7)	2 (4.3)	0.526	3 (5.0)
Empyema without BPF	0 (0)	2 (4.3)	1.000	2 (3.3)
Ventricular arrhythmia/arrest	0 (0)	2 (4.3)	1.000	2 (3.3)
Reintubation	0 (0)	1 (2.1)	1.000	1 (1.7)
Mortality (30 d), n (%)	0 (0)	2 (4.3)	1.000	2 (3.3)

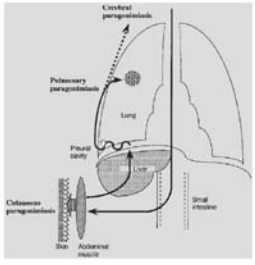
Surgical Therapy of Pulmonary Aspergillomas: A 30-Year North American Experience
Ann Thorac Surg 2014;97:432–8

Pulmonary paragonimiasis

- Paragonimiasis is a subacute to chronic inflammatory disease of the lung caused by lung flukes of the genus *Paragonimus*

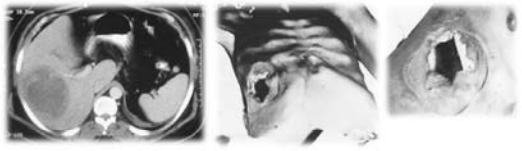
Migration route of Paragonimus in humans.
Paragonimiasis patients express various symptoms depending on the location of the worms.

Paragonimus Westermani egg isolated by bronchial brushing



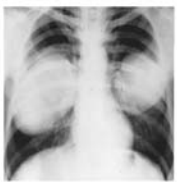
Pleuropulmonary Amebiasis

- Pleuropulmonary amebiasis is almost invariably the result of perforation of an amebic liver abscess through the diaphragm.
- It accounts for 10% of all deaths from amebiasis.
- To understand its management, the nature of amebiasis and of the liver abscess it produces must be understood.



Hydatid disease of the lung

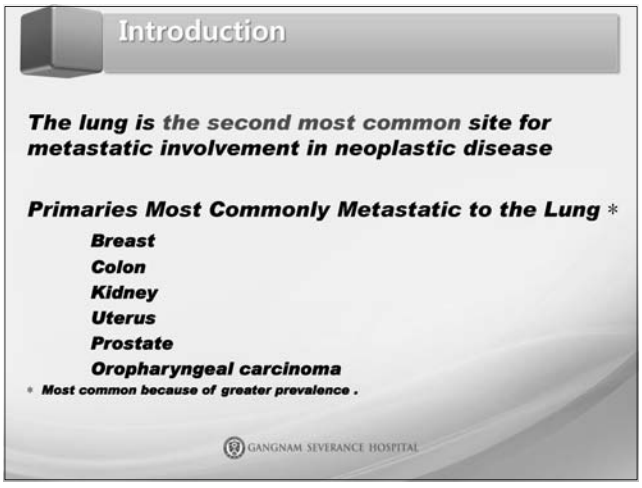
- Hydatid disease is caused by the *Echinococcus granulosus* tapeworm and is known as *echinococcosis* or *hydatidosis*.
- *Echinococcosis* remains a significant health problem in endemic areas.

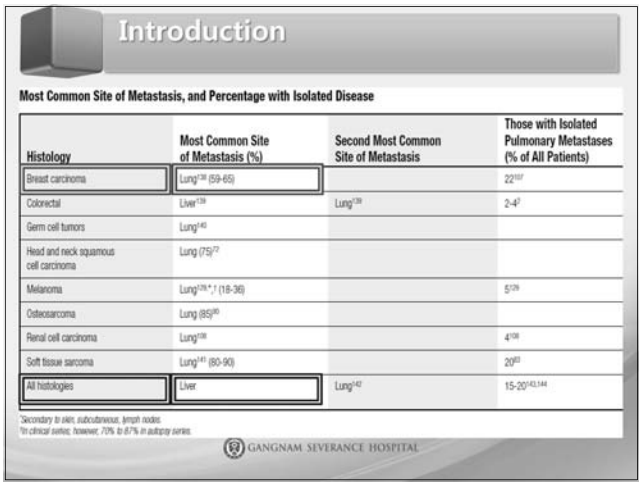


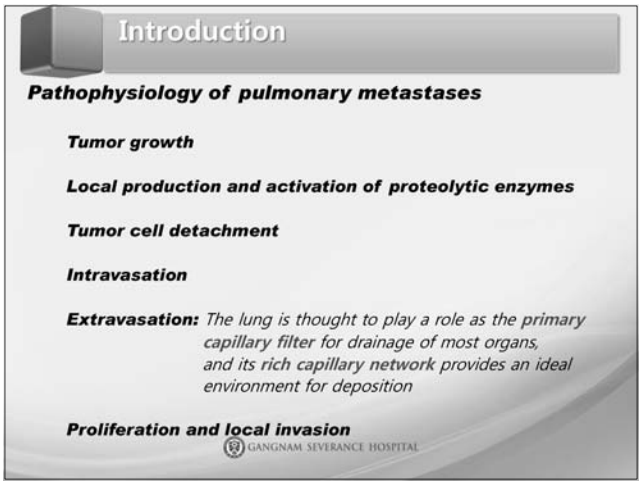
Pulmonary Metastasis

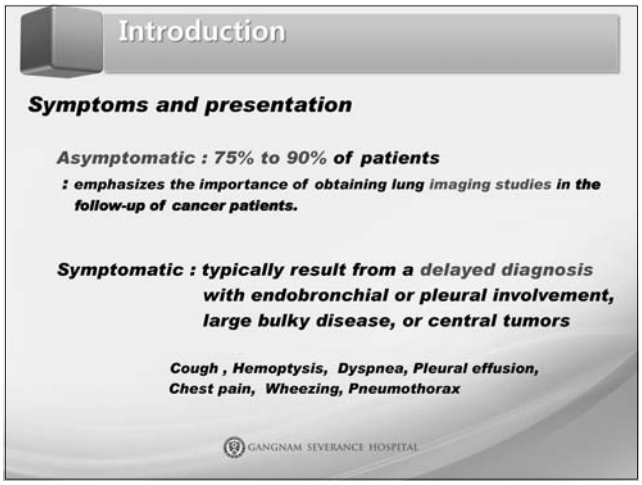
Gangnam Severance Hospital, Yonsei University College of Medicine

Sungsoo Lee, M.D., Ph.D.









Introduction

Radiographic evaluation

CT : The gold standard imaging modality

Spherical shape with well-circumscribed

Smooth borders

Calcifications (rare, may have assocaited with osteosarcomas, chondrosarcomas, and breast and ovarian primaries)

*irregular or spiculated borders (primary lung cancer)

GANGNAM SEVERANCE HOSPITAL

Introduction

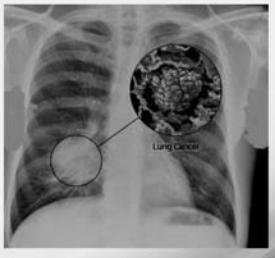
Radiographic evaluation

PET : Extent of disease
- the primary disease
- thoracic
- extrathoracic

Limitation
- false-negative results in patients with sub-centimeter

GANGNAM SEVERANCE HOSPITAL

Introduction



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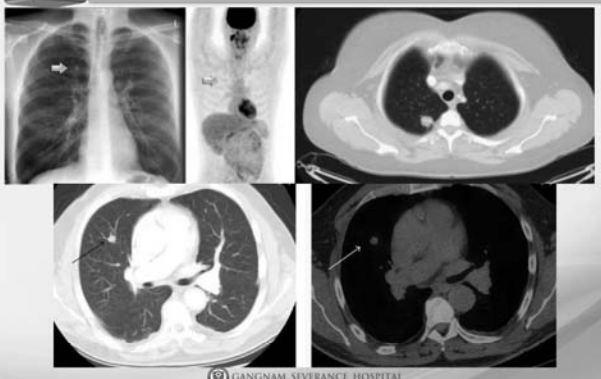
Introduction



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Introduction

Tissue diagnosis

FNA : peripheral

Bronchoscopic biopsy : endobronchial, central

Sputum cytology : often nondiagnostic(peripheral location of most pulmonary metastases)

VATS : therapeutic as well as diagnostic

sensitivity and specificity approaching 100%

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Surgery of metastasis

Selection Criteria* for Metastasectomy

- Local control of the primary tumor or ability to completely resect the primary with synchronous presentations[20]
- Radiologic findings consistent with metastatic disease
- Absence of extrathoracic metastases (i.e., metastasis is confined to the lung)
- Ability to perform a complete resection of the metastases
- No significant comorbidity that would preclude surgery
- No alternative therapy that is superior to surgery

*Approximately a third of patients with metastatic disease meet these criteria.

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Surgery of metastasis

Principles in case metastasectomies

Complete surgical resection
Preserving as much lung tissue as possible
▼
1- to 2-cm margin ***of uninvolved tissue***

****Independent prognostic factors for Pul.metastasis***

Complete surgical resection
Disease-free interval
Metastases to other organs
Histology of the primary tumor

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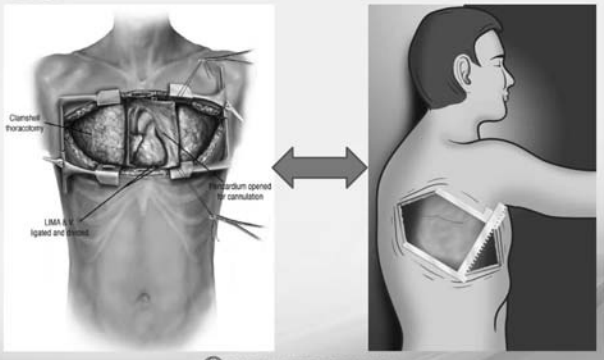
Surgery of metastasis



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Surgery of metastasis

Bilateral exploration

Pulmonary metastases represent a *systemic disease* ***with a great probability of*** *bilateral spread*

Metastases are *not detectable by preoperative imaging*

▼

No survival benefit ***when compared with*** *unilateral exploration*

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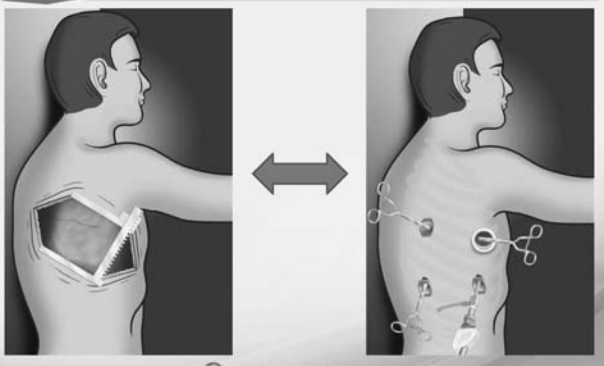
Surgery of metastasis



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Surgery of metastasis

VATS or Thoracotomy

Open surgical exploration *can detect lesions missed by preoperative imaging.*

No evidence of prolonged survival ***with the removal of micronodules with a size of*** *1—2 mm, missed by CT scan* ***and detected by bimanual palpation.***

VATS preserved the ability to perform *repeat operations.*
: VATS results in fewer pleural adhesions than thoracotomy, and does not complicate a potential repeat operation by thoracotomy.

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Surgery of metastasis

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Surgery of metastasis

Bilateral pulmonary metastases in imaging

Bilateral simultaneous or Staged operation

No difference in long-term survival

Approximately 6 weeks later

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Results of metastasectomy

Recurrence after metastasectomy

Two thirds of patients

Close follow-up

repeated pulmonary metastasectomy

Do not influence the survival rate negatively

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Results of metastasectomy

Five-Year Survival Rates of Various Histologic Metastatic Resections

Histology	5-Yr Survival Rate without Metastasectomy (%)	5-Yr Survival Rate with Metastasectomy (%)
All histologies	—	25-40[77,145]
Breast cancer	11[107]	35-50[109,146,147]
Colorectal cancer	<5[54]	40-45[99,148]
Germ cell tumors	—	68[77]
Head and neck squamous cell carcinoma	—	29-60[77]
Melanoma	3-4[128,129]	21-36[77,128,129]
Osteosarcoma	0-17[90,149]	20-40[75,77,150,151]
Renal cell carcinoma	—	13-54[152]
Soft tissue sarcomas	—	20-40[77,79]
Urinary tract cancer	—	25-43[152]

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Results of metastasectomy

Survival after complete metastasectomy	*Survival after untreated metastatic disease*
▪ *5 years : 36%*	▪ *5 years : 5-10%*
▪ *10 years : 26%*	
▪ *15 years : 22%*	

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Metastases to the lung

Colorectal cancer

10—20% (initial diagnosis)

2% Isolated pulmonary metastases

Liver : most common site of metastasis

Lung and liver resection : 5-year survival (25% to 35%)

Chemotherapy : median survival (16 to 20 months)

Favorable factors	Adverse factors
Complete resection Single lesion Long disease free interval	Elevated CEA LN metastases

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Metastases to the lung

Breast cancer

Favorable factors

Estrogen and progesterone receptor (ER/PR) status of the resected nodules

Complete resection

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Metastases to the lung

Testicular cancer

Non-seminomatous germ cell tumor

Wide dissemination

High sensitivity to cisplatin-based chemotherapy

Metastectomy is performed after completion of cisplatin-based chemotherapy.

