Surgical treatment of vascular diseases

Faculty of Medicine, 4th year
Cardiology-angiology
2019
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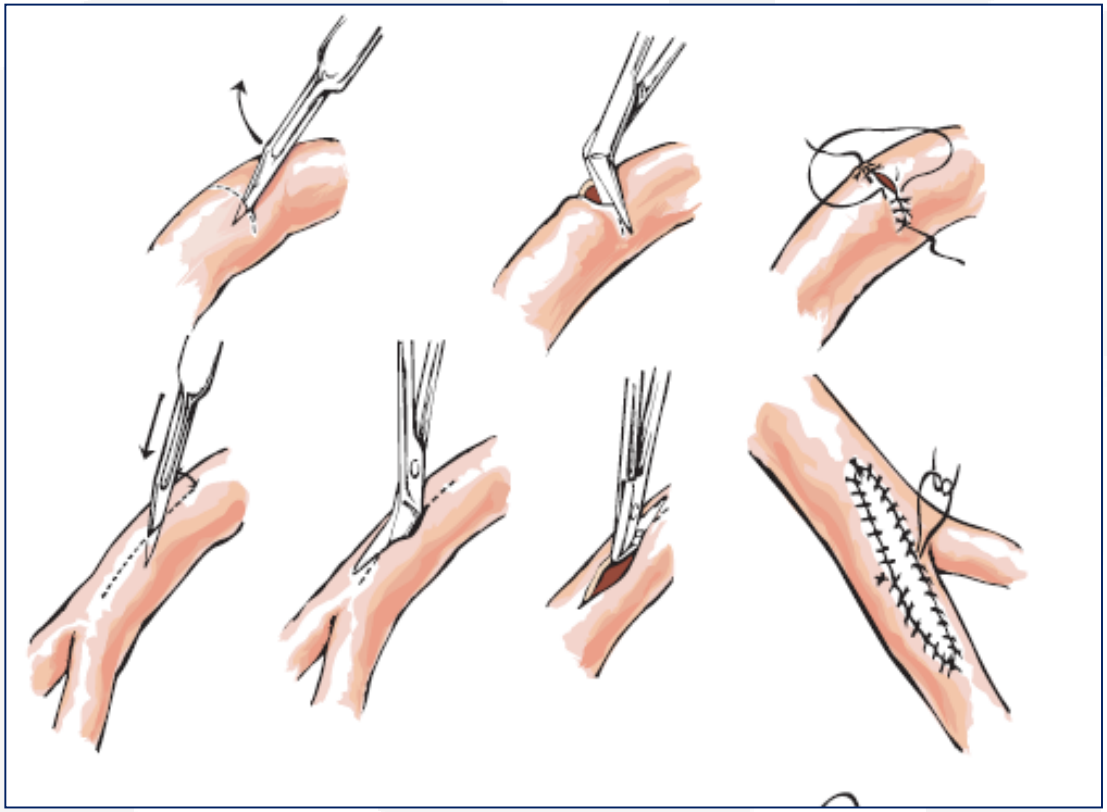
Invasive treatment of arterial diseases - methods

- **Percutaneous interventions**
- **Open surgical techniques**
  - Arteriotomy
  - Embolectomy, thrombectomy, endarterectomy
  - Vascular reconstruction
    - vessel closure
    - bypass, interposition
- **Hybrid techniques**
- **Graft materials**

