Anatomy of TGA
Arterial switch operation

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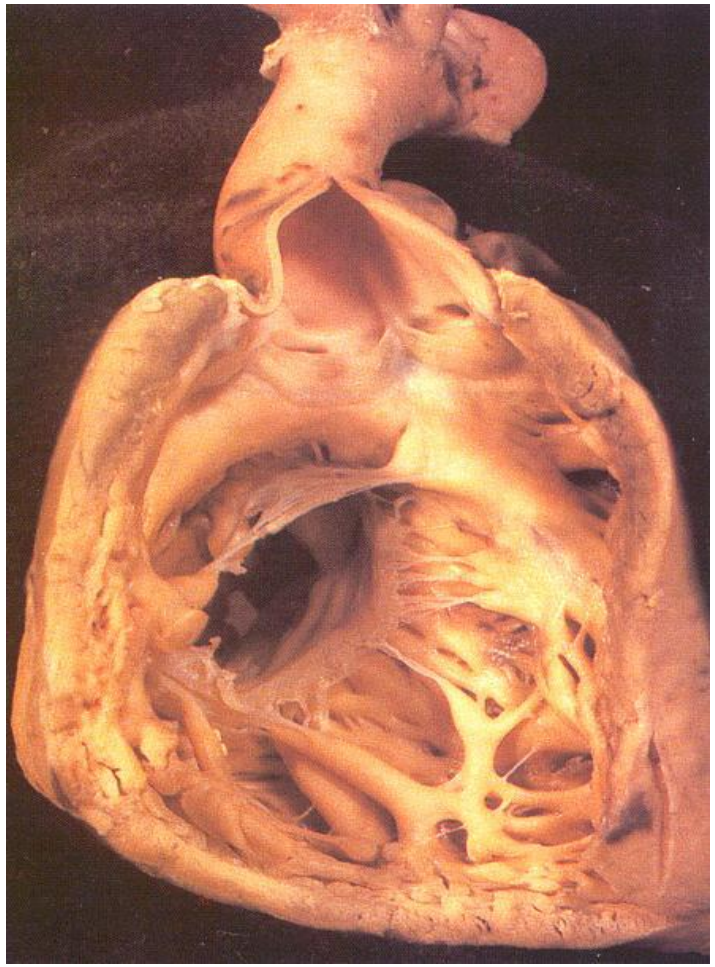
Transposition of great arteries

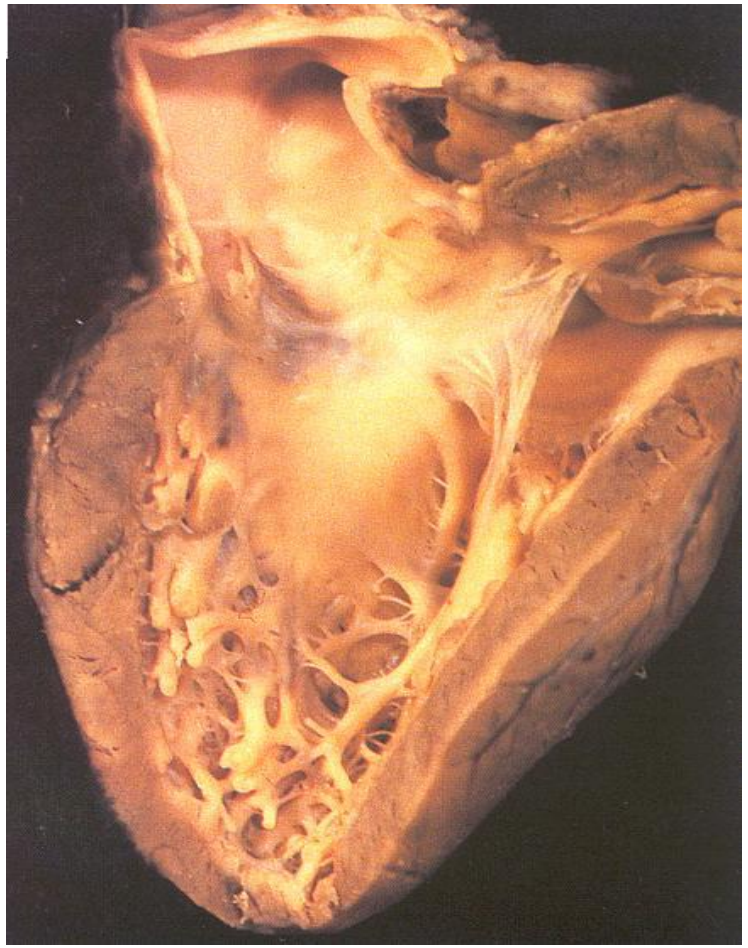
- Definition:

  "ventriculoarterial alignment discordance"

- Complete TGA
- Partial TGA : DORV

Anatomy of TGA



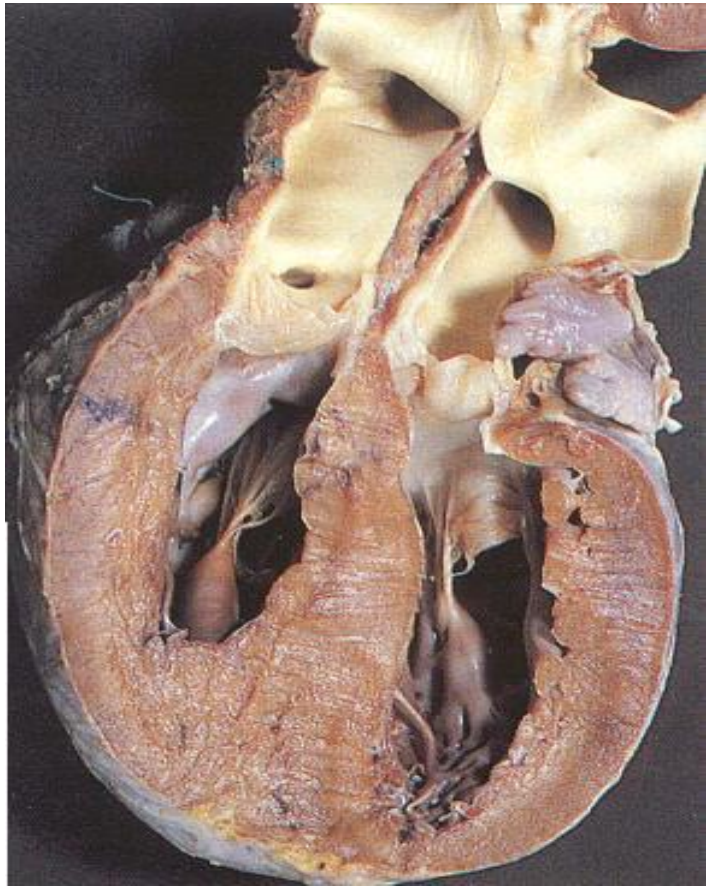


Anatomy of TGA

- Atrial chamber : normal
- Sinus node: in usual position
- AV node: in usual position
- Foramen ovale : present
- Atrioventricular junction: subtle difference
- Membraneous septum: often small or even absent

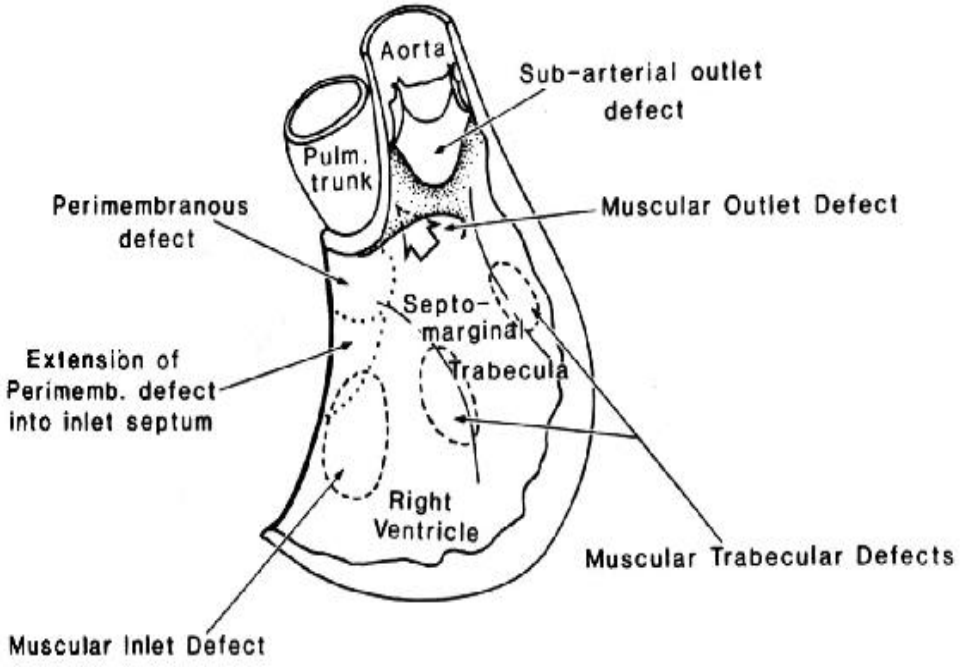
Anatomy of TGA

- Ventricular septum: straight without the curvature(parallel arrangement)
- Muscular subaortic conus : separates the transposed aortic valve above from the both atrioventricular valves below
- Pulmonary- mitral continuity
- Coronary arteries: from the aortic sinuses nearest the pulmonary trunk