Removing residual lung disease

Aggressive resection of all suspicious lesions

Adverse effect on survival: multiple metastases, hCG↑, AFP↑ viable tumor cells in nodule

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Metastases to the lung

Osteosarcoma

10—20% (initial diagnosis) - > 70%

Neo-adjuvant (doxorubicin, high-dose cyclophosphamide, cisplatin)
Resection of the primary osteosarcoma
Pulmonary resection : aggressively

85% (recurrent pulmonary disease) -> Resection

5-year survival : 32% to 40%

Not surgical candidate -> Radiotherapy
Brachytherapy(endobronchial)

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Metastases to the lung

Soft tissue sarcoma

Less sensitive to chemotherapy
-> Surgical treatment

More favorable : malignant fibrous histiocytoma, rhabdomyosarcoma, synovial sarcoma

Worse prognosis : liposarcoma peripheral nerve sarcoma

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Conclusion

Metastasectomy should only depend on the patient's requirements, such as general state of health and oncologic considerations, such as promising multimodal therapy concepts, extrathoracal tumor manifestations or oncologic type of the primary tumor.

Lesions undetected by preoperative imaging or during surgery, but detected during follow-up, may not alter survival as long as they are resected before they become unresectable.

In case of recurrence of pulmonary disease, and if the patient fulfils the initial criteria for pulmonary metastasectomy, repeat surgery should be performed

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2.Hornbech K, Ravn J, Steinbruchel DA. Current status of pulmonary metastasectomy. Eur J Cardiothorac Surg. 2011;39(6):955-62.

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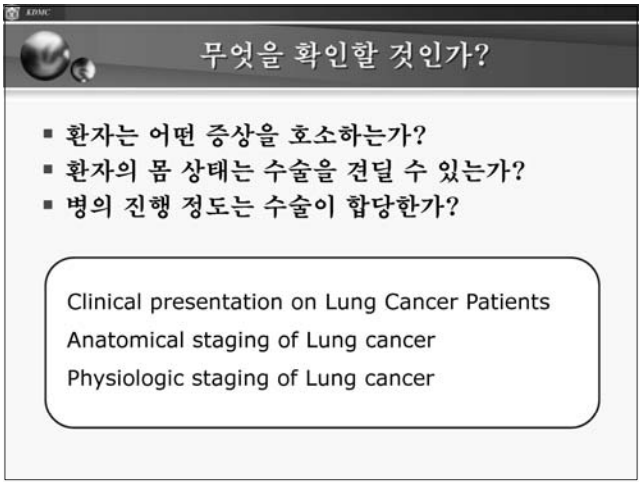
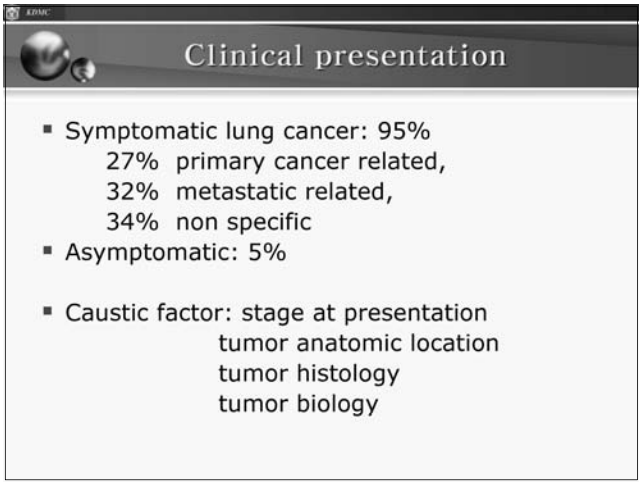
Thank you
for your attention!

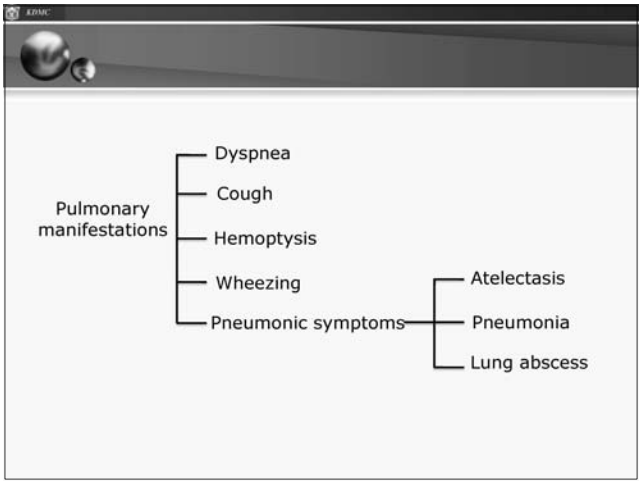
Preoperative Work up for Lung Cancer Surgery

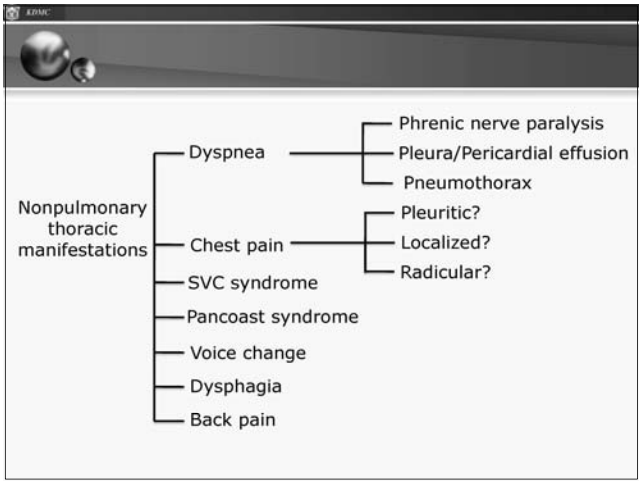
계명대학교 동산의료원 흉부외과학교실

금 동 윤



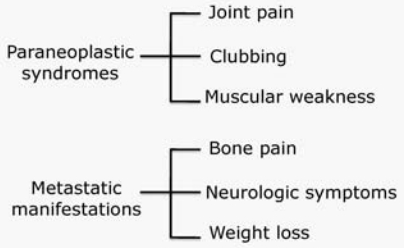


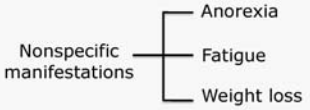




Pancoast syndrome←Superior sulcus tumor

- Shoulder pain← direct invasion of rib and muscle
- Radicular arm pain ← invasion of C8/T1 nerve root of brachial plexus
- Horner's syndrome(enophthalmos, ptosis, miosis,anhidrosis by satellite ganglion invasion)





TNM staging

T 병기

T0	원발종양의 증거가 없는 경우
TX	원발종양에 대해 평가할 수 없거나, 객담 또는 기관지내시경 세척검사에서 악성종양 세포를 증명하였지만 영상검사나 기관지내시경검사에서 보이지 않는 경우
TIS	상피내암종(carcinoma in situ)
T1	종양의 장경이 3 cm 이하이면서 폐실질이나 내장쪽 흉막으로 둘러 싸여 있고 기관지내시경검사에서 엽기관지보다 근위부(주기관지)로 침범의 증거가 없는 경우
T1a	종양의 장경이 2 cm 이하
T1b	종양의 장경이 2 cm 보다는 크고 3 cm 이하
T2	종양 크기가 3 cm보다 크고 7 cm 이하 또는 종양이 다음 경우 중 한 가지를 만족할 때: 주기관지를 침범했으나 기관분기부(carina)로부터 2 cm 이상 떨어져 있을 때; 내장측 흉막을 침범했을 때; 폐문까지 도달하였으나 전폐에 걸치지는 않은 무기폐나 폐쇄성 폐렴을 동반했을 경우
T2a	종양의 장경이 3 cm 보다 크고 5 cm 이하
T2b	종양이 장경이 5 cm 보다 크고 7 cm 이하
T3	종양의 크기가 7 cm보다 크거나 종양이 다음 중 한 가지를 직접 침범했을 때: 흉벽(상고랑종양 포함), 횡격막, 종격동 흉막, 심장막; 기관분기부 2 cm 이내로 주기관지를 침범했으나 기관분기부를 침범하지는 않았을 경우; 전폐를 침범한 무기폐나 폐쇄성폐렴을 동반한 경우; 원발종양과 같은 폐엽(lobe)에 존재하는 종양결절(들)이 있을 때
T4	크기에 상관없이 종양이 다음 중 한 가지를 침범했을 때: 종격동, 심장, 대혈관, 기관, 성대 신경(recurrent laryngeal nerve), 식도, 척추체, 기관분기부, 종양결절(들)이 원발종양과 다른 폐엽(different ipsilateral lobe)에 있는 경우

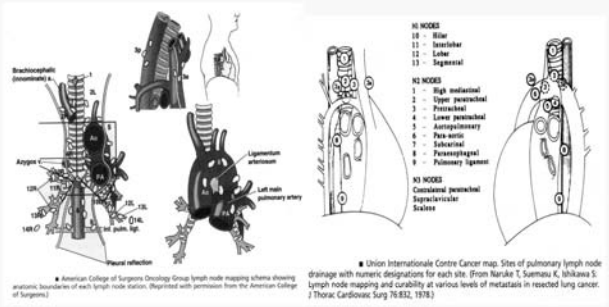
M 병기

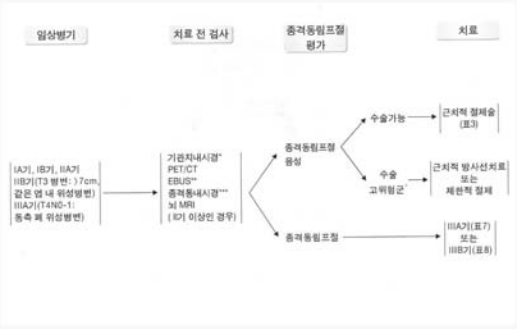
M0	원위부 전이가 없는 경우
M1	원위부 전이가 있는 경우
M1a	원발종양과 반대편 폐엽(contralateral lobe)의 종양결절(들)이 있거나 종양과 관련이 있는 늑막 결절들이 있거나 악성흉수 또는 악성심낭액이 있는 경우[a]
M1b	원격전이가 있는 경우

[a] 폐암과 동반된 대부분의 흉막삼출은 종양에 의한 것이다. 그러나 여러 차례 검사에서 혈성이 아니고, 삼출액이 아니며 세포병리학적으로 음성이 나온 경우는 종양과 관련이 없는 것이며 이 경우 병기판정에서 M0으로 분류한다.

Sixth Edition T/M Descriptor	Seventh Edition T/M
T1 (≤2 cm)	T1a
T1 (>2~3 cm)	T1b
T2 (≤5 cm)	T2a
T2 (>5~7 cm)	T2b
T2 (>7 cm)	T3
T3 invasion	
T4 (same lobe nodules)	
T4 (extension)	T4
M1 (ipsilateral lung)	
T4 (pleural effusion)	M1a
M1 (contralateral lung)	
M1 (distant)	M1b

Lymph node mapping





Diagnostic Tools

- T stage: chest x-ray, chest CT, bronchoscopy, PET-CT, (MRI)
- N staging: chest CT, PET-CT TBNA, EBUS-TBNA, mediastinoscopy, mediastionotomy
- M staging: physical exam, bone scan, brain CT(MRI), PET-CT

Enlarged L.N. on chest CT

- Positive CT result(> 1cm): 70% actual metastasis
  → histological confirm
- False-negative rate less than 10% in negative CT result(< 1cm)
  → T1/T2 + negative CT result: histologic confirm(?) (mediastinoscopy?)

cf. 28% false-negative rate on central T3
→ histological confirm(Daly et al. JTCS 94;664 1987)

cf. High rate of early metastasis in T1 adenoca, large cell ca

Mediastinoscopy/Mediastinotomy

Histologic diagnosis
Accurate determine the N2
Identify extranodal extension of tumor/ involvement of contiguous structure(trachea/ aorta)
Identify N3

Indication
1. L.N. enlargement more than 1cm on preop CT
2. Potential entry to neoadjuvant therapy protocol
3. Negative CT result in T2, T3 tumor and T1 adenoca/large cell ca(relative)

Mediastinoscopy/Mediastinotomy

Routine mediastinoscopy (with negative CT scan)

- Low complication rate
- Resectable N2 without neoadjuvant Tx(single station, ipsilateral, lower paratracheal, no extracapsular extension
- High rate of thoracotomy(curative resection)
- 10-15% false negative rates on chest CT

Selective mediastinoscopy

- High rate of negative mediastinoscopic examination(70%)
- Possible complete resection of unsuspected N2
  ★ unsuspected N2: 8.9%(mostly inaccessable site; post subcarinal, periesophageal, anteroir mediastinal_)

EBUS(+TBNA)

- 2007 ACCP:
  invasive staging
  mediastinoscopy대체 in
  stage II or central cancer
- 2009 NCCN:
  IIIB 치료전 종격동검사
  방법으로 권유
- Node: 1R, 1L, 2R, 4R, 7,
  10, 11(+)
  5, 6, 8, 12(-)
- Sensitivity 95%, specificity 100%

EBUS(+TBNA) 적용

- 폐암의 진단.
  peripheral lung cancer
  central parenchymal lung cancer, bronchoscopy(-)
- 폐암의 림프절 병기결정
  PET N2(+) lung cancer: 민감도 93%, 정확도97%, 음성예측율91%
  PET N2(-) lung cancer: 민감도 89%, 음성예측율 98.9%
  →adenocarcinoma/ >5mm mediastinal node
- **Restaging the mediastinum after CCRT**
  민감도 76%,정확도 77%.음성예측율 20%로 치료전 시행된 것에 비해 낮은 민감도와 정확도 → 추가적 수술확인 필요
- 원인 불분명한 **hilar, mediastinal Lymphadenopathy**
- **Mediastinal mass**

EBUS(+TBNA)

EBUS-TBNA 에서 림프절을 몇 회까지 흡인하는 것이 적절한가?