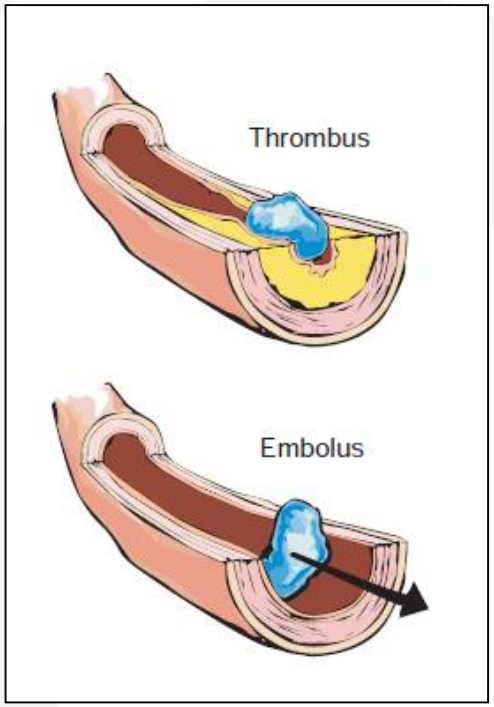
Arteriotomy and vessel closure

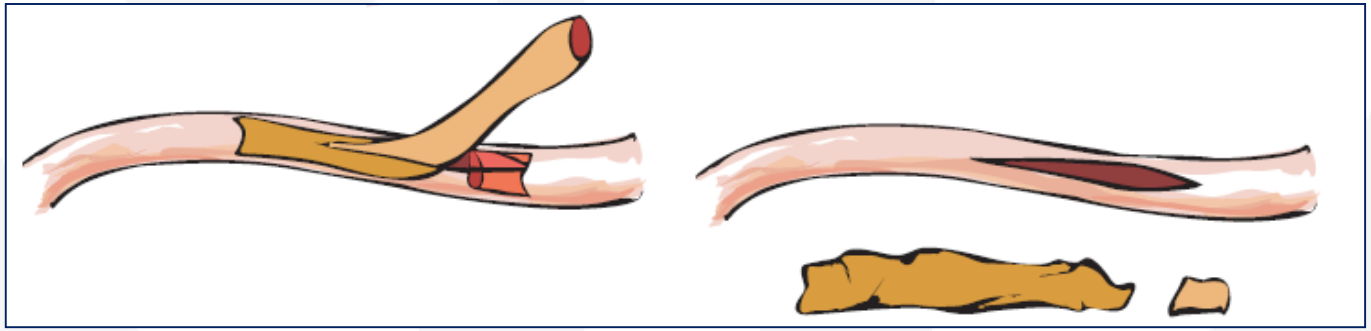


- Transverse arteriotomy and direct suture
- Longitudinal arteriotomy and patchplasty

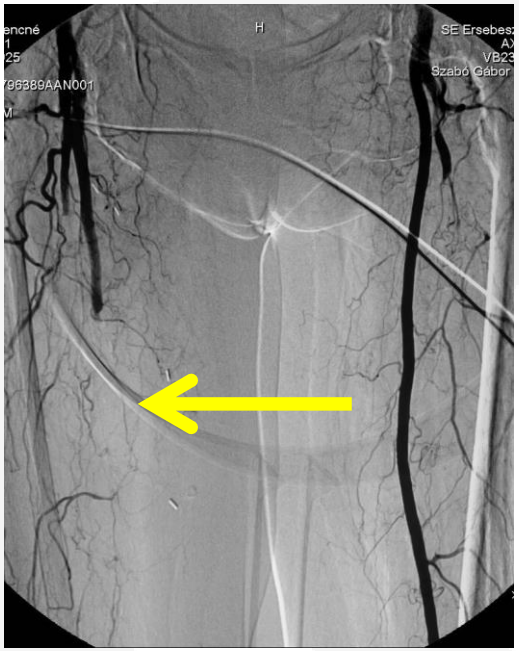
Desobliteration

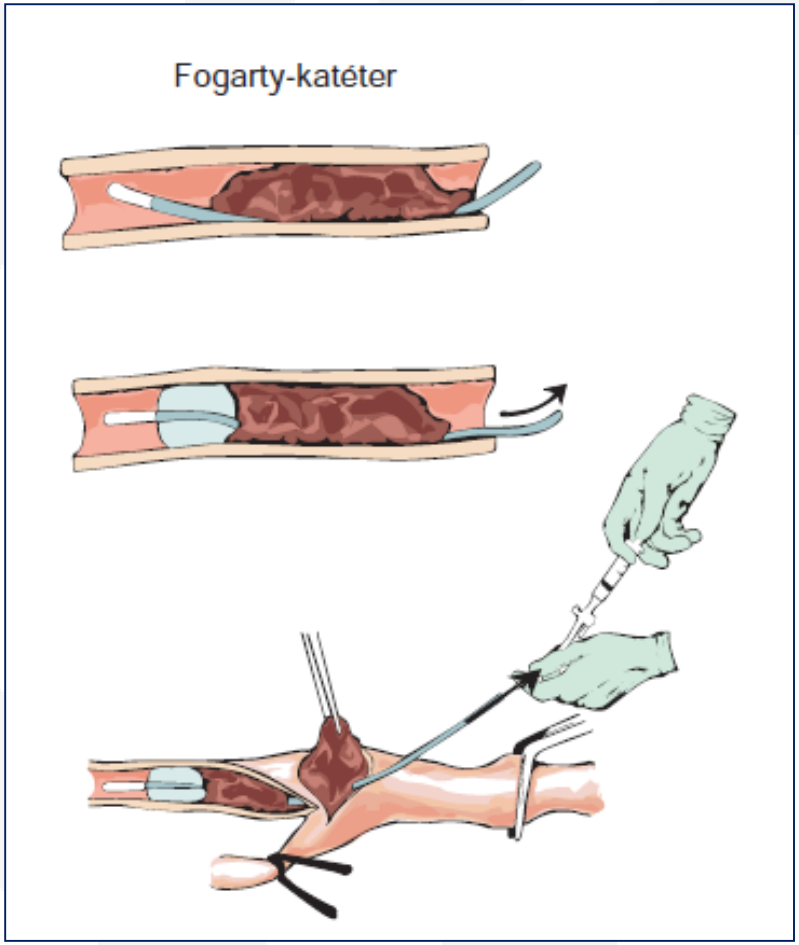
- Thrombectomy
- Embolectomy
- Endarterectomy

