Treatment of a Type IV thoracoabdominal aneurysm(TAAA) with open, hybrid and endovascular treatment

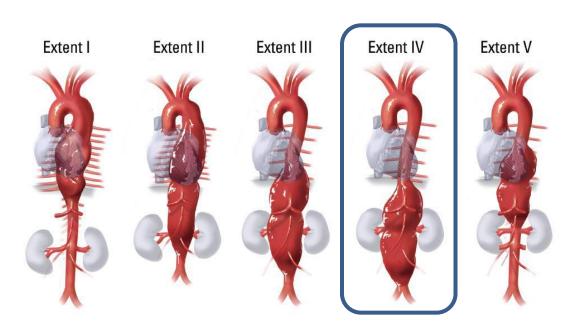
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Thoracoabdominal aortic aneurysm

Modified Crawford classification

- Extent I
 - Above the 6th ICS to renal a.
- Extent II
 - Above the 6th ICS, extend distally into the infrarenal aorta
- Extent III
 - Distal half DTA(below the 6th ICS) to aorticbifurcation
- Extent IV
 - 12th ICS to aorticbifurcation
- Extent V
 - Distal half DTA(below the 6th ICS) to above renal a.



Treatment options

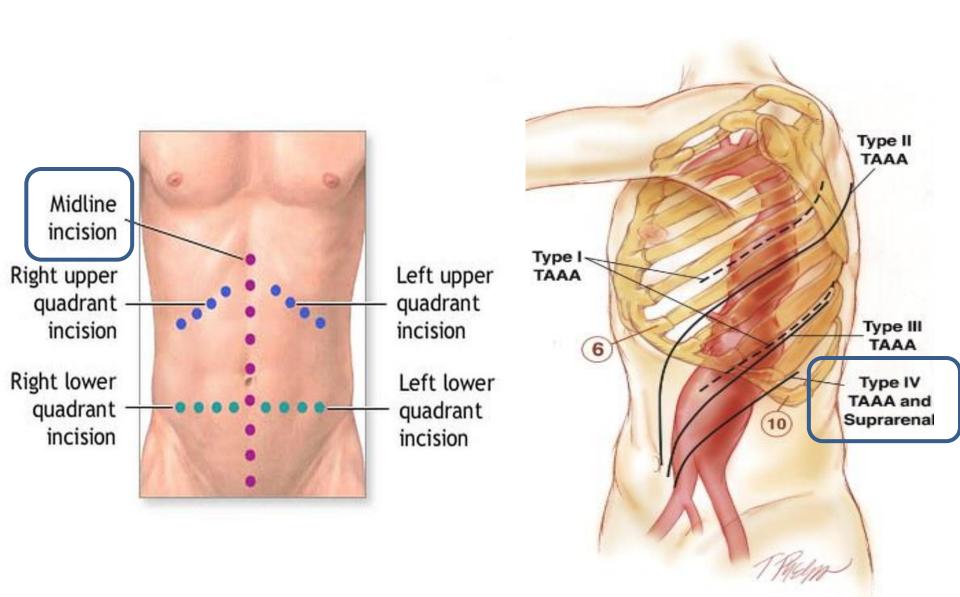
I. Open Surgery

II. Endovascular treatment

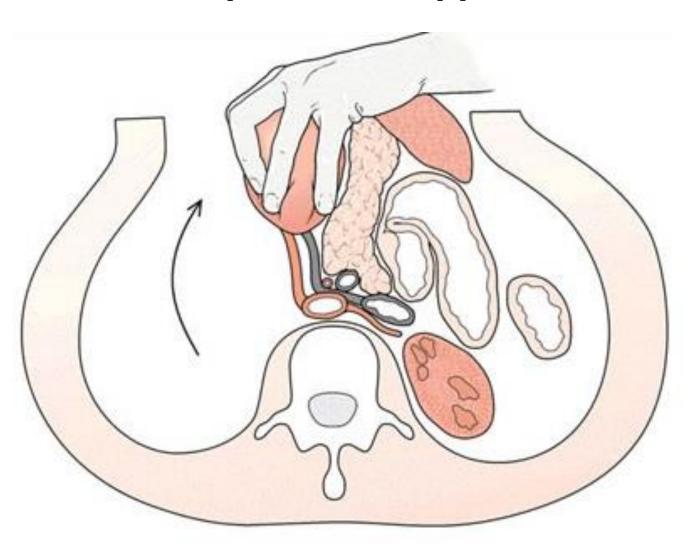
III. Hybrid repair

- 1. Surgical approaches
 - Trans-peritoneal Vs. Retro-peritoneal approach
- 2. Spinal protection
 - Previous Aorta surgery
 - Proximal anastomosis
- 3. Renal protection
 - Clamp time
 - Baseline renal function
- 4. Surgical outcomes

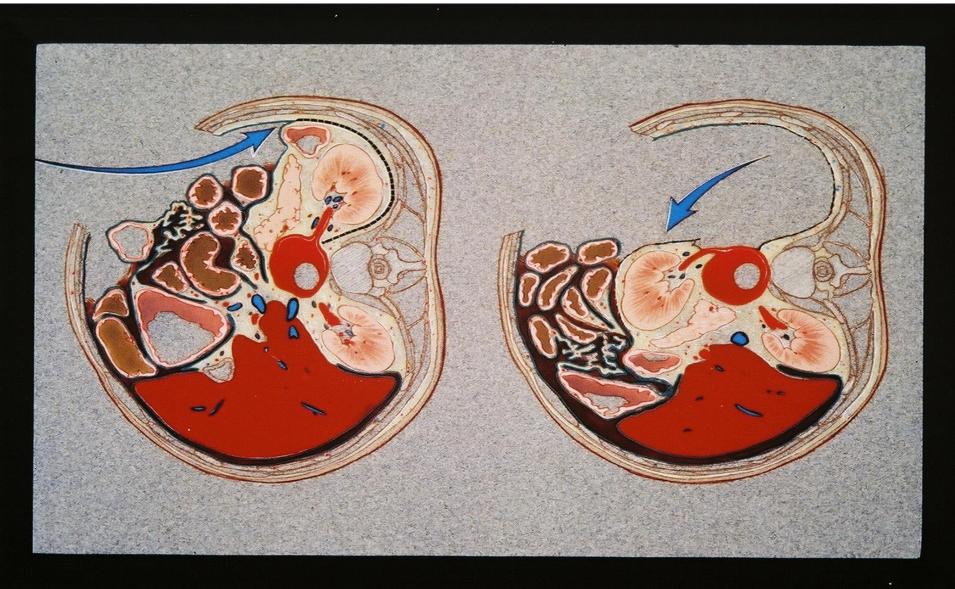
Trans- Vs. Retro-peritoneal approach



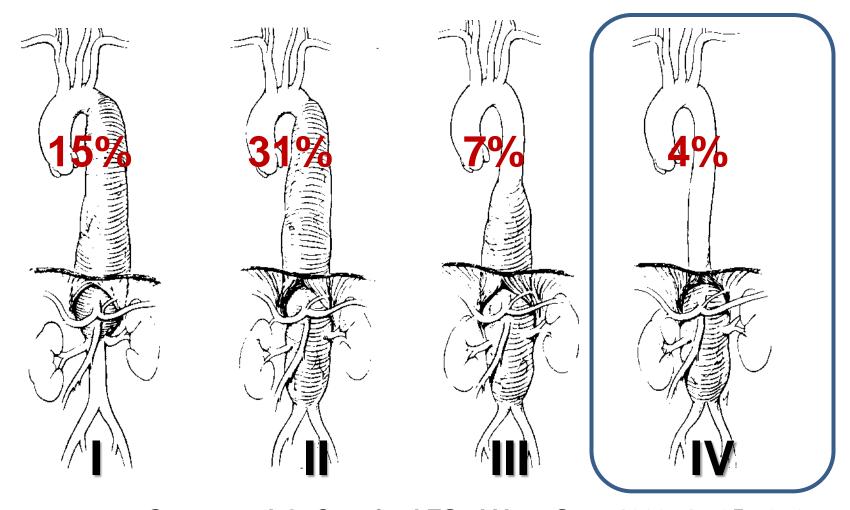
Transperitoneal approach



Retroperitoneal approach



The risk of paraplegia



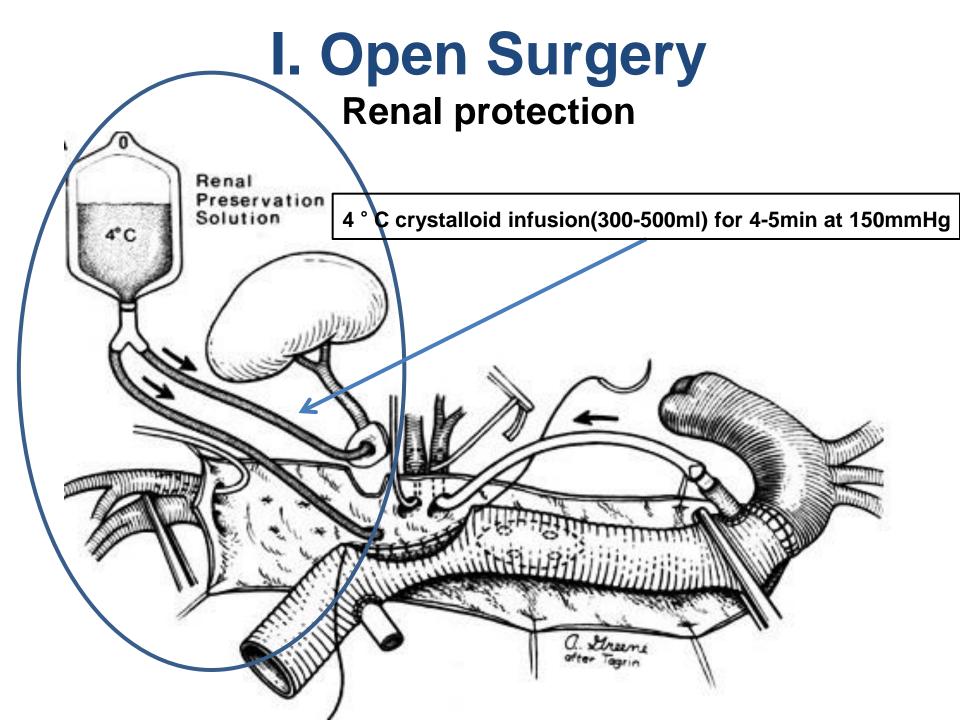
Svensson LG, Crawford ES: J Vasc Surg 1993; 17:357-370

Strategy of spinal protection in Type IV TAAA

- Maintaining good hemodynamic
- Intercoastal a. reattatchment
 - Include ostia of ICAs in Visceral or aortic anastomosis
- CSF drain
 - Previous Aorta surgery
 - Proximal anastomosis above diaphragm
- No need for distal aortic perfusion

Renal protection

- Prevalence of post operative renal failure
 - Up to 20%
 - Significant risk factor for mortality
- Safe time for renal ischemia
 - 45-50min
- Indication of renal protection
 - Preoperative renal dysfunction
 - Clamping time >45-50min



Outcomes

Author	Period of study	n (patients)	Paraplegia n (%)	Renal insufficiency n(%)	Mortality n(%)
Richards et al.	2000-2010	53	1(2)	-	3(6)
Ockert et al.	1997-2004	30	1(1.6)	1(1.6)	2(6)
Lombardi et al	1993-2003	56	0(0)	2(4)	7(13)
Schepens et al.	1981-2003	42	2(5)	4(6)	3(7)
Coselli et al.	1986-2001	329	6(2)	22(7)	12(4)
Cina et al.	1990-2001	42	0(0)	9(21)	2(5)
Cambria et al	1987-2001	66	1(1.5)	-	5(8)
Bicknell et al.	1993-2001	130	6(5)	20(15)	22(17)
Ballard et al.	1996-2001	20	2(6)	0(0)	2(6)

Treatment options

I. Open Surgery

II. Endovascular treatment

III. Hybrid repair

1. Indication

- High risk patient
- Patient without connective tissue disease

2. Totally Endovascular treatment

- a. Chimney technique
- b. Branched EVAR
- c. Fenestrated EVAR

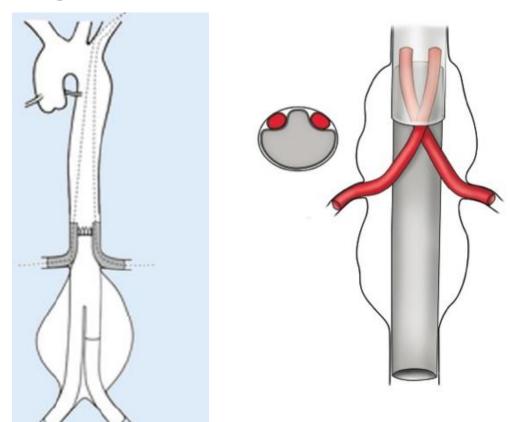
3. Outcome

Indication & Contraindication

- Indication
 - High risk for surgical repair
 - ASA class 3 or 4 with FEV1<50% or EF <40%
 - Old age
 - Suitable anatomy
 - Angulation
 - Length of neck
 - Diameter
- Relative contraindication
 - Connective tissue disease
 - Young age
 - Small branch vessel & stenosis

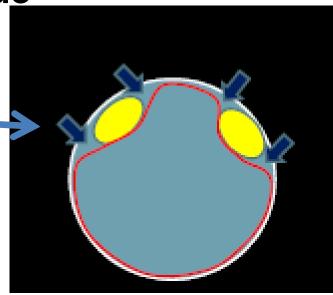
Chimney technique

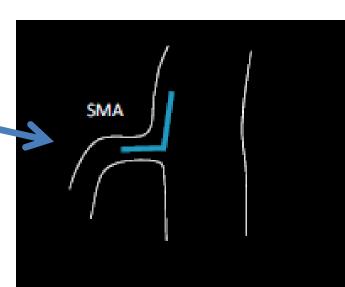
 Adjunctive, <u>parallel branch vessel stenting</u> during intentional endograft coverage of the vessel origin to maintain branch <u>perfusion</u>



Chimney technique

- Limitations
 - Fixation & Seal
 - Loss of wall apposition
 - Risk of endoleak
 - Longer aortic coverage
 - Lack of ideal chimney stent
 - Kinking, compression, occlusion

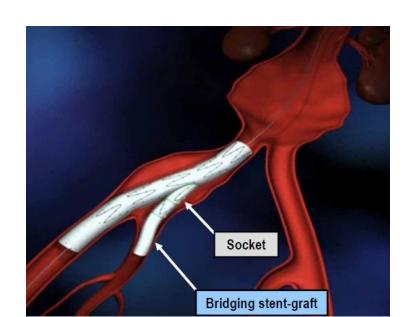




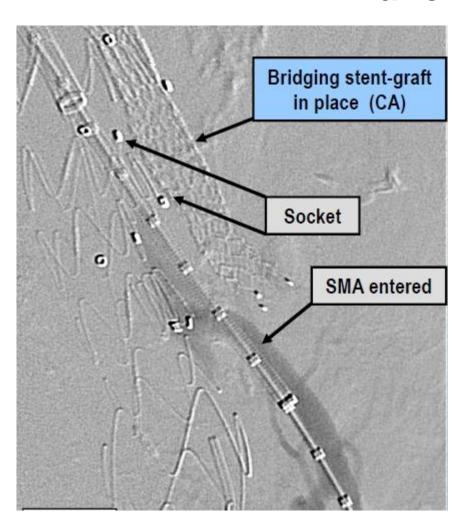
Branched EVAR

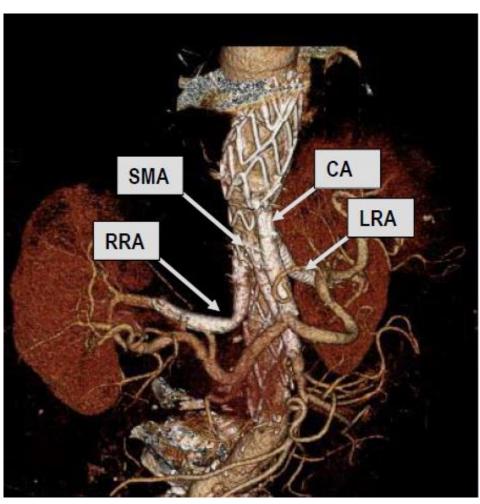
- Endograft with <u>branched socket</u> corresponding to aortic branches
- Custom-designed to patient anatomy