Table 7. Cumulative Diagnostic Values of EBUS-TBNA Shown by the Number of Aspirations

Variables	Aspirations, No.			
	1	2	3	4
Sensitivity	69.8 (30/43)	83.7 (36/43)	95.3 (41/43)	95.3 (41/43)
Specificity	100 (83/83)	100 (83/83)	100 (83/83)	100 (83/83)
PPV	100 (30/30)	100 (36/36)	100 (41/41)	100 (41/41)
NPV	86.5 (83/96)	92.2 (83/90)	97.6 (83/85)	97.6 (83/85)
Accuracy	89.7 (113/126)	94.4 (119/126)	99.4 (124/126)	99.4 (124/126)

*Data are presented as % (No./total). We considered inadequate samples as negative results.

종격종 림프절의 최대한의 정확도를 얻기 위해서는 3회의 흡인이 필요하고 tissue core를 획득한 경우는 2회의 흡인이 필요하다.

PET-CT

- 양전자방출, 동위원소: F-18 fluordeoxyglocose(FDG)
- 폐암세포는 정상세포보다 포도당흡수가 증가, 당분해(glycolysis)속도가 높다.
- PET-CT: CT 해부학적 구조(node size)
  + PET 기능적 구조(metabolism)
- Granulomatous lesion(tuberculoma, histoplasmosis, rheumatoid nodule), inflammatory disease에서 양성
- 크기가 1-1.2cm보다 작을경우 확인 안될 수도 있다.
  False (+) 20%, false (-) 20%
- Carcinoid tumor, bronchioloalveolar carcinoma: PET(-)
- PET detect unexpected distant meta in 10-15% NSCLC
  & unexpected mediastinal node meta in 10%
- 종격동 PET-CT(-): 술전 mediastinoscopy시행하지 않아도 됨. 양성인 경우는 invasive test(mediastinoscopy or EBUS) 필요

Mediastinal staging of lung cancer: novel concepts

Kurt G Tournoy, Steven M Keller, Jouke T Annema

Clinical TNM staging is the standard method used to decide treatment for patients with non-small-cell lung cancer. Although integrated fluorodeoxyglucose (FDG) PET CT increases the accuracy of staging, it only guides direct tissue sampling. Histological assessment of mediastinal lymph nodes has traditionally been done with mediastinoscopy, a surgical procedure. Endobronchial and oesophageal ultrasound-guided lymph node sampling have been assessed as additions or alternatives to mediastinoscopy. We review endosonography and surgical staging, and show that both have a place in the mediastinal staging of lung cancer. We conclude that mediastinal tissue staging should preferentially start with a complete endosonographic assessment. A surgical mediastinoscopy should be reserved for those in whom the endosonography result is negative. Further refinement of this recommendation is likely in the near future because data suggest that the confirmatory mediastinoscopy is particularly useful for patients with enlarged or FDG-avid lymph nodes.

Lancet Oncol 2012; 13: e225–29

Ghent University Hospital, Department of Respiratory Medicine and Thoracic Oncology, Ghent, Belgium (K G Tournoy MD); Albert Einstein College of Medicine, Thoracic Surgery Weiler Division, Bronx, New York, NY, USA (S M Keller MD); Leiden University Medical Center, Department of Pneumology, Leiden, The Netherlands (J T Annema MD)

	Design	Patients enrolled (n)	Received EUS-FNA and EBUS-TBNA (n)	Analysed (n)	N2 or N3 prevalence (%)	Sensitivity (%; 95% CI)	NPV (%; 95% CI)
Ohnishi,* 2011*	Cohort	120	115	110	28%	84% (67–93)	94% (87–97)
Annema,* 2010	RCT	242	123 (1 group)	123	54%	85% (74–92)	85% (75–92)
Hwangbo,* 2010†	Cohort	150	149	143	31%	91% (78–97)	96% (90–98)
Herth,* 2010†	Cohort	150	150	139	51%	96% (88–99)	96% (88–99)
Szlubowski,* 2010*	Cohort	120	120	120	23%	68% (48–84)	91% (83–96)
Wallace,* 2008	Cohort	138	138	138	30%	93% (81–99)	97% (91–99)
Rintoul,* 2005‡	Cohort	20	7	7	57%	75% (19–99)	75% (19–99)
Vilmann,* 2005‡	Cohort	33	31	28	71%	100% (83–100)	100% (63–100)

95% CIs were taken from the article, or if not provided, were calculated with binomial expansion. RCT=randomised controlled trial. NPV=negative predictive value. EUS-FNA=endoscopic ultrasound-guided fine-needle aspiration. EBUS-TBNA=endobronchial ultrasound with real-time-guided transbronchial needle aspiration. PET=positron emission tomography. CT=computed tomography. *Prevalence of malignant nodal metastasis was low because Ohnishi* included any clinical T<4N-M0 after imaging while Szlubowski* included only patients with normal mediastinal nodes (selected with CT, no PET CT available). †EUS-FNA and EBUS-TBNA done with a single (EBUS) endoscope. ‡Feasibility reports, not trials assessing test characteristics.

Table 1: Studies of complete endosonography to stage the mediastinum

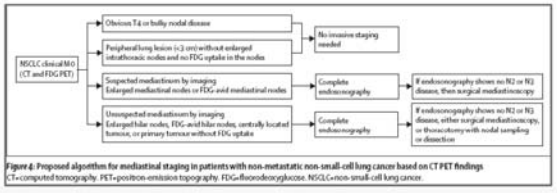


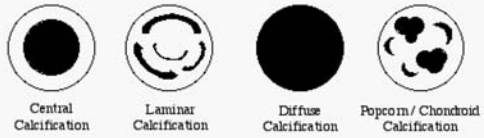
Figure 4: Proposed algorithm for mediastinal staging in patients with non-metastatic non-small-cell lung cancer based on CT PET findings
CT=computed tomography. PET=positron-emission topography. FDG=fluorodeoxyglucose. NSCLC=non-small-cell lung cancer.

Investigation and Management of Nodules Less than One Centimeter in Size

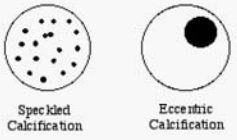
Benign vs Malignant

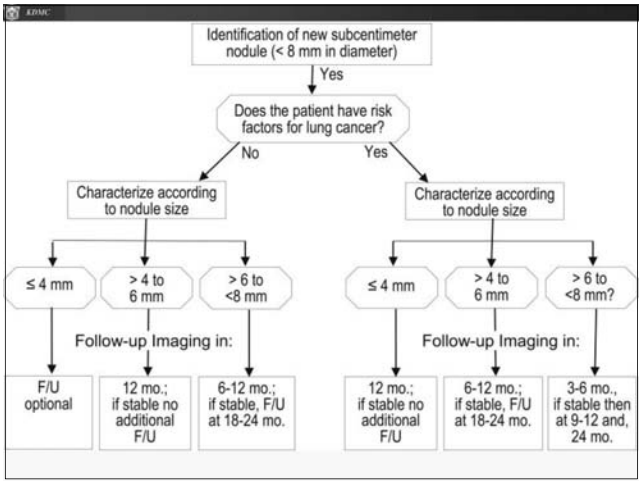
- **Most of pul. Nodules**
  - Postinflammatory change
  - Calcification is the most definitive finding for benign inflammatory lesion
- **Malignant**
  - Diffusely calcified nodule

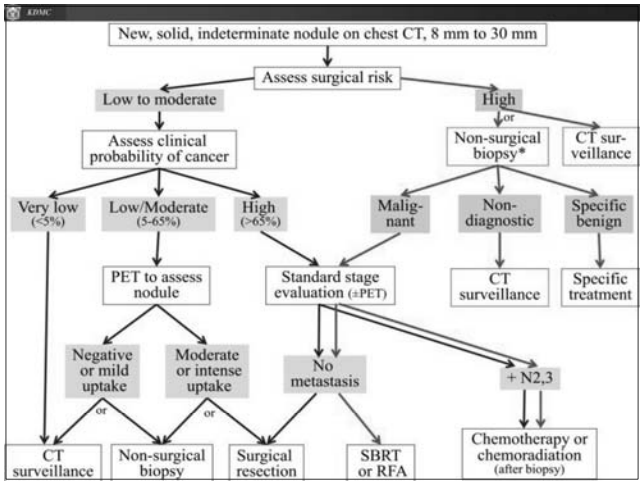
Benign SPN Calcification Patterns



Potentially Malignant SPN Calcification Patterns







Assessment Criteria	Probability of Malignancy		
	Low (< 5%)	Intermediate (5%- 65%)	High (> 65%)
Clinical factors alone (determined by clinical judgment and/or use of validated model)[a]	Young, less smoking, no prior cancer, smaller nodule size, regular margins, and/or non-upper-lobe location	Mixture of low and high probability features	Older, heavy smoking, prior cancer, larger size, irregular/spiculated margins, and/or upper-lobe location
FDG-PET scan results	Low-moderate clinical probability and low FDG-PET activity	Weak or moderate FDG-PET scan activity	Intensely hypermetabolic nodule
Nonsurgical biopsy results (bronchoscopy or TTNA)	Specific benign diagnosis	Nondiagnostic	Suspicious for malignancy
CT scan surveillance	Resolution or near-complete resolution, progressive or persistent decrease in size,[b] or no growth over ≥2 y (solid nodule) or ≥ 3-5 y (subsolid nodule)	NA	Clear evidence of growth

Definitive Diagnosis

- **CT-guided FNAB**
- **Transbronchial Bx**
- **VATS Bx with Marking tools**
  - Needle
  - Methylene blue
  - intraoperative ultrasound (gamma probe)
  - Technetium-99m (percutaneous or transbronchial)

Physiologic staging

- Age
- Pre-existing lung condition(lung function)
- Cardiovascular fitness
- Nutrition and performance status (recent weight loss)
- Smoking
- Obesity
- Patient attitude toward the disease

Age

- Perioperative morbidity increase with advancing age →preop careful assessment of co-morbid
- Clinically stage I, II over 70yrs: same with younger patients(beyond stage II, survival is very poor)
- In Stage I, over 80 is not contraindication to lobectomy
- Pneumonectomy is higher mortality risk(6-36%) in elder, Age should be a factor in deciding suitability for pneumonectomy

TABLE 2-1 Scales for Assessing Individual Performance Status

Grade	ECOG[1]	Score	Karnofsky[2]
0	Fully active, able to carry on all predisease performance without restriction	100 90	Normal, no complaints; no evidence of disease Able to carry on normal activity; minor signs or symptoms of disease
1	Restricted in physically strenuous activity but ambulatory and able to carry out work of a light or sedentary nature (e.g., light housework, office work)	80	Normal activity with effort; some signs or symptoms of disease
2	Ambulatory and capable of all self-care but unable to carry out any work activities; up and about more than 50% of waking hours	70 60	Cares for self; unable to carry on normal activity or to do active work Requires occasional assistance, but is able to care for most personal needs
3	Capable of only limited self-care; confined to bed or chair more than 50% of waking hours	50	Requires considerable assistance and frequent medical care
4	Completely disabled; cannot carry on any self-care; totally confined to bed or chair	40 30 20 10	Disabled; requires special care and assistance Severely disabled; hospital admission is indicated although death is not imminent Very sick; hospital admission necessary; active supportive treatment necessary Moribund; fatal processes progressing rapidly
5	Dead	0	Dead

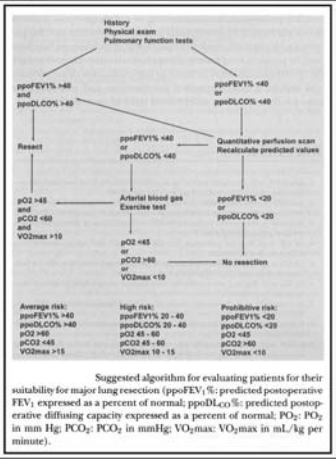
[1]Oken MM, Creech RH, Tormey DC, et al: Toxicity and response criteria of the Eastern Cooperative Oncology Group. Am J Clin Oncol 5:649-655, 1982.
[2]Hollen PJ, Gralla RJ, Kris MG, et al: Measurement of quality of life in patients with lung cancer in multicenter trials of new therapies. Cancer 73:2087-2098, 1994.

PFT

Poor resp function→perioperative morbidity/mortality
- postop long term disability
- poor quality of life

Additional test in poor, risk PFT test
- Ventilation/perfusion scan(ppoFEV1,ppoDLCO)
- VO_2max
- SaO_2 after exercise

3 most important predictors of severe pul complications: D_{LCO}, FEV1/FVC, A-aDO_2



Suggested algorithm for evaluating patients for their suitability for major lung resection (ppoFEV_1%: predicted postoperative FEV_1 expressed as a percent of normal; ppoDL_{CO}%: predicted postoperative diffusing capacity expressed as a percent of normal; PO_2: PO_2 in mm Hg; PCO_2: PCO_2 in mmHg; VO_2max: VO_2max in mL/kg per minute).