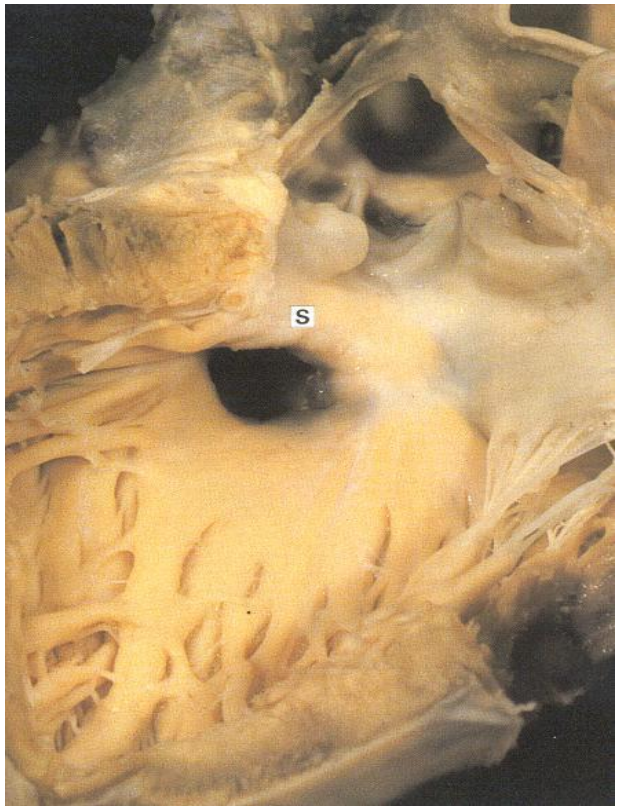
Anatomy of TGA – VSD

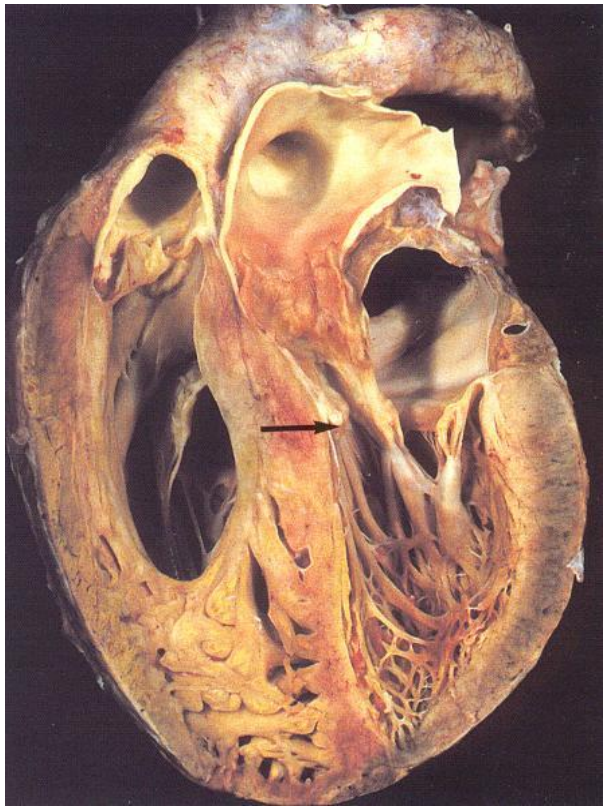
- Conoventricular type -- malalignment of outlet septum with respect to trabecular septum
- Perimembraneous
- Inlet extension
- Others



Anatomy of TGA - LVOTO

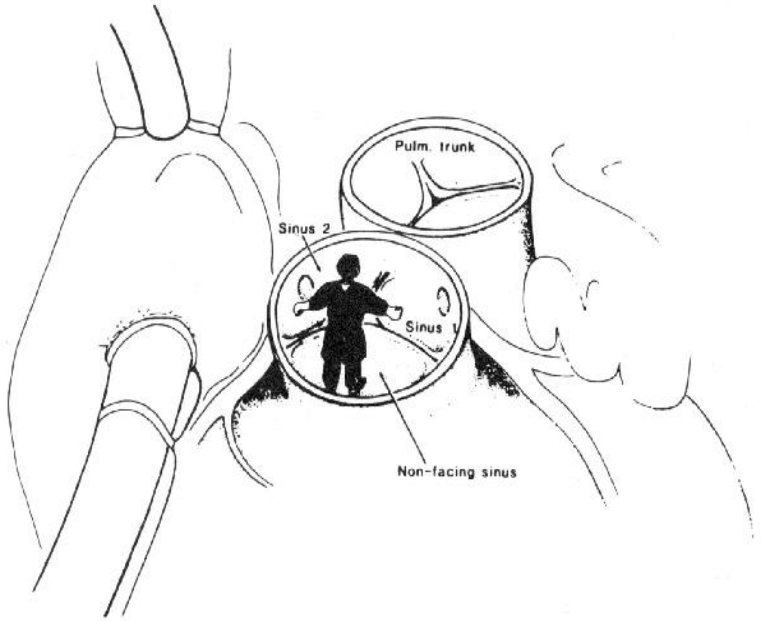
- Conal septum malalignment
- Aneurysm of the pars membranacea septi
- Fibrous subpulmonary stenosis with intact IVS
- Isolated pulmonary stenosis





Coronary anatomy

Leiden convention (Gittenberger-de Groot, 1983)



Pediatr Cardiol 1983;4(suppl 1):15-24

Table I. *Classification of coronary anatomy in D-transposition of the great arteries*

Leiden classification of coronary origin

Sinus

Using the perspective of an individual looking from the aorta to the pulmonary artery:

Sinus 1—The sinus adjacent to the pulmonary artery on the right-hand side of the observer

Sinus 2—The sinus adjacent to the pulmonary artery on the left-hand side of the observer

Coronary arteries

Right coronary artery (R)

Anterior descending artery (AD)

Circumflex artery (Cx)

A comma is used to indicate that major branches originate from a common vessel, whereas a semicolon denotes separate origins

Supplemental descriptive classification

Epicardial course of major coronary branches

Anterior—A coronary branch passing anterior to the aorta

Posterior—A coronary branch passing posterior to the pulmonary artery

Between—A coronary branch passing between the great arteries (usually intramural)

Unusual origins

Commissural—A coronary origin near an aortic commissure

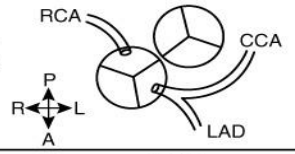
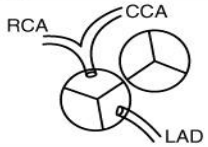
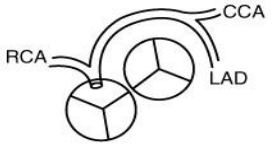
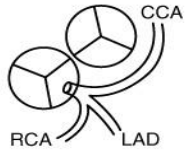
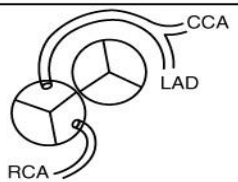
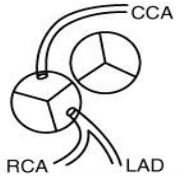
Separate—Separate origins of two coronary branches from the same aortic sinus

Remote or distal—Origin of the circumflex artery and the posterior descending artery as a distal bifurcation of the right coronary artery