Branched EVAR





Branched EVAR

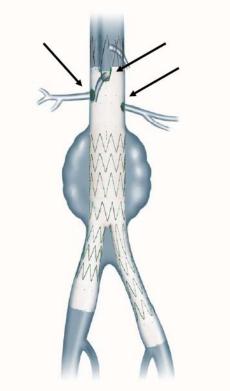
- Limitations
 - Custom-manufacturing
 - Not readily available
 - Exclude emergent/urgent Treatment
 - Unfavorable juxtarenal/suprarenal aortic angle
 - Native Visceral vessel stenosis/occlusion

Cost

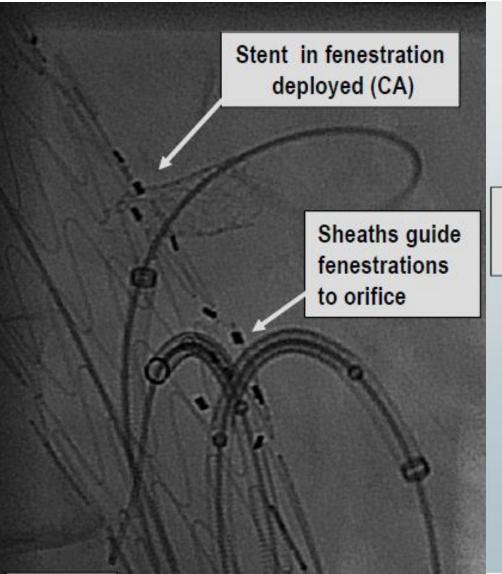
Fenestrated EVAR

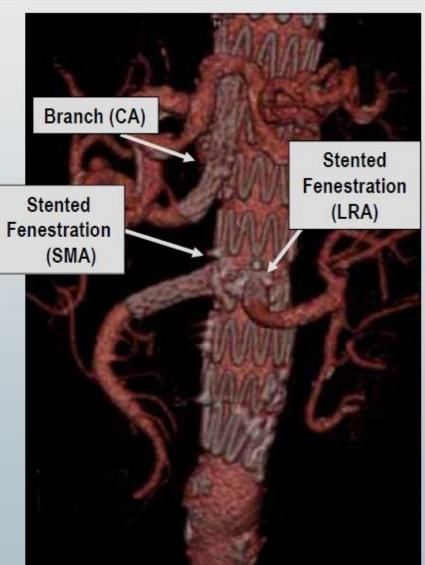
- Endograft with <u>circular and semicircular</u> <u>holes</u> corresponding to aortic branches
- Custom-designed to patient anatomy





Fenestrated EVAR





Fenestrated EVAR

- Limitations
 - Custom-manufacturing
 - Not readily available
 - Exclude emergent/urgent Treatment
 - Insufficient overlap between aortic endograft and branch stent
 - Native Visceral vessel stenosis/occlusion
 - Cost

II. Endovascular treatment Outcomes

- Compared to open surgery
 - Equivalent results
 - 30-day mortality 2.3% (Open surgery: 3~6%)
 - Spinal cord ischemia 1.2 % (Open surgery 1.4~2%)
 - 1 yr- branch stent patency 97.8%

No Long term, randomized result

Treatment options

I. Open Surgery

II. Endovascular treatment

III. Hybrid repair

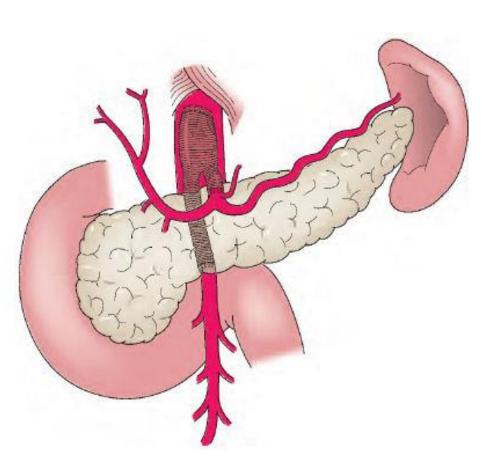
- 1. Indication of Hybrid procedure
 - High risk patient unsuitable for totally endovascular treatment
 - Visceral branch stenosis
- 2. Visceral bypass technique
 - Antegrade Vs. Retrograde bypass
 - Viabahn Open Revascularisaion TEChnique
- 3. Outcome

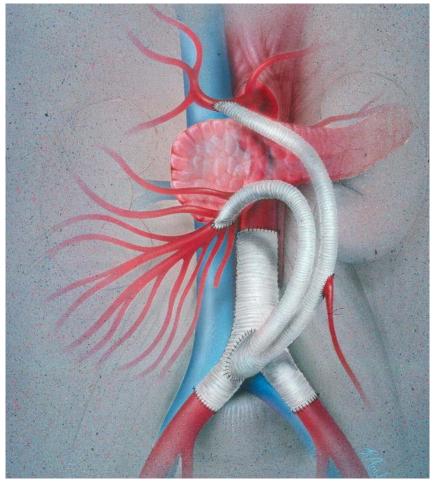
Indication

- High risk patients
 - ASA class 3 or 4 with FEV1<50% or EF <40%
 - Expected adhesion due to previous operation

- Visceral branch stenosis
 - Need surgical revascularization
- No specific advantage in TYPE IV TAAA

Visceral bypass technique

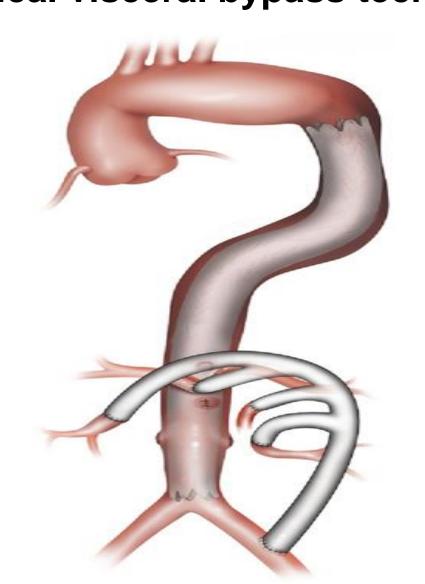




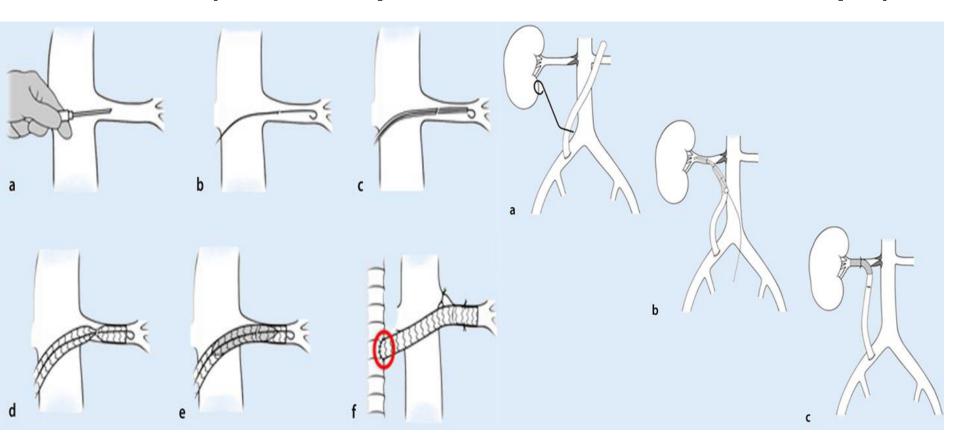
Antegrade visceral bypass

Retrograde visceral bypass

III. Hybrid repair Surgical visceral bypass technique



VORTEC(Viabahn Open Revascularisaion TEChnique)



III. Hybrid repair outcome

- Technical success rate: 98%
- Patency rate
 - 30-day patency rate : 94-98%
 - Mid term patency rate: 84-91%

- No specific benefit in Type IV TAAA
 - Preferred totally open or endovascular repair
- No Long term result

Conclusion

- Treatment of Type IV TAAA
 - Less extent TAAA
 - Endovascular era.
 - Device & technique is evolving
 - FEVAR ,EVAR , Chimney
 - Anatomic & functional definition
 - Anatomic: 12th ICA ~ iliac bifurcation
 - Functional : Supra renal aneurysms

Conclusion

- Totally Endovascular treatment
 - Need a long term data
 - Should be reserved for High risk patients
 - Patient selection is important!
- Hybrid treatment
 - No data comparing with open surgery
 - Require large abdominal exposure
 - Should be reserved for very specific case
 - _Urgent case
 - Unusual anatomy , Reoperation
- Treatment choices are clear
 - Surgery is gold standard treatment.



G-ALIVE 2015

Decision-Making and Techniques on Challenging Type of AAA

- 강남세브란스병원 - Clinical Associate Aortic (Yes

Kwang-Hun Lee & Suk-Won Song

Associate Professor, Interventional Radiology
Aortic Clinic, Gangnam Severance Hospital
Yonsei University College of Medicine

1885 제중원 창립

04 세브란스병원

1913 세브란스의학교

1983 강남세브란스병원





EVAR_Challenging Type of AAA

ANATOMIC

- Juxta-renal AAA
- : Chimneys, Fenestrated
- CIA Aneurysm/ CIA Short/ IIA Aneurysm
- : Sandwiches, IBD
- Hostile Neck

CLINICAL

- Ruptured AAA
- Aorto-enteric Fistula AAA
- Infected Aneurysm
- Combined Dissection



CIA Aneurysm/ CIA Short/ IIA Aneurysm



IBD



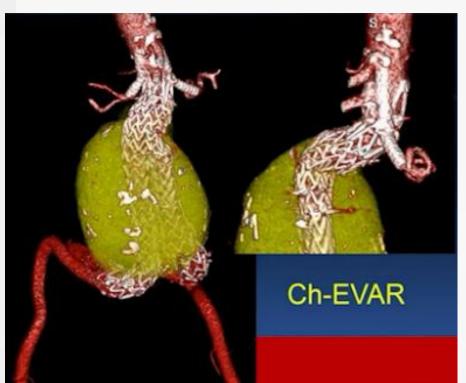


Brazilian Registry of Sandwich





Juxta-renal AAA



- **Ia ENDOLEAK** 3—10%
- Mechanical Interaction
- Uncertain Long-term Durability
- Lack of Strong Evidence
- Violation on Open Conversion

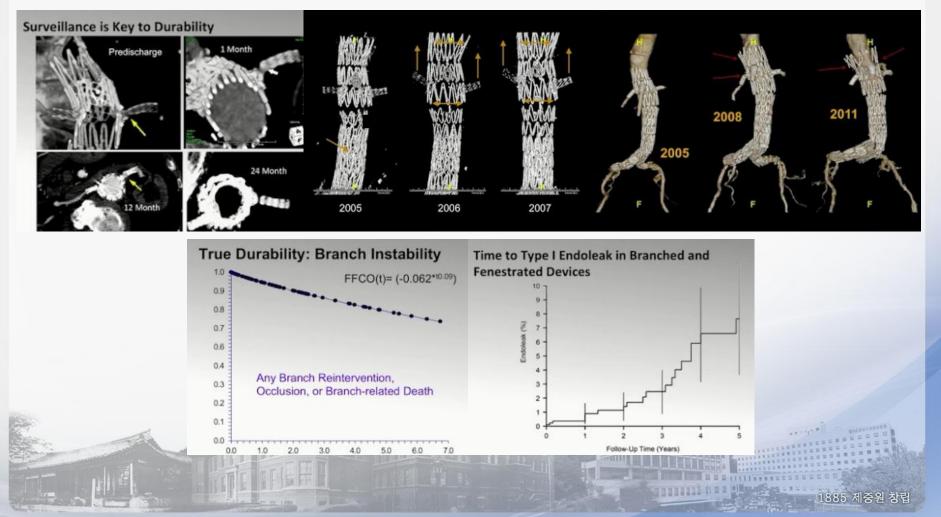
VIETH 2015

1885 제중원 창립



Juxta-renal AAA

VIETH 2015

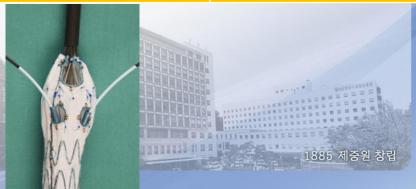


Juxta-renal AAA



Standard EVAR	Standard EVAR with Chimneys	FEVAR	OR
Risk of Type Ia Endoleak X4	Mortality 5%	40% Rejection Rate	Mortality 2.9—5%
Risk of Aneurysm	Type Ia Endoleak 12%	20% Intraprocedural difficulties	Renal impairment 5—38%
Related Mortality X9		Mortality without adverse	
Need longer fu data of Ovation, Nellix		technical issues 4.5% / with adverse technical issues 18%	
NO	UNFIT PATIENT URGENT CASE	FAVORABLE ANATOMY UNFIT PATIENT	FIT PATIENT RENAL ROTECTION





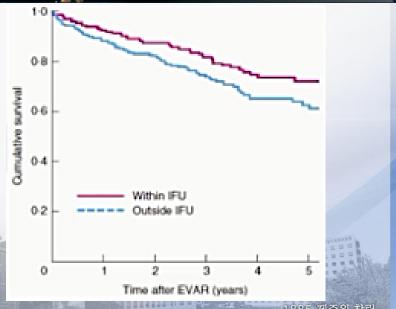
Out of IFU in Cases of Hostile Neck



VIETH 2015



- **♦** Migration
- ◆ Device-related complications
- ◆ Re-interventions
- ◆ Short neck associated with significantly higher type Ia ENDOLEAK 10% -→ 50%
- ◆ Open conversion mortality 18%, morbidity 55%





Out of IFU in Cases of Hostile Neck

Suprarenal Fixation vs. Infrarenal Fixation

How to Adapt to the Angulated Neck?

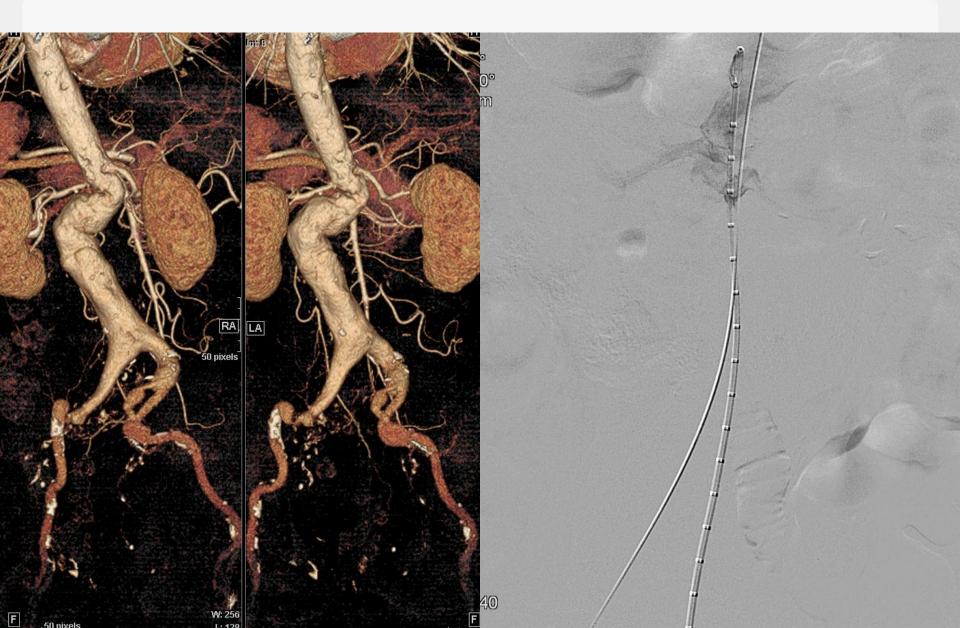


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M/73

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Out of IFU: Neck L 10mm & Angulation 90°



Medtronic ENDURANT Suprarenal Fixation

○ 강남세브란스병원 GANGNAM SEVERANCE HOSPITAL

1. RtMainBody 32-145-16, 2. **ContraLimb selection and Reliant balloon touch up first on the neck**, 3. ContraLimb 16-124-13 + 16-124-10, 4. IpsiLimb 16-93-20, 5. Reliant, 6. LEIA kinking segment Bard E-Luminex 12-4 and 10mm PTA balloon



Out of IFU:

Short primary neck < 10mm

Small primary neck

Acute 90° primary neck: Double

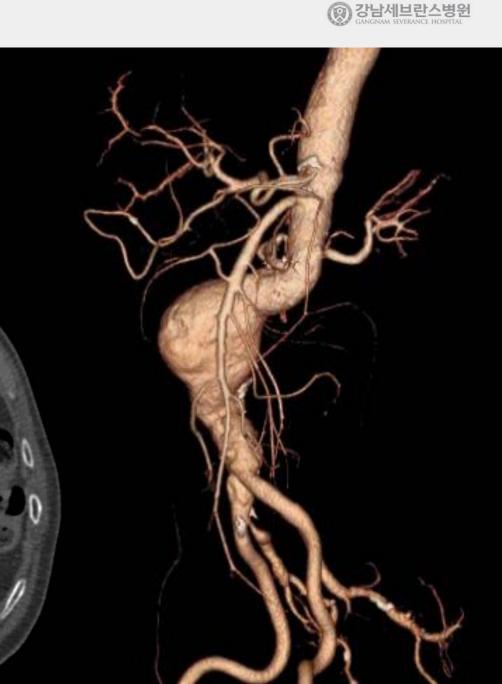
angulation

Large conical secondary neck

Lt renal artery stenosis

Short RCIA

RIIA stenosis



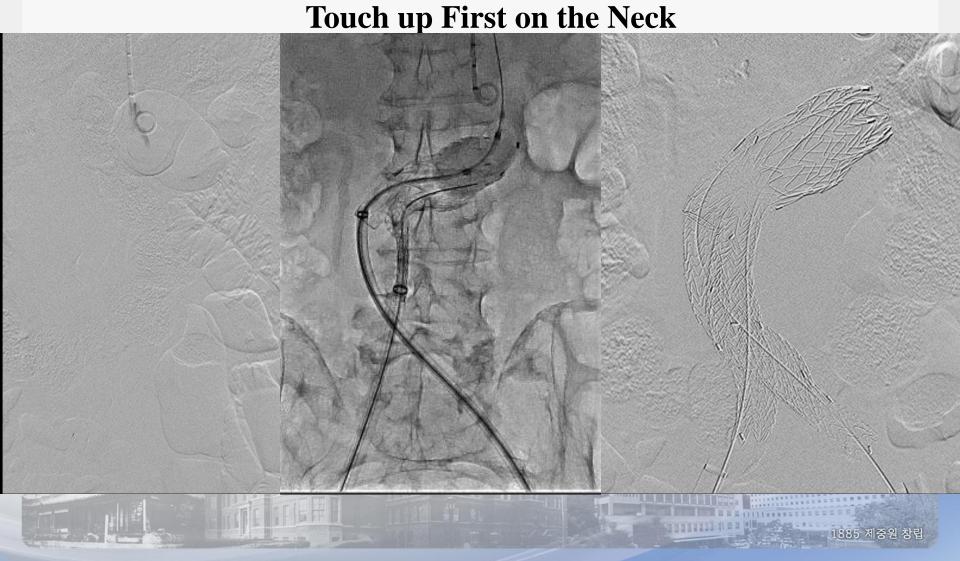
Gore EXCLUDER Infrarenal Fixation

RtMainBody 31-130-14.5

ContraLimb 16-140-14.5 + 16-70-14.5

IpsiLimb 16-95-18

Maintain Aortic Angulation and Balloon
Touch up First on the Nock





Hostile Neck & Juxta-renal AAA

Clinical decision by family: Endo vs. Open Repair

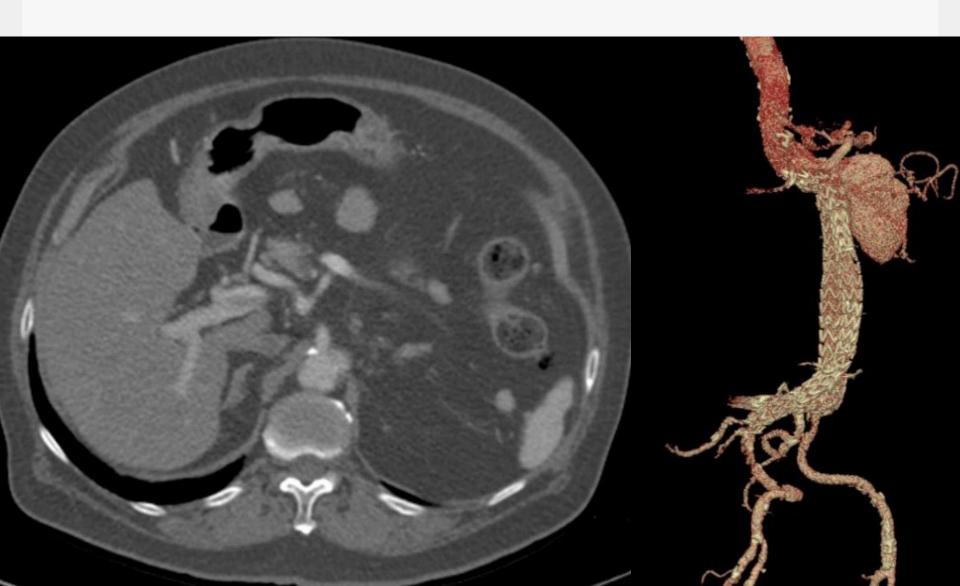


s/p EVAR in 2012 @ Out of Hospital, Endurant MainBody 28mm M/86 (실제나이 90)



8.5 years ago 38-65-29

3 years after EVAR 74-94-40; Type Ia ENDOLEAK_Blind Sac



Juxta-renal involvement of aneurysm Massive Type Ia ENDOLEAK

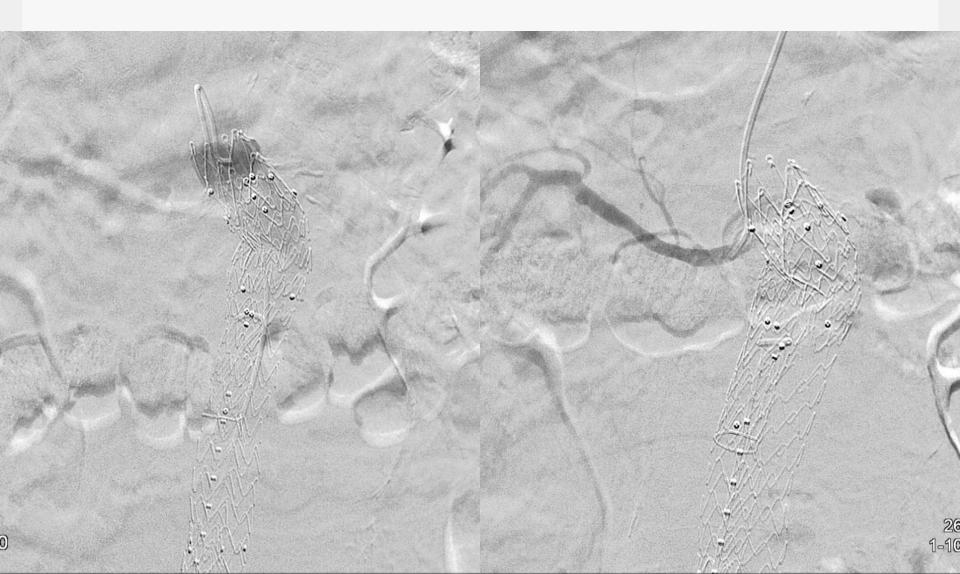




s/p 28mm MainBody

-→ 32mm Endurant Cuff







Chronic Dissecting AAA



SHM브란스병원 GANGNAM SEVERANCE HOSPITAL

Chronic Dissecting AAA

: Entry tear @ juxta-IMA, Re-entry tear @ LCIA s/p Lt nephrectomy d/t RCCa 1995









361992 和部上 万/9. # H. 2 pmohnes himb preduce X2 \$ CLZ \$ IL1 \$ 7L 6/ne. Infased GORE.

(A.MB of-10-6)

Lest. 16-9t-18

CL 16-70-6) + 16-9t-20.





<1> microcoil embolization of IMA to prevent type II endoleak, 5F catheter stay in AA-entry tear-FL

<2> Gore Excluder; RtMainBody 26-120-12/ Rt extension 16-95-18/ ContraLimbLt 16-70-12/ LtLimb extension 16-95-20 <3> NBCA into AA-entry tear-FL-reentry tear

*2 punctures on LCFA: one for ContraLimbGraft, the other for FL embolization

*IMA election via LCIA re-entry-FL-entry tear-AA

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Dissecting AAA-biCIA aneurysm-RIIA aneurysm

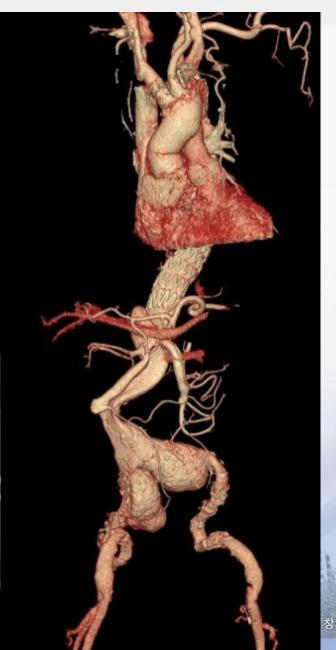
; LIIA auto-occluded

s/p Graft replacement ATA out of hospital 2007

s/p TEVAR Z3 to SC 2013-07-29

: TX2PF 2PT 40-208-36 + 36-197-32

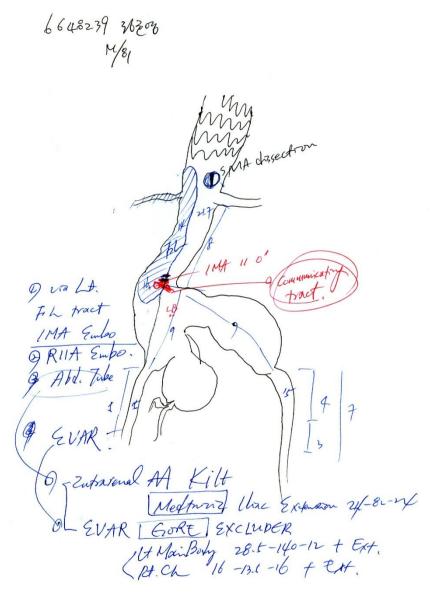




Dissecting AAA-biCIA aneurysm-RIIA aneurysm; LIIA auto-occluded











Dissecting AAA-biCIA aneurysm-RIIA aneurysm; LIIA auto-occluded

s/p Graft replacement ATA out of hospital 2007

s/p TEVAR Z3 to SC 2013-07-29

: TX2PF 2PT 40-208-36 + 36-197-32

◆ 2014.03.25 EVAR & Adjunctives

<1>AAA-FL communication-IMA: 6mm-0.035"

Nester embolization

<2> RIIA: microNester embolization

<3> Infrarenal AA "Kilt"-Medtronic Iliac

Extension 24-82-24

<4> Gore Excluder LtMainBody 28.5-140-12/

IpsiExtension 16-11.5-16/ ContraLimb 16-13.5-16

+ 16-9.5-16

강남세브란스병원 GANGNAM SEVERANCE HOSPITAL

AAA & chronic dissecting FL aneurysm infrarenal abdominal aorta

& DTA distal-thoracoabdominal dissecting aneurysm

& Arch-DTAp aneurysm



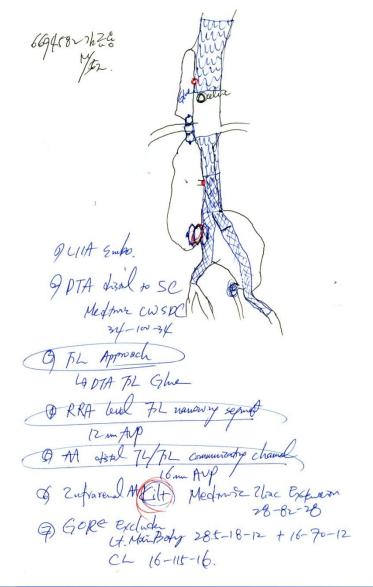


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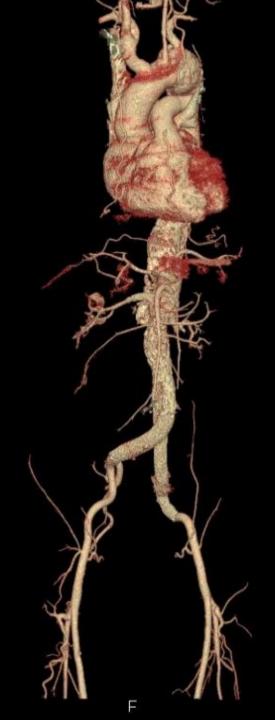
AAA & chronic dissecting FL aneurysm infrarenal abdominal aorta & DTA distal-thoracoabdominal dissecting aneurysm & arch-DTAp aneurysm











- ◆ 2014.03.11 TEVAR & EVAR & Adjunctives
- <1> LIIA-microNester embolization
- <2> DTA distal to Supraceliac Medtronic 34-100-34 CWSDC
- <3> DTA FL-NBCA
- <4> RRA level FL narrowing segment 12mm AVP
- & NBCA
- <5> AA distal TL/FL communicating channel 16mm AVP
- <6> Infrarenal AA "Kilt"-Medtronic Iliac Extension 28-82-28
- <7> Gore Excluder LtMainBody 28.5-180-12/ ContraLimb 16-115-16/ IpsiExtension 16-70-12





for Successful Clinical Outcome:

- Proper Clinical Decision-making
- Procedural Decision-making and Techniques (not only EVAR but Adjunctives)
- Comprehensive Interpretation of CT images







학술대회 안내

행사일시	2015년 10월 31일 (토) 09:00—17:30
행사장소	Grand Auditorium (3F), Gangnam Severance, Yonsei University
사전등록 마감일	~ 2015년 10월 16일 (금)
평점	대한의사협회 6평점



Vascular disease presenting as abdominal pain

김장용 가톨릭대학교 서울성모병원

외과에서 보는 acute abdomen은 복통의 sign과 symptom을 보이며 종종 응급수술을 요하는 질환이다. 정확한 진단이 중요하고 nonsurgical cause 에 대한 이해도 필요하다. 이에, 복통을 일으키는 질환에 대해 surgical treatment의 필요성에 따라 분류하여 보았다.

Surgical Causes of the Acute Abdomen

- Hemorrhage: Solid organ trauma, Leaking or ruptured arterial aneurysm, Ruptured ectopic
 pregnancy, Bleeding gastrointestinal diverticulum, Arteriovenous malformation of gastrointestinal
 tract, Intestinal ulceration, Aortoduodenal fistula after aortic vascular graft, Hemorrhagic pancreatitis,
 Mallory-Weiss syndrome, Spontaneous rupture of spleen
- **Infection**: Appendicitis, Cholecystitis, Meckel's diverticulitis, Hepatic abscess, Diverticular abscess, Psoas abscess
- **Perforation :** Perforated gastrointestinal ulcer, Perforated gastrointestinal cancer, Boerhaave's syndrome, Perforated diverticulum
- **Ischemia**: Buerger's disease, Mesenteric thrombosis/embolism, Ovarian torsion, Ischemic colitis, Testicular torsion, Strangulated hernias

Nonsurgical Causes of the Acute Abdomen

- **Endocrine and Metabolic Causes :** Uremia, Diabetic crisis, Addisonian crisis, Acute intermittent porphyria, Hereditary Mediterranean fever
- Hematologic Causes: Sickle cell crisis, Acute leukemia. Other blood dyscrasias
- Toxins and Drugs: Lead poisoning, Other heavy metal poisoning, Narcotic withdrawal, Black widow spider poisoning
- 그 중에서 흔한 Vascular disease presenting as abdominal pain을 정리해보면
 - · Acute mesenteric ischemia, arterial
 - Acute mesenteric ischemia, venous
 - · Chronic mesenteric ischemia, arterial
 - Acute renal infarction
 - Aortic aneurysm, ruptured
 - Aortic aneurysm, infected
 - Visceral artery aneurysm, ruptured: splenic, celiac, mesenteric artery
 - · Aortic dissection, complicated
 - Pelvic congestion syndrome
 - Nutcraker's syndrome

연수강좌에서 증례 별로 정리하여 보겠습니다.

Tae-Hoon Kim MD, PhD

Interventional Cardiologist, Sejong General Hospital

Distal bypass for limb salvage with an autogenous conduit is an excellent option for patients with critical limb ischemia (CLI). However, multiple prohibitive comorbidities, an inadequate conduit, and a lack of suitable distal targets for revascularization makes the patients far from good surgical bypass candidates significantly. Moreover, the patients with CLI usually had multilevel involvements; a single surgical plan is sometimes not adequate for patients. With the advent of feasible techniques and novel devices for endovascular therapy, there may be a need to reevaluate endovascular therapy.

Long-term patency is essential following intervention for limb salvage. But, patency rates are usually different by the region of lower leg disease involvement.

