A Practical Approach to Common Problems in Vascular Surgery

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CV Today: February 1, 2025

Objectives

To understand the etiology, pathology and management of:

- Aortic Aneurysms
- Cerebrovascular/ Carotid Disease
- Lower Extremity Arterial Occlusive Disease (PAD)
- Lower Extremity Venous Disease (CVI)

Aneurysms
Definition

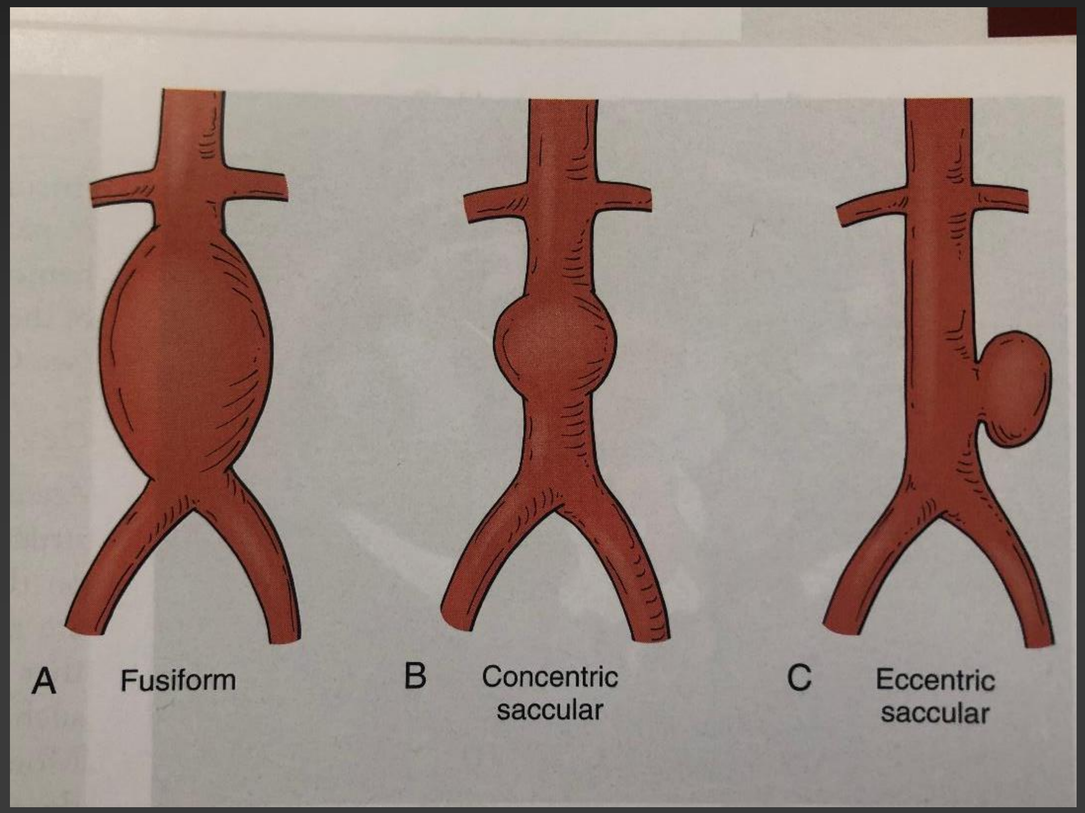
- An aneurysm is a dilatation of any blood vessel of at least 50% increase compared to the normal arterial diameter
- May occur anywhere in the body (even veins) but is most prevalent in the infrarenal aorta (AAA)
- Factors to consider include size, location, etiology, growth rate, and morphology
- May coexist with other aortic or peripheral arterial aneurysms
- AAAs result in significant morbidity and mortality (2014 : 9900 deaths and 120,000 procedures performed)

Aortic Aneurysms
Etiology

- Degenerative- abnormal levels of metalloproteinases and deficits of inhibitors MMP(decreased TIMP-1 in smokers)
- Inflammatory- exaggerated inflammatory response and fibrosis which results in obstruction and technical challenges in repair (e.g. Takayasus, GCA, Behcets disease)
- Late aneurysms associated with chronic dissection
- Traumatic
- Developmental/ Congenital (Connective Tissue Disease)
- Infectious

Aortic Aneurysm

- Size and growth rate are the main determinants for intervention
- Morphology also determines the need for intervention- Fusiform or Saccular



Aneurysms
Complications

- Compression of adjacent structures- DVT , nerve compression
- Thrombosis leading to acute arterial occlusion
- Distal embolization and chronic ischemia (loss of distal flow)
- Fistula formation
- Rupture

Aneurysms

Multiple Sites can Coexist

- 50% of thoracic aneurysm have an abdominal aneurysm
- 12% of patients with AAA have a thoracic component (Gloviczki, 1990)
- Patients with a family Hx have 30% increased risk of having an aneurysm which warrants screening of siblings and children
- Patients with connective tissue disease (Marfans, Ehlers-Danlos, Loeys-Dietz) have significantly higher prevalence of multiple aneurysm development and should be monitored for these in both typical and atypical locations

Abdominal Aortic Aneurysms

Risk of Rupture: The UK Small Aneurysm Trial

- Risk of rupture correlated with larger size on diagnosis, smoking, low FEV1, uncontrolled HTN
- Risk of rupture was not independently associated with age, BMI, Cholesterol levels or ABI
- Females had 3-fold risk of rupture compared to men with similar diameter
- Increased rupture risk for saccular aneurysms
- Risk of rupture declined with smoking cessation and adequate BP control

UK Small Aneurysm Trial (2001)

TABLE 70.2 Twelve month Risk of Rupture Based on AAA Diameter

AAA Diameter (cm.).	Rupture Risk (%) annually
3.0-3.9	0.3
4.0-4.9	0.5-1.5
5.0-5.9	1-11
6.0-6.9	11-22
>7	>30

Rutherford's Vascular Surgery and Endovascular Therapy, 9th ed. , 886.

Abdominal Aortic Aneurysms
Diagnosis

- History- most asymptomatic
- Physical Examination- do a full examination including peripheral pulses
- Ultrasound- good sensitivity and specificity within anatomic limitations
- CTA- greater anatomic detail and reproducibility
- MRI
- Angiography- invasive and less accurate at size estimation, previously recommended when detailed anatomy is needed prior to intervention, largely supplanted by CTA

Abdominal Aortic Aneurysms
Indications for Repair

- Emergent repair of symptomatic or ruptured aneurysms regardless of size
- Elective repair when > 5.5 cm in men and 5 cm in women
- Consider repair if >10 mm growth in 12 months in both men and women
- Saccular aneurysms or those with worrisome radiologic features can be considered for early repair
- The risk of intervention must be weighed in the context of the ability to perform endovascular versus open repair and patient specific factors

Current Clinical Guidelines (SVS)

- Endovascular repair is the preferred method for treatment of AAAs (even rupture) when feasible
- Thorough evaluation of patient- specific factors is necessary prior to repair, risk evaluation
- Lifelong antibiotic prophylaxis after EVAR or OR for dental procedures; and other procedures if infection exists or for immunocompromised patient


AN 11°


RAN 3°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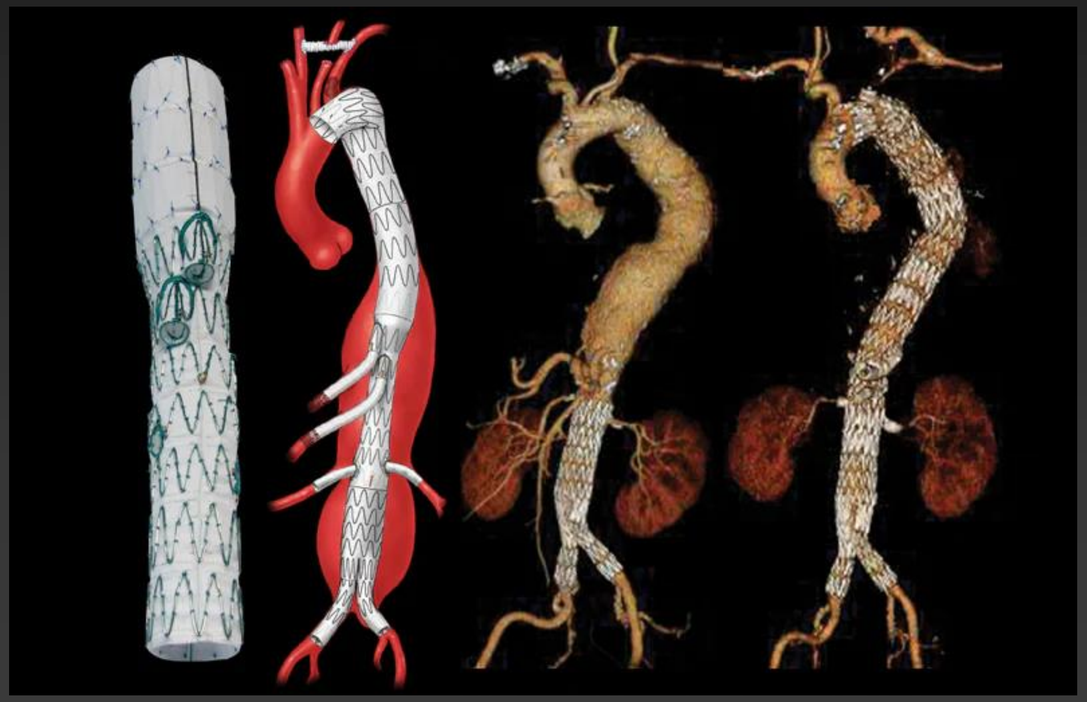
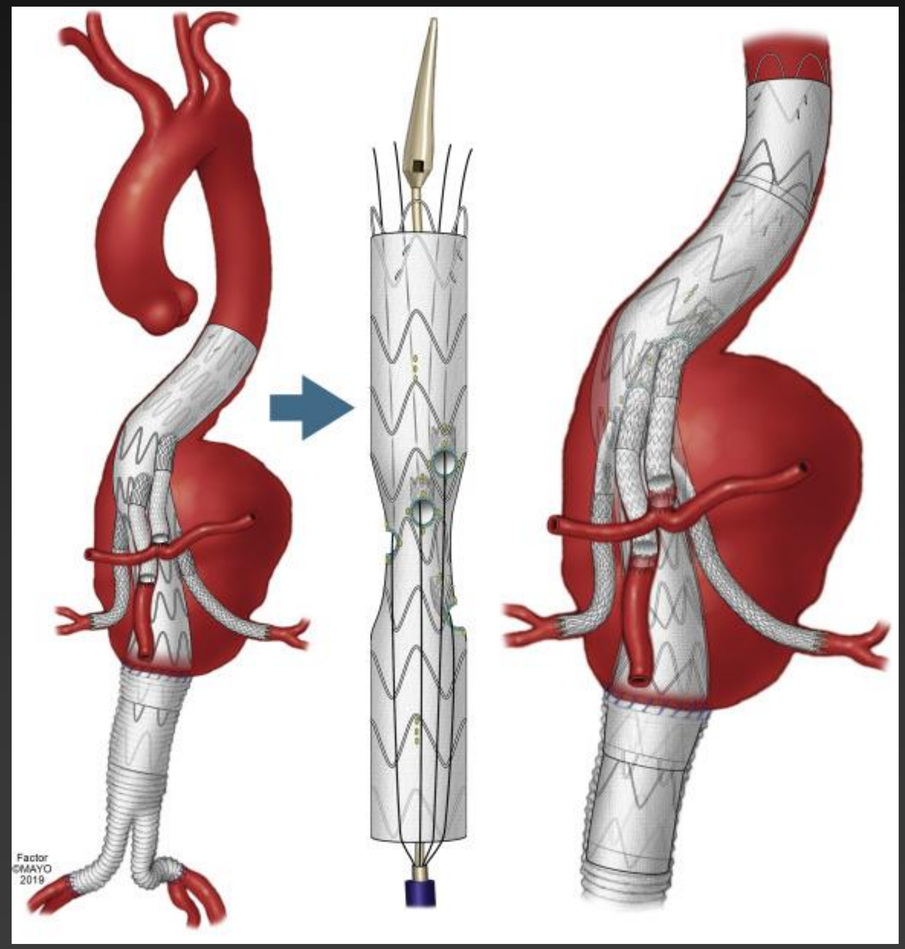
EVAR