Aortic position relative to the pulmonary artery

Right or anterior, left, side by side, or posterior

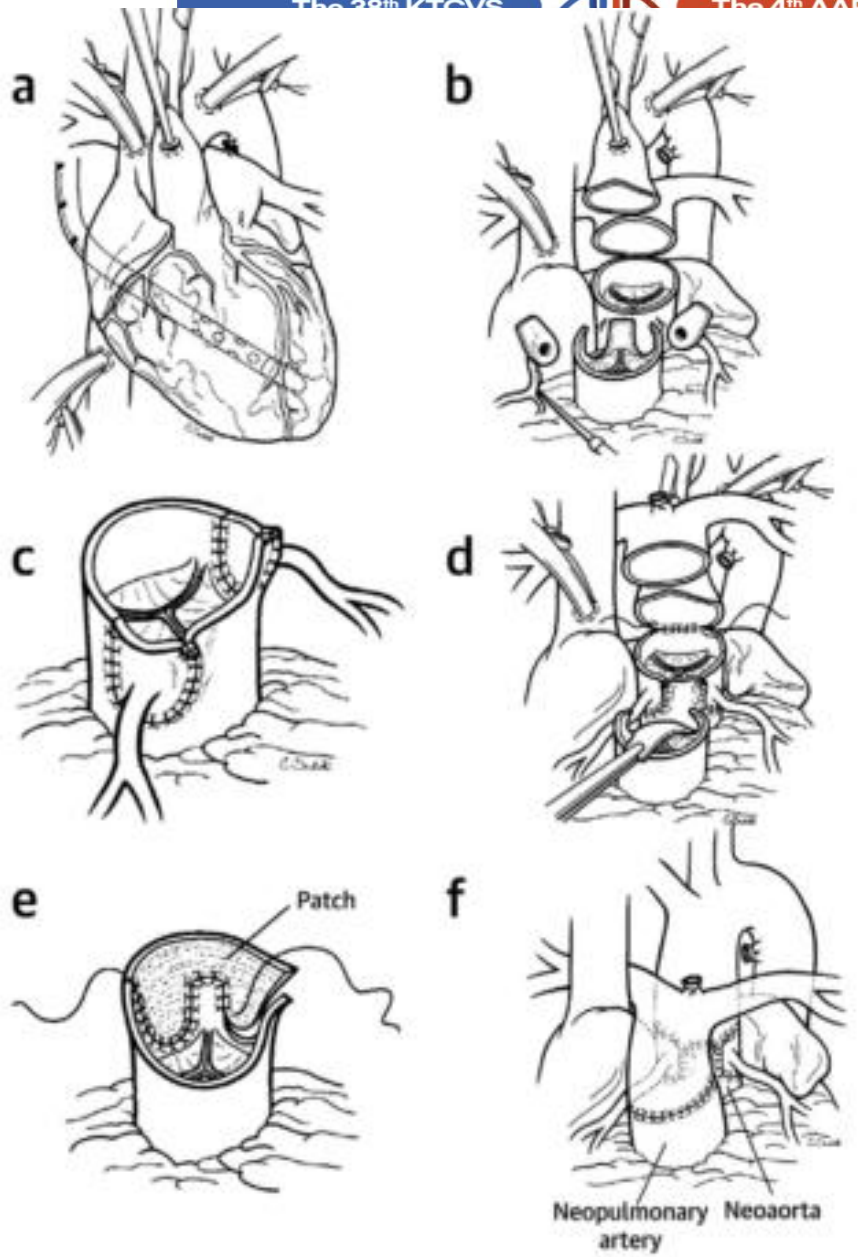
Types of coronary anatomy

		G. *	Q.	Y.
Usual coronary anatomy in TGA 68%		A I	1LCx–2R	A
Circumflex coronary from the right coronary artery 14%		AB I	1L–2CxR	D
Single right coronary artery 4.5%		B I	2LCxR	—
Single left coronary artery 1.5%		A II	1RLCx	—
Inverted origin of the coronary arteries 3%		B II	1R–2LCx	—
Inverted origin of the circumflex and right coronary artery 7%		AB II	1RL–2Cx	E

Surgery of the Chest, 5th ed. Philadelphia: WB Saunders, 1990, pp. 1435–1451.)

Arterial switch operation

well developed standard technique during 40 years



Excision of Coronary artery patch

- Coronary dissection before ACC
- Avoid injury or denuding of coronary artery or vasa vasorum
- Removal of whole sinus of Valsalva lengthens the coronary artery

Infundibular septum and coronary anatomy in Jatene operation

Hiromi Kurosawa, M.D., Yasuharu Imai, M.D., Yoshinori Takanashi, M.D., Shuichi Hoshino, M.D., Kazuo Sawatari, M.D., Masaaki Kawada, M.D., and Atsuyoshi Takao, M.D., *Tokyo, Japan*

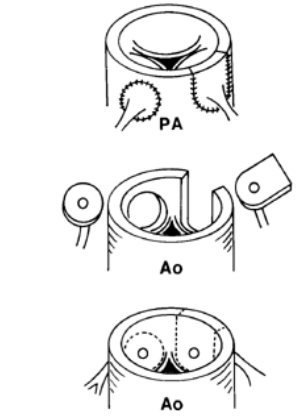


Fig. 1. The whole sinus of Valsalva is removed as a scallop or button *(bottom and middle)* and translocated into the opposing pulmonary sinus *(top)*. *PA*, Pulmonary artery. *Ao*, Aorta.

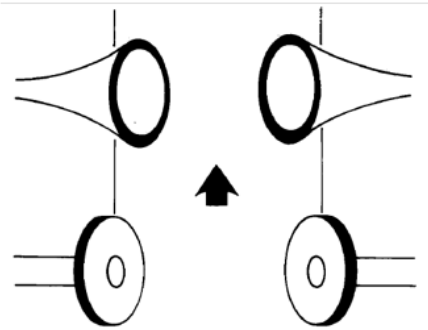


Fig. 2. Removal of the whole sinus of Valsalva *(bottom)* lengthens the coronary artery by forming a funnel-shaped button *(top)*.

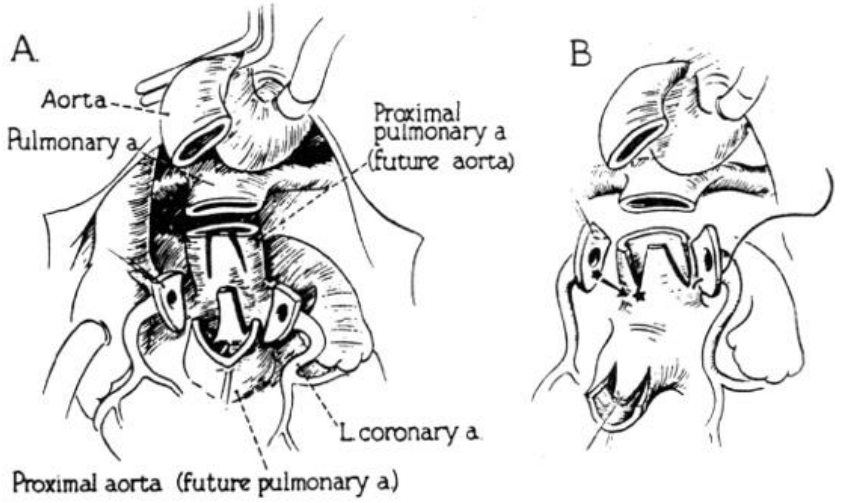
J Thorac Cardiovasc Surg 91:572-583, 1986

Off-axis in transferred coronary artery

- Off axis -- minimize rotation and kinking

Arterial switch in simple and complex transposition of the great arteries

Farouk S. Idriss, MD, Michel N. Ilbawi, MD, Serafin Y. DeLeon, MD (by invitation),



J Thorac Cardiovasc Surg 1988; 95: 29-36

Trap door : less angulation

Early results for anatomic correction of transposition of the great arteries and for double-outlet right ventricle with subpulmonary ventricular septal defect

W. J. Brawn, FRCS, FRACS, and R. B. B. Mee, MB, ChB, FRACS, *Victoria, Australia*

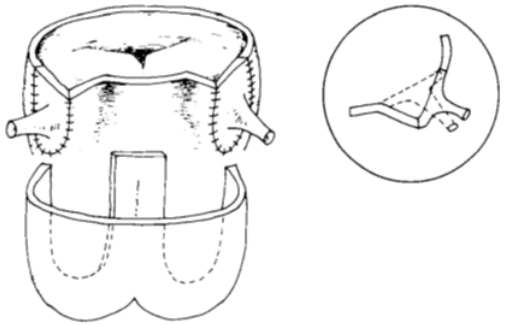
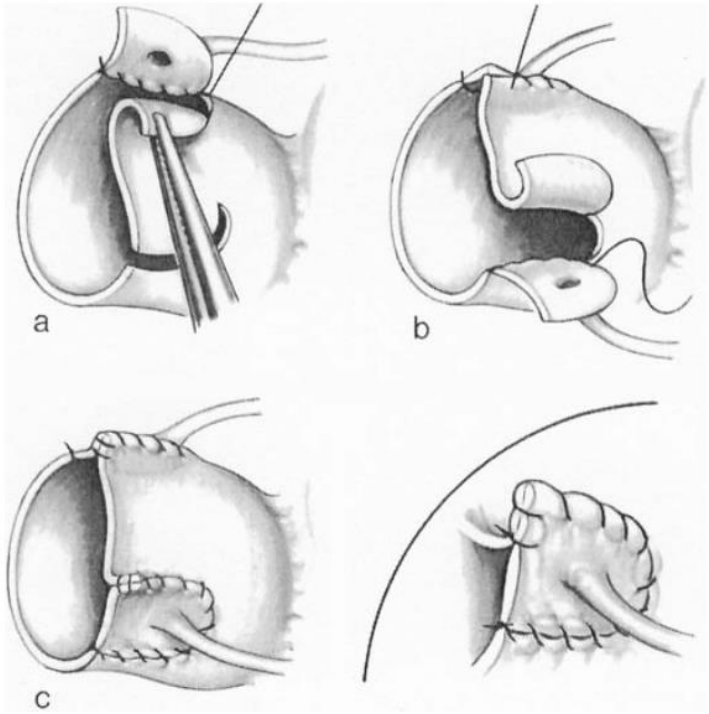


Fig. 2. Transfer of coronary arteries to medially hinged trapdoors in neoaorta. *Inset*, Posterior angulation of coronary artery is less with trapdoor *(solid line)* than without *(dotted line)*.

J THORAC CARDIOVASC SURG 1988;95:230-8



Surgery for congenital heart defects. 2nd edn. Philadelphia: Saunders; 1994. p. 483–500.