Currently, there is new wave for endovascular-first strategy for aortoiliac lesions irrespectively of TASC category. Jongkind et al. 1 performed a meta-analysis of 19 nonrandomized cohort studies on 1711 patients with TASC C or D aortoiliac disease who had endovascular revascularization between 2000 and 2009. Technical success was reported to be between 86% and 100%, with clinical improvement obtained in 83% to 100% of patients. The long-term (4- or 5-year) primary patency rates ranged from 60% to 86%, and secondary patency rates ranged from 80% to 98%. Similar patency rates in iliac disease across all TASC classes have been reported even in studies with long-term follow-up^{2, 3}. Contrary to this, the endovascular treatment for superficial femoral artery (SFA) was not fully recommended even in the CLI conditions because 1 year patency rate reached about the 60~70%, even with the use of new generation stent⁴. However recently, a randomized control study showed

remarkably decreased the target lesion revascularization rates at 12 months with use of drugcoated balloon (DCB) as 2.4%. The result of this rigorously conducted randomized trial warrant a review of current treatment guidelines for peripheral artery disease in the lower extremities. The use of DCB is now available in Korea, and it became an insurance coverage procedure in SFA intervention soon. The continuous advance in the field of vascular intervention has facilitated BTK angioplasty through the development of low-profile balloon, catheters, various drug delivery stent, hydrophilic guide wires, road map facilities, vasodilators, and antiplatelet medication. Thus, it is currently supported by accumulated clinical data and therefore constitutes a first line treatment for BTK arterial occlusive disease. Although the primary patency of PTA at 6 months (65 \pm 7.0 %) and 12 months (58.1 \pm 4.6 %) were significantly lower than of bypass surgery (85.8 \pm 2.1 %, p=0.05, and 81.5 \pm 2.0 %, p=0.05, respectively) in meta-analysis, there was no significant difference between limb salvage at 6 months (88.2 \pm 4.4 % vs. 90.9 \pm 1.9 %) and 12 months (86.0 \pm 2.7 % vs. 88.5 $\pm 2.2 \%$)^{5, 6}. Currently, patients with significant medical co-morbidities that limit life expectancy (<2 years), those at increased risk for surgery, those without an adequate distal target for bypass, or with poor venous conduit should be considered for an endovascular-first approach⁷. Considering the patient probably has variable anatomic and medical conditions, the endovascular treatment could be the first line treatment in some clinical situation for CLI inevitably.

References

- Jongkind V, Akkersdijk GJ, Yeung KK, Wisselink W. A systematic review of endovascular treatment of extensive aortoiliac occlusive disease. *Journal of vascular* surgery. 2010;52:1376-1383
- 2. Ichihashi S, Higashiura W, Itoh H, Sakaguchi S, Nishimine K, Kichikawa K. Longterm outcomes for systematic primary stent placement in complex iliac artery

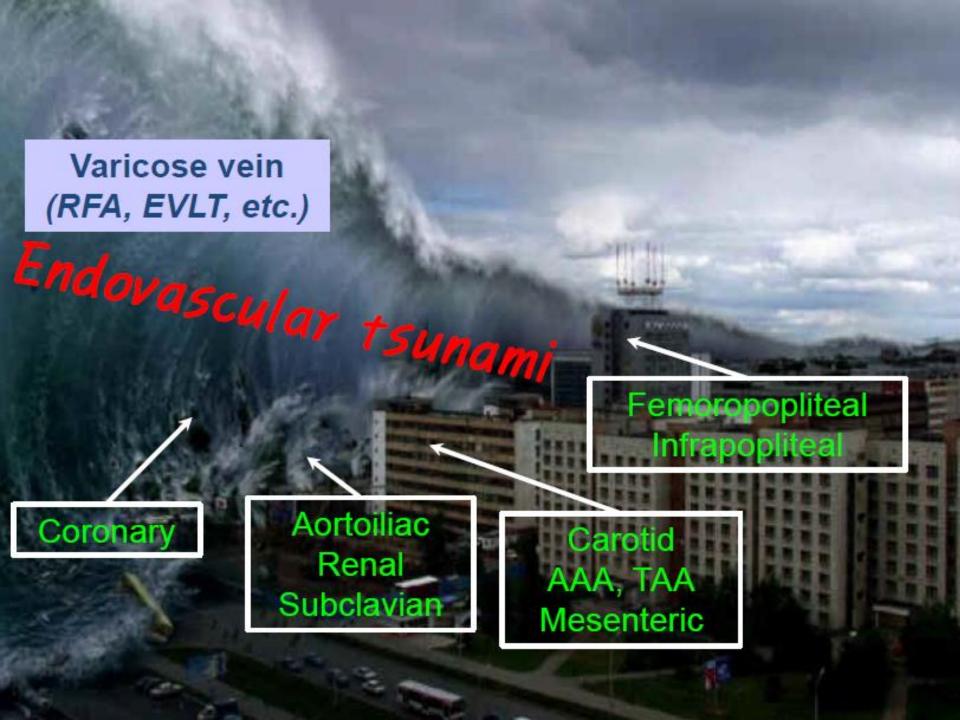
- occlusive disease classified according to trans-atlantic inter-society consensus (tasc)-ii. *Journal of vascular surgery*. 2011;53:992-999
- 3. Pulli R, Dorigo W, Fargion A, Innocenti AA, Pratesi G, Marek J, Pratesi C. Early and long-term comparison of endovascular treatment of iliac artery occlusions and stenosis. *Journal of vascular surgery*. 2011;53:92-98
- 4. Schillinger M, Sabeti S, Loewe C, Dick P, Amighi J, Mlekusch W, Schlager O, Cejna M, Lammer J, Minar E. Balloon angioplasty versus implantation of nitinol stents in the superficial femoral artery. *The New England journal of medicine*. 2006;354:1879-1888
- Romiti M, Albers M, Brochado-Neto FC, Durazzo AE, Pereira CA, De Luccia N.
 Meta-analysis of infrapopliteal angioplasty for chronic critical limb ischemia. *Journal of vascular surgery*. 2008;47:975-981
- 6. Albers M, Romiti M, Brochado-Neto FC, De Luccia N, Pereira CA. Meta-analysis of popliteal-to-distal vein bypass grafts for critical ischemia. *Journal of vascular surgery*. 2006;43:498-503
- 7. Gray BH, Diaz-Sandoval LJ, Dieter RS, Jaff MR, White CJ. Scai expert consensus statement for infrapopliteal arterial intervention appropriate use. *Catheterization and cardiovascular interventions : official journal of the Society for Cardiac Angiography & Interventions*. 2014;84:539-545

<u>Current Trends and</u> <u>Comlication Managements</u>

in Varicose Vein Surery

Department of Thoracic and Cardiovascular Surgery
Sejong General Hospital
Joon Hyuk Kong

Treatment



Laser Therapy: 외부 레이저

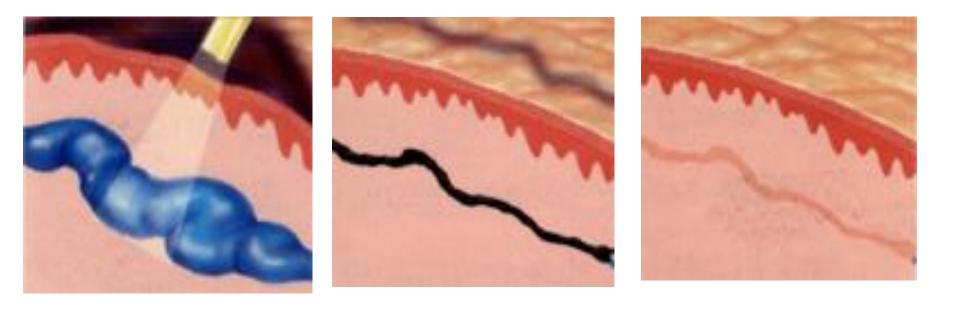
• Telangiectatic type: 거미양형



Laser Therapy (IPL)



Laser Therapy (IPL)



ExothermeTM

• Exotherme is a transcutaneous vascular laser, unique on the market today, dedicated to spider veins and leg and facial telangiectasias, for a

painless treatment.



General Principle of Vascular Laser

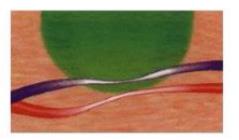
Selective photothermolysis

- very intense laser pulse, shorter than the TRT of the vessel.
- There is no time enough for the induced heat to be dissipated. Sharp rise of pressure inside the vessel Dislocation of the inside wall with a blood extravasation.
- The clinical presence of purpura can be noted during 10 to 14 days due to the blood extravasation.

Selective photocoagulation

Longer laser pulse, superior to the TRT of vessel thermal action collagen





Photothermolysis

Presence of purpura

Photocoagulation
No purpura

Laser Therapy (Exoderme)











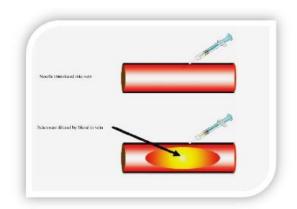


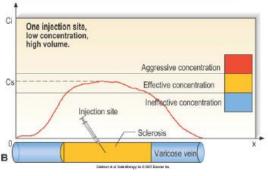
Sclerotherapy: 혈관경화요법

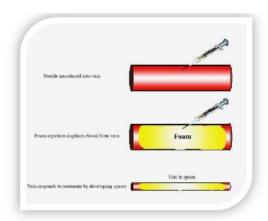
• Reticular type: 망상형

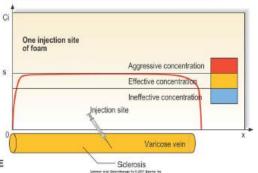


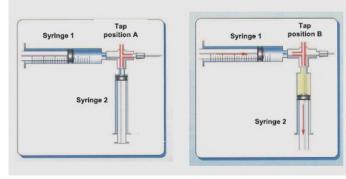
Liquid vs Foam

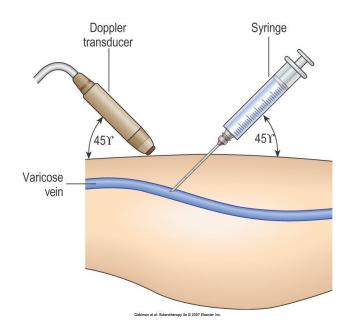






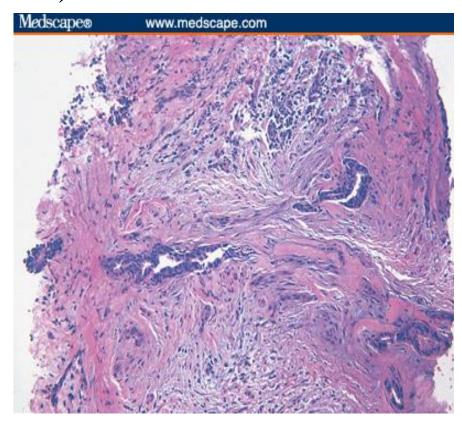






Foam Sclerotherapy

- 1:4 Sclerosant (1% or 3%): Air
- Why foam?
 - Induces spasm
 - Disperses further
 - Enhanced sclerosis



Breu, FX, Guggenbichler, S. European Consensus Meeting on Foam Sclerotherapy, April, 4-6, 2003, Tegernsee, Germany. Dermatol Surg 2004; 30:709.

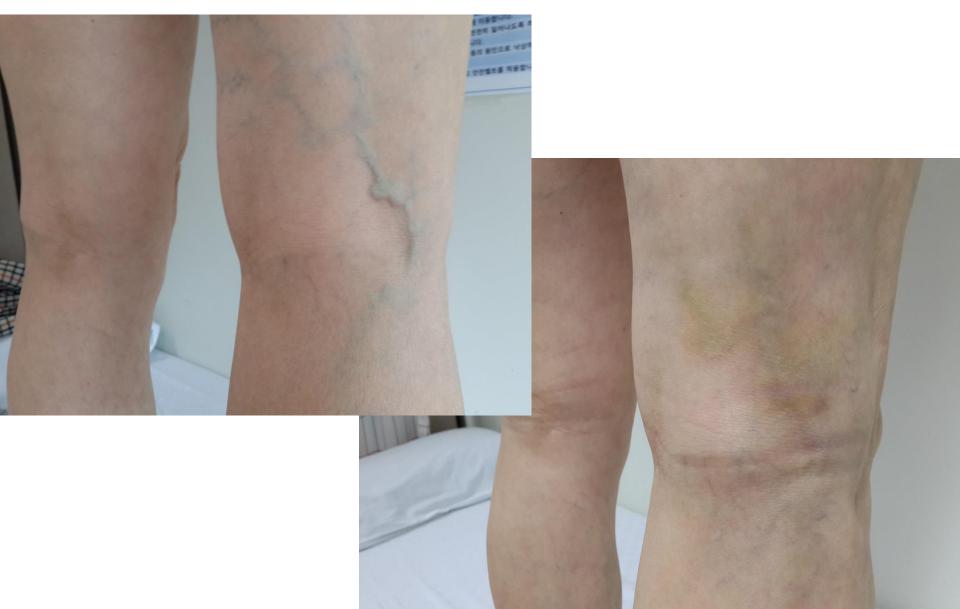
Sclerotherapy



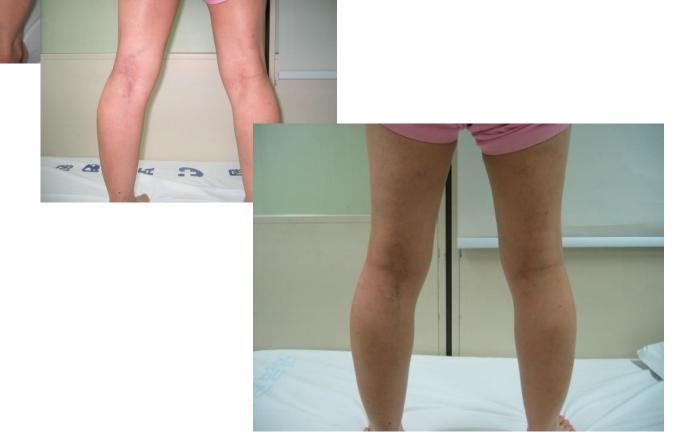
Sclerotherapy

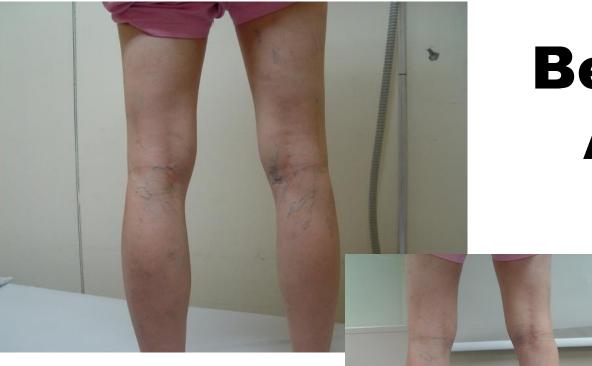


Before & After









Before & After-

30 4:25 PM

Surgical Treatment

Varicoser Vein



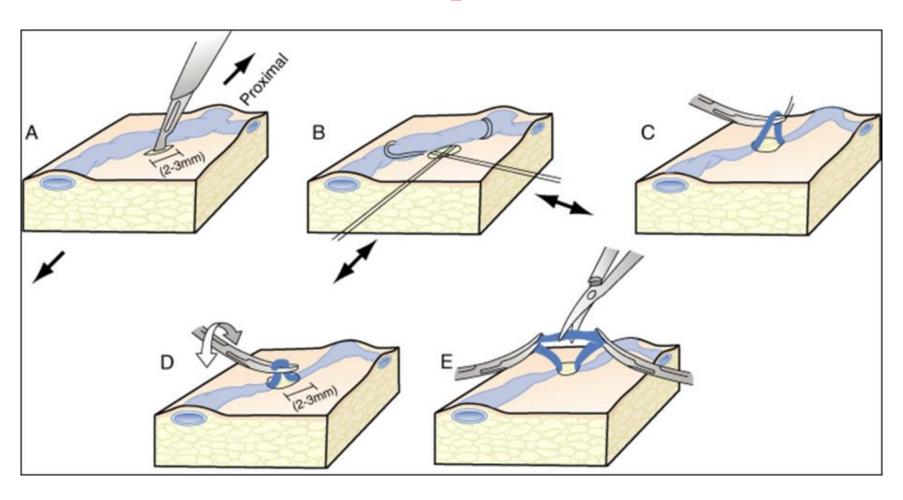
Mutiple Stab Avulsion: 발거술

Varicose Vein



Stab Avulsion

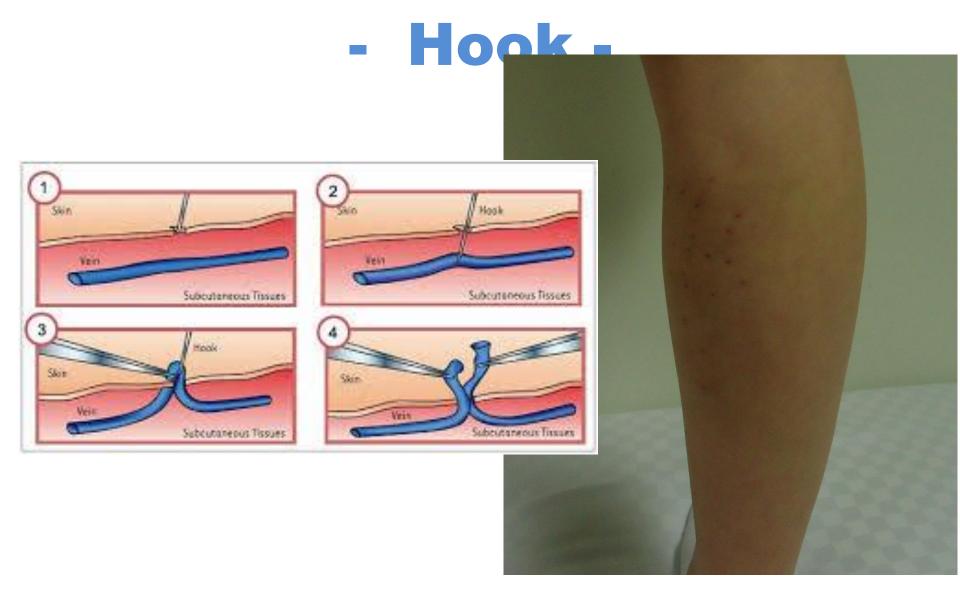
- Mosquito -



Stab Avulsion - Mosquito -



Stab Avulsion



Phlebectomy (Ambulatory, How ?)