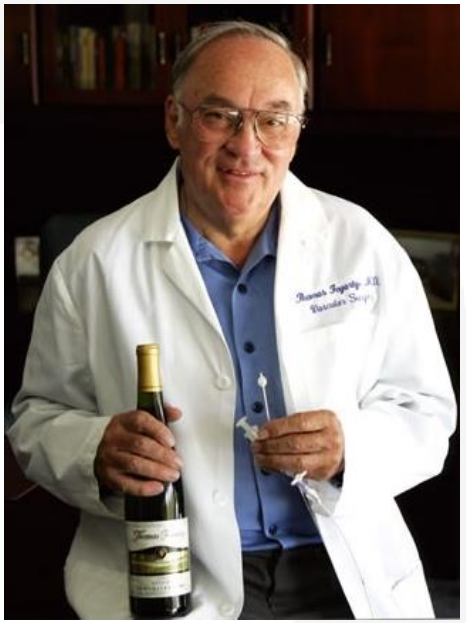




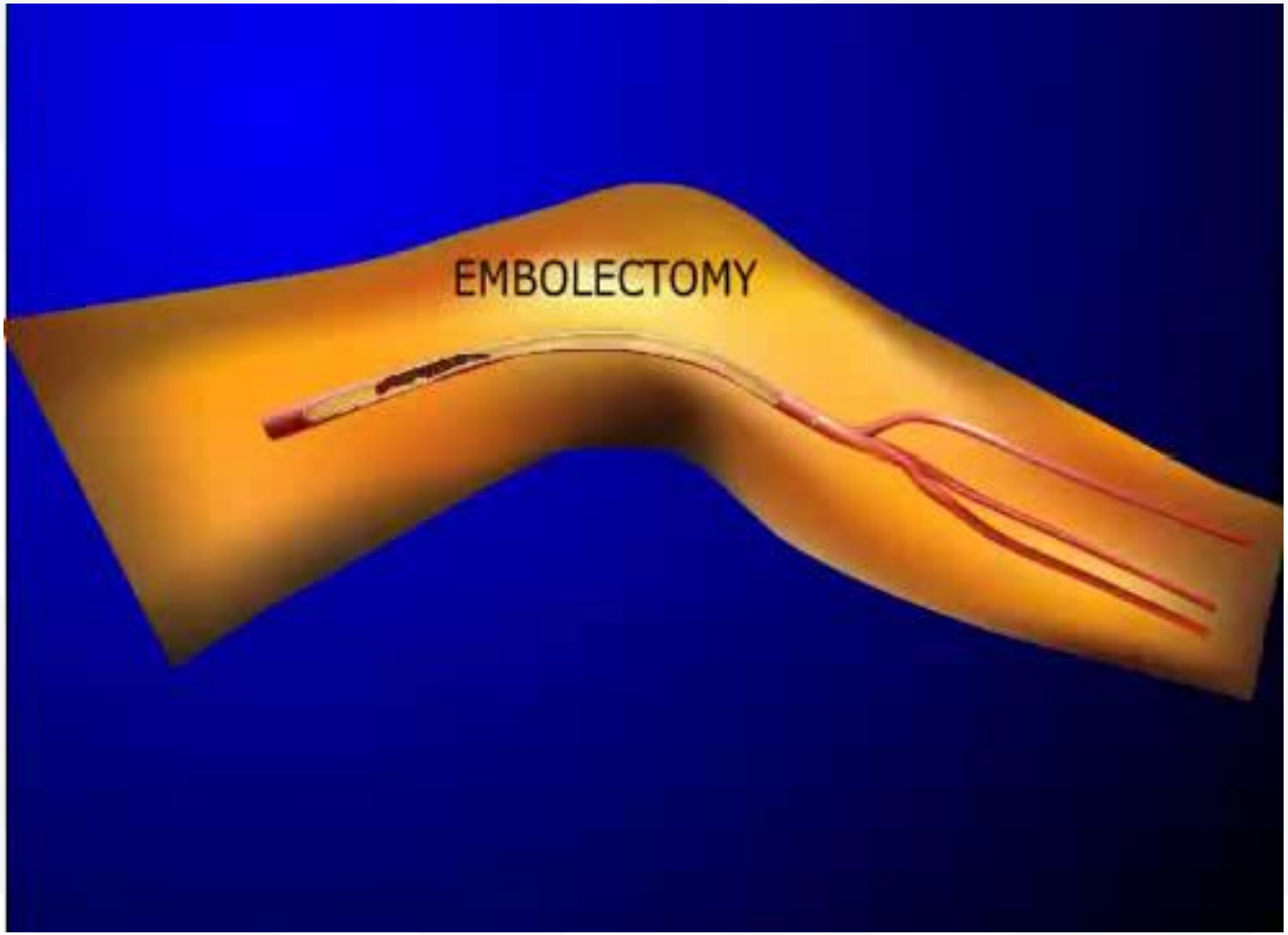
Embolectomy - thrombectomy