EVAR

Advances in Endovascular Repair

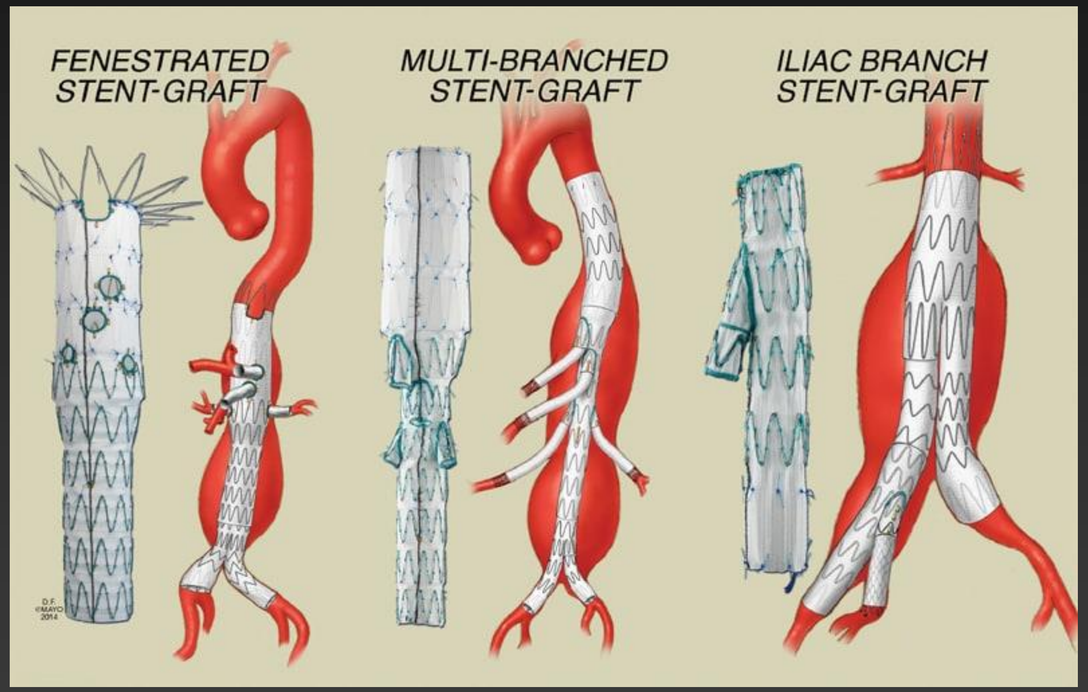
Branched Thoracic and Abdominal Grafts

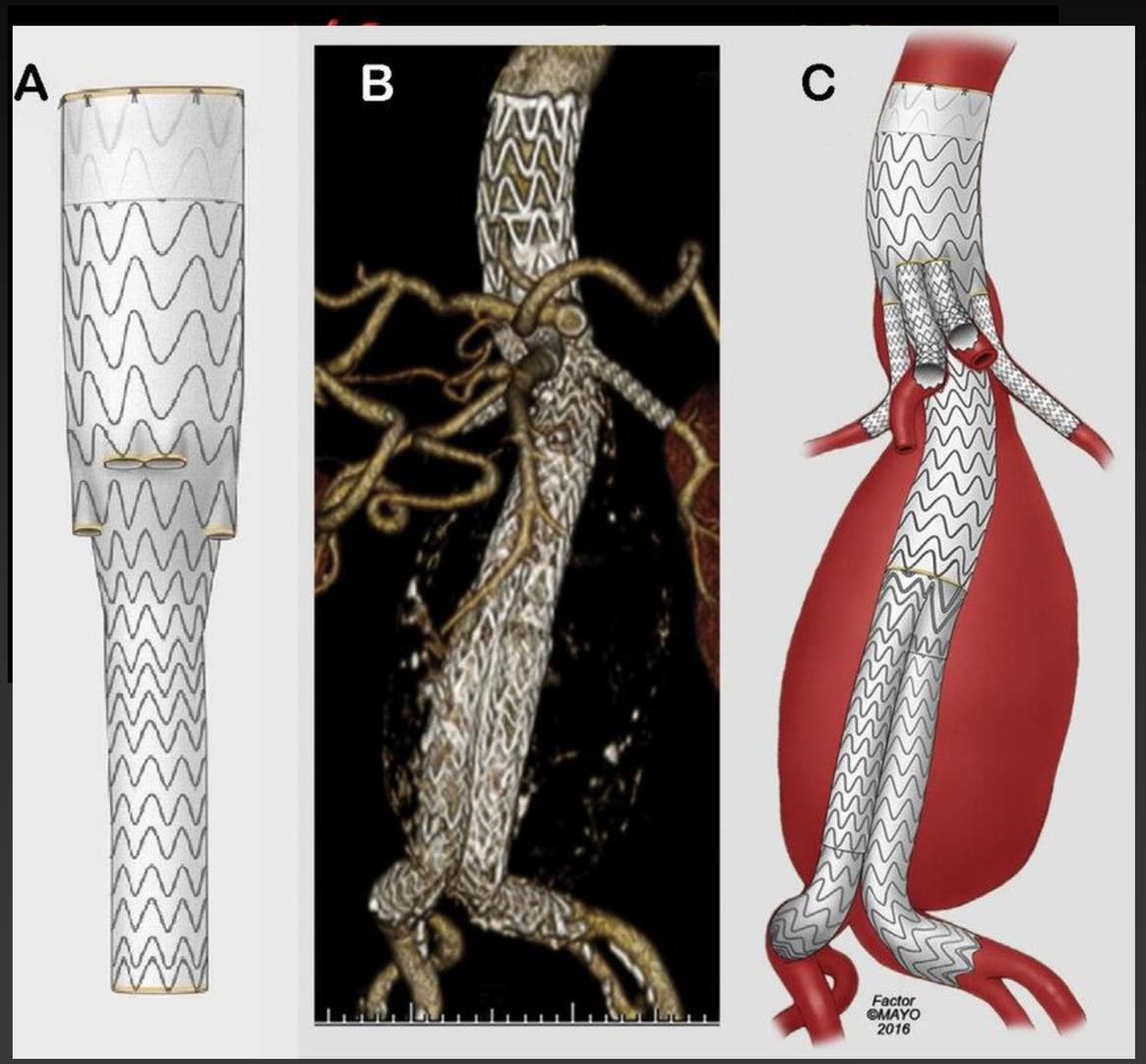




Images courtesy of Dr G Oderich, et al

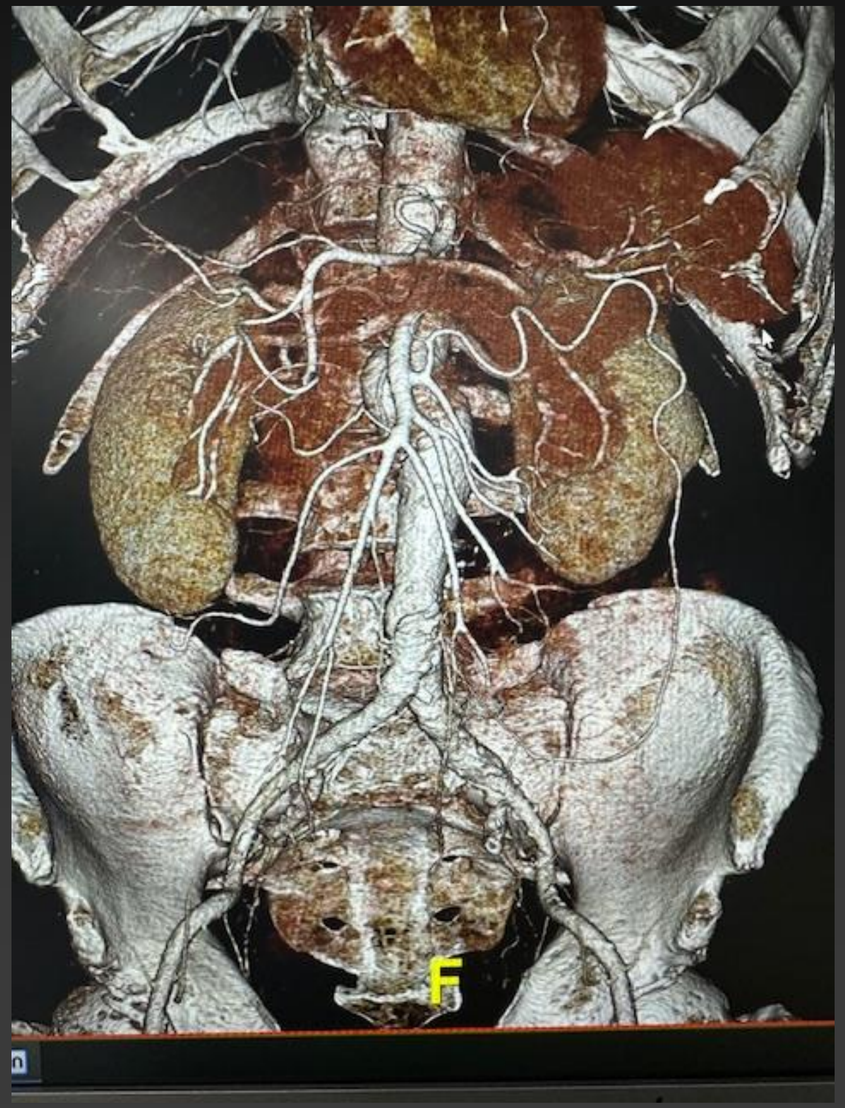
Endovascular Repair
Branched Grafts

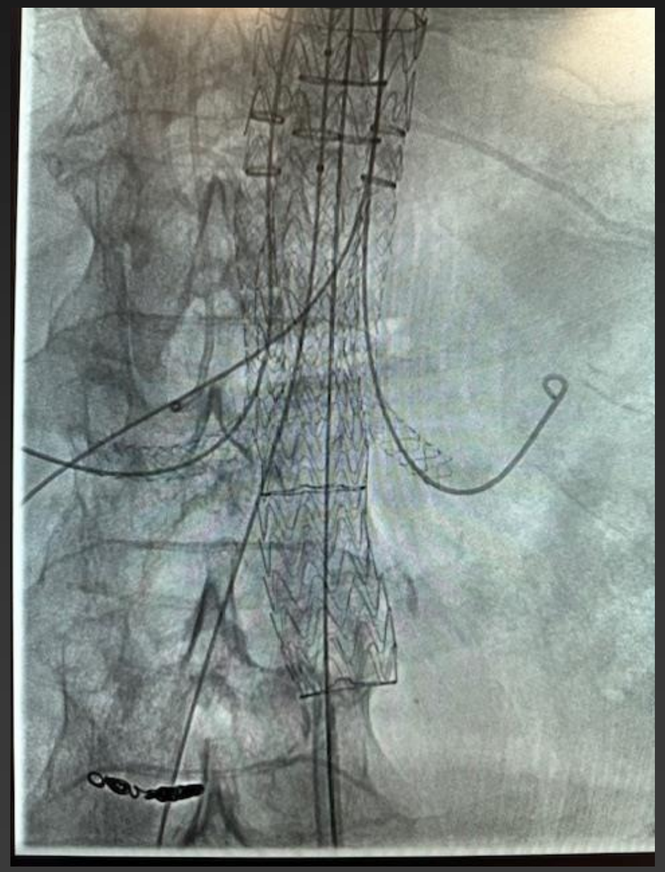




TAMBE

TAMBE





Directions in Aneurysm Care

- Advances in endovascular graft technology as well as adapting hybrid procedures allow for the treatment of highly complex aortic pathology
- Research is ongoing in the realm of cardiac and vascular disease to allow for less invasive repair of ascending and arch pathology

Cerebro-Vascular Disease

Carotid Artery Stenosis

- Stroke is a major cause of M and M worldwide (at a cost of $33.9B in 2013, in the US alone)
- US: 800,000 strokes per year, of which approximately 185,000 are recurrent strokes
- US: 87% of strokes are ischemic and related to atherosclerosis, AF and HTN
- Incidence of stroke varies according to age, sex, race and risk factor profile
- Decline in stroke mortality due to improvements in medical therapy and stroke care

CVD

Natural History Asymptomatic Severe, (>70%) Stenosis

- Risk of stroke is estimated at 2% annually (11-11.9% in 5 years) in the setting of severe asymptomatic but > 70% ICA stenosis (ACAS, ACST data)
- Progression of stenosis is a predictor for increased risk fo stroke (ACSRS)
- In asymptomatic severe stenosis, the decision for intervention should be made in the context of the lifetime estimated stroke risk weighed against age, sex, functional status, life expectancy and medical comorbidities

Symptoms of Carotid Disease

*Symptoms from Carotid disease results from Embolic events related to the plaque rather than limitation of flow

- Amaurosis fugax- transient monocular blindness
- Aphasia/ Dysarthria
- TIA
- Stroke in the distribution of the affected hemisphere and stenosis

CVD

Natural History (Symptomatic Stenosis)

- All cause mortality after stroke was 10.5% at 30 days, 21.2% at 1 year, 39.8% at 5 years (ARIC study)
- TIA variably results in stroke in up to 5% of patients in 2 days, 11% at 30 days, 30% within 5 years based on differing studies
- After TIA, stroke risk was 11-16% in the first year and 5-9% annually after (Oxfordshire study)
- Degree of carotid stenosis is strongly associated with stroke risk in symptomatic patients

CVD and Carotid Disease

- HTN remains the most important risk factor for all stroke types
- Age, Race, Smoking, Family Hx, AF, DM, renal insufficiency, Obesity all incrementally and individually increase the incidence of stroke
- Stroke is the 5th leading COD and the leading cause of serious long term disability in the US
- Disability: In 6 months, 50% had hemiparesis, 26% dependent with ADLs, 30% unable to walk without assistance, 26% were institutionalized
- After Ischemic stroke, 1 and 5 year mortality is 27 and 53% and the risk for recurrent stroke is 12 and 29% respectively

Carotid Artery Stenosis
Testing/Diagnosis

1. Duplex Ultrasound- reproducible, noninvasive, readily available, no radiation or contrast, flow directionality, plaque morphology analysis
2. CTA- excellent structural resolution of extra and intracranial anatomy, and nearly the new gold standard for planning
3. MRI/ CEMRA- limited availability and long acquisition time of images, less reliable for moderate lesions but helpful in flow directionality and brain imaging
4. Angiography- invasive, the older “gold standard” which functions more as a supportive role now, supplanted by DUS and CTA

Management of Carotid Stenosis

- The presence of stenosis whether associated with or without symptoms mandates Best Medical Therapy (BMT)
- Highest indicator of stroke is the presence of recent (within 6 months) ipsilateral neurologic symptoms
- The highest risk of recurrent stroke is within the first month and gradually declines over the next 6 months
- In symptomatic severe 70-99% stenosis, a causal relationship is assumed and intervention preferably within 2 weeks in the setting of stable neurologic status or non disabling stroke is recommended

BMT vs. BMT plus CEA

- At present, data does not support BMT as a stand-alone therapy for pts with severe stenosis who are good candidates for intervention and have a good life expectancy
- Data from CREST and ACST indicate that intervention performed with low complication rates can bring long lasting protection from stroke
- Forthcoming data from CREST-2 will help shed light on each modality for current therapy

Cerebrovascular Disease: Decision making including Medical Therapy, in Rutherford's Vascular Surgery and Endovascular Therapy, 9th ed., 1178.

CEA vs. CAS (Endarterectomy vs. Stenting)

- Mortality data slightly favored CEA but not significantly, seen mostly in patients with acceptable risk and over age 70
- CAS has a 1.5-2 fold increase in stroke and/or death vs CEA, most strikingly in symptomatic patients
- CAS: fewer Cardiac events and nerve injury (55% reduction in MI with CAS vs CEA)
- CREST and ACT1 data similar to above meta-analysis data with major stroke rates similar at 10 years (2.5 vs 2.7%) but differed mainly due to the perioperative event rates which were higher with CAS

Selecting the Appropriate Therapy for The Appropriate Patient

Stenosis < 50% : BMT only for both symptomatic and asymptomatic patients

Asymptomatic 70-99% Stenosis: CEA can be considered if peri-op morbidity and risk is low and patient has a good 3-5 year life expectancy

Symptomatic 50-99% Stenosis:

- CEA is preferred with stable cardiac disease and feasible anatomy

- CAS can be considered in patients with high likelihood of adverse. events due to medical or anatomic factors

TABLE 89.2 Results of CEA Randomized Trials

TABLE 89.2 Results of Randomized Trials of Carotid Endarterectomy Versus Best Medical Therapy (NASCET, ECST, ACAS, ACST)

Study	Population Studied	Number of Patients	Stroke Rate BMT	Stroke Rate BMT+CEA	Study Conclusions
NASCET	Symptomatic patients with carotid stenosis ≥70%	649	26% (2 yr) 28% (5 yr)	9% (2 yr) 13% (5 yr)	CEA is beneficial for symptomatic patients with ≥70% carotid stenosis (P <.001)
NASCET	Symptomatic patients with carotid stenosis ≥50% to 69%	858	15% (2 yr) 22.2% (5 yr)	9% (2 yr) 15.7% (5 yr)	CEA is beneficial for symptomatic patients with ≥50% carotid stenosis (P = .045)
ECST	Symptomatic patients with carotid stenosis 80%-99% ECST (=60%-99% by NASCET)	1279	20.6% (3 yr)	6.8% (3 yr)	CEA is beneficial for symptomatic patients with 60% carotid stenosis (NASCET) (P <.0001)
ACAS	Asymptomatic patients with carotid stenosis ≥60%	1662	11% (5 yr)	5.1% (5 yr)	CEA is beneficial for asymptomatic patients with ≥60% cartoids stenosis (P = .004)
ACST	Asymptomatic patients with carotid stenosis ≥60%	3120	11.8% (5 yr)	6.4% (5 yr)	CEA is beneficial for asymptomatic patients with ≥60% cartoids stenosis (P ≥.0001)

ACAS, Asymptomatic carotid atherosclerosis study; *ACST*, asymptomatic carotid surgery trial; *BMT*, best medical therapy; *ECST*, European Carotid Surgery Trial; *NASCET*, North American Symptomatic Carotid Endarterectomy Trial Collaborators.

Halliday A, Harrison M, Hayter E, et al. 10-year stroke prevention after successful carotid endarterectomy for asymptomatic stenosis (ACST-1): a multicentre randomised trial. *Lancet*. 2010; 376(9746):1074-1084.

Cerebrovascular Disease: Decision making including Medical Therapy, in Rutherford's Vascular Surgery and Endovascular Therapy, 9th ed., 1172.

TABLE 89.6 Summary of Societal Guidelines

	Symptomatic	Asymptomatic
AHA[138]	CEA for 50%-99% stenosis, CAS is recommended when CEA complication rates are high and CAS can be performed with complication rates of 4%-6%	CEA for 60%-99%, *CAS in selected pts, but its effectiveness is not well established.*
SVS[139]	CEA preferred in pts 50%-99%, CAS in hostile neck and severe uncorrectable cardiac conditions	CEA in good-risk pts with 60%-99% stenosis and 3- to 5-year life expectancy with complication rates >3%. Insufficient data to support CAS outside of trials, may be used by selected interventionalists with established complication rates <3%. High-risk pts should have BMT alone.
ESC[140]	CEA for 70%-99% stenosis, CAS for high surgical risk	CEA for 60%-99% stenosis with complications <3% and 5-year survival, CAS *as an alternative* in high-volume centers with complications <3%.
Australasian[141]	CEA for 50%-99%, CAS for pts at high surgical risk	CEA for 60%-99%, no evidence to support CAS, consider BMT as primary treatment.

BMT, Best medical therapy; *CAS*, carotid artery stent; *CEA*, carotid endarterectomy; ESC, European Society of Cardiology; *SVS*, Society for Vascular Surgery.

Cerebrovascular Disease: Decision making including Medical Therapy, in Rutherford's Vascular Surgery and Endovasc Therapy, 9th ed., 1180.

Timing of Intervention

- CEA recommended within 2-6 weeks after an acute non disabling stroke in appropriate patients with mild to moderate NIH deficit scores, absence of hemorrhage and less than 30% of hemisphere involved
- Urgent intervention for crescendo TIAs or unstable neurolgic symptoms
- Recurrent Asymptomatic early (< 24 months) stenosis or late (>24 months) are usually benign and can be treated selectively with a conservative approach or with either CEA or CAS
- Recurrent symptomatic stenosis can be treated with CEA or CAS
- Radiation-induced stenosis is treated selectively based on pt factors

Annals of Vascular Surgery

CLINICAL RESEARCH · Volume 67, P78-89, August 2020

Complexity of Aortic Arch Anatomy Affects the Outcomes of Transcarotid Artery Revascularization Versus Transfemoral Carotid Artery Stenting

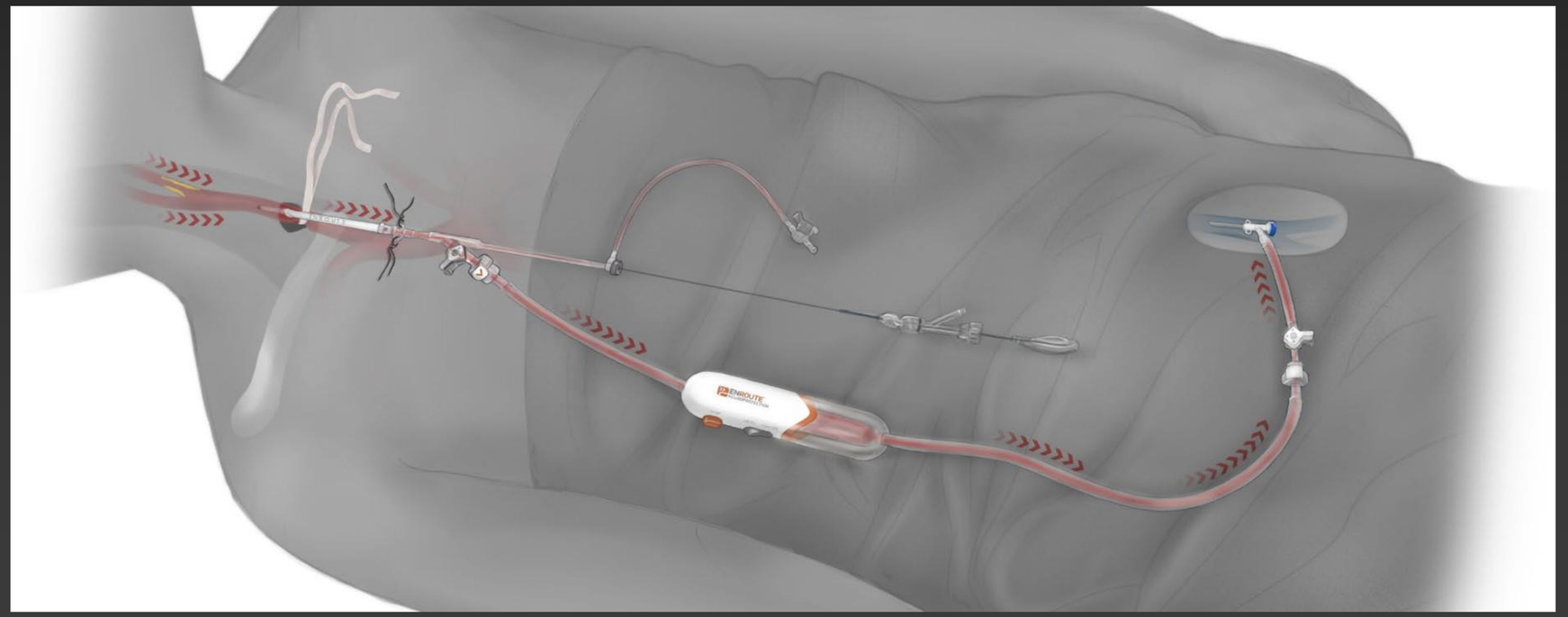
Allan M. Conway · Nhan T. Nguyen Tran · Khalil Qato · ... · Guillaume J. Stoffels · Gary Giangola · Alfio Carroccio... Show more