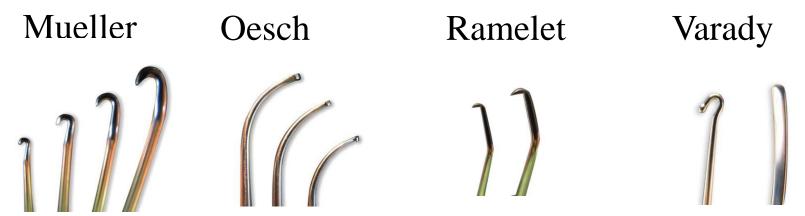






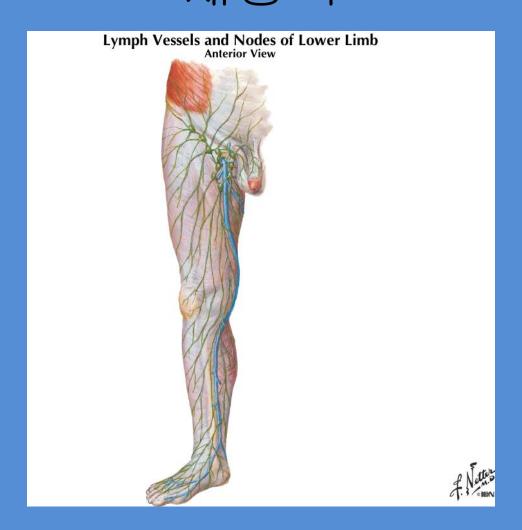
- 1. No Ligature
- 2. No skin sutures
- 3. Initial incision of 2 mm
- 4. Immediate ambulation
- 5. Local anesthesia
- 6. Compression: 3 weeks

Phlebectomy (Ambulatory, How ?)

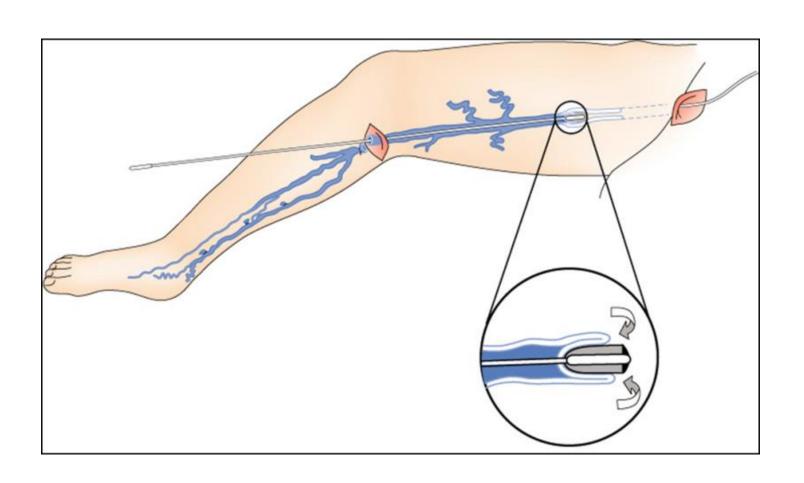


- 1. Avoid nontarget tissues: < 5mm in depth
- 2. Special caution: below knee (saphenous, sural N.), ankle (thick tissue, nerve)
- 3. Do not insert mosquito into the incisions, Squeezing of periincision site
- 4. Incision policy: 30 fold —length vein extracted per incision length
- 5. I prefer the Varady hook (dissection + hook)

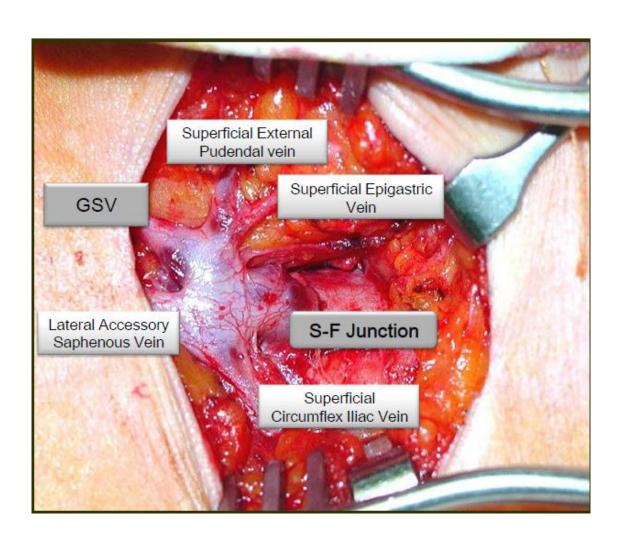
Stripper Stripping (GSV): 대복 재정맥



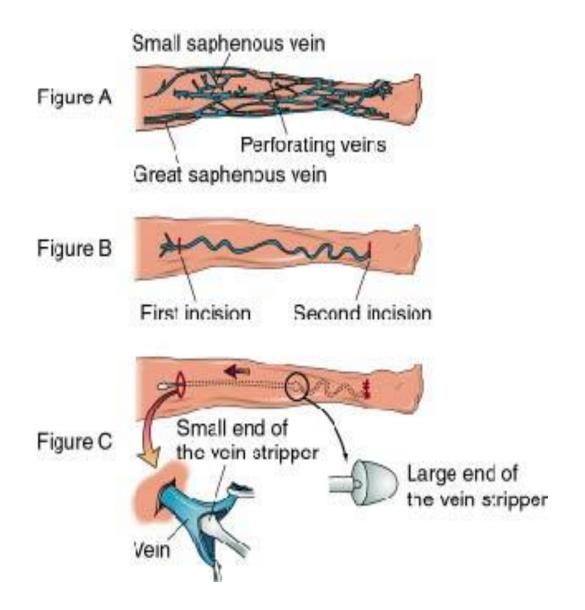
Stripper Stripping (GSV)



Sapheno-femoral Junction



Stripper Stripping (SSV)

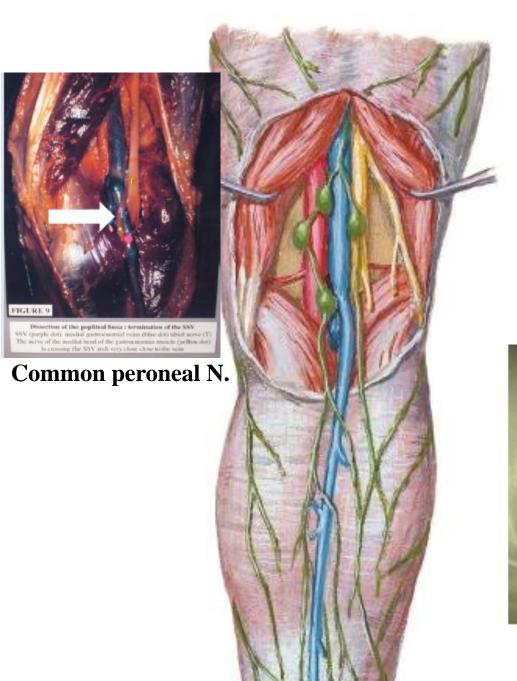


Stripping & Stab Avulsion



Division (SSV): 소복재정맥

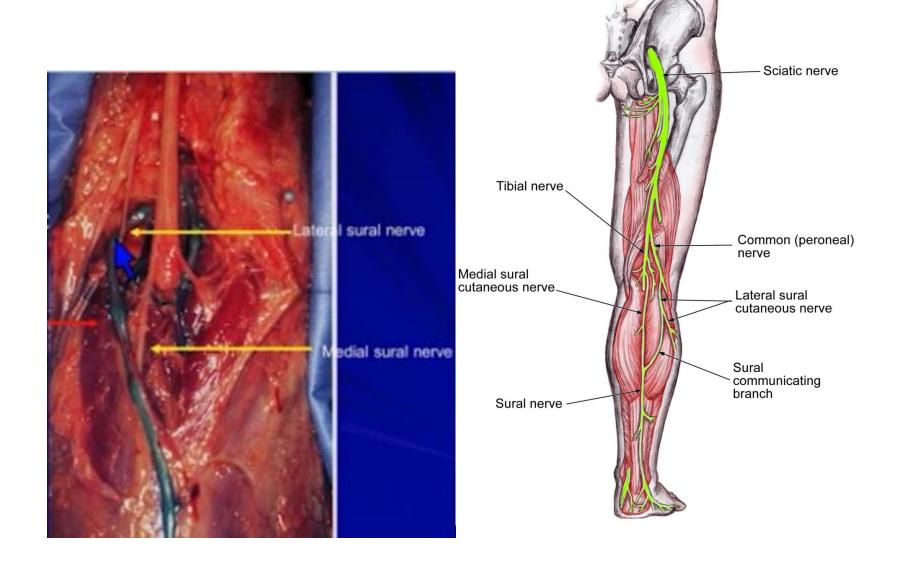






Sural N.

To avoid nerve damage



To avoid nerve damage



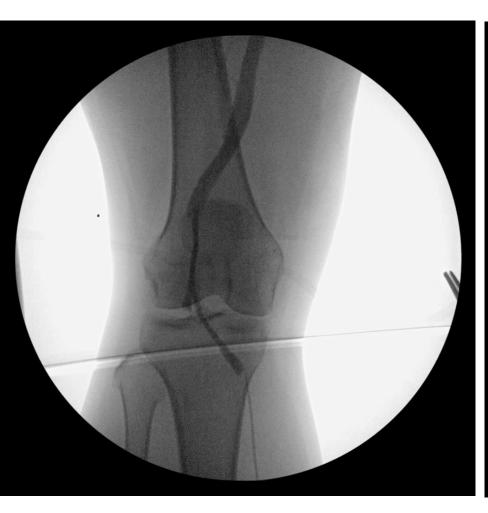
Division (SSV)



SSV venography



SSV venography



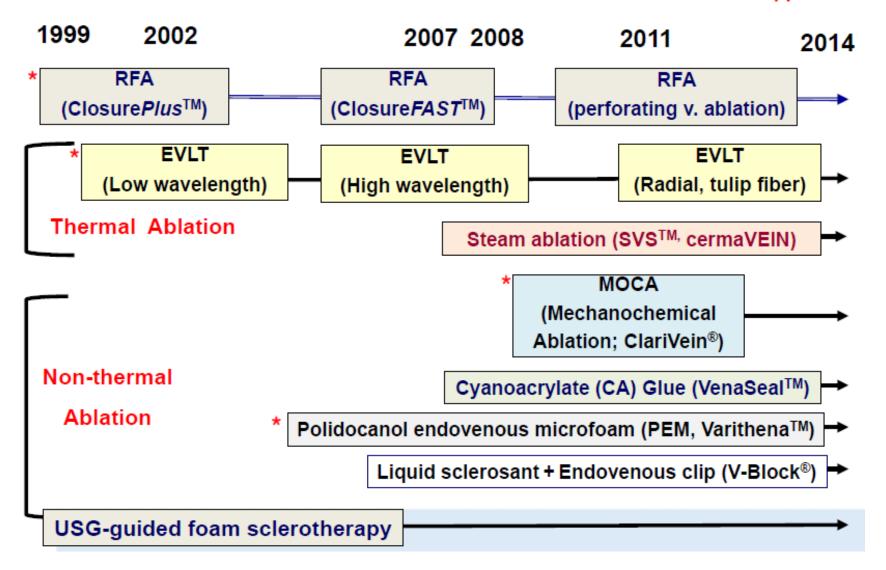


Endovascular Tx (혈관내 치료)

- 레이저치료
- 고주파열제거술

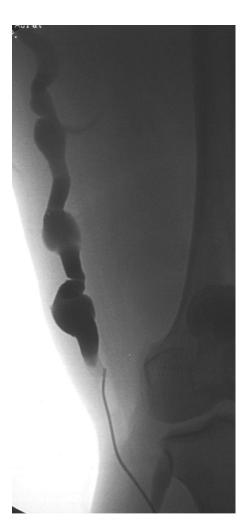
Era of Endovenous Ablation

* FDA approved



대복재정맥치료





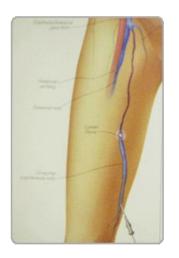


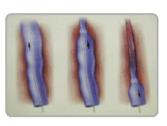
소복재정맥 치료



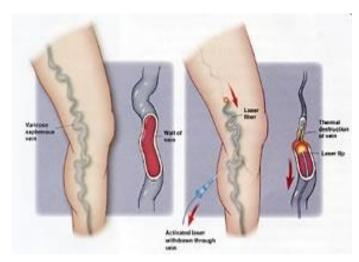
Endovascular Tx(혈관내 치료)

EVLT (레이저)

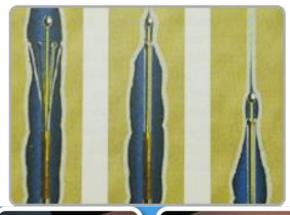




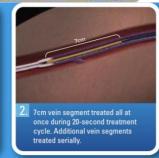




RF (고주파)







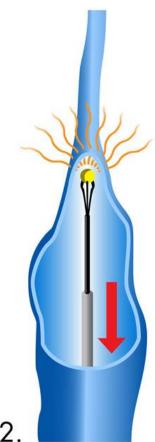




EVLT (EndoVenous Laser Therapy): 레이저



Catheter
advanced to
treatment area



Vein closes as catheter is withdrawn

EVLT (EndoVenous Laser Therapy): 레이저

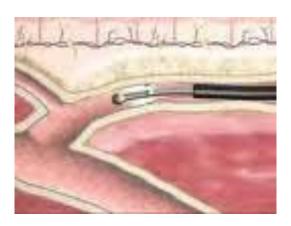
• EVLT (810, 940, 980, 1470-nm diode laser): 12-14W, Continuous, 1-2cm/sec, manually



EVLT (EndoVenous Laser Therapy): 레이저

• EVLT (1,320-nm Nd-YAG laser): Autopullback CoolTouch® Laser

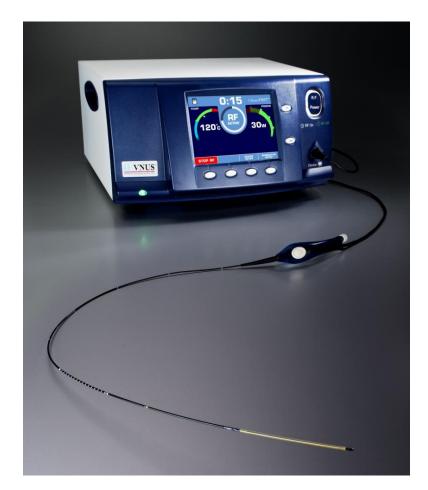




RF (Radiofrequency Ablation): 고주파

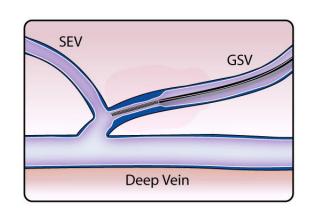


ClosureFAST Catheter



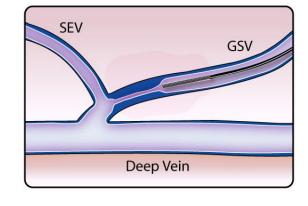
RFGPlus Generator

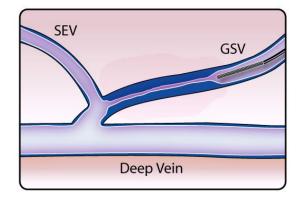
RF (Radiofrequency Ablation)