Trap door with patch

Anatomy of the coronary arteries in transposition of the great arteries and methods for their transfer in anatomical correction

MAGDI H YACOUB AND ROSEMARY RADLEY-SMITH
From Harefield Hospital, Middlesex, and the National Heart Hospital, London, UK

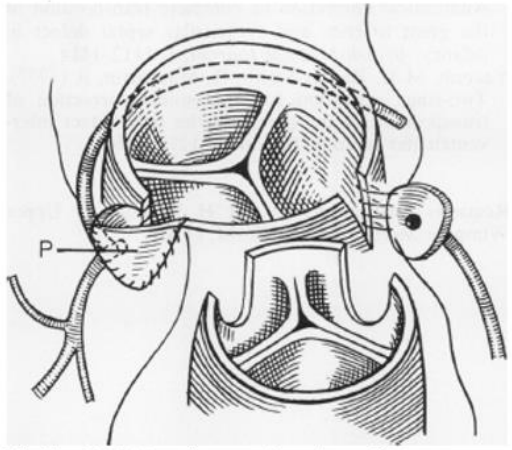
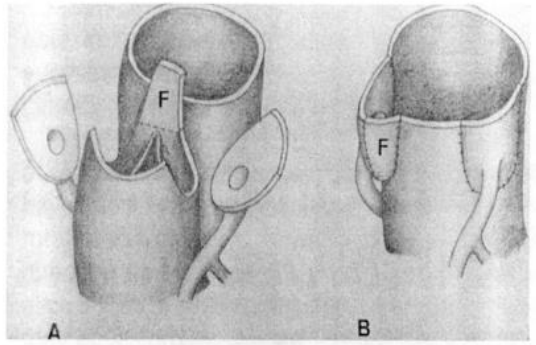


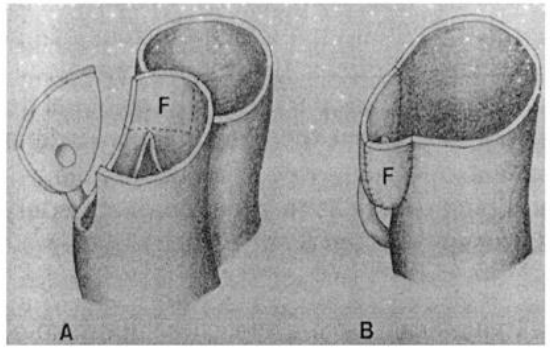
Fig 11 *Technique for transfer of type C coronary vessels. To avoid kinking of circumflex artery, a free patch "P" of autogenous pulmonary artery is used to join anterior edge of disc to the anterior edge of defect created in posterior wall.*

Thorax, 1978, 33, 418-424

Utilization of the Aortic Flap Above the Facing Commissure in Arterial Switch Operations

Ing-Sh Chiu M.D., Ph.D., M. Div., Tsai-Fwu Chou M.D., Shou-Fong Lin M.D., Mei-Hwan Wu M.D., Ph.D., Jou-Kou Wang M.D., Ph.D., Shu-Hsun Chu M.D.





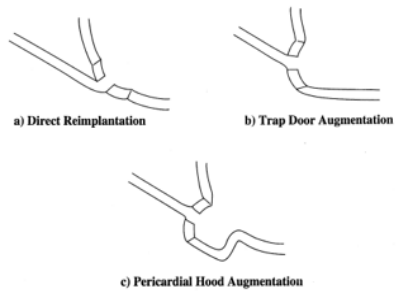
J Card Surg 1996;11: 187-91

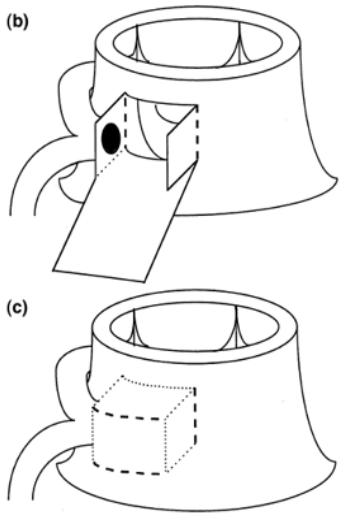
Pericardial hood / Bay window

The use of 'pericardial hoods' for maintaining exact coronary artery geometry in the arterial switch operation with complex coronary anatomy[1]

Andrew J. Parry*, Mascha Thurm, Frank L. Hanley

Department of Paediatric Cardiac Surgery, University of California, San Francisco, CA, USA



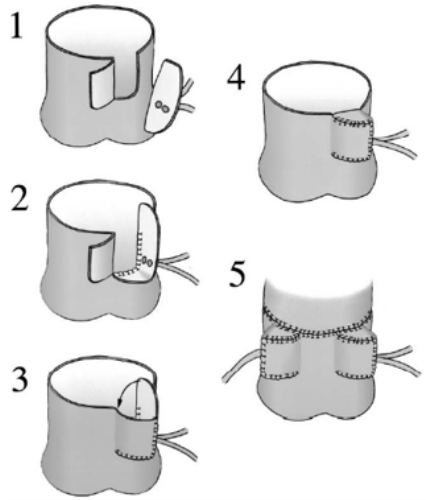


- **Maintain exact coronary geometry**
- **Revision of primary anastomosis**
- **Concern regarding thrombosis in the hood**

Eur J Cardio-thorac Surg 1999;15:159-65

"Bay Window" Technique for the Arterial Switch Operation of the Transposition of the Great Arteries With Complex Coronary Arteries

Masaaki Yamagishi, MD, Keisuke Shuntoh, MD, Katsuji Fujiwara, MD, Takeshi Shinkawa, MD, Takako Miyazaki, MD, and Nobuo Kitamura, MD



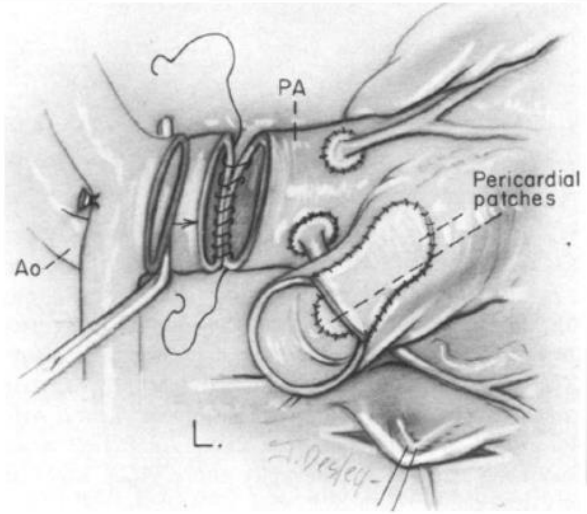
Ann Thorac Surg 2003;75:1769 –74

Level of transferred coronary artery

The arterial switch operation

An eight-year experience

Jan M. Quaegebeur, M.D. (by invitation), John Rohmer, M.D. (by invitation), Jaap Ottenkamp, M.D. (by invitation), Tjik Buis, M.D. (by invitation), John W. Kirklin, M.D.,* Eugene H. Blackstone, M.D.,* and A. G. Brom, M.D., *Leiden, The Netherlands*



J THORAC CARDIOVASC SURG 92:361-384, 1986

Switch operation for transposition of the great arteries in neonates

Claude Planché, MD,[a] Jacqueline Bruniaux, MD,[a] François Lacour-Gayet, MD,[a] Jean Kachaner, MD,[b] Jean-Paul Binet, MD,[a] Daniel Sidi, MD,[b] and Elizabeth Villain, MD,[b] *Plessis-Robinson and Paris, France*

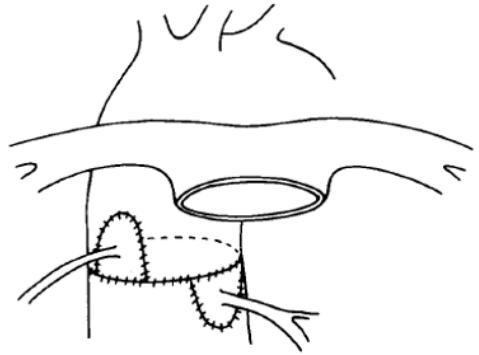


Fig. 7. Reimplantation of high right coronary artery. In TGA, the origin of the coronary arteries is often higher than in normal hearts. The height of the emergence must be reproduced during relocation. Therefore it is sometimes necessary to reimplant the vessel above the aortopulmonary anastomosis.

J Thorac Cardiovasc Surg 1988;96:354-63

Looping course (Planché group III / Yacoub type D or E)

Switch operation for transposition of the great arteries in neonates

Claude Planché, MD,[a] Jacqueline Bruniaux, MD,[a] François Lacour-Gayet, MD,[a]
Jean Kachaner, MD,[b] Jean-Paul Binet, MD,[a] Daniel Sidi, MD,[b] and Elizabeth Villain, MD,[b]
Plessis-Robinson and Paris, France

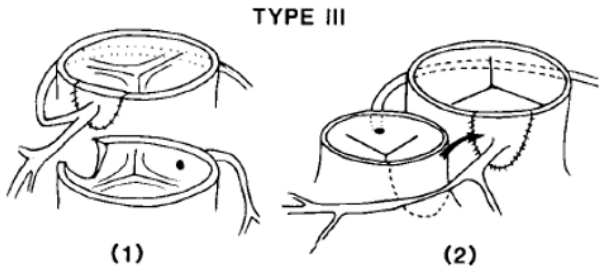
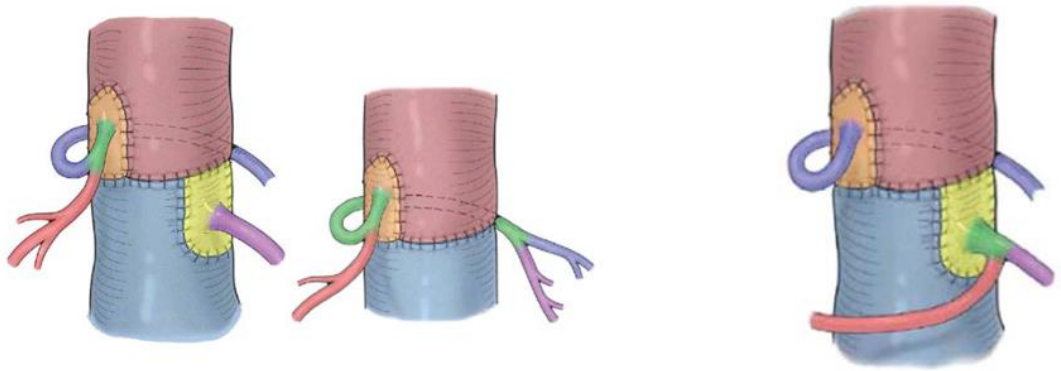


Fig. 11. Coronary relocation in type III. *1*, In a vessel with a posterior course, the posterior translocation creates a risk of angulation by shortening the course of the artery. *2*, In a vessel with an anterior course, there is a risk of elongation by excessive tension.