Low FEV1 postbrochodilator
Low DLCO postbronchodilator

↓

Quantative perfusion scan
ppoFEV1, ppoDLCO

↓

Exercise test
250m walking
Arterial blood gas/O2sat 감소

↓

Peak oxygen consumption test

Absolute contraindication for resection
- **ppoFEV1 < 0.8 L**
- **VO2max < 10ml/kg/min**
- **↑CO2(cor pulmonale) in pneumonectomy**

Cardiovascular Fitness

- All patients for lung resection should have preop ECG
- All patients with audible cardiac murmur should have echocardiogram
- After MI, operation for lung resection should not done within 6 weeks
- MI within 6 month, ask cardiology opinion
- CABG should not preclude lung resection
- Pt with significant lesion on coronary angiography should be considered for CABG before lung resection
- All patient with history of stroke, TIA, carotid bruits, should be assessed with carotid doppler

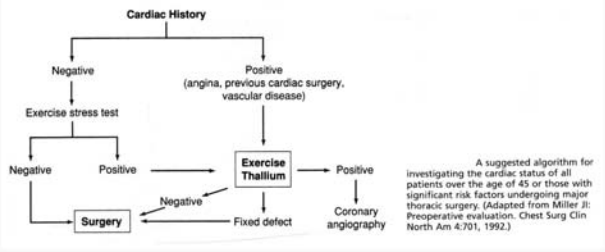
Cardiovascular Fitness

Table 3 Importance of multiple risk factors

Risk factors:	High risk surgery (includes intrathoracic) Ischaemic heart disease Congestive heart failure Insulin dependent diabetes Creatinine >177 μM/l
Number of factors*	Major cardiac complications**
1	1.1%
2	4.6%
⩾3	9.7%

*As intrathoracic surgery is classified as a risk factor, all patients undergoing surgery for lung cancer have at least one factor.
**Myocardial infarction, pulmonary oedema, ventricular fibrillation or primary cardiac arrest, complete heart block.

Cardiovascular Fitness



A suggested algorithm for investigating the cardiac status of all patients over the age of 45 or those with significant risk factors undergoing major thoracic surgery. (Adapted from Miller JI: Preoperative evaluation. Chest Surg Clin North Am 4:701, 1992.)

Weight loss, Performance status, Nutrition

- Patient with preop wt loss >10% or more
- And/or WHO 2 or worse→particular care staging assessment
- Measure of nutritional status(body mass index, serum albumin level)

DETERMINANTS OF POSTOPERATIVE MORBIDITY AND MORTALITY*

- Cardiac disease
- Pulmonary disease
- Tumor characteristics
  - Stage
  - Type
- General medical conditions
  - Diabetes
  - Creatinine level
  - Hemoglobin level
  - Serum albumin level
  - Immnosuppressed status
    - Steroids
    - Chemotherapy
    - Other chronic illnesses
  - Weight loss >10%
  - Age >70
- Anticipated surgery
- Extent of resection
- Additional procedures
- Side of pulmonary resection (R > L)
- Previous surgery

*Significant cardiopulmonary disease, late tumor stage, and extent of resection appear to be the most significant determinants.

Surgery for Lung Cancer

Yonsei University

Dae Joon Kim

[1] Role of surgery in cancer treatment

1. fundamental rules
2. R0 resection
3. incomplete resection
4. uncertain resection

[2] Pulmonary resection

1. types
2. techniques
3. selection of pulmonary resection

[3] Lymphatic drainage of the lung

1. basic drainage patterns
2. evolution of the lymph node map
3. systematic lymph node dissection vs. systematic lymph node sampling
4. techniques of lymph node dissection

[4] Surgical management based on the TNM stage

1. Surgery for stage I, II disease
2. Neoadjuvant therapy followed by surgery in stage III disease
3. NCCN guidelines

[5] Current issues on lung cancer surgery

1. GGO lesions
2. sublobar resection

폐암 수술 후 합병증

서울대학교 의과대학 흉부외과학교실

조 석 기

폐암은 각 병원마다 차이가 있을 수 있지만 흉부종양파트에서 가장 많이 시행하는 수술이다. 최근에는 흉강경 폐엽 절제술이 보편화되면서 수술 후 합병증의 빈도는 많이 감소하였지만, 반대로 고령의 환자가 늘면서 합병증 발생율은 크게 변화 없다. 수술 후 합병증은 수술 전 환자의 기저 질환과 복용 중인 약제, 수술 중 폐의 유착 정도, 혈관처리, 임파선 절제 범위 등에 따라 발생 빈도의 차이를 보일 수 있다. 합병증이 수술 후에 어느 정도는 발생할 수 밖에 없다면, 이를 조기에 발견하고 치료하며 예방할 수 있는 대책을 마련해야 할 것이다. 이 시간에는 폐암 수술 후 발생할 수 있는 다양한 합병증에 대해서 알아보고자 한다.

합병증의 발생으로 파생된 다량의 공기, 다량의 흉수, 염증, 신경 손상 등으로 나누어 보았다.

1. 다량의 공기
   1) Massive airleak, subcutaneous emphysema, dead space, pleurodesis
   2) Bronchopleural fistula
   3) Bronchial dehiscence
   4) Bronchial stenosis
2. 다량의 흉수
   1) Postoperative bleeding
   2) Chylothorax
   3) Empyema: postlobectomy, postpneumonectomy
3. 폐 실질의 문제
   1) Simple postoperative collapse
   2) Lobar torsion
   3) Postoperative pneumonia, acute lung injury, ARDS
4. 신경 손상
   1) Recurrent laryngeal nerve
   2) Phrenic nerve
   3) Vagus nerve
   4) Sympathetic nerve

이상의 합병증에 대한 임상 소견과 영상 소견을 숙지하고, 이를 확진 할 수 있는 최소한의 방법과 적절한 치료법을 결정하는데 최선을 다해야 한다.

【외상 파트】

좌장: 이석기

외상등록체계

부산대학교 의과대학 외상외과학교실

황 정 주

역 할

외상 환자의 일반적 데이터베이스 등록의 목적으로는 의료의 질 향상, 역학, 임상/연구 분야의 활용, 의료정책의 반영을 들 수 있다. 외상 환자의 등록은 1970년대 미국의 일부 외상 센터를 중심으로 외상 환자의 역학적 조사에서부터 시작되었으며, 1982년 이후부터 체계화된 National Trauma Data Bank (NTDB) 사업으로 확대되었다. 이 밖에 독일, 노르웨이, 스웨덴, 핀란드, 덴마크, 일본, 호주/뉴질랜드, 캐나다 등의 선진국과 중국, 파키스탄, 우간다 등 개발도상국까지 외상 데이터뱅크 시스템을 구축하고 있다.

1. 환자치료의 평가 및 개선

등록 데이터는 참여병원의 의료 행위를 비교할 수 있어 적정 치료 방침에 대한 정도 관리(quality control)에 유용한 도구를 제공한다. Jurkovich 등은 1987년부터 10년 동안 외상 시스템의 효용성에 대해 발표한 11개의 논문을 체계적으로 검증하였다. 검증된 논문들은 통합된 외상 데이터뱅크 시스템을 갖춘 병원과 그렇지 않은 병원에 대해 비교하였거나 한 병원에서 외상 데이터뱅크 시스템을 갖추기 전과 후를 비교한 논문이었다. 검증 결과 많은 논문에서 외상 데이터뱅크 시스템의 효용성이 높았다는 것을 주장하고 있었으나 연구 기관마다 시스템이 다르고, 데이터의 일관성이 부족하며, 비교 방법적인 한계가 있었음을 지적하였다. 따라서 통합적인 시스템이 필요하다고 할 수 있다. Nathens 등은 미국 31개 외상 센터의 데이터를 이용하여 외상 센터의 크기와 외상 환자의 치료 결과의 상관성을 조사하였다. 이 연구에서는 연간 650예 이상의 환자를 진료하는 외상 센터에서 사망률 감소와 평균 재원 기간 단축이 의미 있게 나왔다고 발표하였다. 외상 데이터뱅크 시스템을 갖추고 효율적인 데이터 관리와 그 결과를 임상에 적용하여 개선했을 때, 치료 결과의 호전이 있음을 의미한다고 볼 수 있다.

2. 부상 예방의 동기부여

외상 데이터뱅크 시스템을 운용하여 외상의 다양한 원인에 대한 자료를 충분히 모은다면, 자료의 홍보를 통하여 외상 방지를 할 수 있다. 외상 등록 데이터에는 외상의 기전과 수상 당시의 환경을 등록하도록 한다. 데이터를 잘 활용하면 유사한 유형의 외상 위험을 낮출 수 있다. 예를 들면, 자전거 도로에서 부상 예방을 위해 아스팔트를 우레탄으로 바꾸어 부상 지면의 환경을 개선하거나, 오토바이 주행시 헬멧의 착용, 법적 허용이 가능한 알코올 농도의 제한 등을 반영하도록 요구할 수 있다. 데이터가 축적되면 예방 활동 이전과 이후의 사망률과 후유증 발생률을 비교할 수도 있다.

3. 연구 분야 활용

외상 데이터 등록의 가장 큰 목적들 중의 하나는 연구 가설의 발전과 이에 대한 적용이다. 객관화되고 표준화된 데이터를 이용하여 발표되는 연구 논문은 치료의 가이드라인을 제공하여 새로운 치료 방법을 모색할 수 있도록 한다. 미국에서는 NTDB의 데이터를 이용한 논문의 이용이 2003년에 3편에서 2010년에 33편으로 증가하였고, 일본에서도 데이터뱅크 시스템을 도입한 이후에 데이터

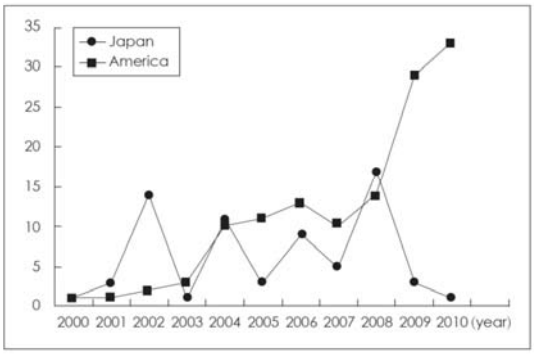


그림 1. 데이터 뱅크를 이용한 논문 발표.

베이스를 이용한 각 프로젝트가 끝나고 1~2년 이내에 이를 이용한 논문 발표가 증가하는 것을 알 수 있다 (그림 1)데이터뱅크에서 추출된 데이터는 논문에 활용되고, 새로운 가이드라인과 새로운 시도를 하는 데에 반영된다.

각국의 데이터뱅크 시스템과 역사

1. 미국의 데이터 뱅크 시스템

컴퓨터를 이용한 외상 데이터베이스의 시작은 1969년 시카고의 Cook hospital에서 시작되었다. 이 데이터베이스 시스템은 일리노이주의 외상환자 등록의 근간이 되어 1971년 50개의 외상 센터가 참여하는 시스템을 구축하게 되었다. 이후 규모가 확대되어 37개 주에서 여러 외상 센터가 참여하는 외상 등록으로 확대되었다. 초기의 등록 작업은 일관성이 부족한 데이터베이스였으며, 주로 외상 환자의 역학적 조사에 초점이 맞추어져 있었다. 주로 외상 환자의 치료 관점에서 의료의 질 향상을 위한 국가적 표준을 마련하는 것이 주목적이었다. 2008년에는 National Trauma Data Standard (NTDS)을 정하여 표준화된 데이터수집을 체계화하였으며, 지난 2013년 전체 814,663명의 환자가 등록되었으며, 한 개 병원당 약 986명을 등록하였고 전체 758개 병원이 참여하였다. 전체적인 사망환자 비율은 4.7%로 매우 낮은데 이는 매우 다수의 경증환자를 진료하고 있기 때문임. ISS가 9점 이상인 경우가 48%정도이다.

2. 일본의 데이터뱅크 시스템

일본에서는 일본외상외과학회와 일본응급의학회의 주도하에 외상 센터 방문 환자의 자료를 구축하고 있음. 2014년 234개 참여기관에서 자료를 수집하여 총 116,466명의 외상 환자가 등록되어 있다, 등록된 사례의 사망률은 10.1%에 달하였다(Japan Trauma Data Bank Report, 2014). 그러나 일본의 경우 ISS가 9점 이상인 경우가 77.9%로 중증도가 높고, 1급 구급구명센터에서만 외상을 치료하는 것이 아니기 때문에 이 자료시스템에 참여하지 않은 훨씬 많은 환자들의 자료가 체계적으로 누락되고 있다. 미국과 인구비례로 살펴보면 전체 인구는 미국이 3배인데, 외상센터 등록 자료는 1/10 정도만 환자수가 등록되고 있다. 따라서 이러한 병원기반 자료 등록시스템은 해당 병원을 제외한 환자가 체계적으로 누락된다는 문제가 있다고 하겠다.

3. 캐나다 데이터뱅크 시스템

캐나다에서는 Canadian Institute for Health Information (CIHI)을 통해 표준화된 국가 외상 등록체계(National Trauma Registry, NTR) (CIHI 2013)를 운영하며 이를 통해 연간 보고서를 발간하고 있다. 이 감시체계는 International Classification of Disease (ICD)체계상 손상의 외인 코드에 해당하고 손상의 중증도를 평가하였을 때 Injury Severity Score (ISS)가 12점을 넘은 환자 중 병원에 입원하였거나, 입원하지 않았어도 해당병원의 응급실에서 치료를 받았거나, 응급실에서 치료를 시작한 후에 사망한 환자를 대상으로 하여 중증의 손상환자를 주요한 대상으로 삼고 있다. 손상의 중증도와 관련된 항목은 Predot injury Codes,

그림 2. KTDB 추진도.