Affiliations & Notes Article Info

Text

Trans-carotid Artery Revascularization (TCAR)

- Hybrid of CEA and CAS with direct open CCA access
- Option for medical and anatomic high risk individuals

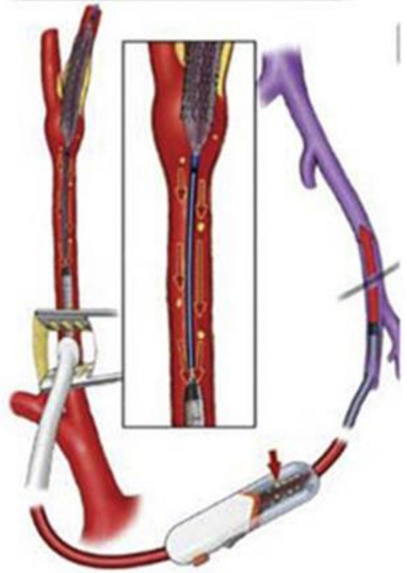


TFC

Impact of Age on In-Hospital Outcomes After Transcarotid Artery Revascularization (TCAR), Transfemoral Carotid Artery Stenting (TFCAS) and Carotid Endarterectomy (CEA)

Retrospective non-randomized study using the Vascular Quality Initiative database

TCAR
N=3152

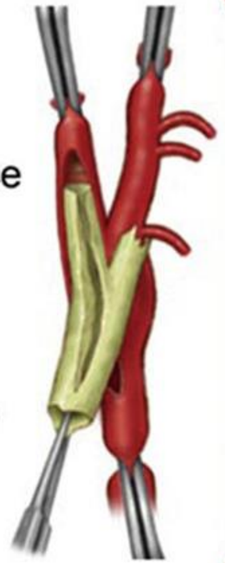


VS:

CEA
N=61,650

No significant difference in outcomes except:

- TCAR was associated with significant decrease in **cranial nerve injury**



TFCAS
N=10,381

In patients ≥ 80 years, TCAR was associated with:

- **72%** Reduction in **stroke risk**
- **65%** Reduction in **risk of stroke/death**

JVS Journal of Vascular Surgery
Official Publication of the Society for Vascular Surgery

Dakour-Aridi et al. *J Vasc Surg September 2020*

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Stenting (CAS)

- Transcarotid Revascularization (TCAR) is indicated for both high and standard risk symptomatic and asymptomatic individuals
- TCAR has similar outcomes compared to CEA
- TCAR is is the preferred modality if CAS is opted for in lieu of CEA
- TFCAS is less favorable compared to CEA and TCAR
- CMS approves Transfemoral stenting (TFCAS) for severe symptomatic and asymptomatic carotid artery stenosis based on shared decision making

Back to Percutaneous Transluminal Angioplasty (PTA) of the Carotid Artery Concurrent with Stenting

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Decision Summary
Decision Memo
Bibliography

National Coverage Analysis (NCA) | Decision Memo

Percutaneous Transluminal Angioplasty (PTA) of the Carotid Artery Concurrent with Stenting

CAG-00085R8

Expand All | Collapse All

Decision Summary

The Centers for Medicare & Medicaid Services (CMS) finds that coverage of percutaneous transluminal angioplasty (PTA) of the carotid artery concurrent with stenting is reasonable and necessary with the placement of a Food and Drug Administration (FDA) approved carotid stent with an FDA-approved or cleared embolic protection device, for Medicare beneficiaries under the following conditions:

A. Patients with symptomatic carotid artery stenosis ≥50%; and
B. Patients with asymptomatic carotid artery stenosis ≥70%.

For both A and B above:

1. Neurological assessment by a neurologist or NIH stroke scale (NIHSS) certified health professional before and after carotid artery stenting (CAS) must be performed.
2. First-line evaluation of carotid artery stenosis must use duplex ultrasound.
3. Computed Tomography angiography or magnetic resonance angiography, if not contraindicated, must be used to confirm the degree of stenosis and provide additional information about the aortic arch, and extra- and intracranial circulation.
4. Intra-arterial digital subtraction (catheter) angiography may be used only when there is significant discrepancy between non-invasive imaging results, or in lieu of computed tomography angiography or magnetic resonance angiography if these are contraindicated.

Prior to furnishing CAS, the practitioner must engage in a formal shared decision-making interaction with the beneficiary. The shared decision-making interaction must include:

Peripheral Arterial Occlusive Disease (PAD)

- Chronic atherosclerotic occlusive disease of the lower extremities
- More than 200 million individuals worldwide are affected by PAD (an increase of 25% in the past decade)
- Risk factors are similar to systemic atherosclerosis (CAD, CVD)

A spectrum of disease with regard to clinical presentation and correlates with functional level of activity

Asymptomatic Intermittent Claudication Critical Limb Ischemia

Risk factors for PAD

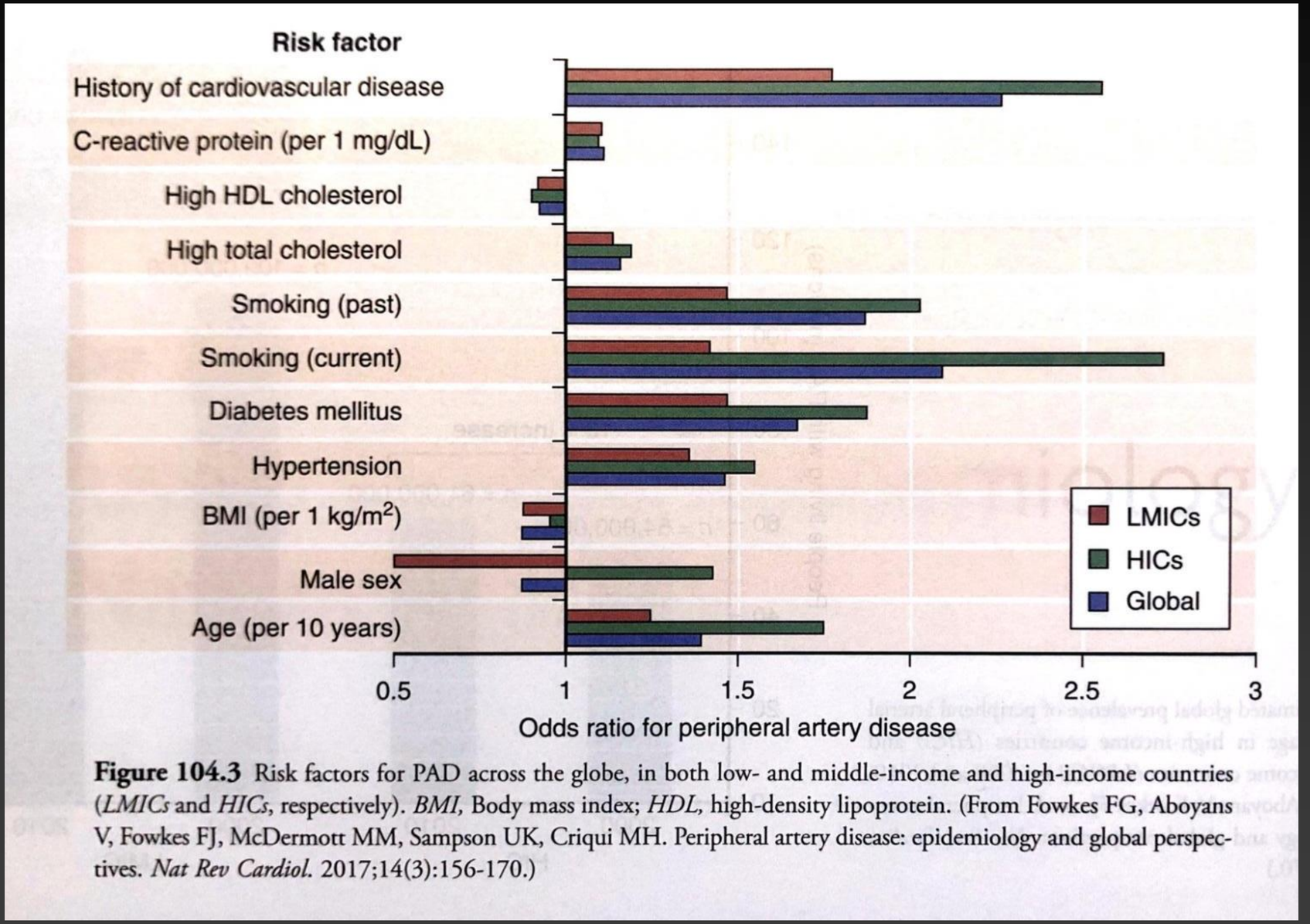


Figure 104.3 Risk factors for PAD across the globe, in both low- and middle-income and high-income countries (*LMICs* and *HICs*, respectively). *BMI,* Body mass index; *HDL,* high-density lipoprotein. (From Fowkes FG, Aboyans V, Fowkes FJ, McDermott MM, Sampson UK, Criqui MH. Peripheral artery disease: epidemiology and global perspectives. *Nat Rev Cardiol.* 2017;14(3):156-170.)

Conte, M., Lower Extremity Arterial Occlusive Disease, in Rutherford's Vascular Surgery and Endovascular Therapy, 9th ed., 1370.

PAD

TABLE 104.1 Stages of PAD

TABLE 104.1 Stages of Chronic Limb Ischemia

Fontaine Grade	Rutherford Category	Clinical Description	Objective Criteria
I	0	Asymptomatic	Normal treadmill or reactive hyperemia test
IIa[a]	1	Mild claudication	Completes treadmill exercise[b]; AP after exercise >50 mm Hg but at least 20 mm Hg lower than resting value
IIb[a]	2	Moderate claudication	Between categories 1 and 3
	3	Severe claudication	Cannot complete standard treadmill exercise[b]; AP after exercise <50 mm Hg
III[a]	4	Ischemic rest pain	Resting AP <30-50 mm Hg; ankle or metatarsal PVR flat or barely pulsatile; TP <30 mm Hg
IV	5	Minor tissue loss	Resting AP <50-70 mm Hg; ankle or metatarsal PVR flat or barely pulsatile; TP <40 mm Hg in nondiabetics, <50 mm Hg in diabetics; $tcPO_2$ <30 mm Hg
	6	Major tissue loss[c,d]	Same as Rutherford 5 (Fontaine IV)

[a]Grades II and III correspond to critical limb ischemia.
[b]Five minutes at 2 miles per hour on a 12% incline.
[c]Nonhealing ulcer or focal gangrene with diffuse pedal ischemia.
[d]Extending above transmetatarsal level, or foot no longer salvageable.
AP, Ankle pressure; *PVR*, pulse volume recording; *$tcPO_2$*, transcutaneous oxygen; *TP*, toe pressure.

Conte, M., Lower Extremity Arterial Occlusive Disease, in Rutherford's Vascular Surgery and Endovascular Therapy, 9th ed., 1372.

PAD

Clinical Presentation and Natural History

Asymptomatic Disease

- Majority of patients detected by noninvasive clinical testing
- 2.7-fold increased risk of mortality and 5.6 fold increased risk of CAD related death
- Tend to decline physiologically over time
- Risk of progression to IC is estimated at 4-11% over a 5 year period
- Imperative to address systemic risk factors in all PAD patients even if asymptomatic

PAD

Clinical Presentation and Natural History

Intermittent Claudication

- 50-75% of patients will have no change or even improvement in 5 years
- 25% will have symptom progression with up to 25% requiring intervention
- 2-4% risk of amputation, notably in smokers and Diabetics
- 5-year mortality is approximately 30% (additional 5-10% will have nonfatal CV event)

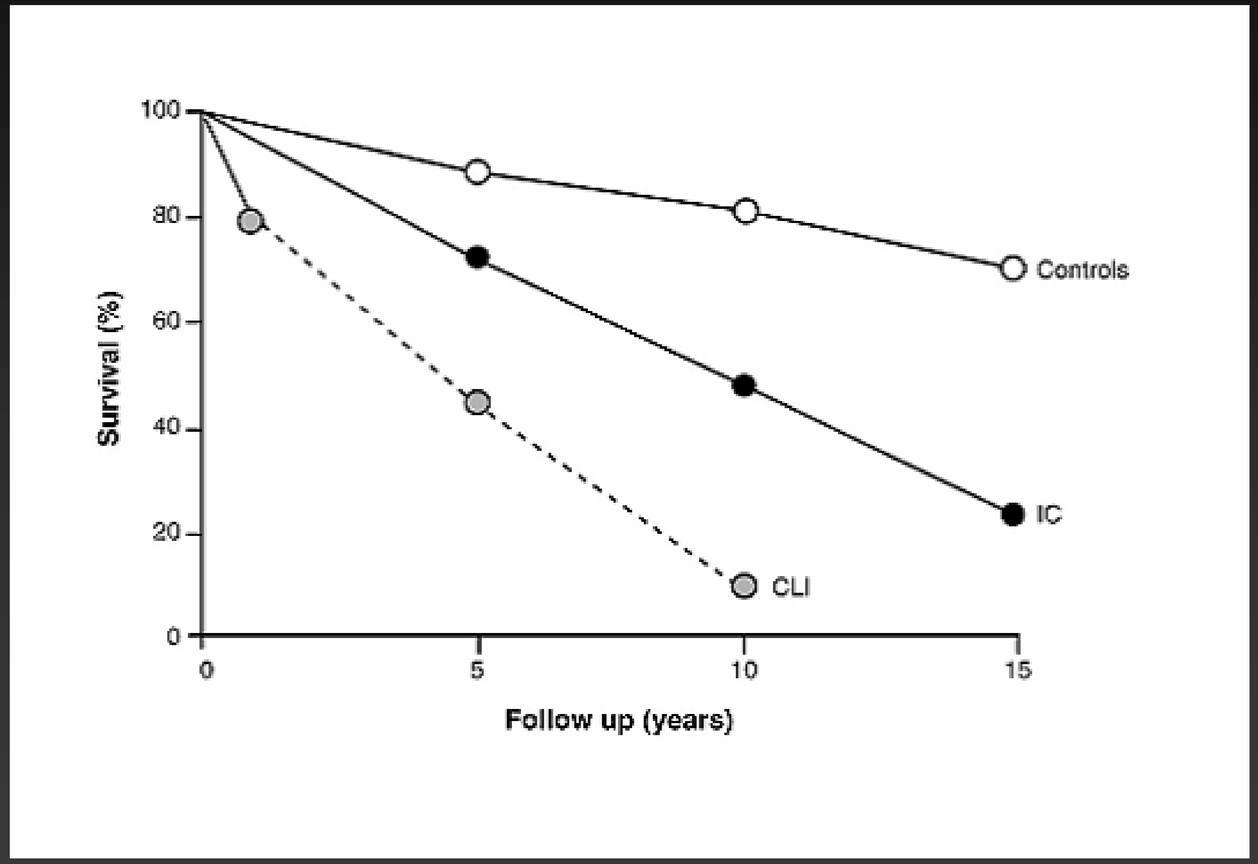
PAD

Clinical Presentation and Natural History

Limb-Threatening Ischemia/ CLTI

- Severe impairment of limb perfusion resulting in pain at rest in the foot as well as tissue necrosis (gangrene or non-healing ulceration)
- affects between 1-10% of PAD patients
- greater atherosclerotic burden with worse CV outcomes
- 22% risk of mortality (12-33%) and amputation (2-42%) in 1 year

Overall Survival in PAD



TASC II
Inter-Society Consensus
for the Management of PAD

Screening for PAD

Universal population screening is controversial and not recommended

SVS Guidelines / ACC 2016 recommend targeted screening for at risk individuals

- older than 65 years
- 50-64 years with risk factors or family Hx of PAD
- older than 50 with DM plus one other risk factor
- any age with established CAD and CVD

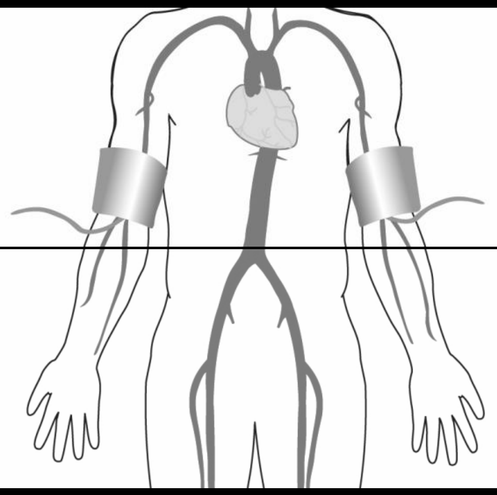
Long-term follow-up for all PAD patients