J Thorac Cardiovasc Surg 1988;96:354-63

A uniform surgical technique for transfer of both simple and complex patterns of the coronary arteries during the arterial switch procedure

Francois Lacour-Gayet,[1] Robert H. Anderson[2]

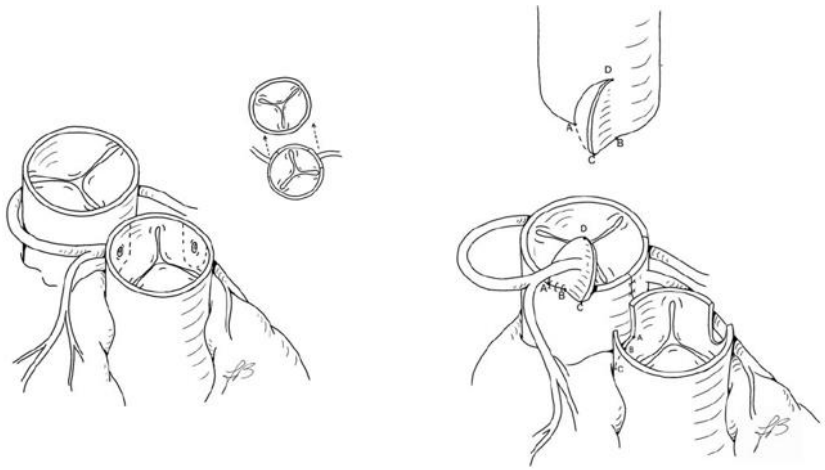


Cardiol Young 2005; 15 (Suppl. 1): 93–101

Looping course (Planché group III / Yacoub type D or E)

Managing the posterior coronary loop in the arterial switch operation: the 'inverse flap' technique

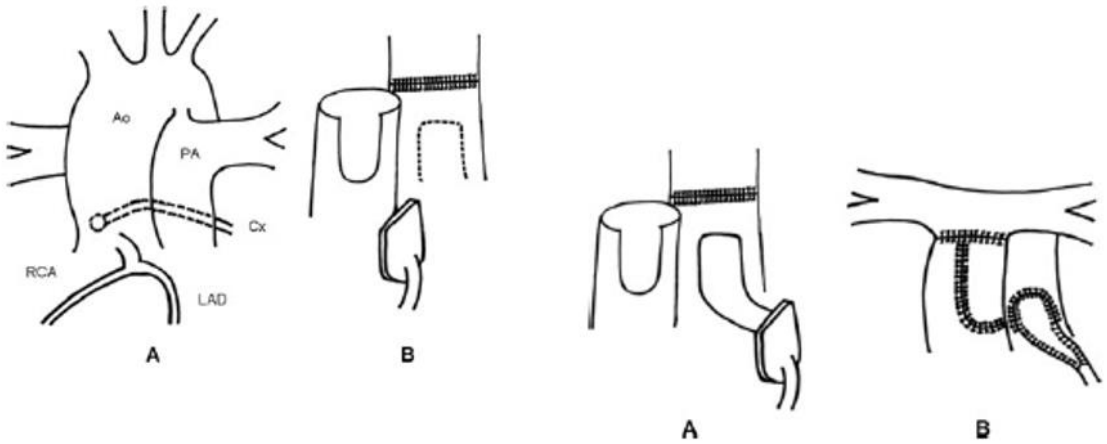
Roberto M. Di Donato[a], Fabrizio Gandolfo[b], Vincenzo Affinito[b] and Gianluca Brancaccio[b,*]



Interactive Cardiovascular and Thoracic Surgery (2013) 1–2

Extension of Coronary Artery with Double Flap Technique in a Complicated Arterial Switch Operation

Riza Turkoz, M.D.,* Canan Ayabakan, M.D.,† Can Vuran, M.D.,* Oguz Omay, M.D.,* and Kursad Tokel, M.D.†



J Card Surg 2011;26:324-327

Planché group II / Yacoub type C
Two coronary ostia –very close to each other
Intramural coronary artery

Anatomy of the coronary arteries in transposition of the great arteries and methods for their transfer in anatomical correction

MAGDI H YACOUB AND ROSEMARY RADLEY-SMITH
From Harefield Hospital, Middlesex, and the National Heart Hospital, London, UK

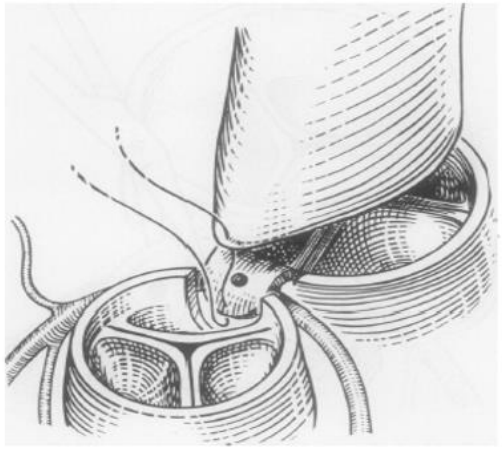
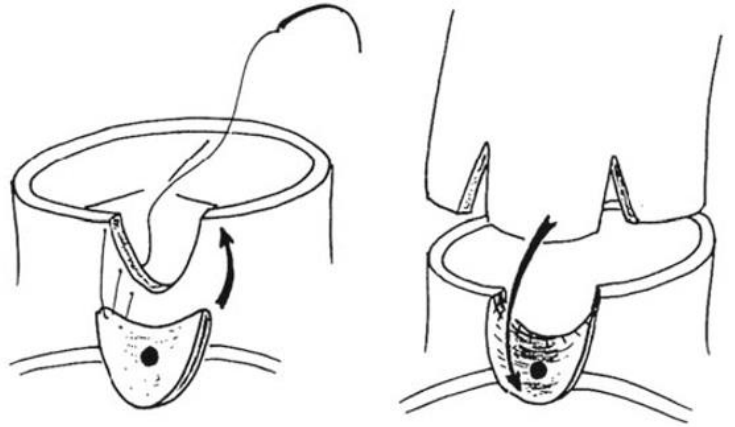


Fig 10 *Anastomosis of upper end of transected anterior vessel to lower end of posterior vessel in a fashion to include disc bearing a common coronary ostium.*

Thorax, 1978, 33, 418-424

Switch operation for transposition of the great arteries in neonates

Claude Planché, MD,[a] Jacqueline Bruniaux, MD,[a] François Lacour-Gayet, MD,[a]
Jean Kachaner, MD,[b] Jean-Paul Binet, MD,[a] Daniel Sidi, MD,[b] and Elizabeth Villain, MD,[b]
Plessis-Robinson and Paris, France

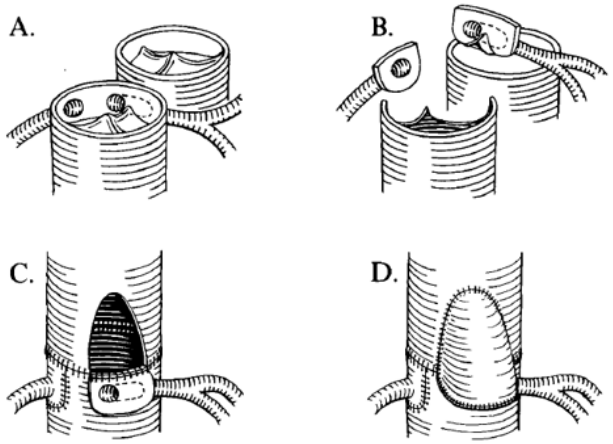


J Thorac Cardiovasc Surg 1988;96:354-63

Planché group II / Yacoub type C
Two coronary ostia –very close to each other
Intramural coronary artery

The influence of coronary anatomy on the arterial switch operation in neonates

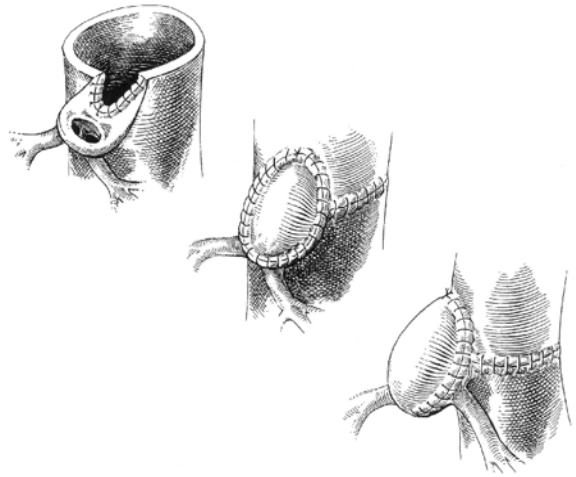
Ronald W. Day, MD, Hillel Laks, MD, and Davis C. Drinkwater, MD, *Los Angeles, Calif.*