1. Apply external compression and deliver energy to vein segment

2. Withdraw catheter to next shaft marker, apply compression and deliver energy





3. Repeat withdrawal, compression and treatments until desired length treated

Movie Clip of 2 gene. RF

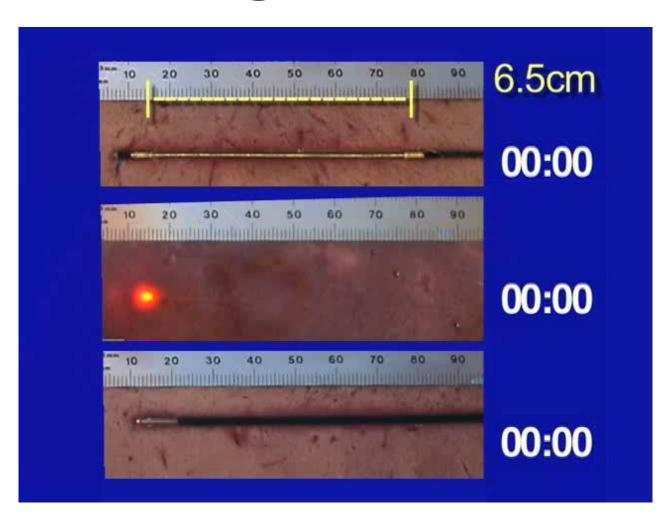


Comparison of EVLT vs RF

2 gene. RF

EVLT

1 gene. RF



RF (Radiofrequency Ablation)

 Ensure Good Vein Wall Contact (compression and exsanguination techniques)

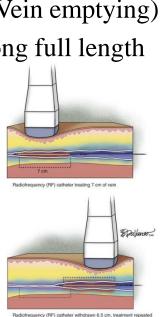
Perivenous tumescent infiltration

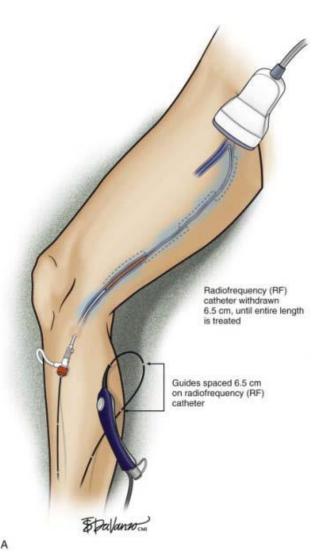
Trendelenburg position (Vein emptying)

External compression along full length

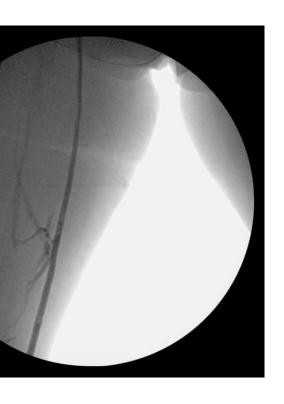
of heating element

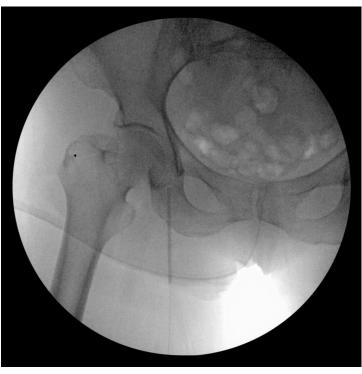






Pre & Intra & Post RF







RFA vs. EVLT (RCTs)

7 Randomized Clincal Trials

RFA is than EVLT (810, 980 low wavelength laser)

- Rasmussen LH et al (Br J Surg 2011;98(8):1079-87)
- Nordon IM et al (Ann Surg 2011;254(6):876-81)
- ➢ Goode SD et al (Eur J Vasc Endovasc Surg. 2010;40(2):246-53)
- Shepherd AC et al. (Br J Surg 2010;97(suppl. 1):810-8)
 - ✓ Less pain, bruising
 - ✓ More phlebitis, paresthesia
 - ✓ Similar results in clinical and QoL improvement
- Gale SS et al (J Vasc Surg 2010;52(3):645-50)
 - ✓ Less pain, bruising
 - ✓ Less secure closure (1yr. recanalization)

RFA < EVLT

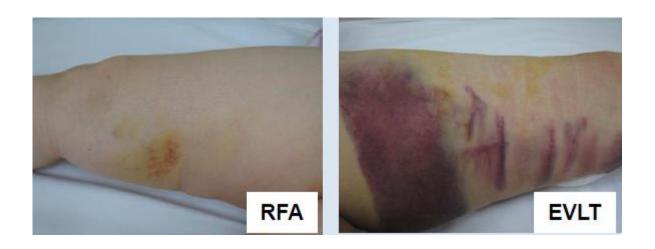
- Morrison N (Semin Vasc Surg 2005;42:502-9)
 - ✓ More occlusion rate
- Almeida JI et al (RECOVERY trail; J Vasc Interv Radiol. 2009;20(6):752-9)
 - ✓ Less pain, ecchymosis, tenderness
 - ✓ Better results in clinical and QoL improvement

RFA > EVLT

RFA = EVLT

Cosmetic Concern

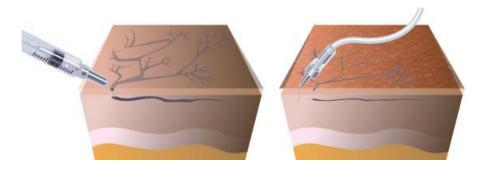
• More cosmetic concern (lower incidence of ecchymosis, pain, induration)



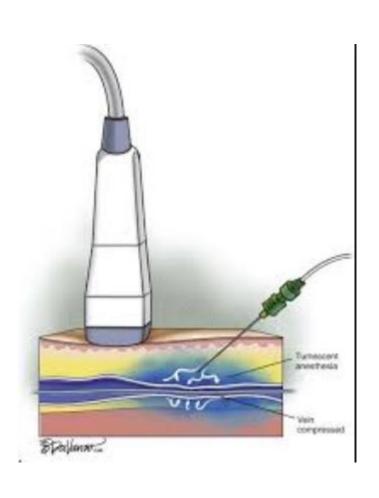
Tumescent injection !!!! In Thermal Ablation



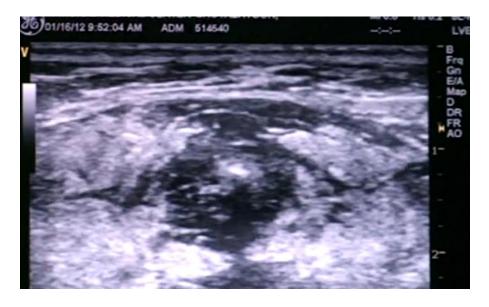




Tumescent injection !!!! In Thermal Ablation



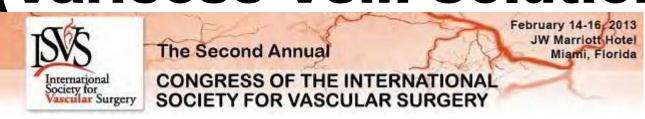


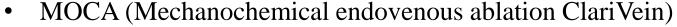


Future ??

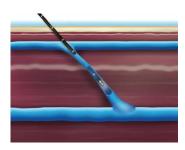


Advanced Techniques (Varicose Vein Solutions)





- Polidocanol endovenous microfoam (PEM)
- RF perforating v. ablation
 - 3cm catheter for treatment of short vein segment, AAGSV, Non-saphenous vein



Steve Elias, NY

- EVSA (Endovenous steam ablation; SVSTM)
- Cyanoacrylate (CA) Adhesive Glue (VenaSealTM):
- Non-thermal ablation, Embolization
- EVSA (Endovenous steam ablation; SVSTM)
- Radial (Tulip) fiber EVLT



Jose Almeida, Miami

Advanced Techniques (Varicose Vein Solutions)

- MOCATM (Mechanochemical endovenous ablation: ClariVein®)
- Cyanoacrylate (CA) Adhesive Glue (VenaSealTM)
- EVSA (Endovenous steam ablation; SVSTM, cermaVEIN®)



Bo Eklof, Sweden

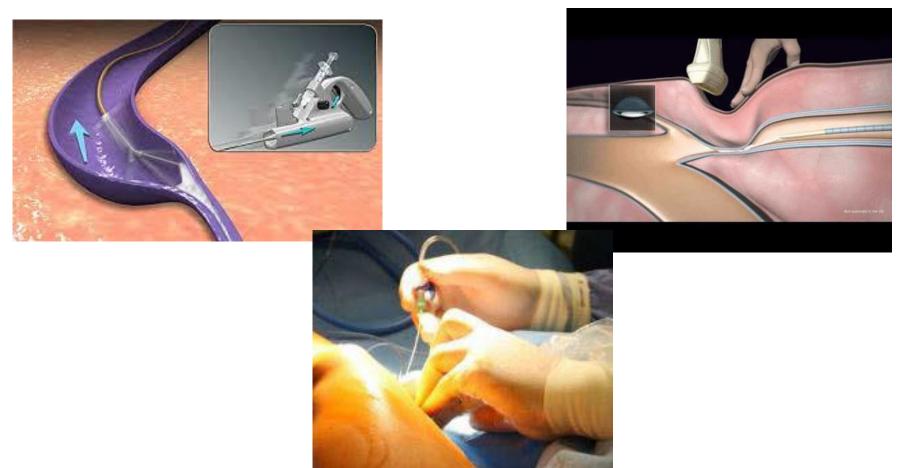


MOCA



MOCA

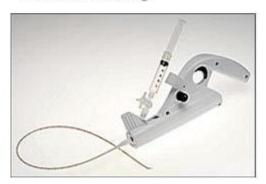
• MechanicO Chemical Ablation



MOCA (Mechanochemical endovenous ablation: ClariVein®)

The Non-Thermal Vein Ablation System

- Safe & effective
- Excellent clinical results
- No thermal ablation No risk of thermal injury
- No nerve damage / paraesthesia
- No tumescent anesthesia
- Minimal discomfort and minimal bruising



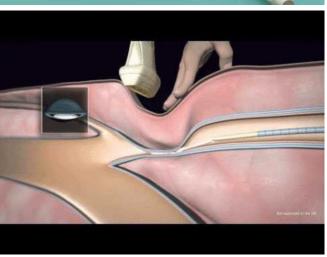
Self-contained disposable system no capital equipment expenditure or maintenance costs.

- 2008 FDA approved
- > 20,000 cases worldwide
- > 90% occlusion rate
- No nerve injury
- Contraindication; large veins >15-19 mm
- Also available in BK saphenous, SSV, ulcer
- No published RTCs, Ongoing, MARADONA

Cyanoacrylate (CA) Adhesive Glue (VenaSealTM)

- 2014 FDA approved
- No tumescent anesthesia
- No routine compression stocking
- Causing no postprocedural paresthesia
- Occlusion rate: 92%, 1yr. (USA, Almeida JI) 94%, 6mo. (Europe, multicenter, Proebstle T et al.)
- Exclusion criteria
 - Tortuous GSV (No 2 primary access sites allowed)
 - Incompetent ipsilateral SSV or ant. accessory GSV
- Thrombophlebitis has been reported in up to 15%
- Expensive
- Ongoing VeClose Randomized Control Trial
- VenaSeal Sapheon Closure System vs. RFA





EVSA (Endovenous steam ablation) (Steam vein sclerosis system; SVSTM, cermaVEIN)

- NOT FDA approved
- Easy procedure (catheter does not require a guide wire and too thin (1.2mm), flexible)
- Stable and relatively low temperature (120°C)
- Uses sterile water: less harmful
- Possible strict temperature regulation: fewer treatment-related symptoms (pain and bruising)
- Occlusion rate: > 90% at 2 years
- **Still need tumescent** anesthesia
- No long-term results, **Only one RCT** (vs. EVLT)

RTC of EVLT vs. steam ablation (LAST trial), BJS 2014;101:1077–1083. The 1-year treatment success of high-dose EVSA was not inferior to that of EVLA.





Paradigm Shift

Change in the Management of Varicose Vein in US

YEAR	Surgery		RFA		Laser		Total
	N	%	N	%	N	%	N
2002	152,520	93%	9,840	6%	1,640	1%	164,000
2005	140,000	43%	60,000	18%	120,000	37%	320,000
2008	25,000	5%	130,000	26%	340,000	69%	495,000

Until Now

 Clinical practice guidelines of the SVS (Society of Vascular Surgery) and AVF(American Venous Forum). J Vasc Surg 2011;53:2S-48S

High ligation and Stripping

- 10.1 For treatment of the incompetent great saphenous vein, we suggest high ligation and inversion stripping of the saphenous vein to the level of the knee.
 10.2 To reduce hematoma formation, pain, and swelling, we recommend postoperative compression. The recommended period of compression in C₂ patients is 1 week.
 10.3 For treatment of small saphenous vein incompetence, we recommend high ligation of the vein at the knee crease, about 3 to 5 cm distal to the saphenopopliteal junction, with selective invagination stripping of the incompetent portion of the vein.
- 1. Strong
 A. High quality
 2. Weak
 B. Moderate quality
 C. Low or very
 low quality

 1 B
 1 B
 1 B

Endovenous thermal ablation (EVLT, RFA)

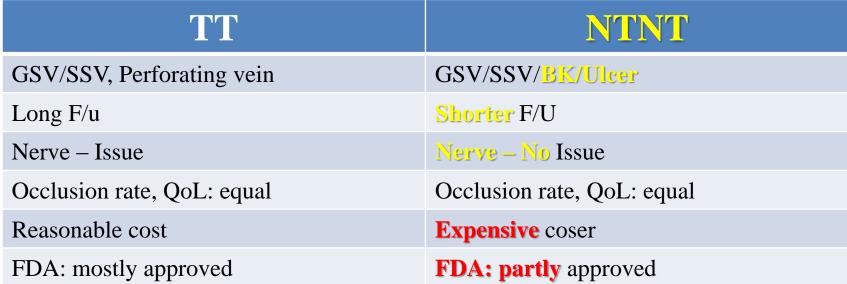
11.1	Endovenous thermal ablations (laser and radiofrequency ablations) are safe and
	effective, and we recommend them for treatment of saphenous
	incompetence.
11.2	Because of reduced convalescence and less pain and morbidity, we recommend
	endovenous thermal ablation of the incompetent saphenous vein over open
	surgery.



Endovenous thermal ablation (EVLT, RFA) is regarded as a standard treatment for GSV insufficiency

From Now

TT (thermal, tumescent) vs. NTNT (Non-thermal, Non-tumescent)



Future of Non-thermal Ablation is the Future of Endovenous Ablation.(?)