PAD

Diagnosis

1. History
2. Physical Examination
3. ABI (less than 0.9 or greater than 1.3 is definitive)
4. ABI/ Segmental Pressures and PVRs (pulse volume recording)
5. Duplex ultrasound - gives localized anatomic flow information and patency but not able to measure distal perfusion6. Laser Doppler/ TCPO2
6. CTA
7. MRI
8. Angiography- gold standard, resaved for when intervention is planned

ABI (Normal 0.9-1.3)



Right ABI = ratio of

Higher of the right ankle systolic pressures (posterior tibial or dorsalis pedis)

Higher arm systolic pressure (left or right arm)

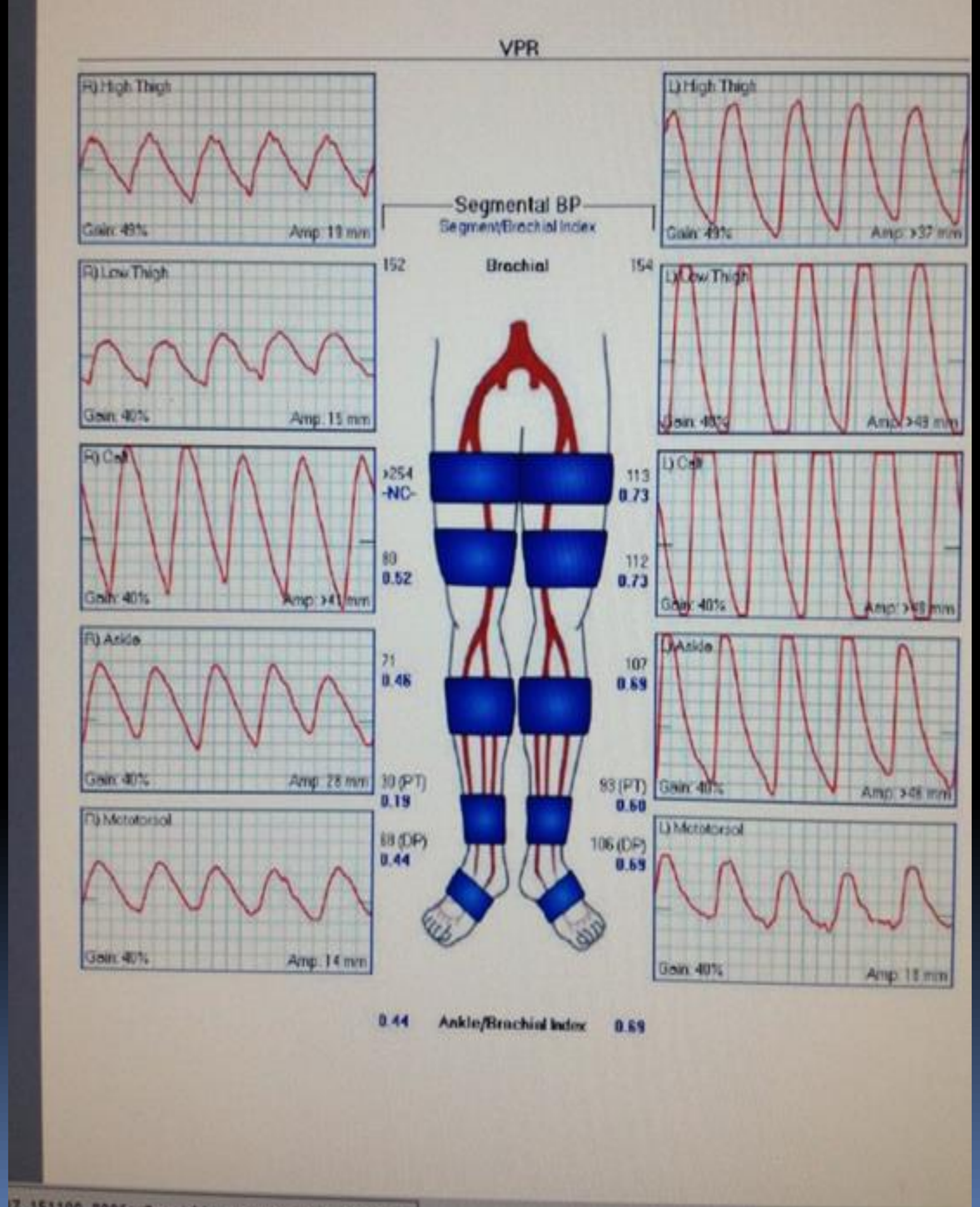
Left ABI = ratio of

Higher of the left ankle systolic pressures (posterior tibial or dorsalis pedis)

Higher arm systolic pressure (left or right arm)

- Recommendations for ankle-brachial index (ABI) screening to detect peripheral arterial disease in the individual patient.
- An ABI should be measured in:
- · All patients who have exertional leg symptoms [B]
- · All patients between the age of 50–69 and who have a cardiovascular risk factor (particularly diabetes or smoking) [B]
- · All patients age ≥70 years regardless of risk-factor status [B]
- · All patients with a Framingham risk score 10%–20% [C].

ABIs/ Segmental pressures and Pulse Volume Recording (PVRs)



Management of PAD- Best Medical Therapy (BMT)

1. Risk Factor Modification
2. Exercise Therapy
    - 30-45 minuets of structured exercise 3-4x per week for 12 weeks
    - improves 5 year CV event free survival, 80.5 vs 56.7% (Sakamoto)
3. Pharmacologic Therapy
    - Cilostazol, ASA, Statin, ACE-I, Xarelto (COMPASS data)
4. Endovascular Intervention
5. Surgical Bypass

Decision Making for Intervention/Revascularization

- Depends on symptom status and severity as well as anatomic extent of disease
- Need to assess meaningful benefit from a successful procedure
- Technical success does not not always equate with clinical success
- Need to consider durability of any intervention
- Assess baseline functional status and comorbid medical conditions
- Evaluate the degree of disease extent and the likelihood of technical success with either less invasive means or surgery for each individual patient

Goals of Intervention

*PAD is a *systemic disease and always requires addressing systemic factors and BMT*

- Relief of symptoms
- Functional Improvement
- Improved quality of life
- Limb salvage
- Secondary prevention of coronary and cerebro-vascular complications

Treatment Guidelines according to Presentation

Claudication

- goal is to preserve life and limb by initiating systemic medical therapy to reduce CV morbidity (annual limb loss rate <1% but CAD mortality 3-5%)

- Best Medical Therapy with or without revascularization

- Intervention reserved for severe disabling IC, progression to CLTI or failure of medical therapy

- Concern for accelerated progression to CLTI with an overly aggressive revascularization strategy

CLTI

Endovascular Treatment versus open surgery

- Endovascular first approach adapted in many centers regardless of extent of obstruction

- Higher correlation of graft failure and amputation after prior intervention (Nolan)

- BASIL Trial: Surgery of greater benefit if survival at 2 years is expected; endovascular and open surgery are complementary (cross over)

Volume 69, Supplement S, June 2019

SVS Society for Vascular Surgery

Supplement to

JVS Journal of Vascular Surgery

Official Publication of the Society for Vascular Surgery

Global Vascular Guidelines on the Management of Chronic Limb-Threatening Ischemia

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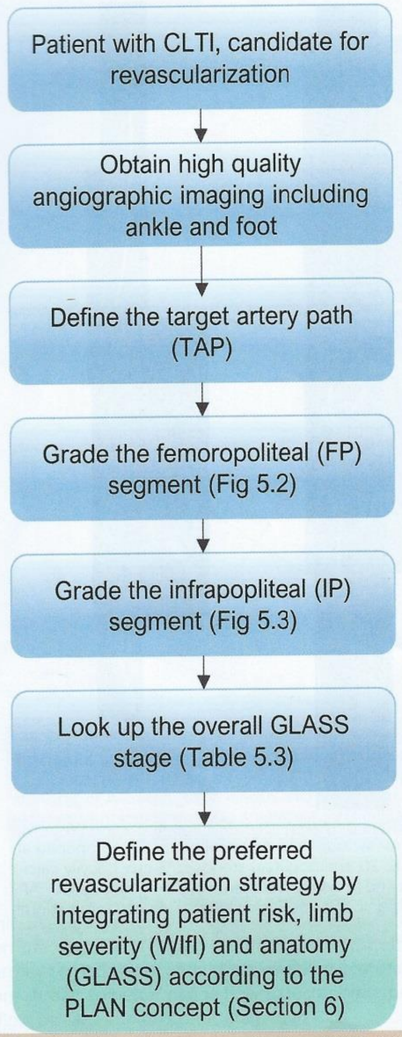

Fig 5.7. Flow chart illustrating application of Global Limb Anatomic Staging System (*GLASS*) to stage infrainguinal disease pattern in chronic limb-threatening ischemia (*CLTI*). *FP*, Femoropopliteal; *IP*, infrapopliteal; *PLAN*, patient risk estimation, limb staging, anatomic pattern of disease; *TAP*, target arterial path; *WIfI*, Wound, Ischemia, and foot Infection.

ORIGINAL ARTICLE

Surgery or Endovascular Therapy for Chronic Limb-Threatening Ischemia

A. Farber, M.T. Menard, M.S. Conte, J.A. Kaufman, R.J. Powell, N.K. Choudhry, T.H. Hamza, S.F. Assmann,* M.A. Creager, M.J. Cziraky, M.D. Dake, M.R. Jaff, D. Reid, F.S. Siami, G. Sopko, C.J. White, M. van Over, M.B. Strong, M.F. Villarreal, M. McKean, E. Azene, A. Azarbal, A. Barleben, D.K. Chew, L.C. Clavijo, Y. Douville, L. Findeiss, N. Garg, W. Gasper, K.A. Giles, P.P. Goodney, B.M. Hawkins, C.R. Herman, J.A. Kalish, M.C. Koopmann, I.A. Laskowski, C. Mena-Hurtado, R. Motaganahalli, V.L. Rowe, A. Schanzer, P.A. Schneider, J.J. Siracuse, M. Venermo, and K. Rosenfield, for the BEST-CLI Investigators†

ABSTRACT

BACKGROUND

Patients with chronic limb-threatening ischemia (CLTI) require revascularization to improve limb perfusion and thereby limit the risk of amputation. It is uncertain whether an initial strategy of endovascular therapy or surgical revascularization for CLTI is superior for improving limb outcomes.

METHODS

In this international, randomized trial, we enrolled 1830 patients with CLTI and infrainguinal peripheral artery disease in two parallel-cohort trials. Patients who had a single segment of great saphenous vein that could be used for surgery were assigned to cohort 1. Patients who needed an alternative bypass conduit were assigned to cohort 2. The primary outcome was a composite of a major adverse limb event — which was defined as amputation above the ankle or a major limb reintervention (a new bypass graft or graft revision, thrombectomy, or thrombolysis) — or death from any cause.

RESULTS

In cohort 1, after a median follow-up of 2.7 years, a primary-outcome event occurred in 302 of 709 patients (42.6%) in the surgical group and in 408 of 711 patients (57.4%) in the endovascular group (hazard ratio, 0.68; 95% confidence interval [CI], 0.59 to 0.79; P<0.001). In cohort 2, a primary-outcome event occurred in 83 of 194 patients (42.8%) in the surgical group and in 95 of 199 patients (47.7%) in the endovascular group (hazard ratio, 0.79; 95% CI, 0.58 to 1.06; P=0.12) after a median follow-up of 1.6 years. The incidence of adverse events was similar in the two groups in the two cohorts.

CONCLUSIONS

Among patients with CLTI who had an adequate great saphenous vein for surgical revascularization (cohort 1), the incidence of a major adverse limb event or death was significantly lower in the surgical group than in the endovascular group. Among the patients who lacked an adequate saphenous vein conduit (cohort 2), the outcomes in the two groups were similar. (Funded by the National Heart, Lung, and Blood Institute; BEST-CLI ClinicalTrials.gov number, NCT02060630.)

The authors' full names, academic degrees, and affiliations are listed in the Appendix. Dr. Farber can be contacted at alik.farber@bmc.org or at the Division of Vascular and Endovascular Surgery, Boston Medical Center, Boston University School of Medicine, Department of Surgery, 85 E. Concord St., 3rd Fl., Rm. 3000, Boston, MA 02118.

*Deceased.

†The BEST-CLI Investigators are listed in the Supplementary Appendix, available at NEJM.org.

Drs. Farber and Menard contributed equally to this article.

This article was published on November 7, 2022, at NEJM.org.

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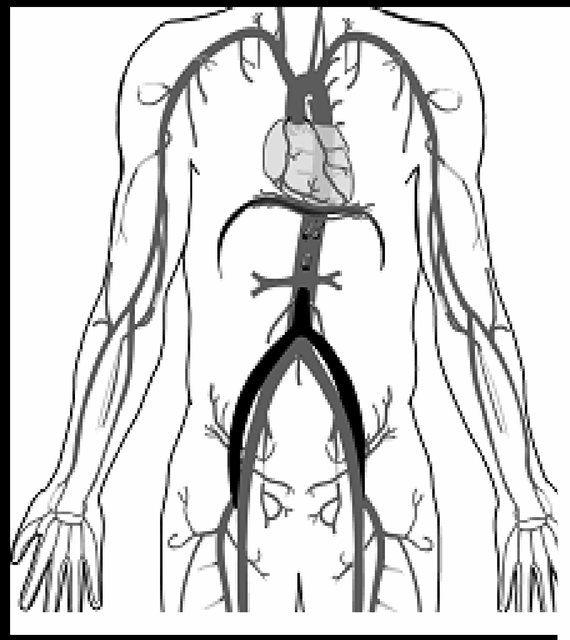
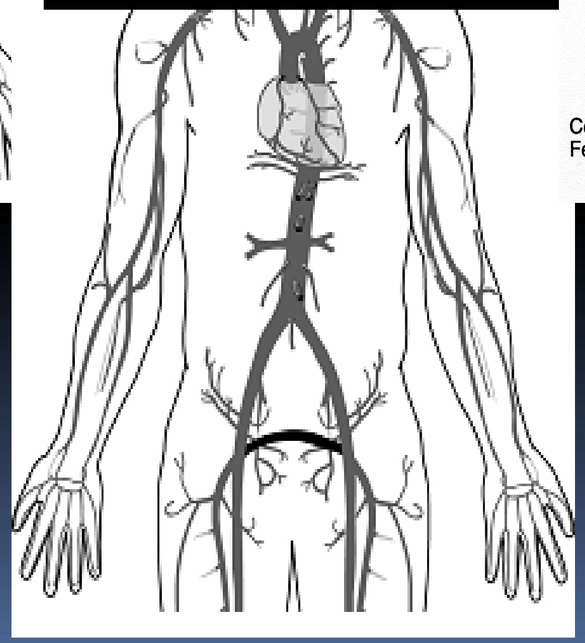
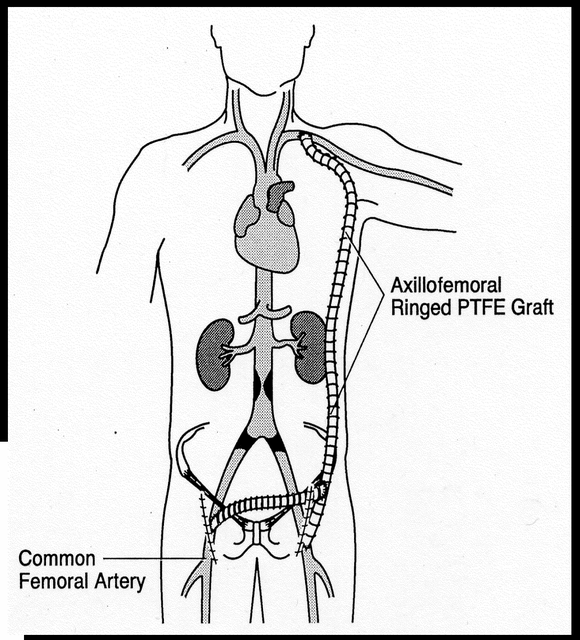
Open surgical revascularization