J Thorac Cardiovasc Surg 1992 ; 104: 706-12

Management of Transposition of the Great Arteries With Single Coronary Artery

Albertus M. Scheule and Richard A. Jonas



Semin Thorac Cardiovasc Surg Pediatr Card Surg Annu 2001; 4: 34-57

Aortopulmonary window

Transposition of the great arteries
New technique for anatomical correction

J. AUBERT, A. PANNETIER, J. P. COUVELLY, D. UNAL, F. ROUAULT, AND A. DELARUE

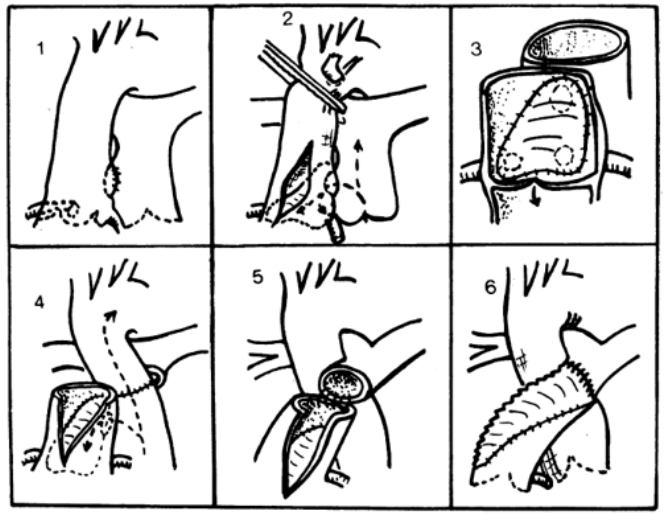


Fig. 1 *Stages 1-3 of the operation: creation of aortopulmonary window and placing of patch to form tunnel between new aorta and coronary ostia. Stages 4-6 of the operation: 'detransposition' of the great arteries completed with incorporation of a Dacron patch into the pulmonary trunk.*

J Thorac Cardiovasc Surg 82:629-631, 1981

Complex coronary arterial anatomy in transposition of the great arteries

Arterial switch procedure without coronary relocation

N. E. Moat, FRCS, A. Pawade, FRCS, and R. K. Lamb, FRCS,
Shirley, Southampton, United Kingdom

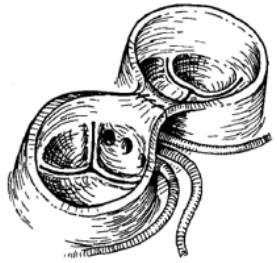


Fig. 2. Inferior wall of aortopulmonary window is created by suturing together aortic wall above coronary-bearing sinus and corresponding part of proximal neoaorta.

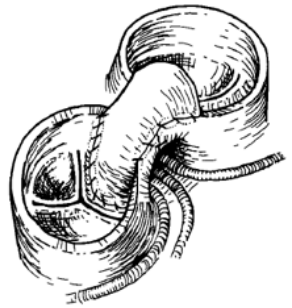


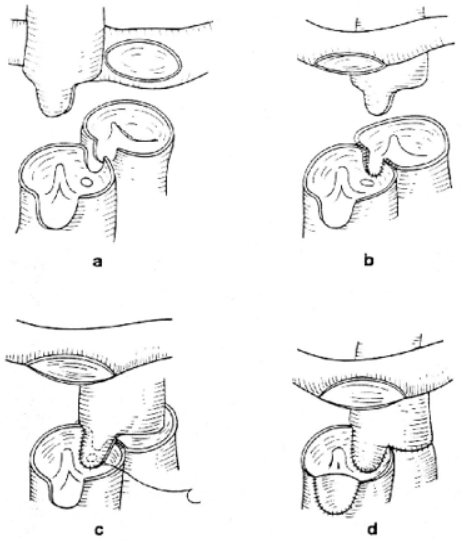
Fig. 3. Bovine pericardial patch sutured into place within coronary-bearing sinus in proximal neopulmonary artery.

J Thorac Cardiovasc Surg 1992; 103: 872-6

Aortopulmonary window

New Technique for the Arterial Switch Operation in Difficult Situations

Shigeyuki Takeuchi, MD, and Toshiyuki Katogi, MD
Department of Surgery, School of Medicine, Keio University, Tokyo, Japan



Ann Thorac Surg 1990;50:1000-1)

Arterial Switch Operation With and Without Coronary Relocation for Intramural Coronary Arteries

Hiroshi Koshiyama, MD, Mitsugi Nagashima, MD, Goki Matsumura, MD, Takeshi Hiramatsu, MD, Toshio Nakanishi, MD, and Kenji Yamazaki, MD

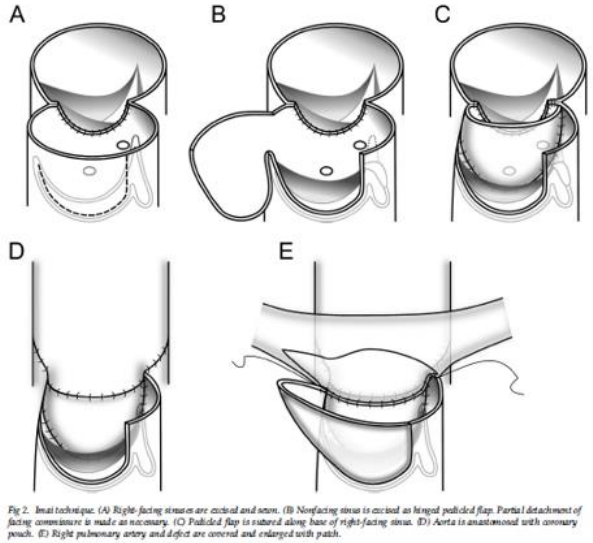


Fig 2. Imai technique. (A) Right-facing sinuses are excised and sewn. (B) Nonfacing sinus is excised as hinged pedicled flap. Partial detachment of facing commissure is made as necessary. (C) Pedicled flap is sutured along base of right-facing sinus. (D) Aorta is anastomosed with coronary pouch. (E) Right pulmonary artery and defect are covered and enlarged with patch.

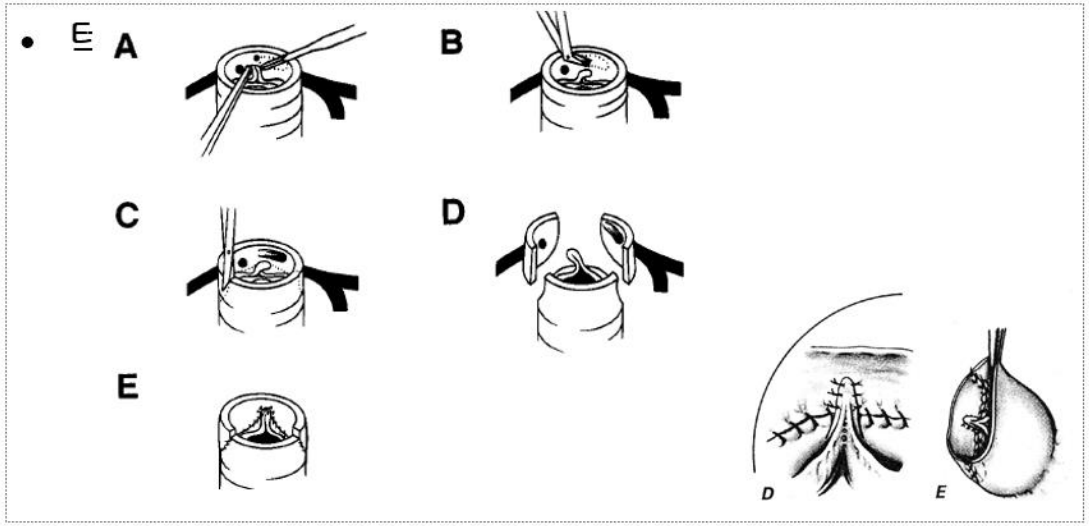
Ann Thorac Surg 2016;102:1353–9

Separating buttons in intramural

Arterial Switch: Translocation of the Intramural Coronary Artery

Toshihide Asou, MD, Tom R. Karl, MD, Ash Pawade, FRCS, and Roger B. B. Mee, FRACS

Victorian Cardiac Surgical Unit, Royal Children's Hospital, Melbourne, Australia



Ann Thorac Surg 1994;57:461-5

Excellent Long-Term Outcomes of the Arterial Switch Operation in Patients With Intramural Coronary Arteries

Tyson A. Fricke, MBBS, BMedSci, Anne Eva Bulstra, BS, Phillip S. Naimo, MD, Andrew Bullock, MBBS, Terry Robertson, MBBS, Yves d'Udekem, MD, PhD, Christian P. Brizard, MD, and Igor E. Konstantinov, MD, PhD