Severity Codes and ISS Body Regions, MAIS Code by ISS Body Region, Injury Severity Score가 있다.

4. 한국의 데이터뱅크 시스템

국내 외상등록체계는 미국 NTDB를 응용한 2012년 KTDB를 개발하여 2013년부터 기선정된 외상센터를 중심으로 등록사업을 시행하고 있다. 하지만 아직 데이터 결과 보고 및 질관리가 되고 있지 않다. 코드기준은 증상(UMLS 코드), 처치/수술(EDI 표준수가코드), 진단(KCD-6th) AIS(update 2008)를 사용하고 있다.

5. 기타 선진국 및 개발도상국에서의 데이터뱅크 시스템

국제적으로, 많은 수의 국가들이 인구학적 근거에 기초한 국가 외상환자 등록 사업을 추진하고 있다. 북유럽 국가 가운데 노르웨이는 Norwegian National Trauma Registry, 스웨덴에는 Swedish Trauma Registry Standard (KVIT-TRA), 핀란드에는 TOOLO, 덴마크에는 Odense와 같은 등록 시스템이 있으며, 독일에는 Trauma Registry of the German Society for Trauma Surgery, 호주와 뉴질랜드에는 National Trauma Registry Consortium 등이 있다.

개발도상국에서의 외상 환자 등록은 전무하거나 만약 있더라도 원시적이고 불완전한 데이터가 대부분이다. 대부분의 데이터는 외상 환자에 대한 역학적인 데이터로서 기억에 의존하는 후향적 수집이며, 외상 정도에 대한 정보가 부정확하다. 비용이 많이 들고 제대로 된 숙련된 기술 인력이 부족하기 때문에, 제대로 된 데이터뱅크 디자인은 매우 어려운 실정이다. 파키스탄에서는 외상 환자의 입원시마다 Trauma and Injury Severity Scoring (TRISS)를 이용하여 생존 예측을 할 수 있는 소프트웨어를 통해 환자를 등록하고 있다. 우간다에서는 19가지의 아이템을 포함하는 비교적 간단한 형태의 데이터 등록을 시행하고 있다. 등록에 필요한 내용은 한 페이지 분량으로 적은 데이터이지만 역학, 외상의 원인, 치료 후 결과를 모두 포함하고 있다. 외상 환자 등록 사업을 추진하는 데에 많은 어려움과 방해 요인이 있지만, 개발도상국 일부 국가에서는 이를 활용하여 향상된 임상 결과를 제공하고, 외상을 예방하는 데에 적극적으로 활용할 수 있는 데이터를 수집하여 성공하고 있다.

손상척도 분류 체계

현재 각국에서는 대부분 AIS (abbreviated injury scale)을 외상등록의 기본분류 체계로 하여 등록을 시행하고 있다(표 1). 앞으로 다양한 중등도 평가 지표를 살펴보고자 하나 주로 AIS에 대해 설명하고자 한다.

1. 생리학적 지표

생리학적 지표로는 환자의 의식상태를 평가하는 데 널리 사용되는 Glasgow Coma Scale (GCS), 수축기 혈압과 호흡수, GCS를 이용한 Revised Trauma Score (RTS), circulation, respiration, abdominal/thoracic, motor, speech (CRAMS) scale과 중환자실에서 환자 평가에 주로 사용되는 Acute Physiologic and Chronic Health Evaluation (APACHE) 등이 있다.

표 1. 각국의 외상 분류체계

지역	국가(주)	종류	개소(년)	자금	데이터 등록방법	AIS	항목수
아시아	일본	국내	2004	참가비, 조성금	홈페이지	AIS98	92
	말레이시아	국내	2006	정부	등록용지, 홈페이지	불명확	36
	UAE	국내	2003	불명확	홈페이지	불명확	100
	이스라엘	국내	1995	불명확	홈페이지	불명확	300
북미	미국	국내	1993	정부, 학회, 데이터 이용료	데이터 전송	AIS80～AIS2005	107
	캐나다	국내	1997	정부	데이터 전송	AIS90 (～2012.3) AI2005 (2012.4～)	46
유럽	영국	국내	1989	참가비	홈페이지	AIS98 (2009.5) AIS2005 (2009.6～)	250+
	독일	국내	1993	조성금	등록용지, 홈페이지, 데이터 전송	AIS98, AI2005	287
	그리스	국내	2005	학회	불명확	불명확	150
	프랑스	국내	1995	불명확	등록용지	AIS90	23
	이탈리아	국내	2004	정부	홈페이지	AIS98 (～2008) AIS2008 (2008～)	110～130
	Euro TARN	다국간	2002	국제협력	데이터전송	불명확	237
오세아니아	빅토리아주	주	2001	정부, 데이터 이용료	홈페이지	AIS98 (～2010.6) AIS2008 (2010.7～)	36
	뉴사우스웨일즈주	주	2002	정부	홈페이지	AIS98 (～2007.6) AIS2005 (2007.7～2009)	>32
	퀸즈랜드주	주	1998	정부, 보험공사, 대학	홈페이지	AIS90 (1998～2008) AIS2008 (2009～)	97
	남오스트레일리아주	주	1994	정부, 대학	등록용지	AIS98	95

1) GCS

GCS는 두부외상환자의 신경학적 평가를 정확하고도 간편하게 행하기 위해 Jannett 등이 발표한 기준이다. 개안, 통증자극으로 인한 사지의 반응 및 언어기능의 3대항목이 각각 4 (4 : 자발적 개안, 3 : 부르는 소리에 개안, 2 : 통증자극시 개안 1 : 개안하지 않음, 6 (6 : 자발적, 5 : 동통부위 인식가능, 4 : 도피굴곡가능, 3 : 이상굴곡반응, 2 : 사지진전반응, 1 : 전혀 움직이지 않음) 및 5 (5 : 대화가 가능 4 : 회화혼란, 3 : 언어혼란, 2 : 이해할 수 없는 신음소리, 1 : 없음) 단계로 수치화되고 합계점수(만점 : 15)로 환자의 상태를 평가할 수가 있다. GCS는 환자의 예후판정에 유용하고 7이하는 예후불량이라는 보고가 많다.

2) Revised Trauma Score (RTS)

RTS는 호흡수, 수축기 혈압, Glasgow coma scale 이상 3개의 생리학적 임상지표를 사용한다. 각각 0-4점까지 점수로 구분하며 0-12점까지로 구분하며 11점 이하인 경우는 적절한 병원으로 이송이 필요하다고 할 수 있다.

revised trauma score=(points for respiratory rate)
+(points for systolic blood pressure)
+(points for Glasgow coma score)

코드화된 RTS는 다음과 같이 계산할 수 있다.

$$RTSc = 0.9368\ GCSc + 0.7326\ SBPc + 0.2908\ RRc$$

표 2. Revised trauma score

Parameter	Finding	Points
Respiratory rate	10-29 per minute	4
	＞29 per minute	3
	6-9 per minute	2
	1-5 per minute	1
	0	0
Systolic blood pressure	＞89 mm Hg	4
	76-89 mm Hg	3
	50-75 mm Hg	2
	1-49 mm Hg	1
	0	0
Glasgow Coma Score	13-15	4
	9-12	3
	6-8	2
	4-5	1
	3	0

표 3. Injury severity

Injury Severity	Abbreviated Injury Score
Minor injury	1
Moderate injury	2
Severe but not life-threatening	3
Potentially life-threatening but survival likely	4
Critical with uncertain survival	5
Unsurvival	6

나머지 생리학적 지표는 외상에서 잘 사용하지 않으므로 생략한다.

2. 해부학적 지표

해부학적 손상지표로는 국제질병분류(International Clas sification of Disease; ICD)와 1950년대에 처음 개발되어 신체부위별로 손상의 중증도를 점수화한 목록으로 이루어진 Abbreviated Injury Scale(AIS), AIS의 신체부위별 점수를 이용한 Injury Severity Score (ISS), Anatomic Profile 등이 있다.

1) Injury Severity Score (ISS)

Abbreviated injury scale (AIS)은 신체부위별로 발생하는 수 백가지의 손상을 각각 점수를 매겨 평가하는 것으로, minor 1점, moderate 2점, serious 3점, severe 4점, critical 5점, maximum 6점의 점수를 매겨 환자의 손상을 구분하고 있다. AIS가 각각의 신체손상에 대한 평가라면, ISS는 다발성 외상시 신체부위별 손상 정도를 총괄하여 해부학적인 중증도를 평가하는 지표이다. 신체부위를 두부 및 경부, 안면부, 흉부, 복부 및 골반강, 사지 및 골반, 그리고 외부(열상, 화상)의 6부위로 나누고 손상 정도를 점수화하여(AIS: 1-5점) 손상이 큰 부위로부터 세 곳의 제곱을 더하여 산출하여 계산하며 점수의 범위는 1점부터 75점까지 얻을 수 있다. 외상환자 사망률 평가방법론으로 가장 널리 사용되는 것 중의 하나이며 일반적으로 ISS 점수 15 이상을 중증 외상 환자

환자라고 간주한다.

$$ISS = AIS\ (1)^2 + AIS(2)^2 + AIS(3)^2$$

3. 생리, 해부지표의 병합된 사망예측 평가법

1) Trauma and Injury Severity Score(TRISS)

외상환자의 중증도를 평가하는 데 있어서 생리학적인 지표와 해부학적 손상지표를 한꺼번에 이용하여야 한다는 것이 일반적인 견해이다. 이러한 개념에 입각한 대표적인 사망률 평가방법론이 TRISS와 A Severity Characterization of Trauma (ASCOT)이다. 1982년에서 1989년에 걸쳐 160개 이상의 병원이 제출한 17만명 이상의 중증외상환자에 대한 자료를 이용한 대규모 외상환자 사망률에 대한 연구인 MTOS가 시행되었다. 이 연구는 중증도를 평가하는 방법론을 보다 정교하게 하고, 외상환자 진료의 국가적인 표준을 설정하며, 이를 이용하여 개별 의료기관의 질적 수준을 평가할 수 있는 객관적인 자료를 제공하는 것을 가능하게 하였다. 이 연구에서 이용된 방법론이 바로 TRISS이다. 1981년에 처음 도입된 TRISS는 후향적으로 외상환자 생존확률을 산출하는 가장 대표적인 방법론으로 북미에서 외상환자등록사업에서 사용되고 있다.

TRISS는 손상기전을 기준으로 둔상(blunt injury)과 관통상(penetrating injury)으로 구분 하고, 각각의 환자군에 대하여 ISS와 RTS, 연령 변수를 이용한 로짓회귀 분석모형(logistic regression model)을 구축함으로써 외상환자의 생존확률을 예측하는 도구이다. 사망률 예측도구의 타당도는 민감도, 특이도, 차이(disparity) 등으로 평가될 수 있는데, 이 도구의 예측도는 매우 훌륭한 것으로 나타났다. MTOS의 연구결과 둔상에서는 민감도 64.3%, 특이도99.1%, 차이 0.614로 나타났고, 관통상의 경우 민감도 84.2%, 특이도98.7%, 차이 0.810으로 나타났다. TRISS에 의한 외상환자 생존확률은 아래 식에 의하여 계산된다. 동일한 중증도의 외상에 있어서 환자의 연령이 55세 이상인 경우 사망확률이 더 높기 때문에, 아래 식에서 55세 이상인 경우는 AGE=1이 되고, 55세미만인 경우는 AGE=0이 된다. 북미에서 외상환자 진료의 질적 수준에 대한 국가적인 표준(norm)을 설정하기 위하여 수행되었던 MTOS의 각 변수별 회귀계수는 다음과 같다.

$$Ps = 1/(1+e^{-b})$$

$$b = b0 + b1(RTS) + b2(ISS) + b3(AGE)$$

2) ICD-9 based Injury Severity Score(ICISS)

TRISS나 ASCOT와 같은 방법론을 적용하기 위해서는 AIS의 목록에 의거하여 손상을 기술해야 하기 때문에, 외상환자등록체계와 같은 별도의 자료수집체계를 갖추어야 한다. 그런데 이러한 자료수집체계를 갖추기 위해서는 많은 노력과 비용이 소요되기 때문에, 전국적인 수준에서 많은 의료기관을 대상으로 적용되기 곤란하다는 문제점이 지적되어 왔다. 외상환자 등록체계가 가장 발달되어있는 미국에서조차도 이러한 자료수집체계는 일반화되어 있지 못하다. 미국 전체 50개 주 중 24개 주에서만 외상환자등록체계를 갖추고 있으며, 전체 외상환자의 20% 미만에서만 진료과정에 대한 평가가 이루어지고 있고, 영국과 호주, 뉴질랜드 등에서도 소수의 병원에서만 연구의 목적으로 운영되고 있다. 그러나 최근 들어 병원에서 일상적으로 생성되는 퇴원요약자료(discharge abstract)의 ICD-9코드를 활용하여 외상환자의 중증도를 평가하기 위한 시도가 이루어져 왔다. 그 중 가장 뛰어난 성과를 보이고 있는 것은 Osler 등이 개발한 ICISS이다. ICISS는 기존의 퇴원환자 자료를 이용하여 특정 상병을 가진 환자의 기대생존확률(survival risk ratio; SRR)을 경험적으로 계산해낸 것이다. 경험적인 외상환자 데이터베이스에 계산된 기대생존확률은 0에서 1 사이의 값을 갖는데, 중증도가 낮은 손상은 높은 생존확률 값을 갖고, 중증도가 높은 손상은 낮은 생존확률 값을 갖는 것이다. Osler 등의 연구에서는 ICISS가 ISS에 비하여 더 나은 성적을 나타냈고, ICISS에 연령, 손상기전, RTS를 추가하였을 때는 TRISS보다 우수한 예측 타당도를 나타냈다. 이러한 방법론을 이용한 ICISS에서는 별도의 자료수집체계가 필요 없기 때문에 큰 비용을 들이지 않고도 많은 의료기관을 대상으로 외상환자 진료성과에 대한 평가가 가능하다는 것이 가장 큰 장점이다. 그 밖에도 ICISS에서는 특정 환자의 생존확률이 그 환자의 여러 손상의 개별 생존위험확률의 곱으로 표현되는데, 이는 기존의 ISS에서 중증도를 평가하는 사용되었던 손상의 수를 3개로 제한하였던 문제를 극복한 것으로 보인다. 즉, ISS가 다발성손상의 중증도를 평가하는데 있어서 안고 있었던 문제를 어느

정도 해결한 것이다. 또한 이와 마찬가지로 외상환자에서 이전에 지니고 있는 다른 질환의 생존확률에 대한 영향을 고려할 수 있다는 장점을 지니고 있다.