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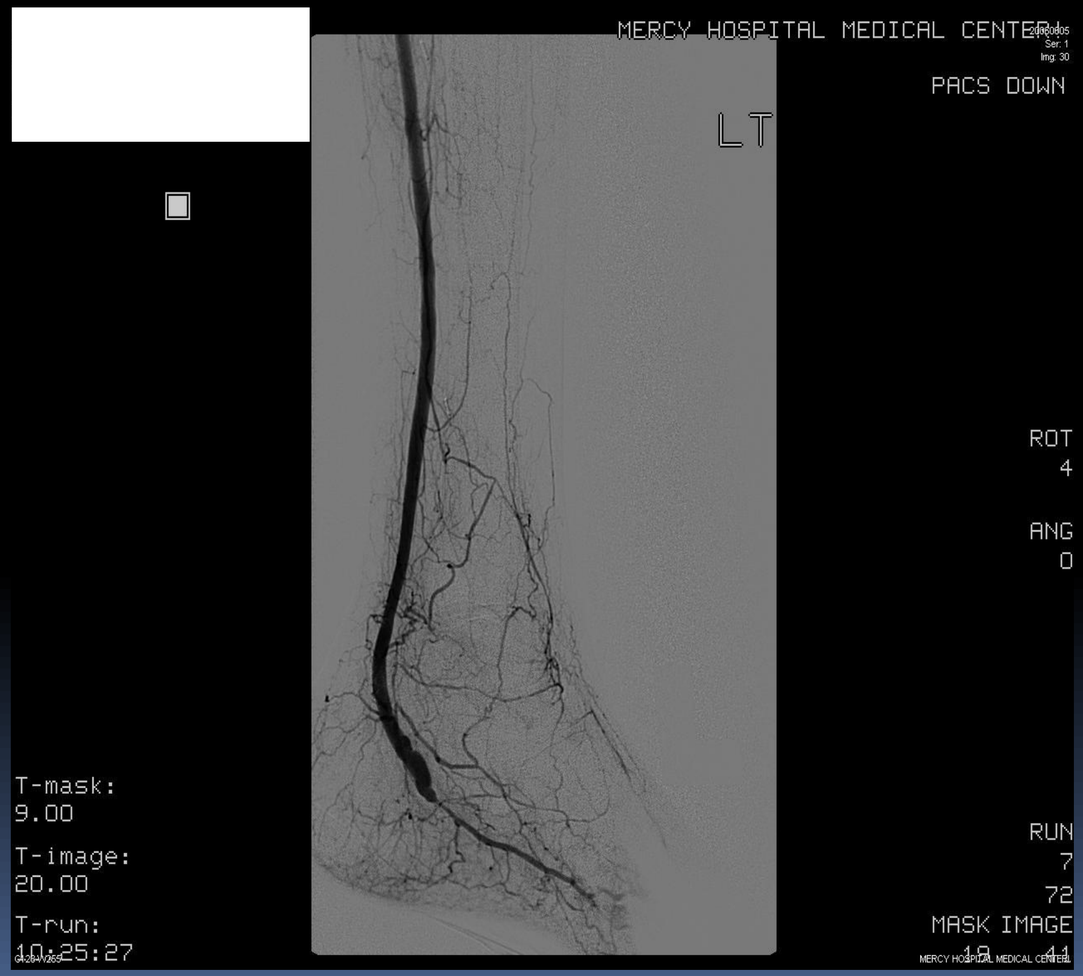

THE LANCET

ARTICLES · Volume 401, Issue 10390, P1798-1809, May 27, 2023 · *Open Access* Download Full Issue

A vein bypass first versus a best endovascular treatment first revascularisation strategy for patients with chronic limb threatening ischaemia who required an infra-popliteal, with or without an additional more proximal infra-inguinal revascularisation procedure to restore limb perfusion (BASIL-2): an open-label, randomised, multicentre, phase 3 trial

Prof Andrew W Bradbury, MD [a,b,d] · Catherine A Moakes, MSc [c] · Matthew Popplewell, MD [b] · Lewis Meecham, FRCS [m] · Gareth R Bate, PGDip [d] · Lisa Kelly, PGDip [d] · et al. Show more

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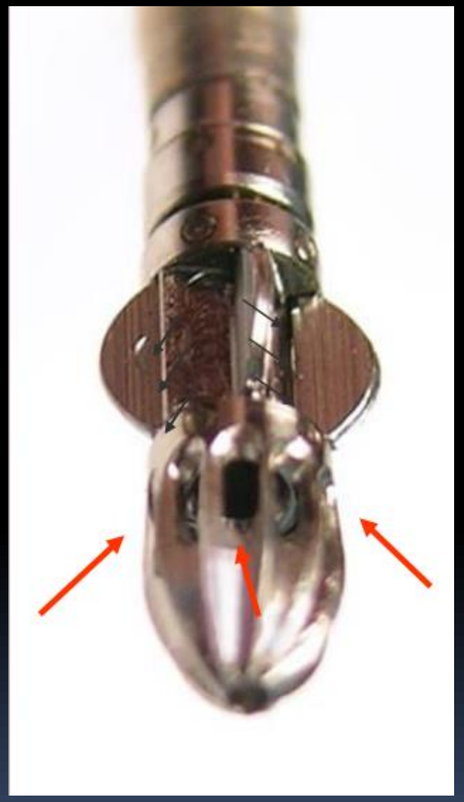
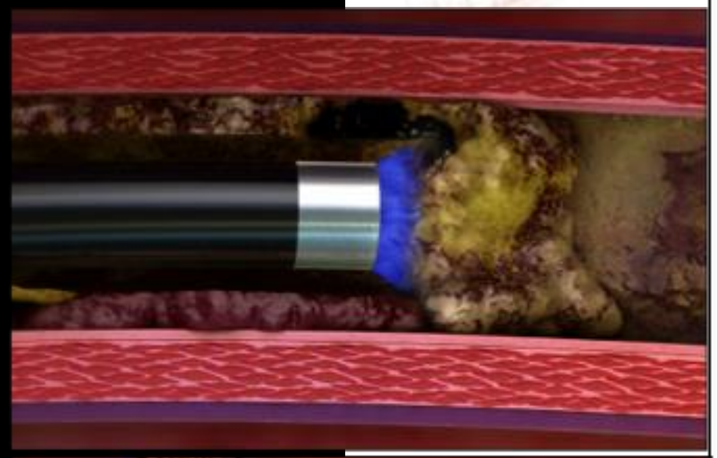
Interpretation

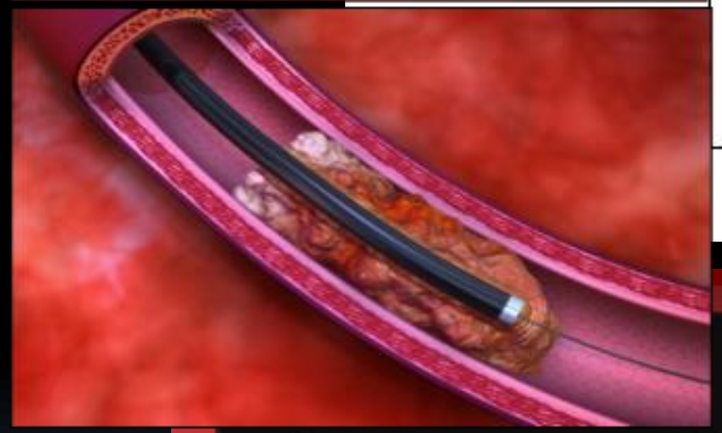
In the BASIL-2 trial, a best endovascular treatment first revascularisation strategy was associated with a better amputation-free survival, which was largely driven by fewer deaths in the best endovascular treatment group. These data suggest that more patients with chronic limb-threatening ischaemia who required an infra-popliteal, with or without an additional more proximal infra-inguinal, revascularisation procedure to restore limb perfusion should be considered for a best endovascular treatment first revascularisation strategy.

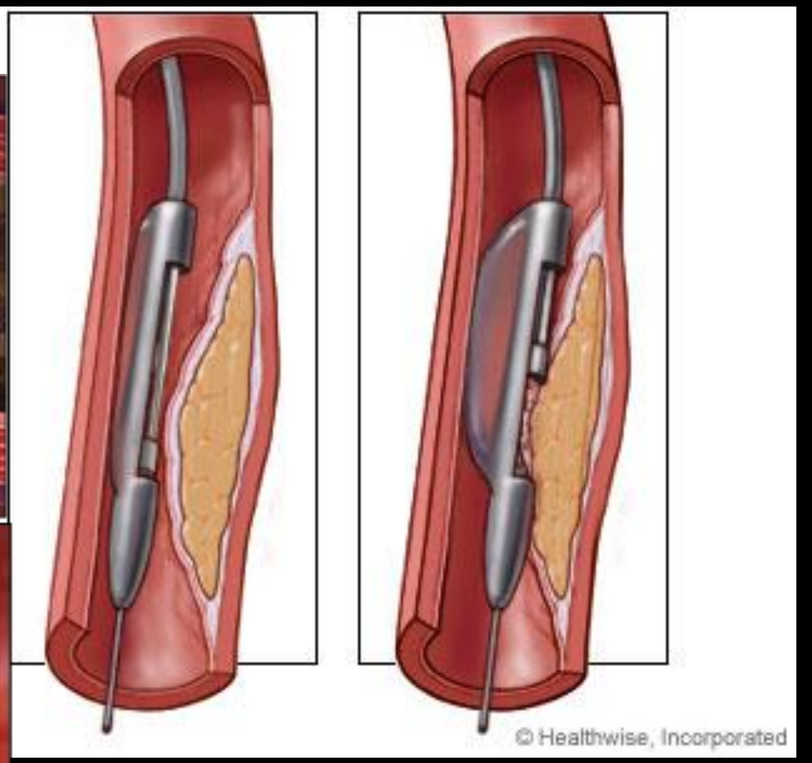
best endovascular treatment first revascularisation strategy in terms of preventing major amputation and death in patients with chronic limb threatening ischaemia who required an infra-popliteal, with or without an additional more proximal infra-inguinal, revascularisation procedure to restore limb perfusion.

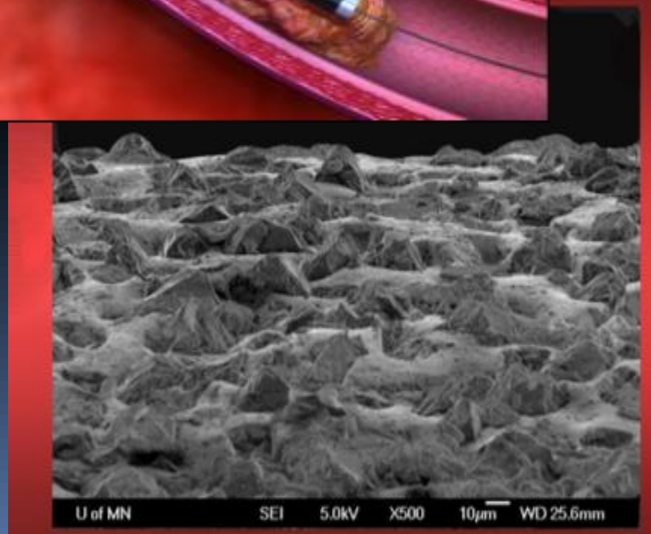
Intervention











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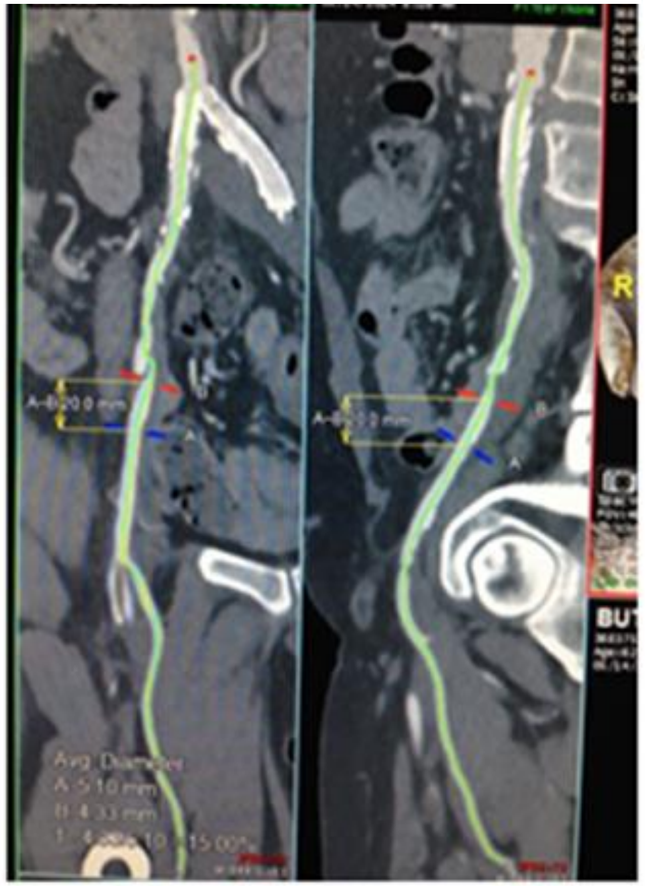
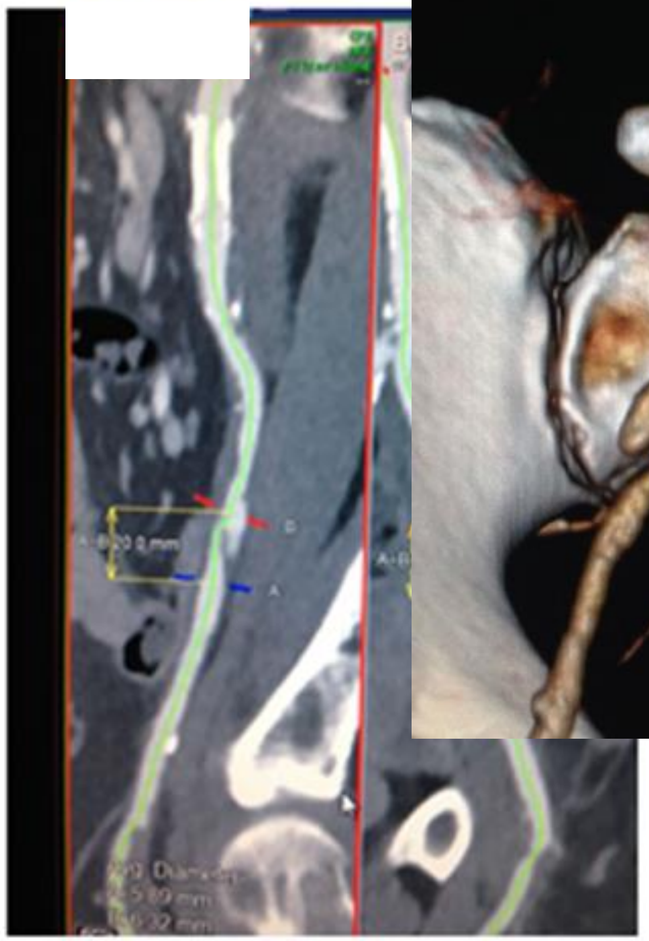
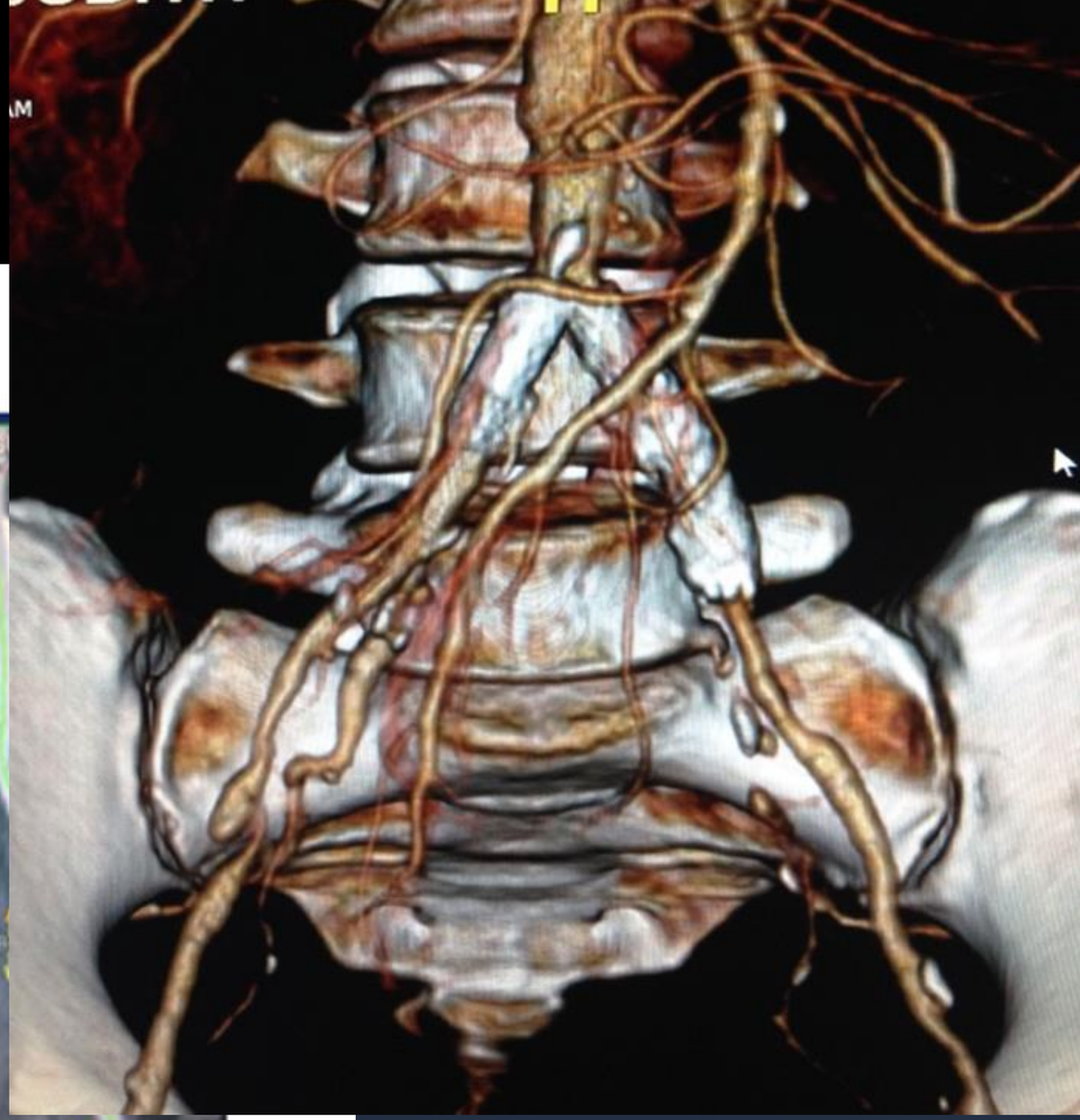
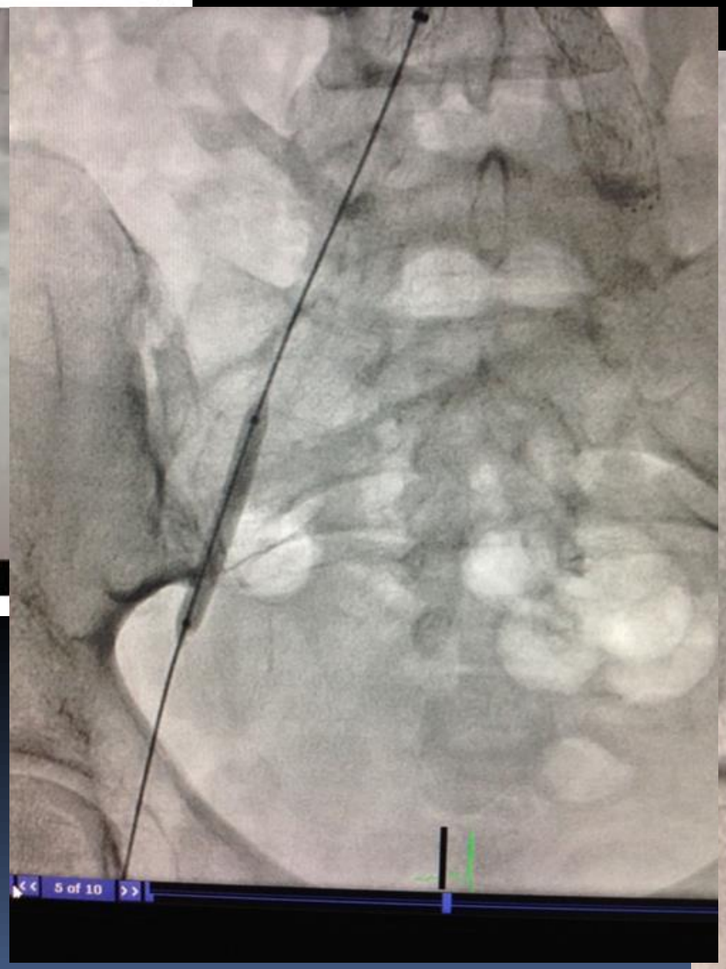
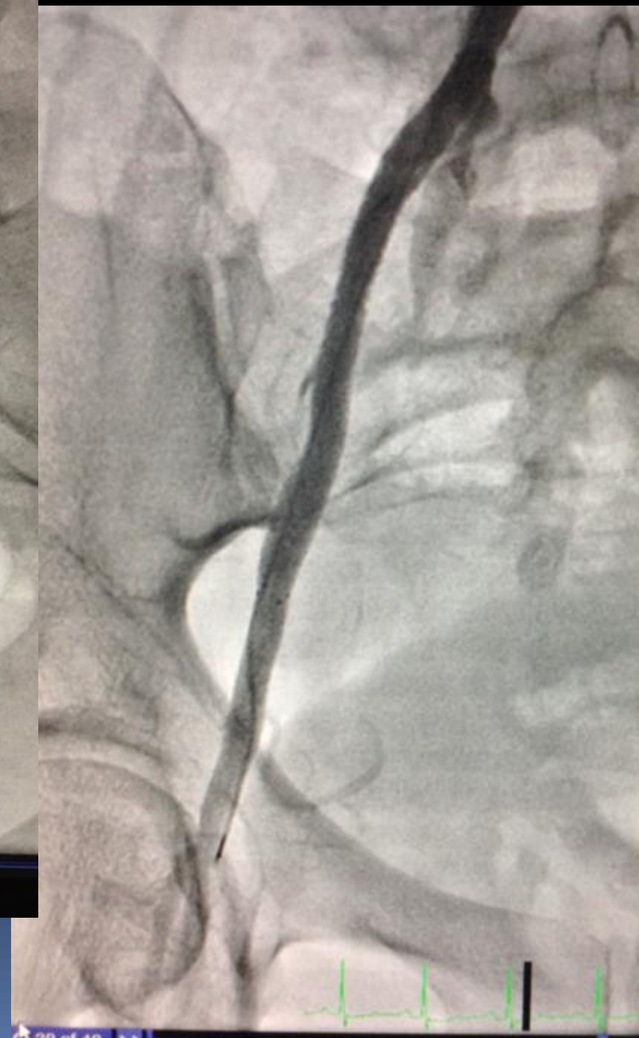