Steve Elias, NY

Postop. Complications

Sclerotherapy

(주사경화요법 합병증)

- Hyperpigementation (과색소침착)
- Inflammation (염증)

Hyperpigmentation

(과색소침착)









Surgical Treamtent

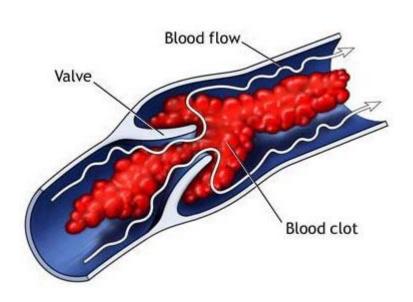
(수술의 합병증)

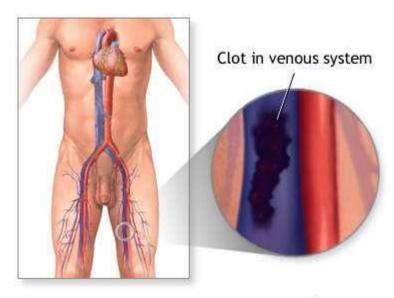
- Paresthesia (통증)
- Nerve Injury (신경손상)

Endovasulcar Tx

(레이저나 고주파의 합병증)

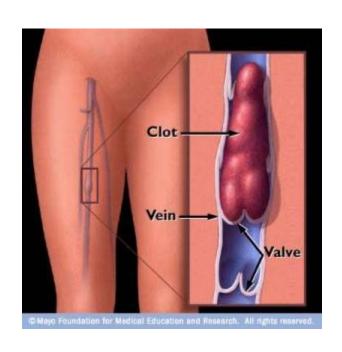
- Stricture <= Burn (화상)
- Deep Vein Thromosis (심부정맥혈전)





- Deep Vein Thrombosis -

(심부정맥혈전)

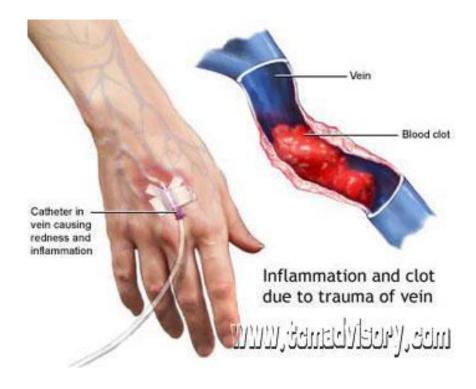




- Superficial Vein Thrombosis -

(표재성 정맥 혈전)





Efforts to minimize complications

Complication Rate

(합병증 확률)

Author	No.	F/U(m)	Success (%)	Cx(%)
Pannier et al	100	12	100	none
Schwarz	312	3	100	SVT(1.9)
Fernandez	1985	30	78.25	DVT(0.2) Transient parasthesia(2.4)
Christenson	104	12	95.2	Bruising(14.4) Hematoma(4.8)
Meyers	404	36	80	Thromboembolism(2.2)
Huang	230	6	100	Paresthesia(7)
Kalteis	100	4	100	Hematoma(12)

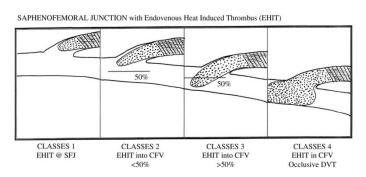
Efforts to minimize complications

Complication	Prevention	Therapy
Ecchymosis	Correct energy dose*	Compression (elastic stockings)
Pain	Tumescent anesthesia, correct energy dose	Compression (elastic stockings) NSAIDs
Skin burn	Tumescent anesthesia, correct energy dose, stop laser activation at entry site, caution at extrafascial part	Post-operative cooling
Superficial thrombophlebitis	Prior or simultaneous phlebectomy	Compression (elastic stockings) NSAIDs
Nerve injury	Tumescent anesthesia (especially at short saphenous vein junction), knowledge of anatomy	None
Deep vein thrombosis	Correct positioning laser tip, immediate mobilization, screening for coagulating disorder in selected patients, avoid postoperative immobilization	Low-molecular-weight heparin compression (elastic stockings)
Hematoma	Correct energy dose, prior phlebectomy	Incision compression (elastic stockings)

EHIT (Endovenous Heat-Induced Thrombosis)

- Thrombus extending from the superficial venous system into the deep venous system at, or proximal to, a site of recent thermoablation.
- Incidence: 2.99% (Post-RFA, 0-16% In the literature)
- Risk factors: Large vein diameter, male sex, and multiple phlebectomies.
- Treatment: observation or antiplatelets (EHIT class 1 and 2),
- anticogulation (LMWH >> warfarin, class 3 and 4)
- Progression: resolved within 2 to 4 weeks in most patients.
- Efforts to minimize complications





(Sufian S et al. J Vasc Surg: Venous and Lym Dis 2013;1:427-436)

Nerve Injury

Are there any risks?

Nerve damage: Damage to the small nerves that supply feeling to the skin a quite common (1 in 10 risk - 10%), as these can be cut or stretched when the varicose veins are removed. This may result in a patch of numbness and tingling, especially around the ankle. The affected area often becomes smaller with time.

Damage to the major arteries, veins and nerves in the leg have all occurred during varicose vein operations. These are very rare complications, which we take great care to avoid.

Operations behind the knee have a very small risk of foot drop due to nerve lamage (less than 1 in 100 risk - 1%). This problem usually improves as nerve function returns.

be higher in low volume hospitals compared with high – volume hospitals. The nerves at highest risk include the saphenous nerve, adjacent to the GSV below the Knee and the Sural nerve adjacent to the SSV, but both of these nerves have only sensory components, and the most common manifestation of nerve injury is paresthesia or dysthesia, which is often transient (Rutherford 2010). The nerve injury can occur with sheath and catheter introduction, during the delivery of tumescent anaesthesia, or by direct thermal injury. The rates of permanent paresthesias typically reported for laser are approximately 0-10% for GSV treatment. Only a few ser is look at the SSV nerve injuries and the reported rates of temporary paresthesia following SSV EVLA are 0-10% in son series. It is reported that the rate of paresthesia is inversely related to the operator experience with perivenous ultrasound –guided anesthesia (Morrison et al 2011). It has also been suggested that greater volumes of tumescence may be required during ablation of the SSV to prevent any thermal injury to the sural nerve which is in close proximity to the vein.

Wavelength	Recommended Pullback		
810 nm	1 cm every 3-5 seconds		
810 nm	50-70 J/cm		
940 nm	1 cm every 3-5 seconds		
980 nm	50-80 J/cm		
1319 nm	Unknown		
1320 nm	Automated fiber pullback device at 1 mm/second		
1470 nm	UnKnown		
	810 nm 810 nm 940 nm 980 nm 1319 nm 1320 nm		

Table 1. Endolaser Ablation Devices

음파감시하에 시행할 것을 권고한다

목재성백의 정맥 내 열치료를 할 경우 정맥천자를 시행할 때, 팽창용액을 주입할 때, 그리고 카타 타 끝의 위치를 확인할 때 초음파를 이용하여 시행할 것을 권장한다.

권고 13. 대복재정맥과 소복재정맥을 레이저 혹은 고주파 열치료 장비를 이용하여 치료할 때 정맥주위에 팽창용액을 주입할 것을 권장한다.

복재정맥의 정맥 내 열치료를 시행할 때, 정맥 주위의 신경손상과 피부손상을 줄이기 위해 복자 구획에 팽창용액을 주입할 것을 권장한다.

3-4. 초음파유도 경화요법

권고 14. 모세혈관확장증(telangiectasia)와 망상정맥(reticular vein)은 경화요법으로 치료할 것을 권장한다. 초음파 유도 경화요법은 대복재정맥 또는 소복재정맥의 역류를 동반한 하지정맥류 환자에게 적용할 수 있지만, 발거술 혹은 정맥 내 열치료법에 비해 재발률이 높으므로 치료 전 환자에게 재발에 대한 설명이 필요하다. 수술적 치료 혹은 정맥 내 열치료가 어려운 정맥류 (치료후 재발된 정맥류, 정맥 기형, 관통정맥, 정맥성 궤양 등)에서 경화요법을 시행할 수 있다.

Vein Injury

• The incidence rate : low (0.0017%-0.3%)

Table 1.

Type of vascular injury complicating varicose vein surgery: 81 patients suffering from 87 injuries

,	
Type of injury	Number
Venous injuries	
Laceration of the femoral vein	14
Ligation of the femoral vein	4
Division of the femoral vein	13
Stripping of the femoral vein	4
Resection of the femoral vein	2
Laceration of the popliteal vein	4
Stripping of the popliteal vein	1
Resection of the popliteal vein	1
Subtotal: all venous injuries	43
Arterial injuries	
Crushing of the femoral artery	4
Division of the femoral artery	14
Rupture of the femoral artery	1
Incision in the femoral artery	2
Resection of the femoral artery	6
Stripping of the femoral artery	17
Subtotal: all arterial injuries	44
Total: all injuries	87

	Table 2.	
Type of injury ar	nd repair during	the study period

	1945– 1959	1960– 1979	1980– 1999	2000
Venous injury				
Resection or stripping	0	1	4	2
Others	6	8	15	7
Venous repair				
End-to-end or bypass	0	5	10	2
Others	6	4	9	7
Arterial injury				
Resection or stripping	0	11	12	0
Others	4	8	8	1
Arterial repair				
End-to-end or bypass	1	13	13	0
Others	3	6	7	1

Rudström H, Björck M, Bergqvist D. Iatrogenic vascular injuries in varicose vein surgery: a systematic review. World J Surg. 2007 Jan;31(1):228-33.

Vein Injury

Table 3.
Surgical treatment of iatrogenic vascular injuries during varicose vein surgery

vein surgery						
Type of repair	Number					
Venous injuries						
Suture	9					
Patch	3					
Venous ligature	5					
Venous end-to-end anastomosis	6					
Venous bypass	12					
Unclear	3					
No treatment	5					
Subtotal: all venous injuries	43					
Arterial injuries						
Suture	3					
Patch	2					
Arterial end-to-end anastomosis	6					
Arterial bypass	23					
Unclear	2					
No treatment	8					
Subtotal: all arterial injuries	44					
Total: all injuries	87					

Fatal Injuries

Among the case reports, four patients died, all after venous injury. One 50-year-old woman had her femoral vein stripped, and the injury was reconstructed with the contralateral great SV.²⁰ After 1 month, she died in kidney failure after a venous gangrene and toxic process. Another patient had a venous laceration in the groin, with severe bleeding.¹⁸ In spite of femoral vein ligation, she died after a few hours in hemorrhagic shock. Two almost identical cases had intraoperative bleeding in the groin, and after blind clamping, the femoral artery and vein were ligated.²¹ This led to amputation after 5 days in 1 case, and both died a few days later from pulmonary embolism. In the medicolegal report by Natali, 1 patient died also from femoral vein hemorrhage.⁴

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Incidence, causes and Tx. of Recurrent varicose veins following EVLA



(1) Terminology

- Recurrent varices: reappearance of varicose veins in an area previously treated successfully
- **Residual varices**: varicose veins remaing after treatment
- PREVAIT: PREsence of Varices (residual or recurrent) After InTervention.

PREVAIT concept

- 2009. VEIN-TERM translantic interdisciplinary consensus document
- Recurrent와 residual varicose vein 구분이 어렵고
- REVAS 는 수술에 국한된 용어
- 비침습 치료법(laser, RF, SCT 등) 후에 생긴 recurrent 또는 residual varicose vein을 통 칭하는 용어가 필요

(2) Recurrence rate

- RFA with ClosurePlus: 27.4%, 5yr F/U
- EVLA: 6-36% 3yr F/U, RCT
- Open surgery; 6.6-37% 2 yr. 51% 5 yr

Operative treatment	PREVAIT	P	Open, reluxing GSV	Р	Reoperation	P
Surgery	20.2%		6.5%		15.5%	
RFA	14.9%	0.29	7%	NS	11.1%	NS
EVLA	20 %		6.8%		12.5%	
USGFS	19.1%		26.4%	<0.0001	31.6%	<0.0001

Abbreviations: EVLA, endovenous laser ablation; GSV, great saphenous vein; PREVAIT, presence of varices after operative treatment; RFA, radiofrequency ablation; USGFS, ultrasound-guided foam sclerotherapy.

Table II. Rasmussen 3-year clinical and DS outcome and reoperation percentages. Modified after reference 111: Rassmusen et al. J Vasc Surg: Venous and Lym Dis. 2013;1:349-356.

(3) Possible mechanisms of PREVAIT

- Tactical errors wrong or incomplete Dx.
- Technical problems at 1st OP.
 - non flush ligation(HL/VS의 경우)
 - insufficiency energy, irradiance or fluence in laser or RF
 - Inappropriate sclerosing agent dose
- Neovascularization
- Evolution of the disease

Neovascularisation and Recurrence 2 Years After Varicose Vein Treatment for Sapheno-Femoral and Great Saphenous Vein Reflux: A Comparison of Surgery and Endovenous Laser Ablation

N.S. Theivacumar, R. Darwood, M.J. Gough*

Table 2 Comparison of vascularisation rates bet tional surgery or EVLA			
1-year follow-up $(n = \text{limbs})$	Surgery $(n = 63)$	EVLA (n = 71)	р
Clinical recurrence Incompetent perforator Recanalisation residual GSV	2/63 (3%) 2 (3%) 2 (3%)	5/71 (7%) 1 (1%) 3 (4%)	
Reflux into the AAGSV ^a Neovascularisation	0 — 7/63 (11%)	1 (1%) 1/71 (1%)	
2-years follow-up $(n = \text{limbs})$	Surgery $(n = 60)$	EVLA (n = 69)	р
Clinical recurrence	4/60 (7%)	5/69 (7%)	0.44
Incompetent perforator	2 (3%)	1 (1%)	0.45
Recanalisation/residual GSV	2 (3%)	3 (4%)	0.36
Reflux into the AAGSV	0 —	1 (1%)	0.53
Neovascularisation	11/60 (18%)	1/69 (1%)	0.001
^a AAGSV: anterior accesse	ory great sapher	nous vein.	

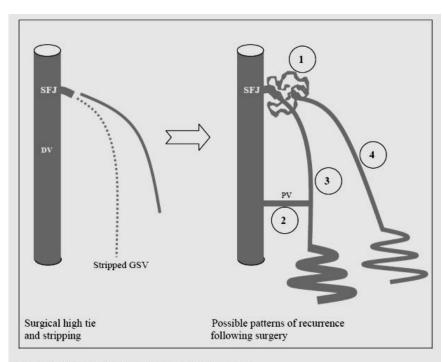


Figure 7.2: Possible patterns of reflux after surgery

- 1: Neovascularisation
- 2: Incompetent perforating vein
- 3: Persisting GSV/ new vessel formation
- 4: Para-reflux (AAGSV) connecting via neovascularisation

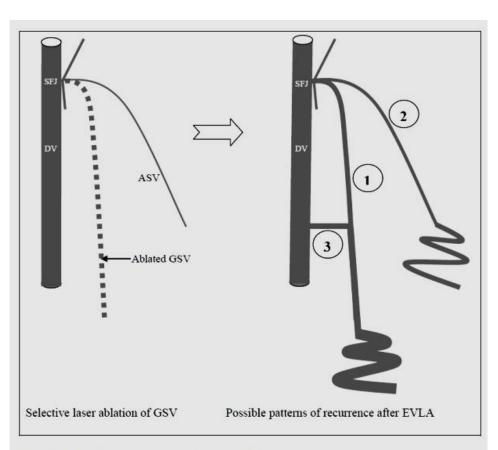


Figure 7.1: Possible patterns of reflux after EVLA

- 1: Re-canalisation,
- 2: Para-reflux (AAGSV),
- 3: Perforator incompetence

REVATA study

- 2014. prospective non randomized study
- 7 center, GSV, SSV, AAGSV ablaion
- 2380 patients
- 164 patients recurrence, median 3 yrs f/u
- Recurrence pattern analysis
- Perforator pathology was present in 64% of patients

164 recurrence case

- Initial Tx GSV ablation(RF :33, laser:126, 52 SSV, AAGSV ablation concurrently)
- Majority of recurrences in association with perforating veins.
- Total or partial GSV recanlization 47 례
- New AAGSV reflux 40례
- New SSV reflux 24례
- Neovascularization rare

Recurrence of varicose veins after endovenous ablation of the great saphenous vein in randomized trials

J Vasc Surg: Venous and Lym Dis 2015

Thomas F. O'Donnell, MD, a Ethan M. Balk, MD, MPH, Meghan Dermody, MD, MS, Erica Tangney, BA, and Mark D. Iafrati, MD, Boston, Mass

- Meta analysis
- 2000.1.1 2014.7.1
- 20 RCTs, EVA 중에서 2년 이상 f/u 한 7개 RCTs 분석
- Overall recurrence rate; EVA(22%), L&S (22%)
- Doubling of REVAS over time for both EVA and L&S
- Neovascularization EVA(2%), L&S (18%)
- Recanalization EVA(32%)
- Ant. Accessory saphenous vein reflux(19%)
- Incompetent calf perforating vein (7%)

Causes of Recurrence

Table V. Causes of recurrence [number and percentage of cause/total causes per study]

Study	Methods	Limbs at risk	Neo, No. (%)	Tech, No. (%)	Recan, No. (%)	Thigh Perf, No. (%)	AASV, No. (%)	Calf Perf, No. (%)	Total number
Lurie, 18 2005	RFA	36	1 (17)	2 (33)	3 (50)	0	0	0	6
	L&S	29	4 (100)	NR	NR	NR	NR	NR	4
Perala, 19 2005	RFA	15	1 (25)	1 (25)	0	0	2 (50)	0	4
5 m V - 3 m 10 m 2 m 10 m 10 m 10 m 10 m 10 m 10	L&S	13	1 (50)	1 (50)	0	0	0	0	2
Rasmussen, ²⁰ 3 years	RFA	74	NR	8 (50)	8 (50)	NR	NR	NR	16
	L&S	66	NR	8 (100)	0	NR	NR	NR	8
Christenson, ²¹ 2010	EVLA	95	0	11 (61)	7 (39)	0	0	0	18
PRODUCTION OF THE STATE OF THE	L&S	99	2 (100)	NR	0	0	0	0	0
Rasmussen, ²⁴ 5 years	EVLA	48	0	3 (10)	5 (22)	5 (22)	6 (26)	4(17)	23
	L&S	41	0	2 (3)	3 (14)	8 (38)	8 (38)	NR	21
Rasmussen, ²⁰ 3 years	EVLA	73	NR	8 (50)	8 (50)	NR	NR	NR	16
50	L&S	66	NR	8	0	NR	NR	NR	8
Rass, 23 2012	EVLA	173	0	6 (33)	6 (33)	5 (28)	0	1(6)	18
L&S	L&S	143	1(5)	2 (10)	2(10)	4 (20)	3 (15)	8 (40)	20
22	EVLA	56	0	0	3 (27)	2 (18)	6 (55)	0	11
520	Cryo	55	11	0	0	6 (35)	0	0	17

AASV, Anterior accessory saphenous vein; EVLA, endovenous laser ablation; L&S, ligation and stripping; Neo, neovascularization; NR, not reported; Perf, perforator; Recan, recanalization; RFA, radiofrequency ablation; Tech, technical.