ICISS=SRRinj(1)×SRRinj(2)……×SRRinj(10) ICISS full model은 기존 ICISS에 RTS를 추가한 것으로 계산식은 다음과 같다.

$$Ps=1/(1+e-b)$$

$$b=b0+b1(RTS)+b2(ICISS)+b3(Age\ Index)$$

외상 데이터뱅크 시스템의 구축

1. 데이터뱅크 시스템 구축을 위한 핵심요소

효율적인 외상 데이터뱅크 시스템을 구축하기 위한 필요한 핵심 요소로는 1) 연구계획의 수립 2) 포함/제외 기준의 설정 3) 수집자료의 변수 결정 4) 등록 소프트웨어 5) 입력요원의 선정과 교육 6) 자료를 관리하는 전략을 들 수 있다. 이러한 외상 데이터뱅크 시스템의 각 요소를 잘 이해하는 것은 매우 중요하며, 데이터뱅크 시스템을 발전시키고 적용하는 데에 반드시 고려해야 한다.

2. 연구계획의 수립(Study design)

데이터 수집의 목적과 향후의 활용을 어떻게 할 것인가에 따라 데이터뱅크의 규모와 데이터 범주가 달라질 수 있다. 단일 기관이나 지역 단위의 기관이 참여할지 국가적인 규모에서 할지 참가의 범위를 설정해야 한다. 세계 각국에서 추진하고 있는 데이터뱅크 시스템에는 참여병원의 범위와 포함 기준/제외 기준을 명확하게 명시하고 있다 데이터 수집을 하기 이전에 미리 연구의 목적과 목표를 설정하고 계획된 연구의 방법을 포함하는 프로토콜을 만들어야 한다. 이러한 프로토콜에는 1) 연구의 목적과 포함/제외 기준 명시 2) 각 변수의 명확한 정의 3) 숙련된 데이터 수집 및 입력 요원의 확보 4) 표준화된 데이터 수집 방법 및 서식 5) 데이터뱅크 위원회의 정기적인 모임을 통한 데이터 운영의 문제 도출 및 해결 6) 데이터의 지속적인 모니터링과 관리가 포함되어 있어야 한다.

3. 포함/제외 기준의 결정

모든 외상 환자의 등록 시스템은 포함 기준(inclusion criteria)과 제외 기준(exclusion criteria)을 명확히 하고 있다. 좋은 데이터를 얻기 위한 연구의 목적이 뚜렷하다면 기준을 잘 정의하여야 한다. 캐나다의 등록된 외상 환자 6,839명 중 포함 기준을 만족하지 못해 등록에서 제외된 환자를 분석하였는데, 포함 기준을 Injury Severity Score (ISS) 15점으로 높게 적용한 치료 제외 환자에서 사망률 및 요양 기간 재활 치료의 비율이 높았음을 보고하였다.

4. 데이터 변수의 결정

미국 외상 데이터뱅크의 데이터 변수에서는 환자 정보(demographic information)와 외상 기전에 대한 변수로서 자동차, 자전거, 오토바이, 보행자 사고와 같은 교통 사고의 종류와 낙상 사고도 낙상 높이와 바닥의 상태를 자세히 기술하며, 스포츠 손상도 운동의 종류, 충돌의 종류, 창상 및 관통상 여부를 기술한다. 치료의 종류 및 경과, International Classification of Disease (ICD-9)를 이용한 임상적 진단 분류, 재원 기간, 합병증 및 사망률도 변수로서 기술하도록 하고 있다. 또한 부상의 정도 [abbreviated injury scores (AIS)], 치료비용, 치료 부담의 주체, 추적 관찰 결과 등도 변수에 포함하고 있다.

데이터 변수의 각 아이템에는 데이터화하기 편리하도록 주관적인 표현이나 숫자로 등급을 표시하게 되는 경우가 많다. 약물치료의 반응 정도를 "Excellent/Good/ Fair/Poor"로 나눈다면 각 단계의 정의가 명확해야 한다. 참여 기관마다 외상 환자 등록에 관한 변수를 어떻게 정의하는가에 따라 다양하게 해석할 수 있으므로 명확히 할 필요가 있다. 수상 시간을 표시할 때에도 분 단위로 할지 시 단위로 할지를 명확하게 정의해야 한다. 재원 기간의 경우에도 날짜로 표현하거나 시간으로 표현할 수 있다. 수술의 방법과 치료 약물의 용량, 사용 방법이 병원마다 다양하므로 이를 표준화하는 것은 어려운 과정이 될 수 있다.

빠른 데이터 수집과 결과의 도출을 위해서는 수상 기전, 치료와 환자의 치료 결과를 객관적으로 부호화해야 한다. 이 부호화는

서로 통용이 가능하고 쉽게 비교할 수 있도록 일반화해야 한다. 미국의 NTDS는 데이터 변수와 반응 정도를 부호화하도록 하고 있다. 외상 환자의 최초 수상 정도의 평가에는 Glasgow Coma Score, Revised Trauma Score, ISS가 활용된다. 생존 가능성을 예측하는 평가로는 TRISS가 사용되며, 국가 간 데이터의 비교를 할 때 유용하다

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Trauma Education Program

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이 석 기

2012년부터 보건복지부는 외상으로 인한 사망자 중 적정 진료를 받았을 경우 생존할 것으로 판단되는 사망자의 비율인 '예방가능 사망률'을 권역외상센터 설치지원사업을 통해 현재 35.2%인 을 2020년까지 선진국 수준인 20% 미만으로 낮춘다는 목표로 5개 '권역외상센터' 시작하여 연차적으로 2017년까지 권역 별로 17개 운영할 예정으로 점차적으로 중증외상환자가 전국 어디서나 1시간 이내 적절한 치료가 가능하도록 할 것이다. 중증외상에 대한 신속하고 적절한 처치를 위한 외상외과의로서 좀 더 적극적 역할이 요구되고 있다. 이를 위하여 'Trauma Education Program'이 각 권역외상센터뿐만 아니라 전세계적으로 개발되어 시행하고 있다. 현재 시행되고 있는 대표적인 프로그램들은 아래와 같다.

In American College of Surgeons Committee on Trauma (ACS COT)

- ATLS (Advanced Trauma Life Support)
- TEAM (Trauma Evaluation and Management)
- ATOM (Advanced Trauma Operative Management) : Animal Lab

Introduction and Trauma Laparotomy: Cardiovascular, Pancreatic Injury and Duodenal, Hepatic Injury, Genitourological and Spleen and Diaphragmatic Injury

- RTTDC (Rural Trauma Team Development Course)
- DMEP (Disaster Management and Emergency Preparedness)
- ASSET (Advanced Surgical Skills for Exposure in Trauma)
- Advanced Trauma Operative Management (ATOM
- Advanced Surgical Skills for Exposure in Trauma (ASSET) :

- Definite Surgical Trauma Care (DSTC): Case discussion & Animal Lab

Trauma laparotomy, damage control, trauma to the neck, thoracic injury, trauma to the liver, trauma to the spleen, trauma to the pancreas and duodenum, urological trauma, Craniofacial trauma, Extremity injury, Pelvic trauma, interventional radiology, burns and escharotomy and so on.

- Essential Surgical Procedures in Trauma (ESPIT) : KARPET(외상술기교육연구회: Korean Association for Research, Procedures, and Education on Trauma) : 2014

Airway, abdomen, chest and E-FAST

: BESPIT (Basic Essential Surgical Procedures in Trauma)

- Korean Trauma Assessment and Treatment course (KTAT) : 한국형 전문외상처치술

Trauma Education Program (외상외과 세부전문의 수련지침)

1. 수련 목표

- 외상외과 세부전문의 수련과정에 있는 전임의는 수련기간 동안 외상환자에 대한 초기 소생술과 치료 및 임상적 판단에 필요한 지식과 술기를 습득한다.
- 외상외과 세부전문의로서 외상환자에 대한 최종치료를 담당하는 능력을 함양하고, 여러 전문 분야가 어우러진 외상팀을 이끌어 가는데 필요한 지도력을 계발한다.
- 외상에 관련된 임상연구 및 논문 집필에 참여하고, 외상에 관련된 여러가지 교육 프로그램에 참여하며, 외상전문센터 발전을 위한 표준화 지침서 개발을 위해 노력한다.

2. 수련 내용

외상외과 세부전문의 수련은 외상전문센터에서 지정한 외상 관련분야에 대한 순환근 무 형태로 이루어지며, 중환자치료 및 각 분야의 집담회, 응급수술, 정규수술 등에 참 여할 수 있도록 한다.

타과 수련 시 수술기법과 환자 치료과정에 충분히 참가할 수 있어야 하며, 이러한 경험을 바탕으로 외상환자 치료에 필요한 필수술기를 습득하여 실제 상황에 적용할 수 있도록 한다.

3. 수련 일정

전문의	외상외과	외과	흉부외과	신경외과	정형외과	기타	방사선중재술	선택
외과	12	3	1	1	1		1	
흉부외과	12	1	3	1	1		1	
신경외과	4	1	1	12	1			
정형외과	4	1	1	1	12			
기타외과	4	1	1	1	1	12		

4. 수련 내용(외과, 흉부외과 전문과목 전임의 기준)

1) 전임의 1년차

진료

50명 이상의 중환자 진료 및 연관된 필수술기 습득

30명 이상의 병동환자 진료 참여

50례 이상의 외상환자 수술 참여

파견과와 연관된 플수 술기 습득

야간 외상 당직

학술

외상 및 중환자의학 강의 참여

외상관련학회: 연2회 이상 참여

논문집담회 참여

외상 증례집담회 참여

학회발표: 연1회 이상

한국형 전문외상처치술(KTAT, Korean Trauma Assessment and Treatment course) 이수

2) 전임의 2년차

진료

50명 이상의 중환자 진료 및 연관된 필수술기 습득

30명 이상의 병동환자 진료 참여

50례 이상 외상환자 수술 참여

파견과와 연관된 필수 술기 습득

야간 외상 당직

학술

외상관련학회: 연2회 이상 참석

논문집담회 참여

외상 증례집담회 참여

학회발표: 연1회 이상

외상기본수술술기(ESPIT, Essential Surgical Procedures in Trauma) 이수

연구

: 2년의 수련기간 동안 대한외상학회지에 제1저자로서 원저 1편, 또는 증례 2편 이상 게재를 최소 기준으로 함

4. 필수 술기

외과 흉부외과 전문과목 전임의는 참여 또는 참관, 신경, 정형, 기타외과 전문과목 전임의는 참관

부위	시술 및 수술	필수	선택	확인란
기도	윤상갑상연골절개	o		
	기관삽관술(비강 및 구강)	o		
	기관절개술(수술적 및 경피적)	o		
두부	두개내압의 조절 및 치료	o		
	두피 봉합술	o		
	급성 척수 손상에 대한 치료	o		
	보호대(brace) 적용 판단	o		
안면부	복잡 안면 골절 출혈에 대한 압박지혈술	o		
경부	인후두손상에 대한 접근, 치료	o		
흉부	기관지 내시경(진단적 및 치료적 목적)	o		
	흉강 삽관 및 흉관 관리	o		
	개흉술(thoracotomy, sternotomy)	o		
	심낭절개술(pericardiostomy or pericardiotomy)	o		
	기관-기관지 또는 폐 손상에 대한 수술적 치료	o		
	식도손상에 대한 수술적 치료	o		
	횡경막손상에 대한 수술적 치료	o		
	흉부 혈관손상에 대한 손상 통제수술	o		
	늑골/동요흉/흉골 골절 고정술	o		
	체외막순환 운용(ECMO)	o		
	둔적흉부대동맥손상에 대한 수술적치료		o	
복부	초음파(진단적 및 치료적)	o		
	복부구획증후군 치료	o		
	위루술, 공장루술 및 대장루	o		
	손상통제수술	o		
	위, 소장 및 대장 손상에 대한 치료	o		
	십이지장손상에 대한 치료	o		

	췌장손상에 대한 치료	o	
	간손상에 대한 치료	o	
	비장손상에 대한 치료	o	
	직장항문손상에 대한 치료	o	
	주요 복부과 골반 혈관 손상에 대한 치료	o	
	괴사 조직제거에 따른 복벽 재건술	o	
사지	골절 부목	o	
	탈구 정복술	o	
	골반 골절의 밴드 고정술	o	
	근막 절개술(하지)	o	
	탈구 줄임 괴사성 연부 조직에 대한 근치적 제거	o	
	골반 골절 외고정술		o