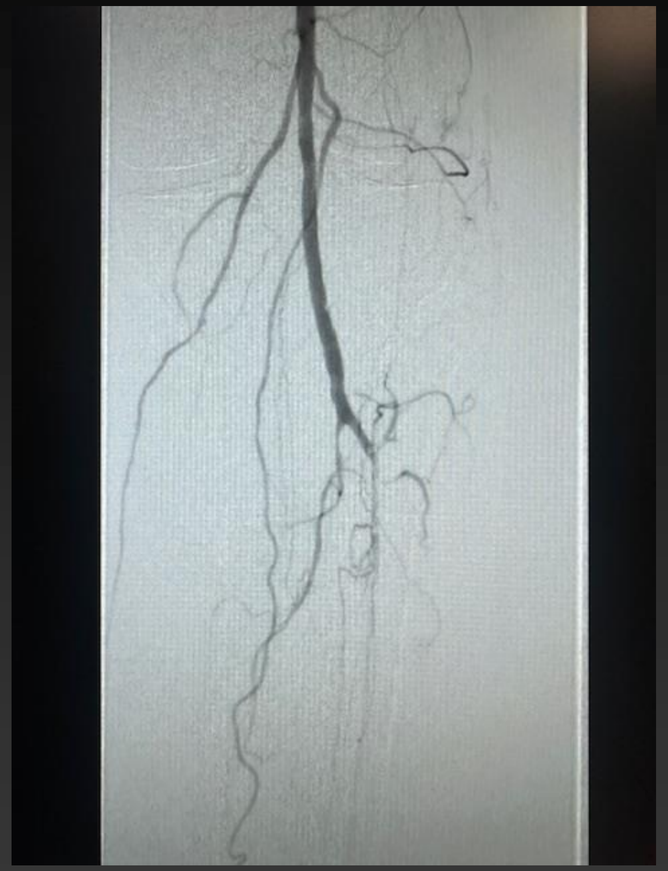


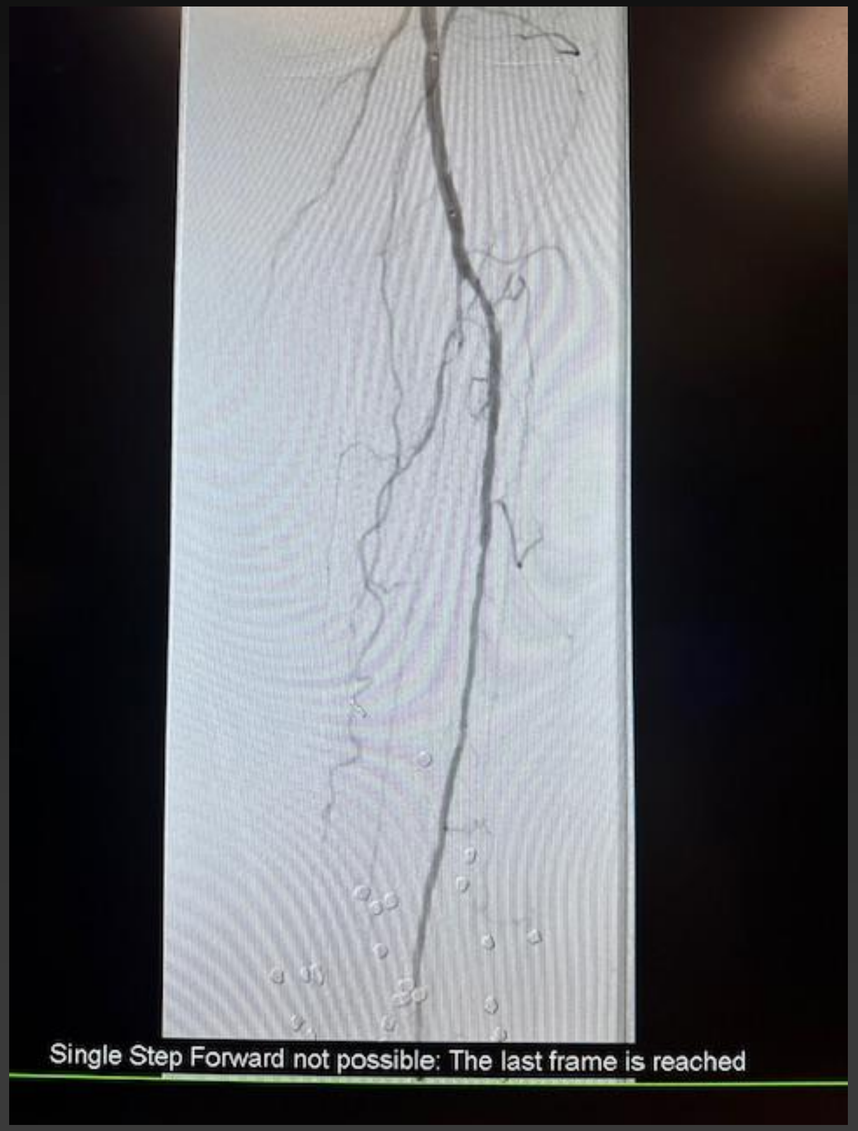


- Endovascular intervention








Single Step Forward not possible: The last frame is reached

Technique and early results of percutaneous femoropopliteal bypass with stent graft

Pierre Sarradon, MD,[a] Baris Ata Ozdemir, MD, PhD,[b] *and*
Jean Pierre Becquemin, MD,[c] *Monte Carlo, Monaco; Bristol, UK; and Champigny sur Marne, France*

ABSTRACT

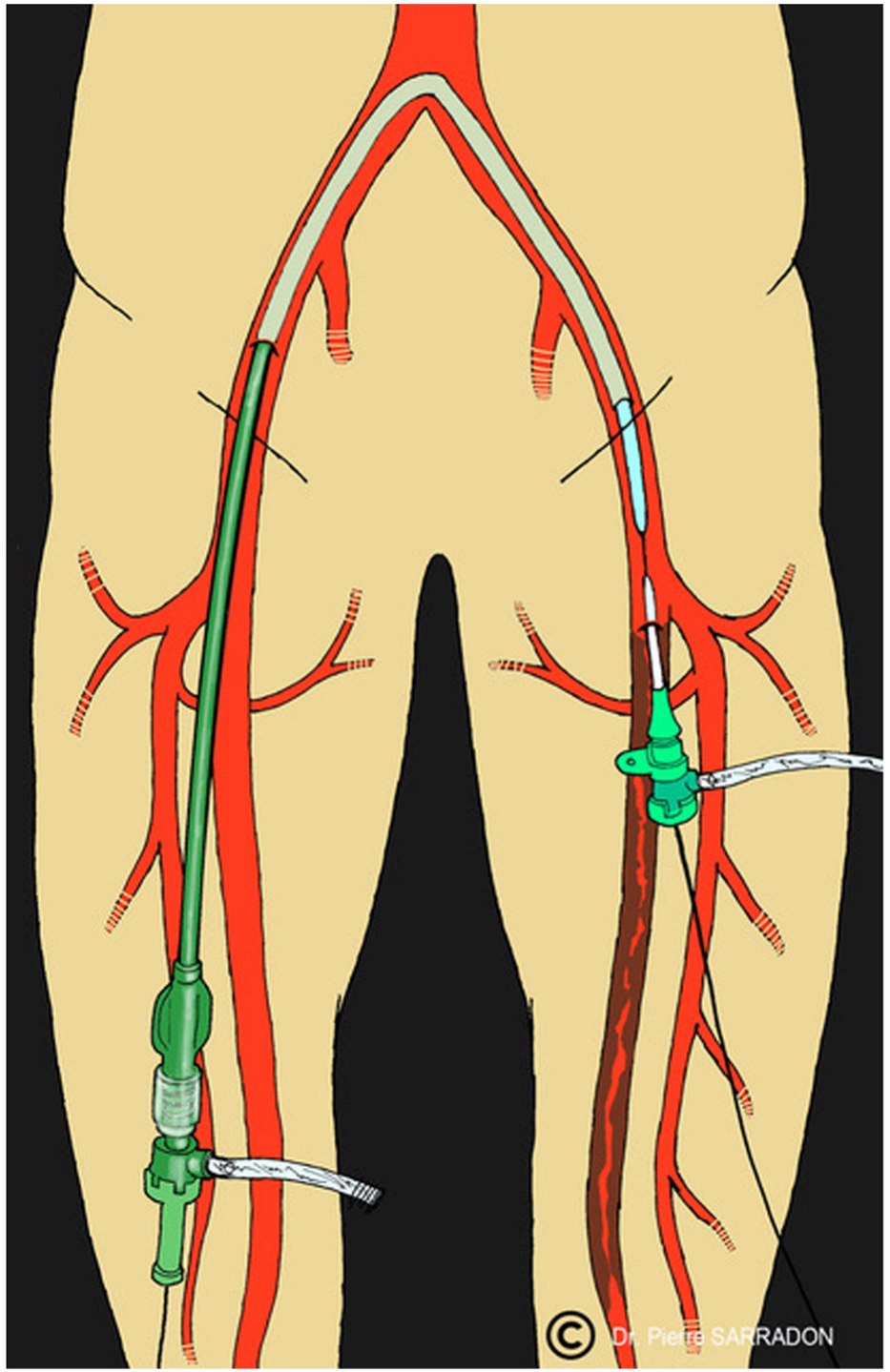
Objective: We describe the technique and early results of lower extremity revascularization with total percutaneous bypass using extravascular placement of a stent graft (percutaneous prosthetic bypass).

Methods: Patients with severe chronic limb threatening ischemia for whom open or endoluminal repair was either not feasible and or had failed were selected for a pilot study using percutaneous prosthetic bypass. The procedure requires placement of three introducer sheaths in the contralateral common femoral artery, and the ipsilateral proximal and distal superficial femoral arteries (SFAs). A guidewire is placed from the contralateral sheath to the ipsilateral popliteal artery via the two ipsilateral sheaths. Two self-expanding polytetrafluoroethylene-covered stents are then placed from the proximal SFA to the distal SFA.

Results: A total of 30 bypasses were performed in 28 patients aged 71 ± 3 years. Of the 28 patients, 16 had severe claudication (Rutherford class 3; 53%) and 14 had critical ischemia (Rutherford class 4-6; 47%). The early results were excellent, with no deaths and one occlusion successfully treated with thrombolysis. No other complications requiring reintervention occurred. The mean follow-up was 25.4 months (range, 3-36 months). The 12- and 36-month Kaplan-Meier survival curve was 100% and 81%, respectively. The primary patency, secondary patency, and freedom from amputation rates were 75% and 75%, 78% and 75%, and 100% and 91%, respectively.

Conclusions: For patients with long lesions and/or failed endovascular treatment, the described technique offers the advantage of a total percutaneous procedure with acceptable early results. If these favorable outcomes are confirmed in larger series with longer follow-up, percutaneous extravascular bypass of the SFA will represent a complementary tool for infrainguinal arterial repair. (J Vasc Surg Cases Innov Tech 2023;9:101317.)