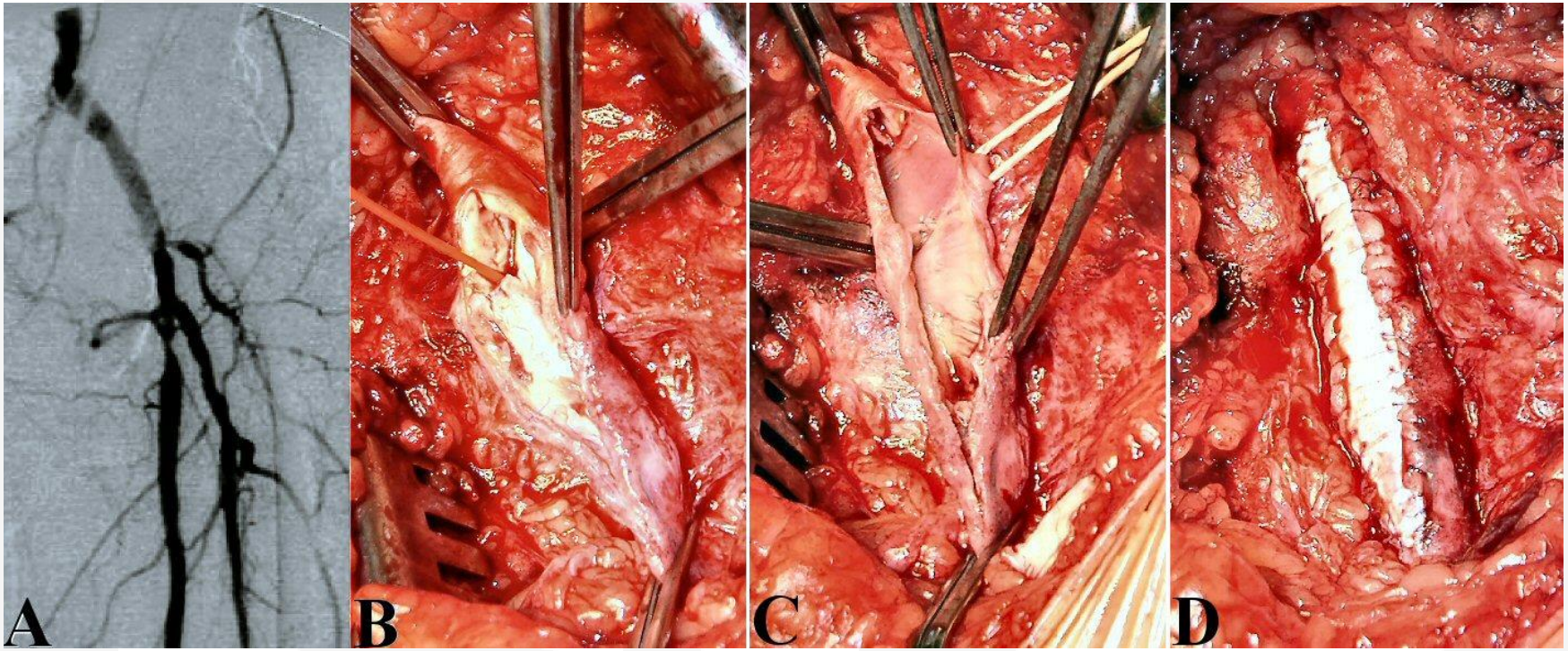




Embolectomy
Fogarty balloon catheter

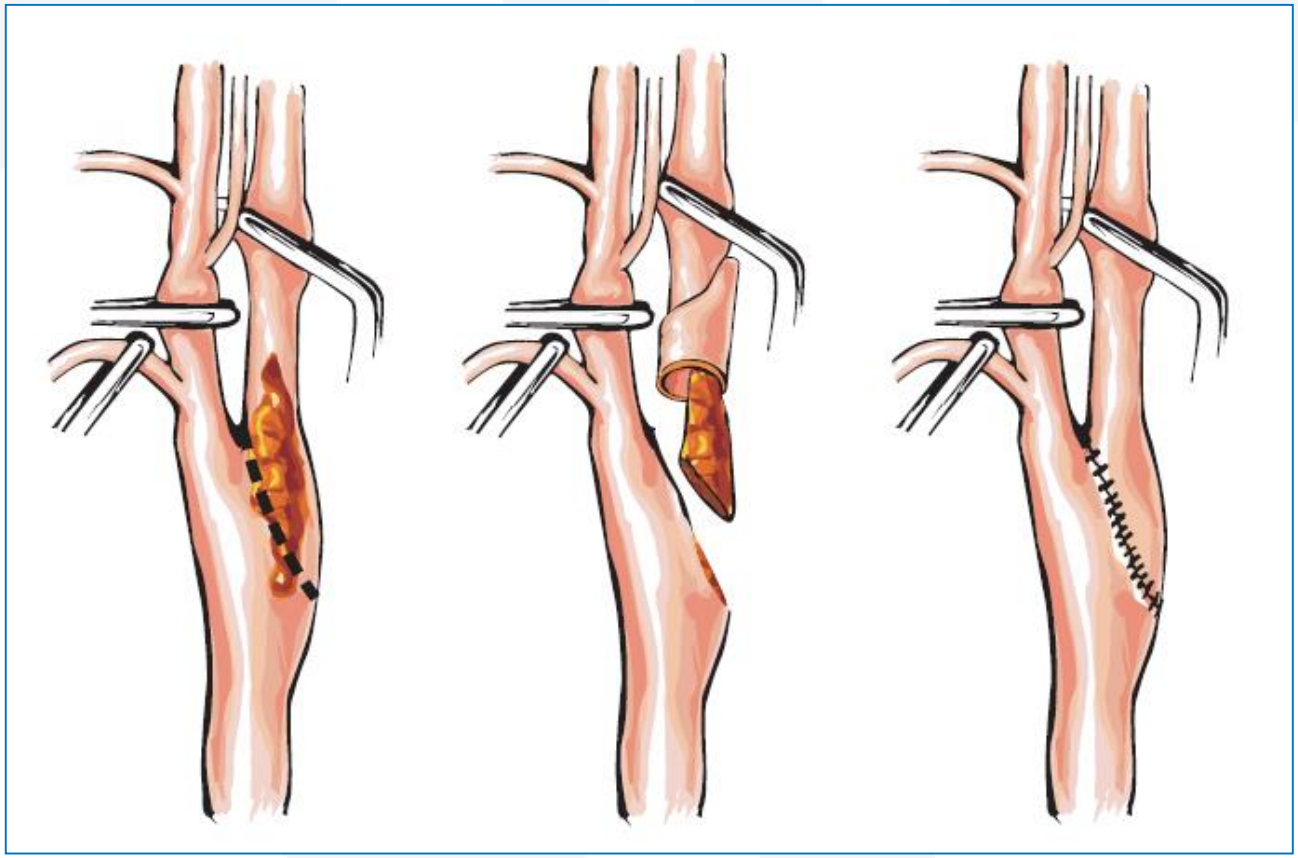


Open endarterectomy



Open endarterectomy–common femoral artery fixation of distal intima flap, PTFE patchplasty