- 1983 – 2009
- 28 / 720(3.9%): intramural

- First 3 -- aortopulmonary window
- 25/28 -- two separating buttons

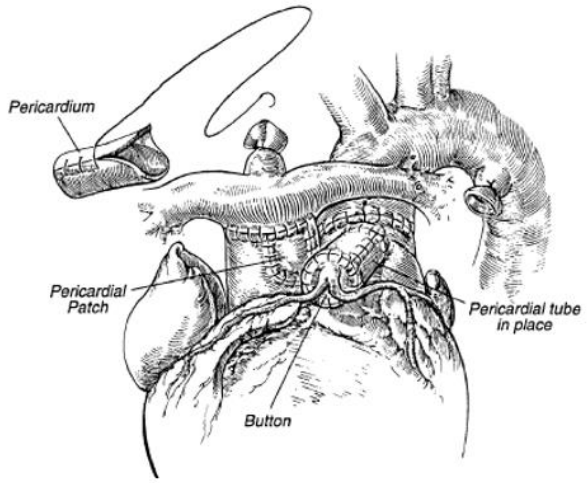
- No mortality
- No coronary problems

Ann Thorac Surg 2016;101:725–9

Single coronary artery

Management of Transposition of the Great Arteries With Single Coronary Artery

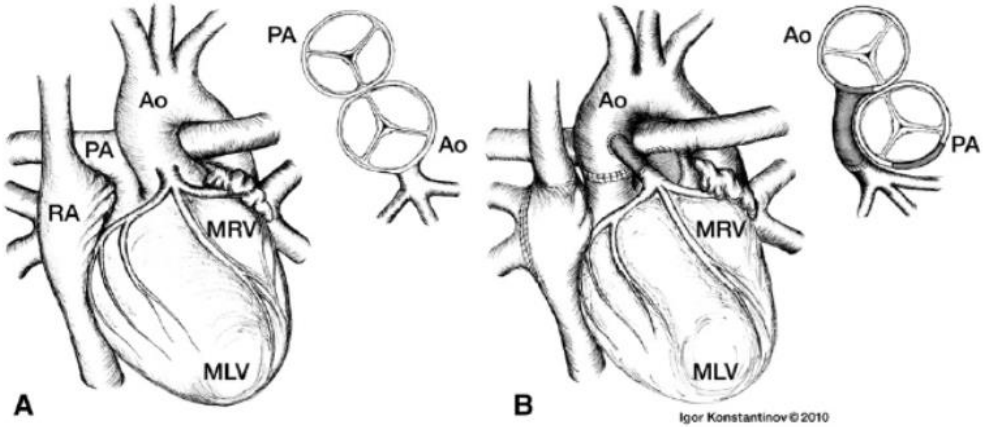
Albertus M. Scheule and Richard A. Jonas



Semin Thorac Cardiovasc Surg Pediatr Card Surg Annu 2001; 4: 34-57

Translocation of a single coronary artery from the nonfacing sinus in the arterial switch operation: Long-term patency of the interposition graft

Igor E. Konstantinov, MD, PhD,[a] Tyson A. Fricke, BMedSci,[a] Yves d'Udekem, MD, PhD,[a] and Dorothy J. Radford, MBBS, MD,[b] Melbourne and Brisbane, Australia



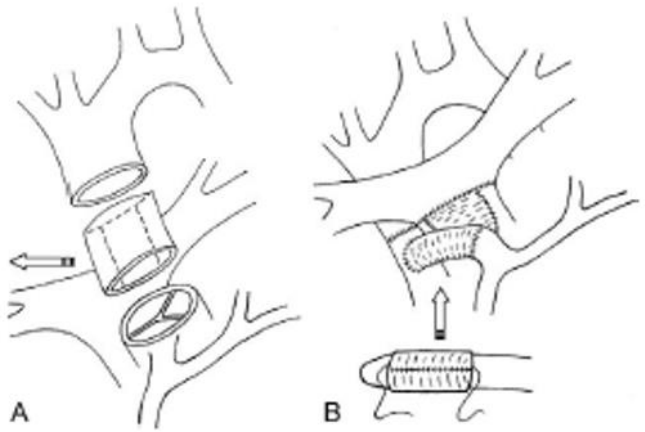
J Thorac Cardiovasc Surg 2010;140:1193-4

Single coronary artery

Arterial Switch Operation With a Single Coronary Artery: The Autograft Concept

Loïc Macé, MD, PhD, Fabrice Vanhuyse, MD, Jean-Marc Jellimann, MD, Dany Youssef, MD, Anne Moulin-Zinsch, MD, Jean-Paul Lethor, MD, and François Marçon, MD

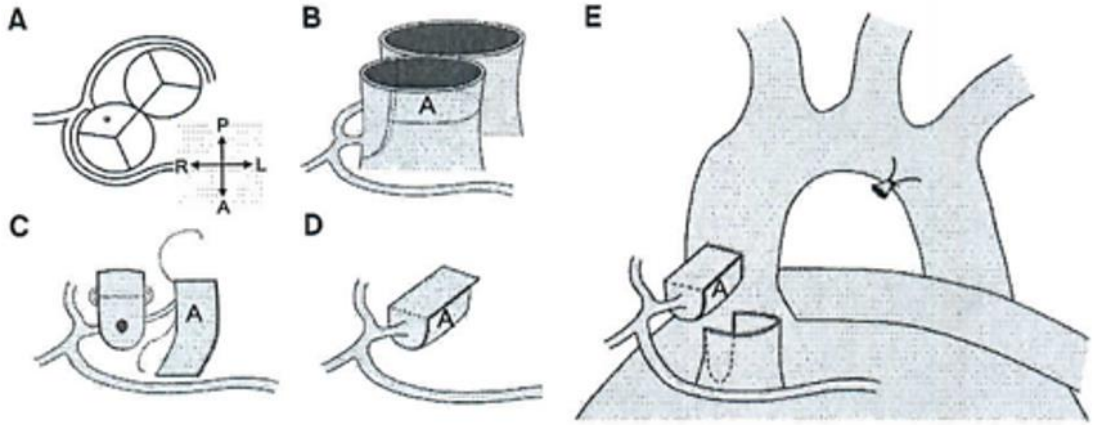
Departments of Cardiovascular and Pediatric Cardiac Surgery, and Pediatric Cardiology, Nancy Hospital, Henri Poincaré University, Nancy, France



Ann Thorac Surg 2009;87:1967– 8

Technique of Coronary Transfer for TGA with Single Coronary Artery

Tae Ho Kim, M.D., Jae Jun Jung, M.D., Yong Han Kim, M.D., Ji-Hyuk Yang, M.D., Ph.D., Tae-Gook Jun, M.D., Ph.D.

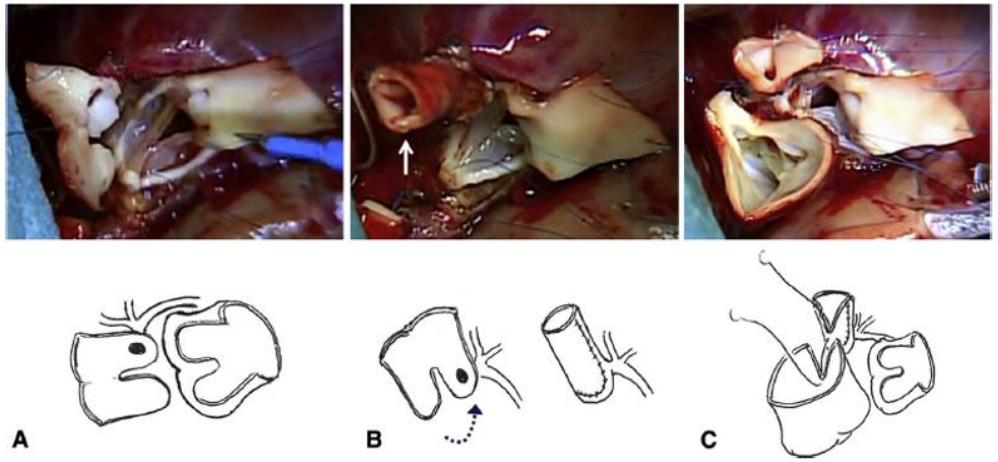


Korean J Thorac Cardiovasc Surg 2014: 47: (in press)

Aortic Sinus Pouch Technique

New coronary transfer technique for transposition of the great arteries with a single coronary artery

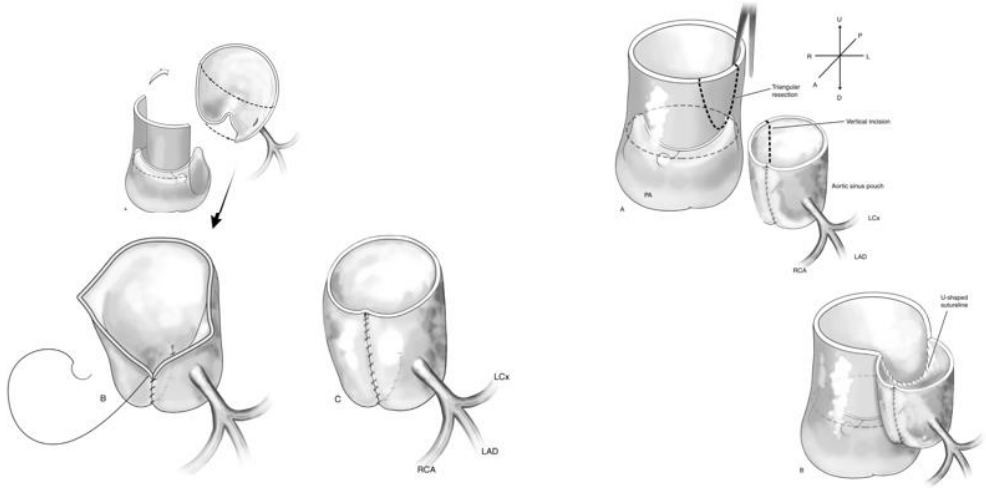
Yoshihiro Ko, MD, Koji Nomura, MD, and Mitsutaka Nakao, MD, Saitama, Japan