Keywords: Endovascular; Lower limb revascularization; Percutaneous bypass graft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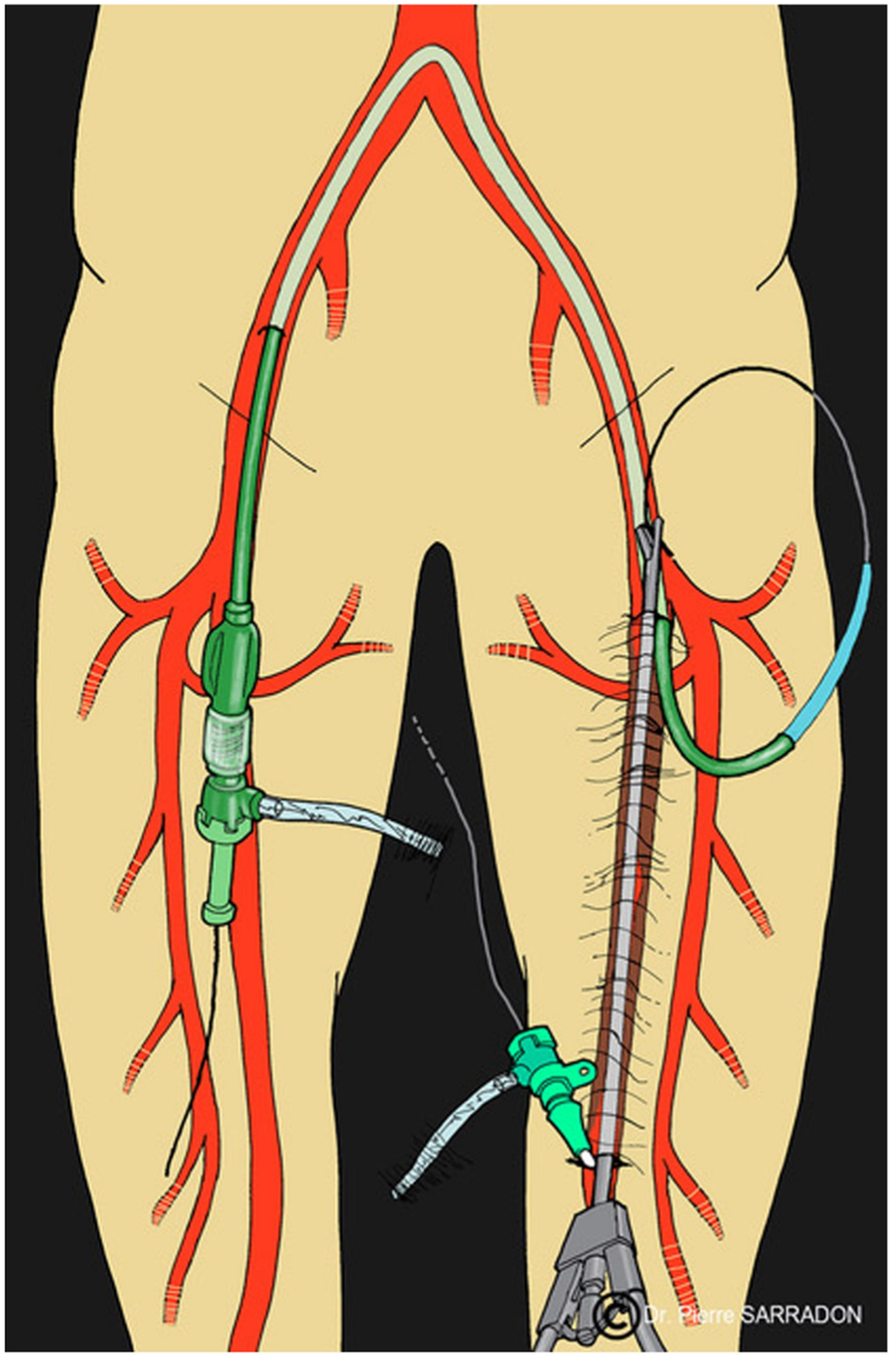
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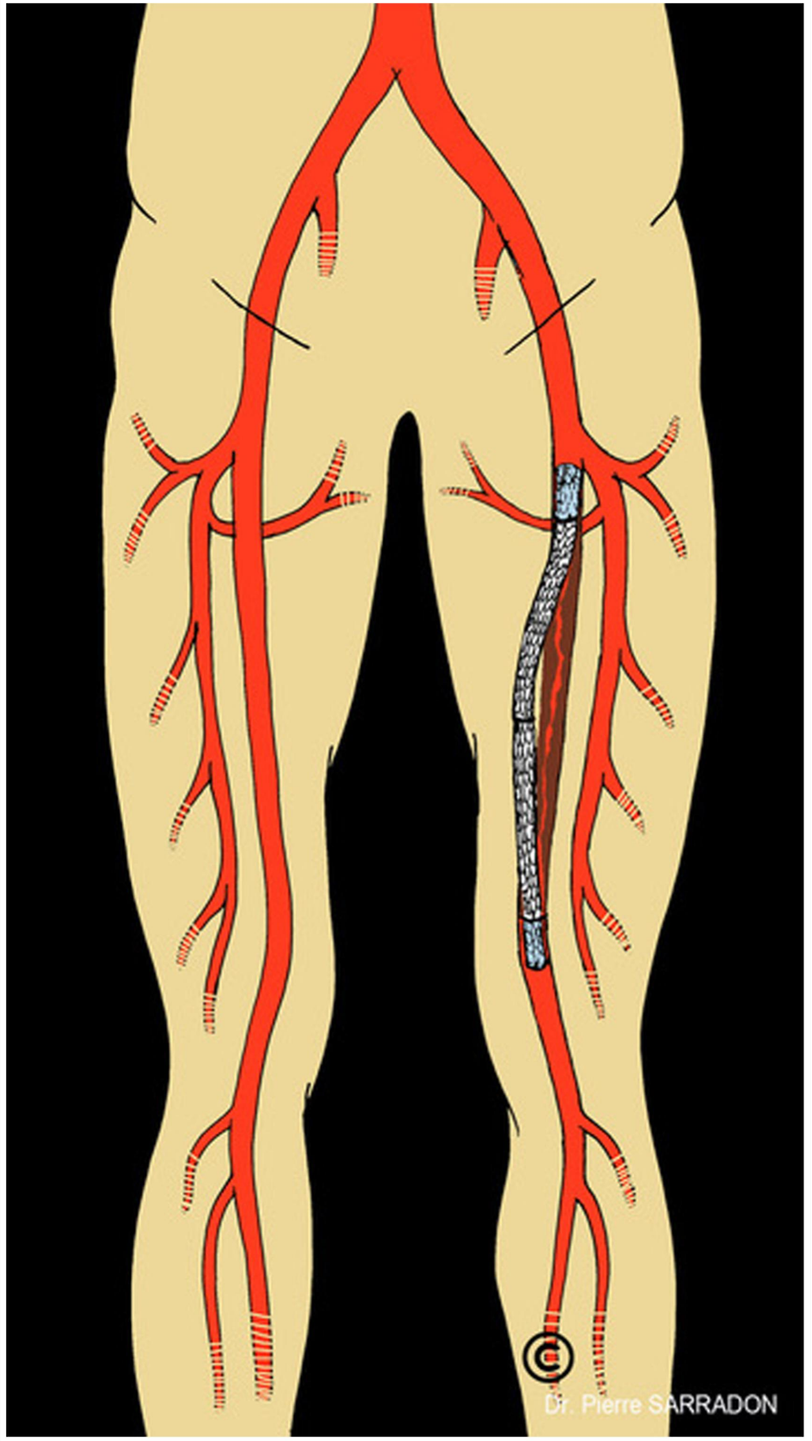
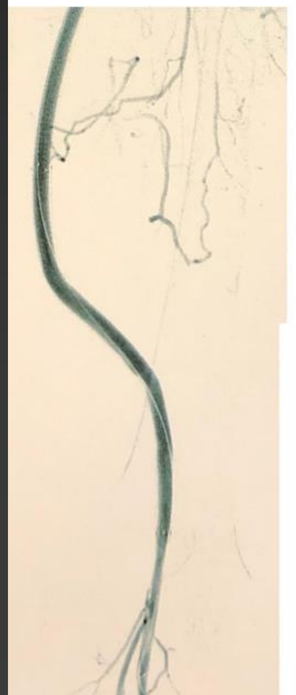

Dr. Pierre SARRADON



RESEARCH SUMMARY

Transcatheter Arterialization of Deep Veins in Chronic Limb-Threatening Ischemia

Shishehbor MH et al. DOI: 10.1056/NEJMoa2212754

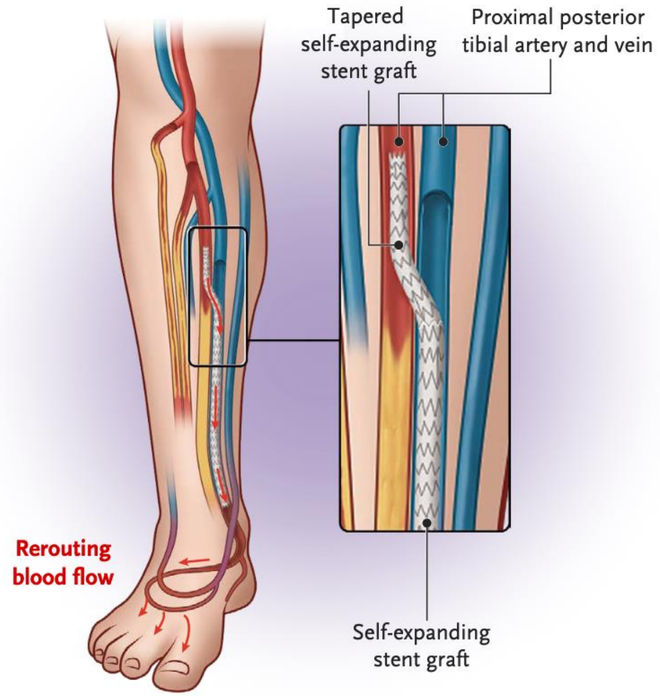
CLINICAL PROBLEM

Arterial revascularization is standard care for patients with chronic limb-threatening ischemia. However, up to 20% of patients are not candidates for revascularization — primarily owing to the absence of a distal runoff arterial target or lack of an appropriate conduit for surgical bypass — putting them at high risk for above-ankle amputation. Transcatheter arterialization of the deep veins is an alternative endovascular approach in which an arteriovenous fistula is created proximal to the diseased tibial arteries by means of a covered stent, allowing oxygenated blood to be diverted from the tibial arteries to the tibial veins and ultimately reaching the foot through the pedal veins. The effectiveness of this approach in patients with chronic limb-threatening ischemia without revascularization options is unclear.

CLINICAL TRIAL

Design: A prospective, single-group, multicenter study assessed the effectiveness and safety of transcatheter arterialization of the deep veins in patients with chronic limb-threatening ischemia and nonhealing ulcers with no option for revascularization.

Transcatheter Arterialization of Deep Veins



Amputation-free Survival


A
B
C
D
E
F
G
H
I
J
K

Take Home Message

- Claudication has a relatively benign course and may not require intervention
- Depending on the severity of symptoms, intervention may be considered
- The mode of intervention must be tailored to the individual patient
- Quality of life issues must always be considered in all patients (function, free
- Multidisciplinary care is essential in caring for high risk patients
- Limb salvage can be achieved with minimally invasive means

Comprehensive care of Vascular disease

- Multidisciplinary approach for vascular patients
- Commitment to limb salvage
- Consider all options including traditional bypass reconstruction when appropriate
- Advanced and complex endovascular techniques and modalities

Venous Disorders
Spectrum of Disease

Acute

- DVT
- PE

Chronic

- Varicose veins
- Swelling/Edema
- CVI
- PTS (Post-thrombotic syndrome)

Risk Factors for DVT/PE

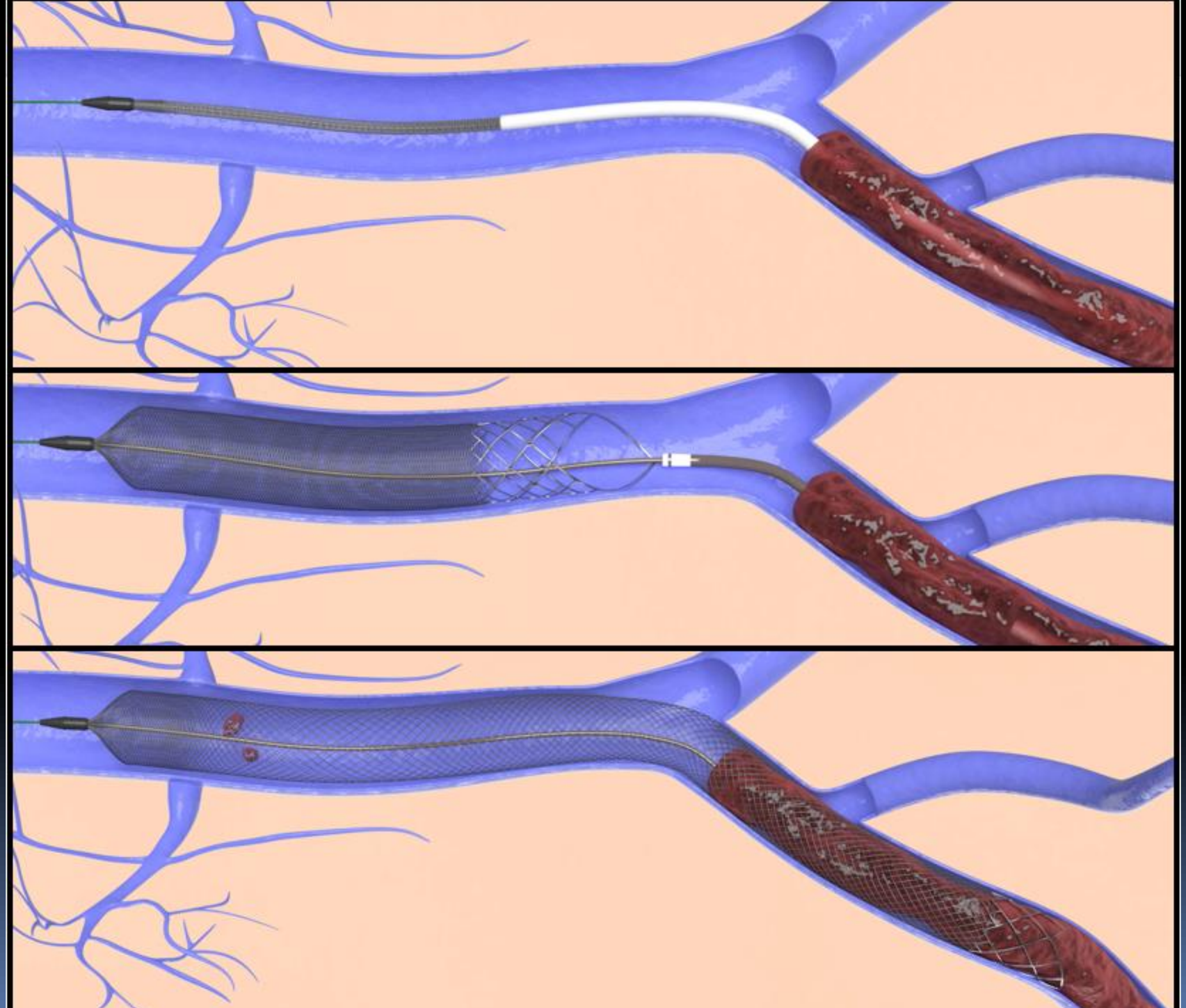
1. Age- increasing incidence
2. Immobilization
3. Travel- 1/600 for flights > 4 hours, 150-fold higher in flights > 5000 Km.
4. History of VTE- 23-26%
5. Obesity- Framingham Study hazard ratio of 1.88
6. Malignancy- 20% of all first time DVT are associated with underlying malignancy, 1 in 7 in-hospital cancer related deaths are due to PE
7. Surgery
8. Trauma
9. Pregnancy
10. Hormonal Therapy

Diagnosis of DVT

- History and PE: PROVOKED or UNPROVOKED
- D-Dimer
- P-Selectin: less available, more in malignancy, more specific than D-Dimer
- Wells Clinical Scoring
- Caprini Risk Assessment Tool
- Duplex Ultrasound: “Gold standard”

Treatment of DVT/PE

- Anticoagulation
- Compression
- Early mobilization after appropriate and therapeutic anticoagulation
- Endovenous Catheter-Directed Interventions for severe symptomatic Ilio-femoral DVT
- IVC filter- when anticoagulation is contraindicated




CAT8/SEP8
CATD/SEPD
CAT6/SEP6
CAT5/SEP5 &
CAT3/SEP3
Pump MAX
Penumbra

Chronic Venous Insufficiency (CVI)

- Sequelae of DVT or valvular dysfunction
- Chronic limb changes due to venous hypertension, proximal obstruction and/or distal reflux
- Spectrum of clinical disease ranging from varicosities, LE swelling to skin changes and chronic Long-term sequelae of LE VTE
  - 29-79% of patients present with “some degree” of PTS
  - 7-23% have severe manifestations
  - 4-6% develop ulceration
  - Patients who present with recurrent VTE have 6-fold increased incidence of PTS

CEAP Classification in CVI

Clinical Classification (C)

0	No visible disease
1	Reticular veins, <3 mm
2	Varicose Veins, >3 mm
3	Edema without skin changes
4a	Pigmentation or eczema
4b	Lipodermatoslcerosis, atrophie blanche
4c	Corona phlebectatica
5	C4 with healed ulceration
6	C4 with active ulceration

Villalta scale	*CEAP*
Symptoms: Heaviness Pain Cramps Pruritus Parathesis Signs: Pretibial edema Induration Hyperpigmentation New venous ectasia Redness Pain of calf compression (Ulceration receives a score of 15) Each factor is scored: 0 (none) to 3 (severe) Mild: score 5-9 Moderate: score 10-14 Severe: score >15	Clinical: 0–None 1–Telangiectasis 2–Varicosities 3–Edema 4–Pigmentation, lipodermatosclerosis 5–Healed ulceration 6–Ulcer Etiology: Congenital/primary/secondary Anatomic distribution: Superficial, deep, perforator, or combination Pathophysiology: Reflux, obstruction, or combination Severe: > C_4

Hk

C4a Eczema

C4b Atrophie blanche

C4b Lipodermatosclerosis

C5 Healed ulcer

C6 Ulceration

Treatment
Chronic Venous Insufficiency

Diagnosis is clinical and correlated with Venous Reflux/ Duplex Ultrasound

Management :