Eversion endarterectomy

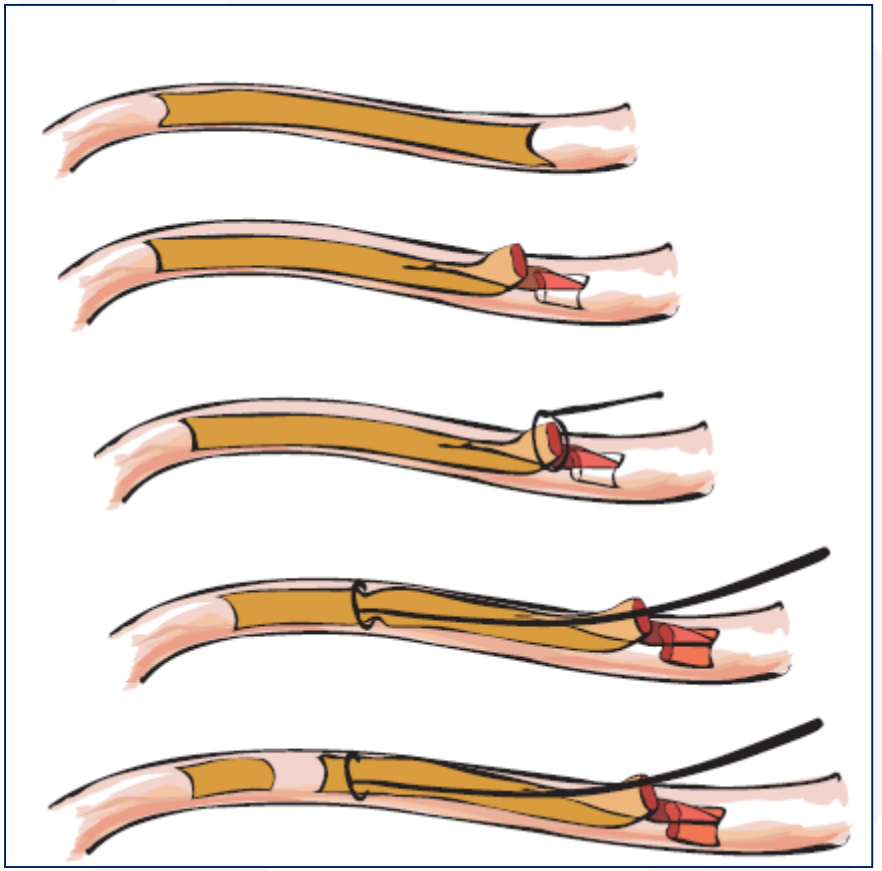


- Open endarterectomy, reimplantation
- Carotid surgery

Partially open endarterectomy

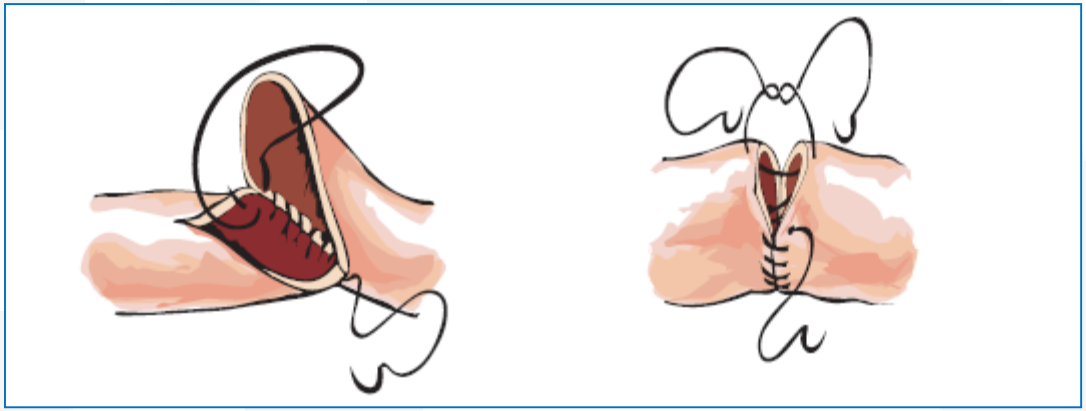
- Intima and media layers are removed with plaques to proximal and/or distal direction