Table VI. Summary comparison of recurrence rates by cause and technique

			Studies with dataa								
Cause	Technique	1	2	3	4	5	6	7	No. of studies	Summary percentage(95% CI) ^b	P value
Neovascularization	RFA	X	X						2	5.0 (0.9-12.1)	.056
	EVLA				X	X	X	X	4	0.2 (0.0-1.0)	
	L&S	X	X X		X	X X	X X		5	2.3 (0.9-4.1)	
Technical	RFA	X	X	X					3	9.4 (5.0-14.9)	.43
	EVLA			X	X	X X	X X	X	4	6.9 (4.7-9.5)	
	L&S	X	X	X		X	X		4 5	4.1 (2.1-6.6)	
Recanalization	RFA	X	X	X					3	8.9 (4.7-14.4)	.037
	EVLA			X	X	X	X	X	5	6.5 (4.4-8.9)	
	L&S	X	X X		X	X	X		5	1.5 (0.5-3.1)	
Thigh perforator	RFA	X	X						2	0.9 (0.1-4.9)	.54
	EVLA				X	X X	X X	X	4	2.9 (1.5-4.9)	
	L&S	X	X		X	X	X		4 5	2.7 (1.3-4.7)	
ASSV	RFA	X	X X						2	2.9 (0.2-8.9)	.94
	EVLA				X	X	X	X	2 4	1.7 (0.7-3.3)	
	L&S	X	X		X	X	X		5	2.4 (1.1-4.4)	
Calf perforator	RFA	X	X						2	0.9 (0.1-4.9)	.72
	EVLA				X	X	X	X	4	1.1 (0.3-2.4)	
	L&S	X	X		X	X	X		5	2.5 (1.1-4.4)	

AASV, Anterior accessory saphenous vein; CI, confidence interval; EVLA, endovenous laser ablation; L&S, ligation and stripping; RFA, radiofrequency ablation; *X*, studies with data for that outcome.

a1, Lurie, 18 2005; 2, Perala, 19 2005; 3, Rasmussen, 20 2013; 4, Christenson, 21 2010; 5, Rasmussen, 24 2013; 6, Rass, 23 2012; 7, Disselhoff, 22 2008.

^bPercentage is the percentage of limbs analyzed, not percentage of recurrences.

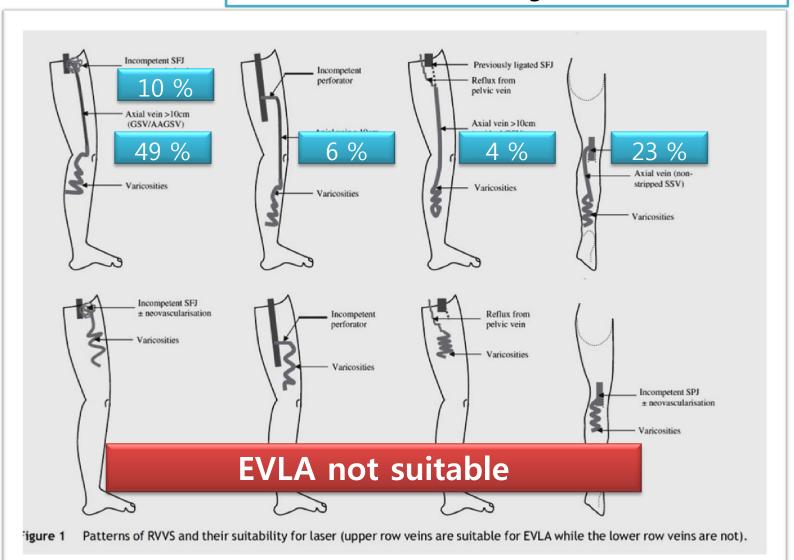
(4) Treatment Options

- Endovenous thermal ablation
- Duplex guided foam sclerotherapy
- Ambulatory phlebectomy
- Embolization of pelvic vein

EVLA for REVAS

Author	N of patients	Complications	F/U	Outcome
Groenendael (2009)	Surgery 149 EVLA 67	Wound inf. 8% Paraesthesia 27% † Recovery & return to work Paraesthesia 13% Skin tightness 31%	13.5 months	Re-recurrence: Surgery29%, EVLA 19% EVLA > surgery
Anchala (2009)	56	Bruising, some	4-6 weeks	No recurrence
Nwaejike (2010)	77	Pul. Embolism 1 (POD #10, both GSV, both SSV)	18 months	No recurrence
Theivacumar (2011)	104	Same as primary varicose vein	12months	2 recanalization

Eur J Vasc Endovasc Surg(2011) 41, 691-696



USFS for REVAS

Author	N of limbs	Sclerosant	F/U	Outcome
Kakkos (2006)	45	3% STS foam	3 weeks	#2 – 89%
Creton** (2007)	129	1% POL foam	3-40 days	#1 - 93%
Darvall (2011)	91	3% STS foam	1 yr	# 1 - 92%

^{** :} peroperative foam injection

Table VII. Incidence and type of procedures for recurrent varices after surgery (REVAS)

Study	Group	No. of procedures (%)	Type of treatment
Perala, 2005 ¹⁹	RFA	1 (6.6)	-
	L&S	2 (6.6)	
Rasmussen, ²⁰ 2013	RFA	12 (8.1)	UGFS ± phlebectomy
	EVLA	14 (9.7)	UGFS ± phlebectomy
	L&S	18 (12.7)	UGFS ± phlebectomy
Rasmussen, ²⁴ 2013	EVLA	17 (24.6)	UGFS ± phlebectomy
	L&S	15 (22.1)	UGFS ± phlebectomy
Christenson, ²¹ 2010	EVLA	3 (3.2)	L&S
	L&S	0	<u>21-17</u>
Rass, 23 2012	EVLA	16 (9.2)	Sclerotherapy + phlebectomy (15); L&S (1)
	L&S	23 (16.1)	Sclerotherapy + phlebectomy
Disselhoff, ²² 2008	EVLA	10 (17.8)	Sclerotherapy (2); L&S (3)
5%	Cryo	17 (30.9)	Sclerotherapy

Cryo, Cryogenic surgery EVLA, endovenous laser ablation; L&S, ligation and stripping; RFA, radiofrequency ablation; UGFS, ultrasound-guided foam sclerotherapy.

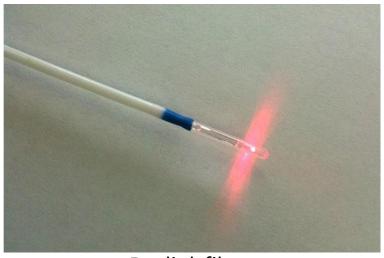
(5) Prevention of Recurrence

- Laser power, Pullback velocity, Vein diameter
 - determine the thermal response of EVLA
 - no standard protocol
 - Optimal LEED = 70-80 joules/cm
- Hb or water target wavelength
 - irrelevant because blood consists of over 60% water and 15% Hb.
- Trendelenburg position, tumescent anesthesia
 - → smaller vein diameter

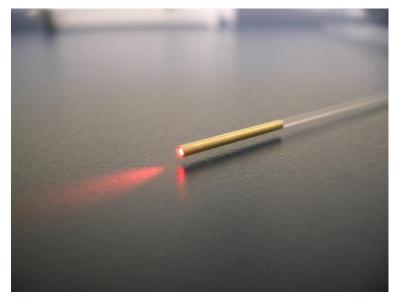
Laser Fiber modifications

Prevent ulceration and perforation Even energy distributuion, Direct contact 줄여줌

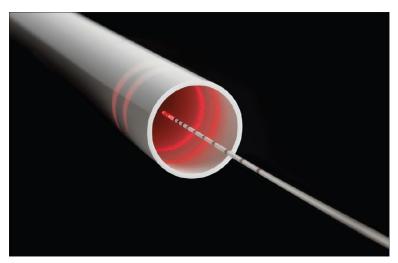
- Radial fiber(Cereals E, Biolitec)
- Two-ring fiber(Biolitec)
- Tulip catheter Vuylsteke, Mordon et al.
- NeverTouch Venacure fiber(Angiodynamics)



Radial fiber



NeverTouch Venacure fiber



Two-ring fiber

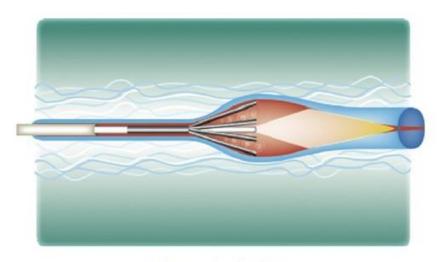


Figure 2. The tulip fibre.

J Vasc Surg:Venous and Lym Dis 2014;2:61-9

Journal of Vascular Surgery
Venous and Lymphatic Disorders™

Influence of fibers and wavelengths on the mechanism of action of endovenous laser ablation

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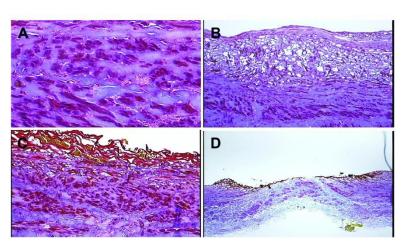
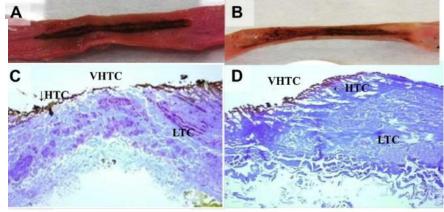
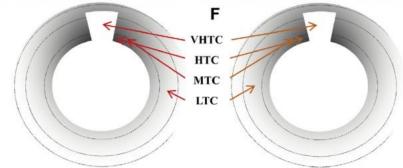


Fig 2. A, Low-temperature changes (LTCs) were indicated by swelling of the smooth muscle or elastic fibers (\times 400, azan trichrome stain). B, Mid-temperature changes (MTCs) meant fusion or vacuolization of the elastic fibers (\times 200, azan trichrome stain). C, High-temperature changes (HTCs) included carbonization of tissue (\times 200, azan trichrome stain). D, Very high-temperature changes (VHTCs) denoted loss of tissue (\times 100, azan trichrome stain).

LTC : low temp. change
MTC : mid temp. change
HTC : high Temp. change

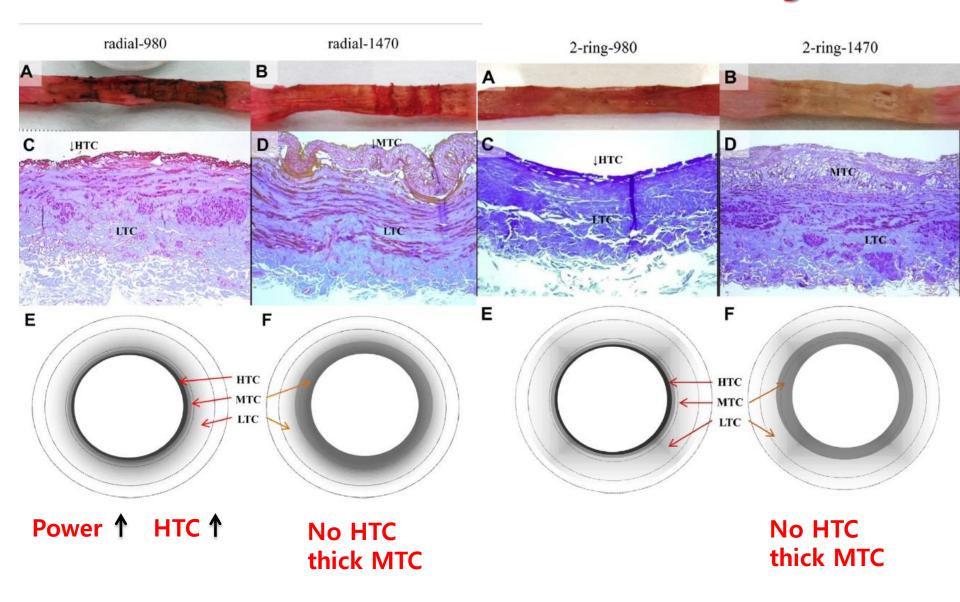
VHTC: very high temp. change





No histological difference

Irreversible, Circumferential Damage



Factors Associated with Saphenous Vein Recanalization after Endothermal Ablation

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- Retrospective, risk factor analysis
- 249 limbs, RFA, 3 yr F/U
- Recanlization 17 limbs(6.8%)- segmental 9 , completer 8 limbs

Table II. Clinical factors and comorbidities

Variable	Recanalization, $n = 17$, (%)	No recanalization, $n = 232$, (%)	Odds ratio	<i>P</i> value
CEAP 5/6	23.5	22.8	1.0	0.57
Antiplatelet	0	3.4	300000	0.56
Anticoagulation	11.7	6	2.1	0.3
Tobacco use	0	9	_	0.21
Diabetes	23.5	11.6	2.3	0.14
Hypertension	52.9	44.8	1.4	0.34
Congestive heart failure	5.8	3	2.0	0.43

Duplication of GSV

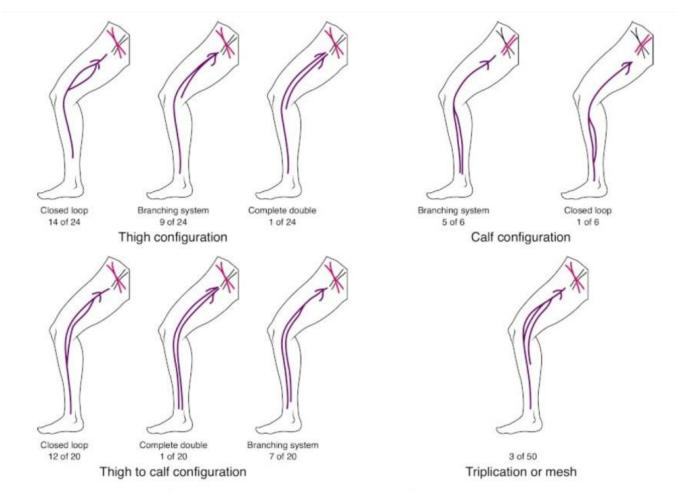


Fig. 2 Anatomical configuration of duplications of the long saphenous vein on saphenography

Importance of F/U

Rasmussen et. al

clinical recurrence is doubling over time

- 26% 2 yr → 47% 5 yr for EVLA
- 1 yr study RFA 4.8% EVLA 5.8%
- 3 yr study RFA 14.9%, EVLA 20%

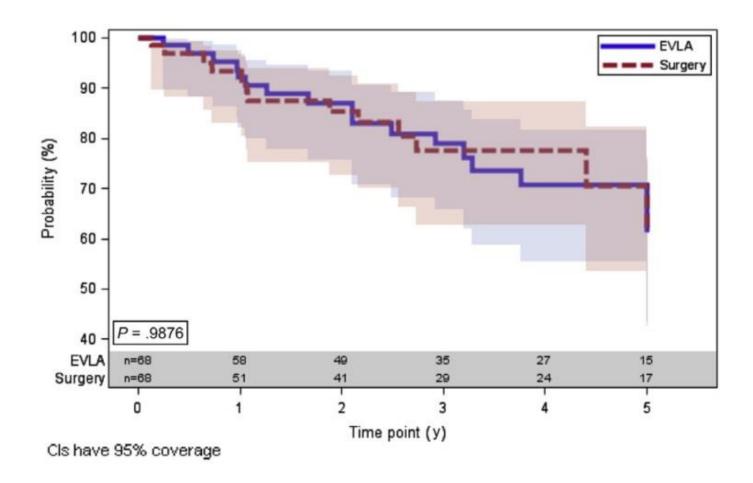


Fig 4. Legs without reoperations. CI, Confidence interval; EVLA, endovenous laser ablation.