1. Compression
2. Exercise
3. Ablation
4. Endovenous Intervention (IVUS guided)

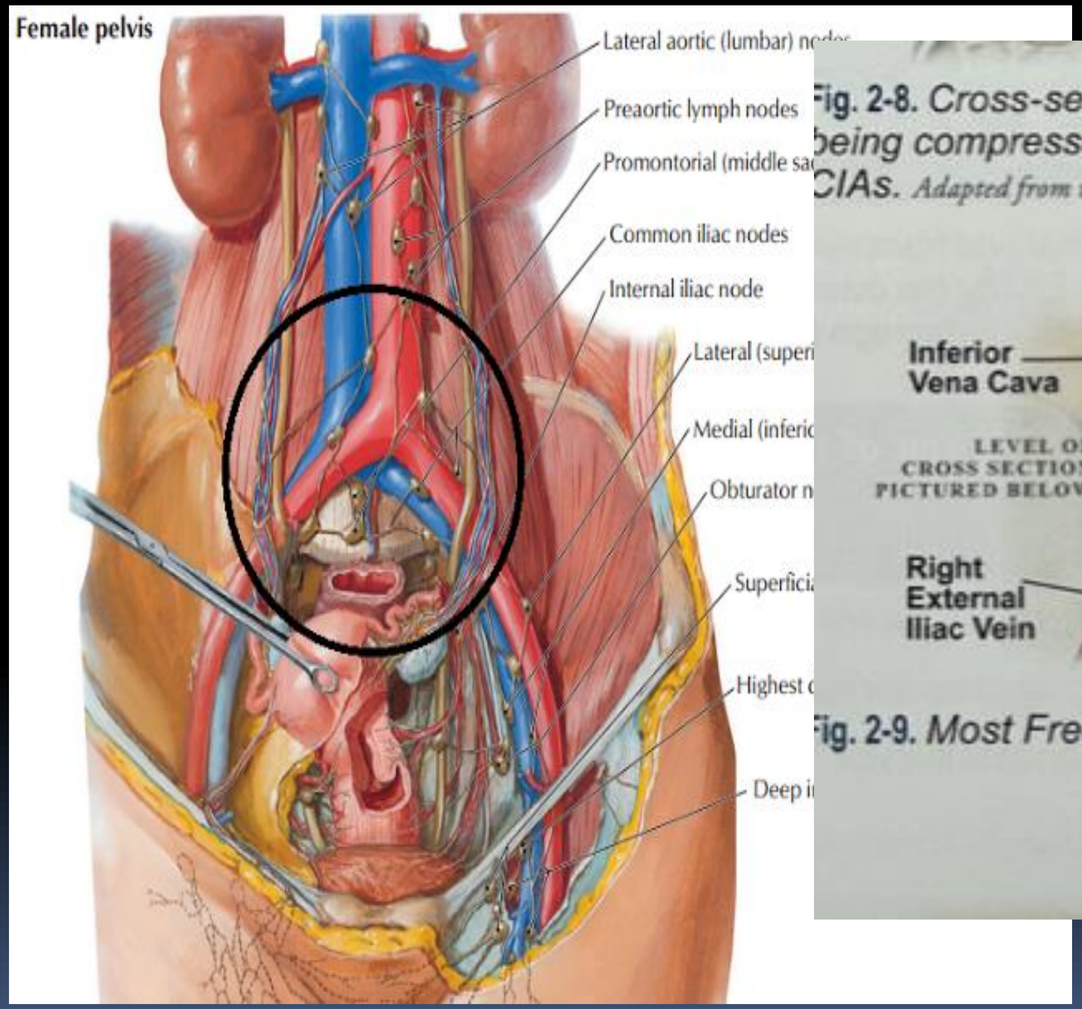
Advances in Venous Disease

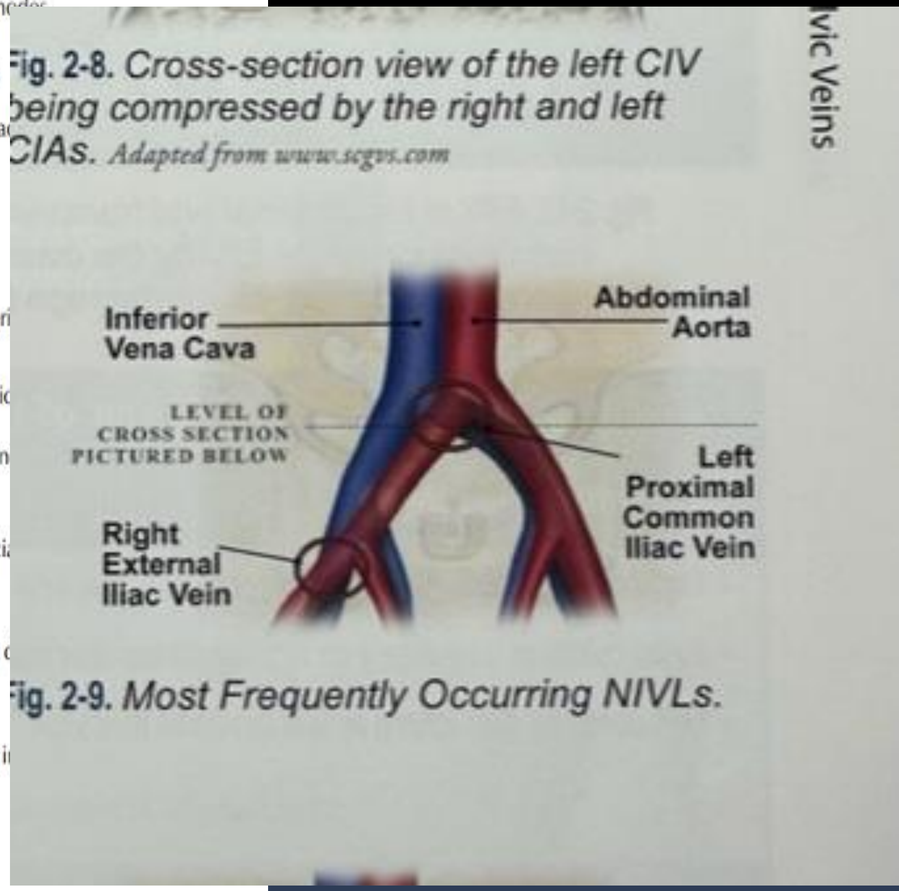
- Superficial Venous Ablation (Laser, RFA, Nonthermal modalities)
- Selective endovascular intervention for acute DVT

  Pharmacologic/Mechanical Thrombectomy
- Endovascular intervention for chronic Iliofemoral DVT Intravascular Ultrasound/ Iliac venous intervention
- Surgical Intervention for TOS

Venous Compression : May-Thurners Syndrome

- Iliofemoral DVT resulting from anatomic compression of the left iliac vein by the overlying right common iliac artery
- 37-61% risk of edema or DVT





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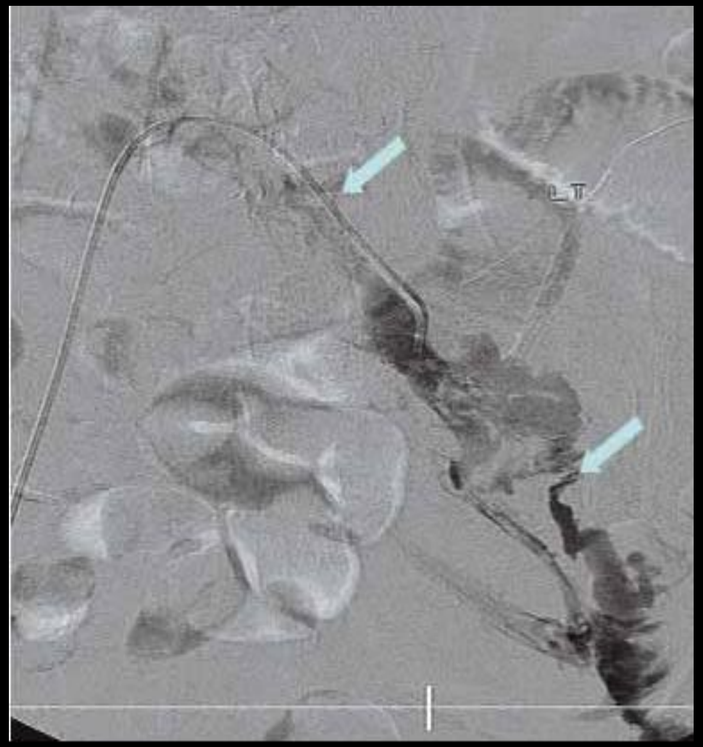
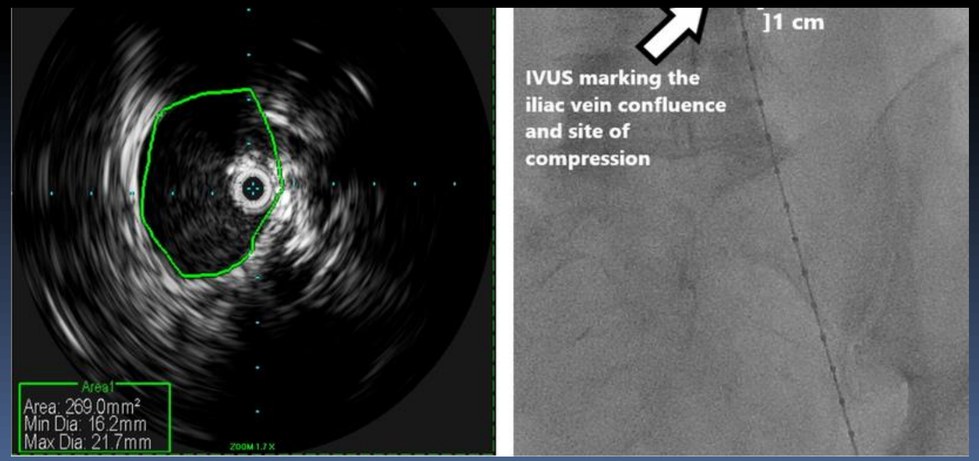


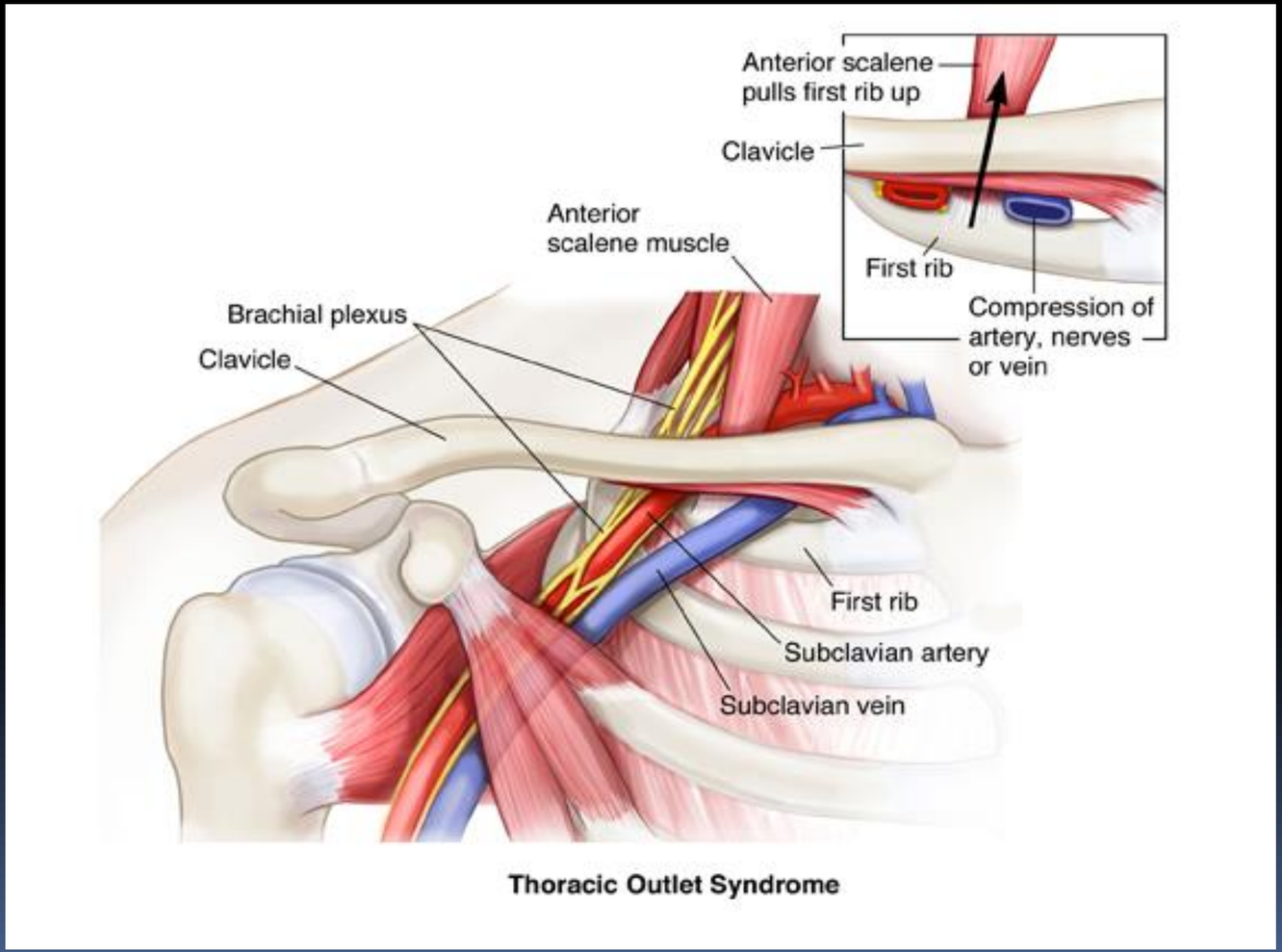


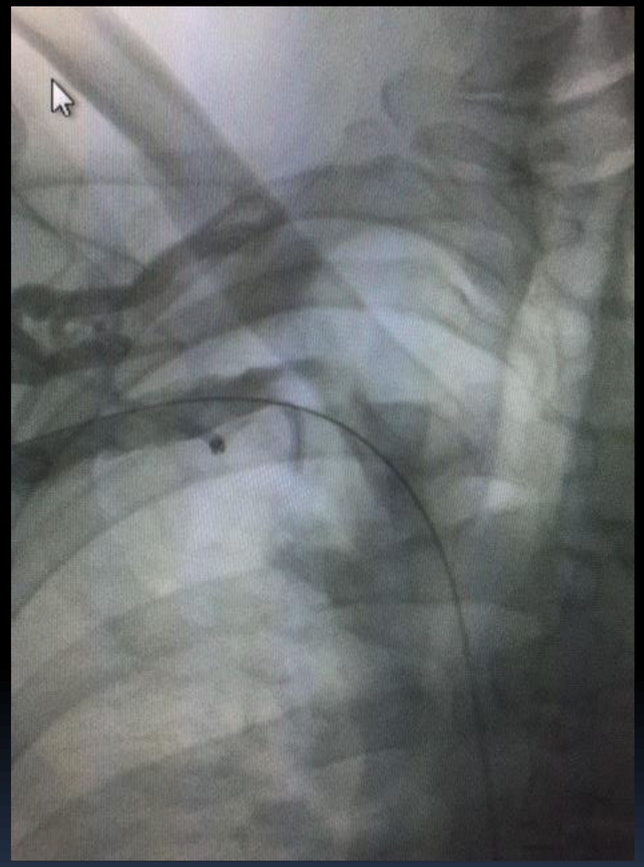
Courtesy of Z KRAJCER, MD, and SR ATMAKURI, MD

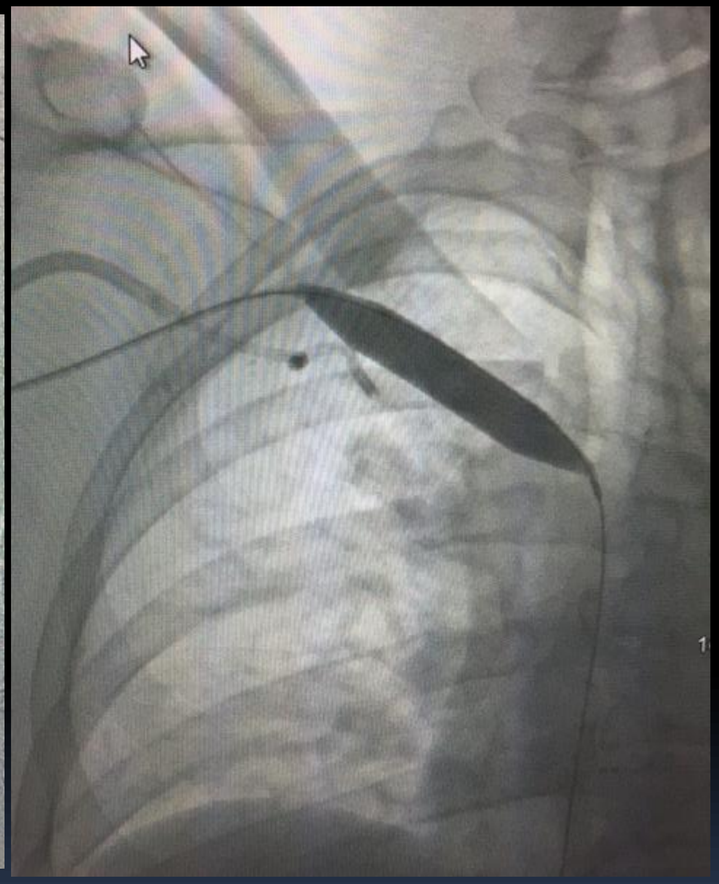
Axillo-subclavian DVT (Paget-Schroetter syndrome)

- Accounts for 1-4% of all DVTs in the absence of central venous catheters
- CVCs increase incidence of DVTs by 2-16%
- 24% of UE DVTs are spontaneous and related to thoracic outlet compression, often in young healthy individuals
- PTS can occur in 7-46% of patients and is associated with increased functional disability and decreased QOL

Axillo-subclavian DVT (Paget-Schroetter syndrome)








80 mm

Summary

- Understanding the more common vascular conditions facilitates early diagnosis, referral and appropriate treatment and may lead to improved patient satisfaction, QOL and outcomes
- Vascular disease is a systemic disease and should always incorporate BEST MEDICAL MANAGEMENT
- We are committed to provide the best, comprehensive, up to date and appropriate management of our complex vascular patients: TEAM APPROACH and INNOVATION


Thank You