【중환자 파트】

좌장: 이석기

흉부외과 의사가 바라본 패혈증의 진단과 치료

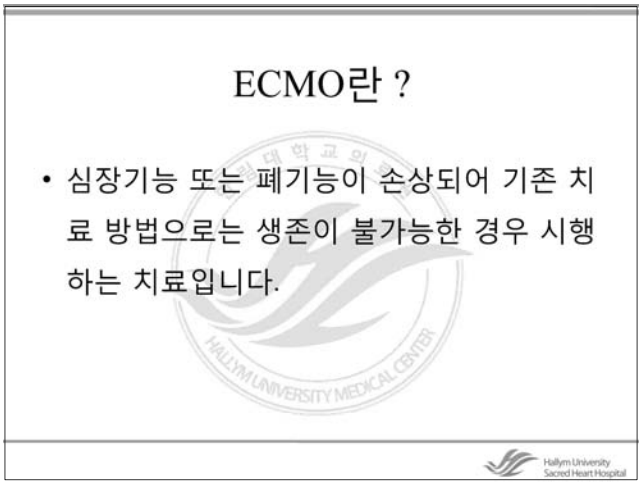
서울대학교 의과대학 흉부외과학교실

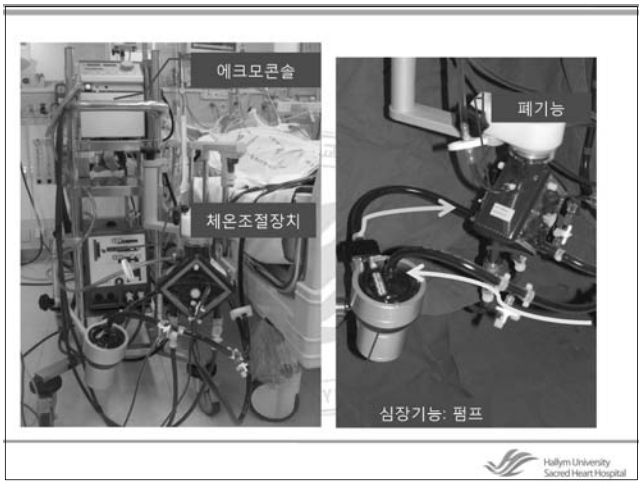
김 동 중

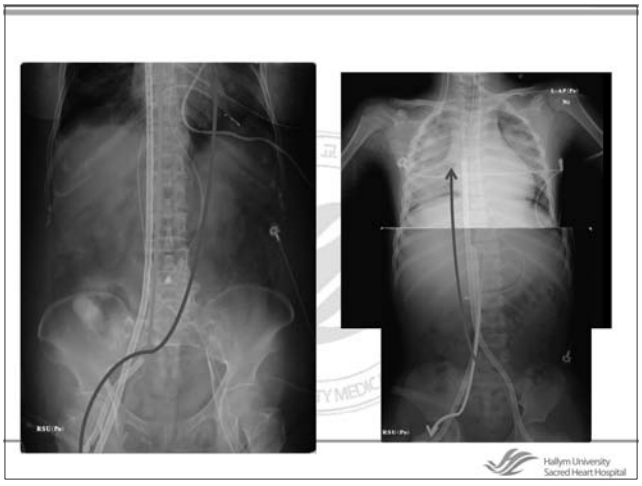
전공의를 위한 시골 의사의 ECMO 길라잡이

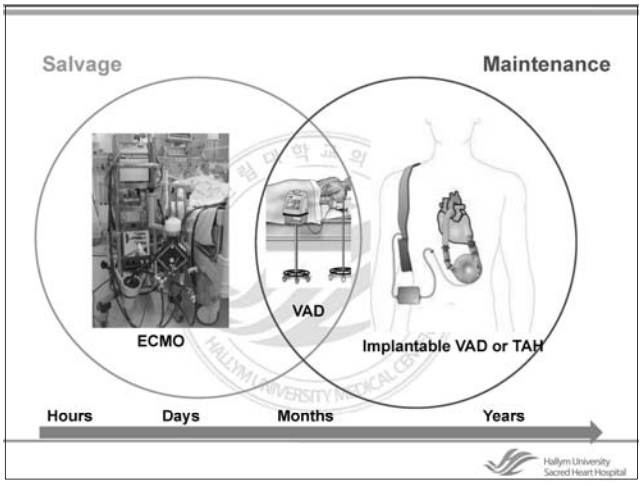
한림대학교 성심병원 흉부외과, ECMO 센터장

김 형 수









http://www.elsonet.org/index.php?option=com_phocadownload&view=category&id=4&Itemid=627

Extracorporeal Life Support Organization (ELSO)

General Guidelines for all ECLS Cases

ELSO Guidelines Version 1.3 November 2013

Hallym University Sacred Heart Hospital

ECLS is the use of mechanical devices to temporarily (days to months) support heart or lung function (partially or totally) during cardiopulmonary failure, leading to organ recovery or replacement.

I. Patient condition

A. Indications

Acute severe heart or lung failure with high mortality risk despite optimal conventional therapy. ECLS is considered at 50% mortality risk. ECLS is indicated in most circumstances at 80% mortality risk. Severity of illness and mortality risk is measured as precisely as possible using measurements for the appropriate age group and organ failure. See patient- specific protocols for details.

B. Contraindications

Most contraindications are relative, balancing the risks of the procedure (including the risk of using valuable resources which could be used for others) vs. the potential benefits. The relative contraindications are: 1) conditions incompatible with normal life if the patient recovers; 2) preexisting conditions which affect the quality of life (CNS status, end stage malignancy, risk of systemic bleeding with anticoagulation); 3) age and size of patient; 4) futility: patients who are too sick, have been on conventional therapy too long, or have a fatal diagnosis. See patient-specific protocols for details.

C. Specific patient considerations

See patient-specific protocols

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Extracorporeal Life Support Organization (ELSO)

Guidelines for Adult Cardiac Failure

ELSO Adult Cardiac Failure Supplement to the ELSO General Guidelines

Version 1.3 December 2013 Page 1

Hallym University Sacred Heart Hospital

A. Indication for ECMO in adult cardiac failure is cardiogenic shock:

1. Inadequate tissue perfusion manifested as hypotension and low cardiac output despite adequate intravascular volume.

2. Shock persists despite volume administration, inotropes and vasoconstrictors, and intraaortic balloon counterpulsation if appropriate.

3. Typical causes: Acute myocardial infarction, Myocarditis, Peripartum Cardiomyopathy, Decompensated chronic heart failure, Post cardiotomy shock.

4. Septic Shock is an indication in some centers.

Guidelines on relative survival without ECMO:
IABP score postcardiotomy(Hausmann H Circ 2002)
Samuels score postcardiotomy (Samuels LE J Cardiac Surg 1999)
Options for temporary circulatory support
Surgical temporary VAD: Abiomed, Levitronix
Percutaneous VAD:TandemHeart, Impella

ECMO: Advantages: Biventricular support, bedside immediate application, oxygenation, Biventricular failure, Refractory malignant arrythmias, Heart failure with severe pulmonary failure
ECMO is a bridge to…
Recovery: Acute MI after revascularization, Myocarditis, Postcardiotomy
Transplant: Unrevascularizable acute MI, Chronic heart failure
Implantable circulatory support: VAD, TAH

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B. Contraindications to ECMO

1. Absolute: Unrecoverable heart and not a candidate for transplant or VAD, Advanced age, Chronic organ dysfunction (emphysema, cirrhosis, renal failure), Compliance (financial, cognitive, psychiatric, or social limitations), Prolonged CPR without adequate tissue perfusion.

2. Relative: Contraindication for anticoagulation, Advanced age, Obesity.

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Extracorporeal Life Support Organization (ELSO)

Guidelines for ECPR Cases

ELSO ECPR Supplement to the ELSO General Guidelines

Version 1.3 December 2013 Page 1

Hallym University Sacred Heart Hospital

A Indications

AHA guidelines for CPR recommends consideration of ECMO to aid cardiopulmonary resuscitation in patients who have an easily reversible event, have had excellent CPR.

Contraindications: All contraindications to ECMO use (such as Gestational age < 34 weeks) should apply to ECPR patients.

DNR orders

Futility: Unsuccessful CPR (no return of spontaneous circulation) for 5-30 minutes. ECPR ma be indicated on prolonged CPR if good perfusion and metabolic support is documented.

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Extracorporeal Life Support Organization (ELSO)

Guidelines for Adult Respiratory Failure

ELSO Adult Respiratory Failure Supplement to the ELSO General Guidelines

Version 1.3 December 2013 Page 1

Hallym University Sacred Heart Hospital

A: Indications

1. In hypoxic respiratory failure due to any cause (primary or secondary) ECLS should be considered when the risk of mortality is 50% or greater, and is indicated when the risk of mortality is 80% or greater.

a. 50% mortality risk is associated with a PaO2/FiO2 < 150 on FiO2 > 90% and/or Murray score 2-3.

b. 80% mortality risk is associated with a PaO2/FiO2 < 100 on FiO2> 90% and/or Murray score 3-4 despite optimal care for 6 hours or more.

2. CO2 retention on mechanical ventilation despite high Pplat (>30 cm H2O)

3. Severe air leak syndromes

4. Need for intubation in a patient on lung transplant list

5. Immediate cardiac or respiratory collapse (PE, blocked airway, unresponsive to optimal care)

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B: Contraindications

There are no absolute contraindications to ECLS, as each patient is considered individually with respect to risks and benefits. There are conditions, however, that are associated with a poor outcome despite ECLS, and can be considered relative contraindications.

1. Mechanical ventilation at high settings (FiO2 > .9, P-plat > 30) for7 days or more

2. Major pharmacologic immunosuppression (absolute neutrophil count <400/mm3)

3. CNS hemorrhage that is recent or expanding

4. Non recoverable co morbidity such as major CNS damage or terminal malignancy

5. Age: no specific age contraindication but consider increasing risk with increasing age

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Acute Cardiac Failure

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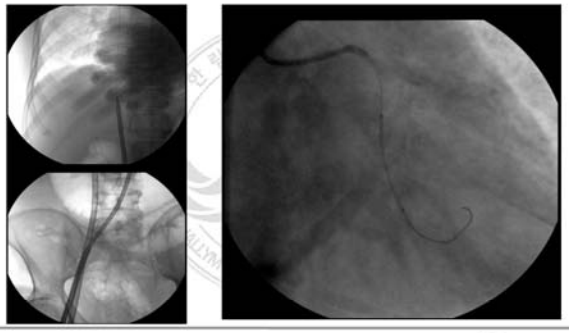
ECPR & PCI



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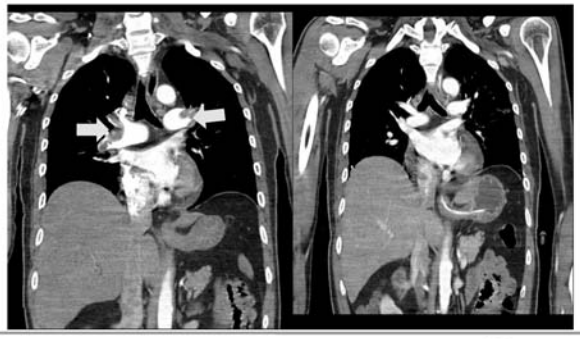
Acute PTE



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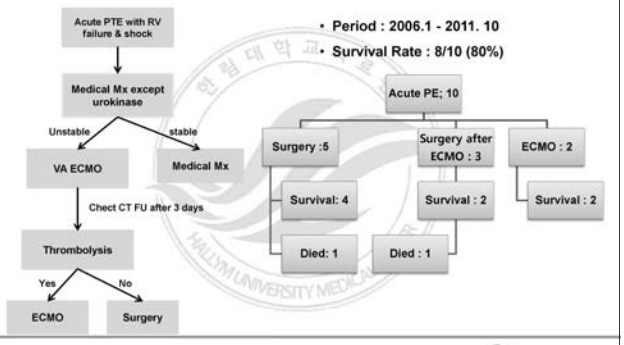
Acute PTE Mx protocol



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Refractory shock state (?)