J Thorac Cardiovasc Surg 2017;153:1150-1152

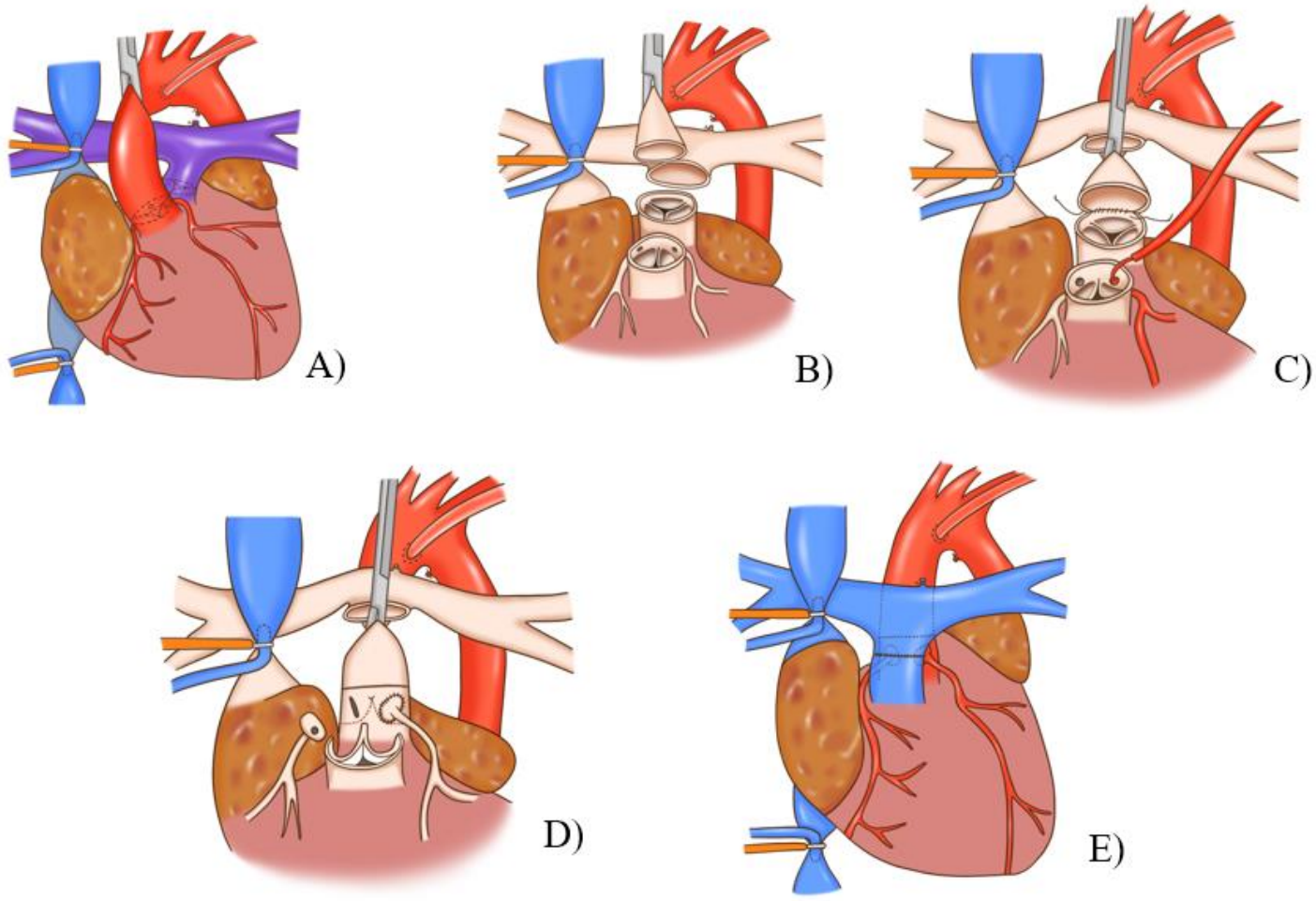
Aortic Sinus Pouch Technique for Dextro-Transposition of the Great Arteries With a Single or Intramural Coronary Artery

Yusuke Yamamoto, MD, PhD, Koji Nomura, MD, PhD, Sho Isobe, MD and Fumiaki Murayama, MD



Operative Techniques in Thoracic and Cardiovascular Surgery 2021; 26:616 - 28

Aorta reconstruction first coronary artery transfer next (closed technique)

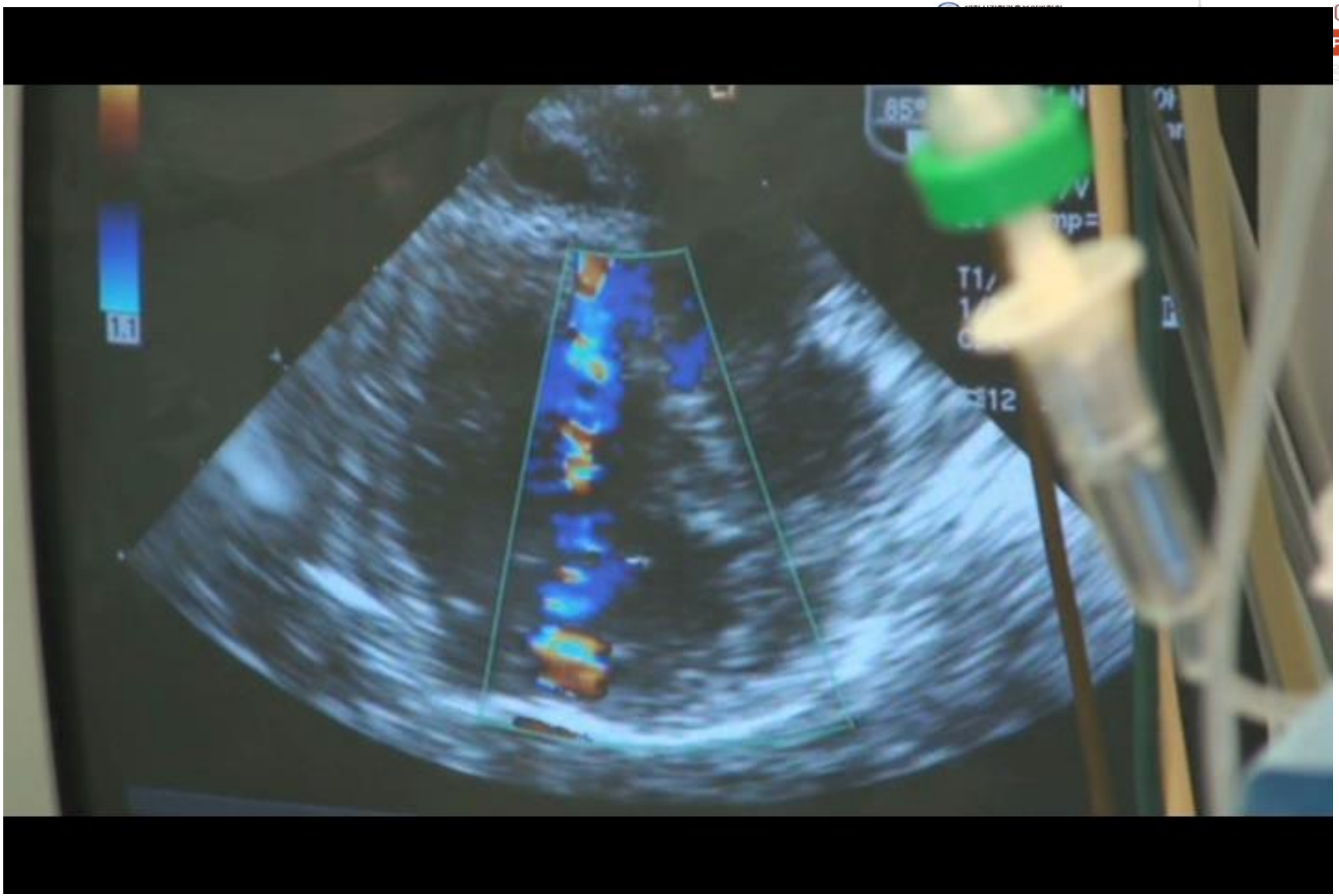


ASO strategy in Samsung Medical Center

- Primary arterial switch operation even in complex TGA, DORV, with without arch anomalies

- Neoaorta reconstruction first , coronary artery transfer second
- Lecompte maneuver in most of the cases
- Neopulmonary artery reconstruction is done using autologous pericardium fixed with glutaraldehyde solution

- Modified ultrafiltration



Summary

- Basic concepts in arterial switch
  - Off axis
  - Trap door
- Level of coronary artery should be considered carefully.
- There are various modifications that can be utilized in complex coronary arteries.

Summary

- Aorta first, coronary second technique for ASO

  - ➢ Easy to reconstruct aorta
  - ➢ Easy to control bleeding
  - ➢ Easy to locate the adequate location of coronary artery
  - ➢ Easy to learn for young surgeon
  - ➢ It can be one of the solution in a center of small volume