	Refractory cardiogenic shock	Refractory septic shock
Cause	AMI, Malignant arrhythmia, Myocarditis……	Various
Inotropics	INEPI : 0.5ug/kg/min (?)	INEPI : 0.5ug/kg/min (?)
IABP	With/without	-
Mode	VA, VA→ VV or VAV	VA, VV, VAV

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ECMO in Trauma Patients

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Accidental Hypothermia

17:19 Calling 119 to report victim
17:53 Rescued by 119 helicopter
vital sign 0-0-0 SpO2 0
pupil F8/F8
AED : arrest
CPR
17:59 Arrived at ED
pupil F6/F6
DC shock d/t Vf →no response
18:36 transported to CAG room

검사항목	2013-03-02 18:29	2013-03-02 18:10
pH	6.800	6.800
pCO2	92	105
pO2	71	37
HCO3-act		
BE(B)		
BE(ecf)		
ctco2		
Hct	47.0	46.0
c1Hb(est)	16.0	15.6
O2SAT(est)		
Na+	133	120
K+	3.6	9.0
Ca++	0.81	0.86
Lactic acid -현장검사	15.0	15.0
Glu	341	224

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19:00 VA ECMO start
Biomedicus 17Fr, 21Fr
PLS system
Heater 33℃
EKG Vf,
BP 110mmHg
NEPI 0.38ug/kg/min
Pump flow 3.5L/min
19:10 Brain CT check : WNL
19:20 ICU

검사항목	2013-03-02 21:14	2013-03-02 21:02
pH	6.676	6.741
pCO2	33	11
pO2	657	639
HCO3-act	3.7	1.4
BE(B)	-32.3	-33.8
BE(ecf)	-32.8	-34.1
ctco2	4.8	1.7
Hct	34	46
c1Hb(est)	11.6	15.6
O2SAT(est)	99.7	99.8
Na+	137	131
K+	2.4	2.2
Ca++	0.49	0.40

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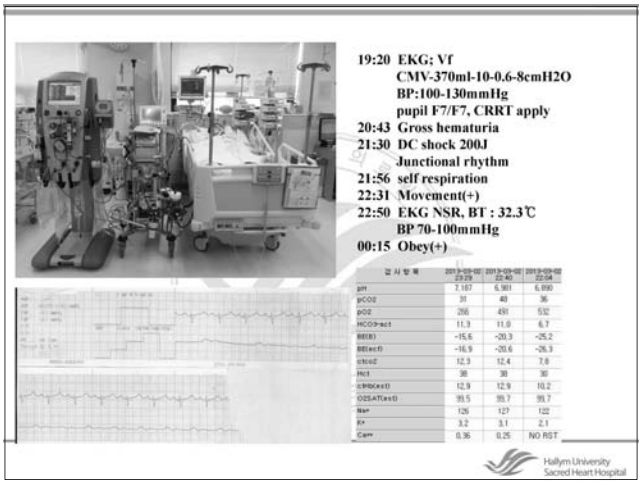
19:20 EKG; Vf
CMV-370ml-10-0.6-8cmH2O
BP:100-130mmHg
pupil F7/F7, CRRT apply
20:43 Gross hematuria
21:30 DC shock 200J
Junctional rhythm
21:56 self respiration
22:31 Movement(+)
22:50 EKG NSR, BT : 32.3℃
BP 70-100mmHg
00:15 Obey(+)
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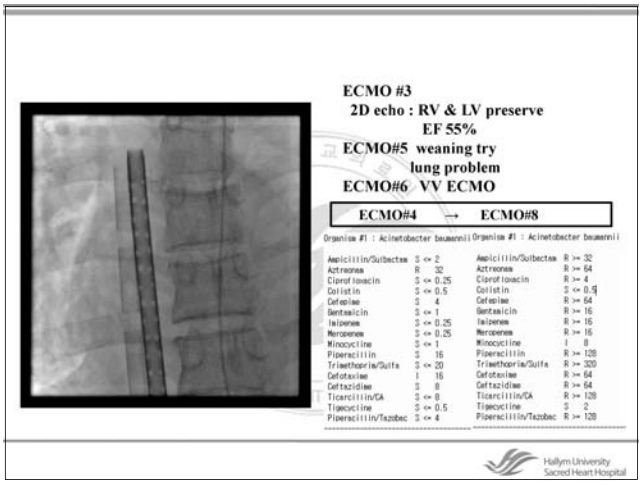
ECMO #3
2D echo : RV & LV preserve
EF 55%
ECMO#5 weaning try
lung problem
ECMO#6 VV ECMO
ECMO#4 → ECMO#8
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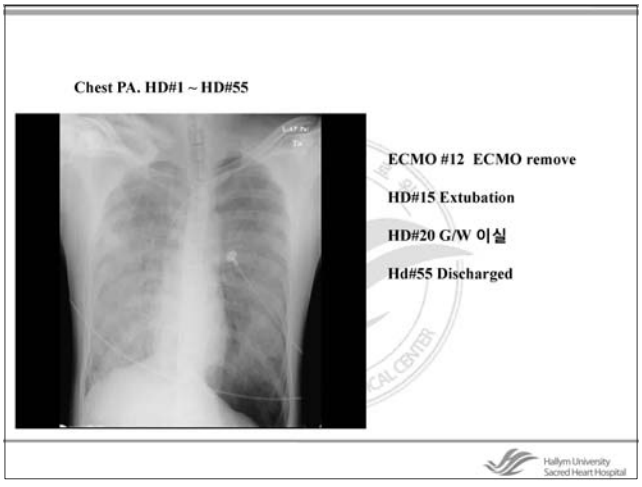
Chest PA. HD#1 ~ HD#55
ECMO #12 ECMO remove
HD#15 Extubation
HD#20 G/W 이실
Hd#55 Discharged
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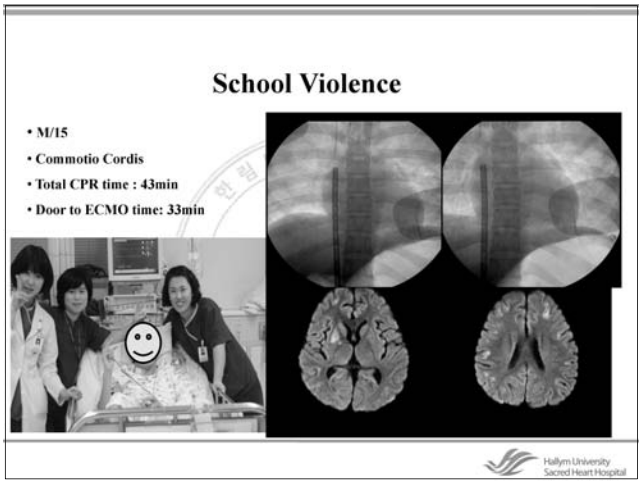
School Violence
• M/15
• Commotio Cordis
• Total CPR time : 43min
• Door to ECMO time: 33min
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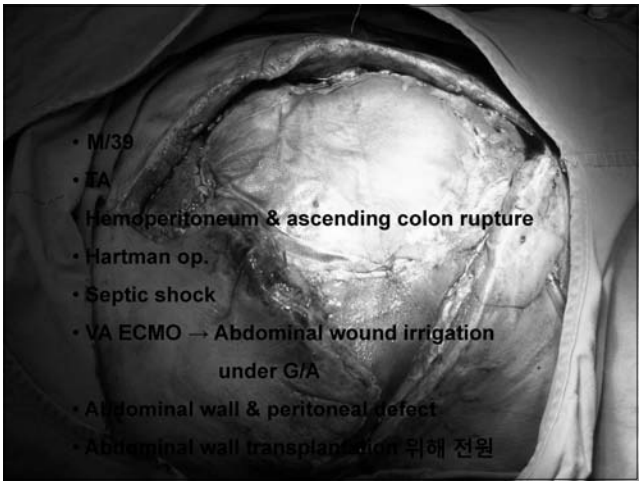
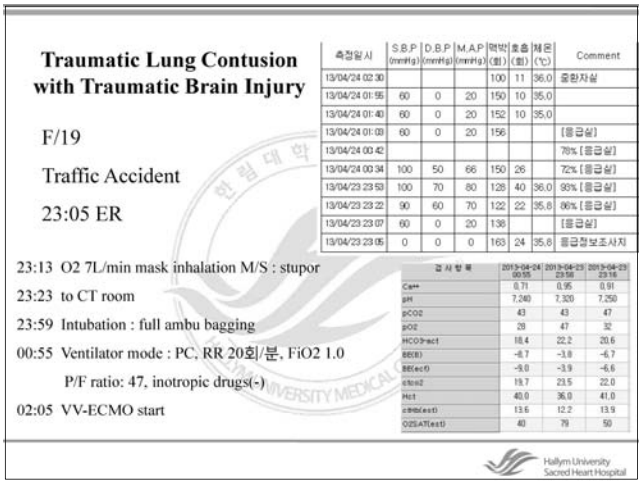

• M/39
• TA
• Hemoperitoneum & ascending colon rupture
• Hartman op.
• Septic shock
• VA ECMO → Abdominal wound irrigation
under G/A
• Abdominal wall & peritoneal defect
• Abdominal wall transplantation 위해 전원


Traumatic Lung Contusion
with Traumatic Brain Injury
F/19
Traffic Accident
23:05 ER
23:13 O2 7L/min mask inhalation M/S : stupor
23:23 to CT room
23:59 Intubation : full ambu bagging
00:55 Ventilator mode : PC, RR 20회/분, FiO2 1.0
P/F ratio: 47, inotropic drugs(-)
02:05 VV-ECMO start
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Traumatic Lung Contusion with Traumatic Brain Injury

- Brain injury : Lt frontal contusional hematoma, Lt frontal SDH, multiple pneumocephalus, Basal skull fracture
- Chest injury : Hemorrhagic lung contusion, mediastinal hematoma
- Abdomen & Pelvis : Lt kidney parenchymal laceration, small hemoperitoneum in pelvic cavity, Rt superior pubic ramus fracture
- Heparin 2000u loading
- Nafamostat mesilate used as an anticoagulant: aPTT 60-80 sec

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Traumatic Lung Contusion with Traumatic Brain Injury

VV ECMO for 6 days
ICU stay for 17days
She was discharged after 3months
She returns to her normal life now

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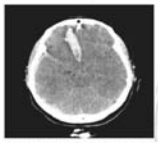
CASE REPORT
Emergency & Critical Care Medicine

JKMS

Extracorporeal Membrane Oxygenation for Acute Life-Threatening Neurogenic Pulmonary Edema following Rupture of an Intracranial Aneurysm



- ✓ **F/28**
- ✓ **A-com rupture**
- ✓ **Neurogenic pulmonary edema**
- ✓ **FiO2 1.0 : PaO2 32-44mmHg, PaCO2 48-68mmHg**
- ✓ **VV ECMO**
- ✓ **Aneurysm clipping and decompression craniectomy for ICP control**
- ✓ **ECMO was weaned off 7days after application**
- ✓ **Neurologic status recovered fully by 1 month after op.**
- ✓ **She returned to her normal life at 3month after treatment.**

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Thoracic Surgery Assisted with VV ECMO

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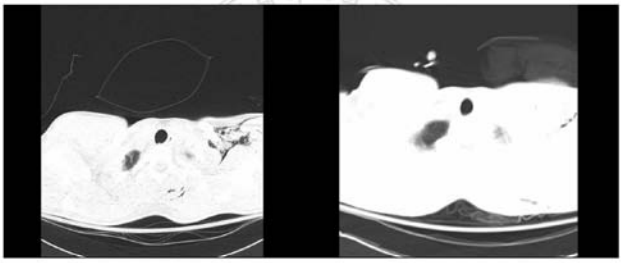
Gun shot

P/F ratio : 351

P/F ratio : 75 → 350 ⇒ 250



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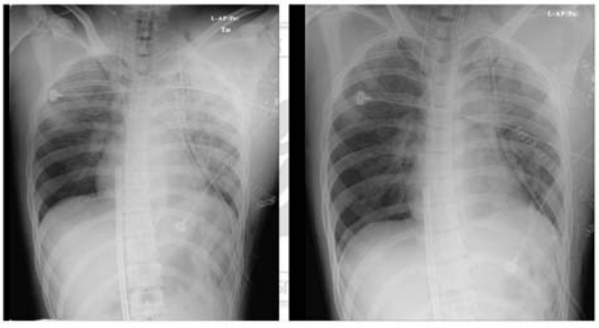
Chest PA after LUL lobectomy

POD #1



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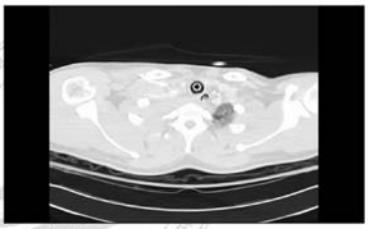
Rt subclavian artery bleeding d/t DIC



P/F ratio : 43

vv-ECMO under CPR (5min)

Dx: ICH, IVH, Rt renal injury, Spleen injury, L-spine Rt 1-5 transverse process Fx, Lt femur head Fx

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Initial Settings and Goals of ECMO

Circuit flow	50 ~ 80 mL/kg/min
Sweep gas flow	50 ~ 80 mL/kg/min
FiO2 (sweep gas)	100%
Inlet pressure	> -100 mmHg
SaO2 (return cannula)	100%
SaO2 (drainage cannula)	> 65%
Arterial oxygen saturation	VA > 95%, VV: 85 ~ 92%
SvO2	> 65%
$PaCO_2$	35 ~ 45 mmHg
pH	7.35 ~ 7.45
Mean arterial pressure	65 ~ 95 mmHg
Hematocrit	30 ~ 40%
Activated partial thromboplastin time	60 ~ 80 sec ; 1.5 ~ 2 times normal
Platelet count	> 50,000/uL

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Schedule of initial Point of Care and Laboratory Testing During ECMO

Arterial blood gases	3 ~ 4 hourly
Mixed venous O2	Daily
Pre- and post-oxygenator blood gases	Daily
Complete blood count	6 hourly
Coagulation tests	6 hourly
Thromboelastograph	12 hourly
Blood chemistry, renal function, and liver function	12 hourly
Plasma free hemoglobin	12 hourly
Blood culture from the circuit	Daily

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Transfusion

Lab Monitoring		Maintain	
Platelets	q 6-12hr	> 50,000-100,000	Platelets concentrates
INR	q 6-12hr	< 2.0	Fresh frozen plasma
Fibrinogen	q 12-24hr	> 100mg/dL	Cryoprecipitate
CBC	q 8-12hr	Hct >35%	pRBC
Antithrombin	Daily and/or prn	> 50%	FFP, AT3

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ECMO program

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경청해주셔서 감사합니다.

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