- Ring stripper
  - w or w/o wire snare

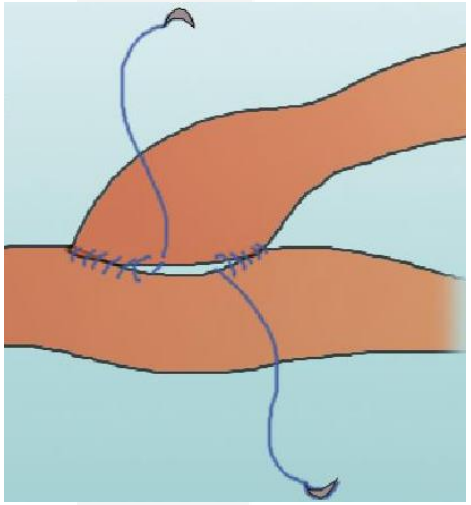


Vessel closure - anastomosis

- End to end anastomosis



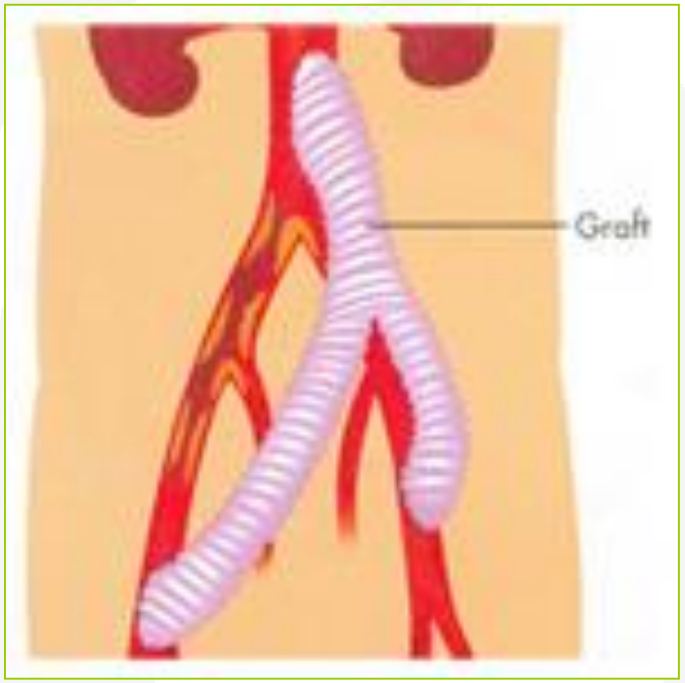
- End to side anastomosis



Vessel reconstruction

Interposition

- vascular pathology is resected
- end to end anastomosis
- e.g. aneurysm



Bypass

- vascular pathology remains
- end to side anasztomosis
- e.g. occlusive diseases

Hybrid technique

- **Endovascular intervention**
- **Open surgery**

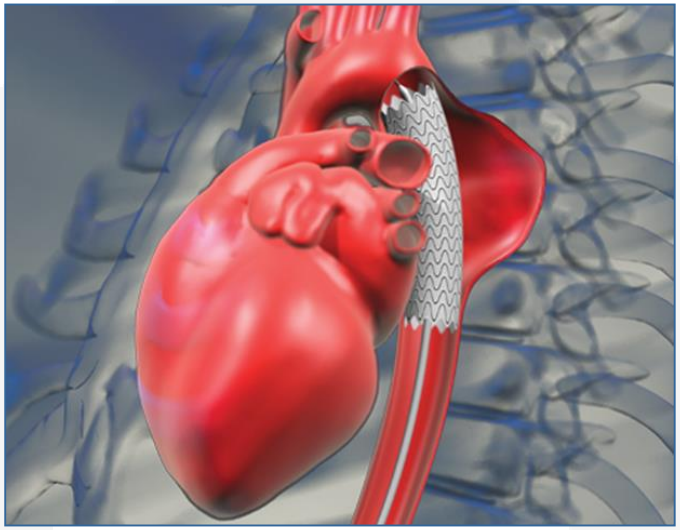
Optimal combination

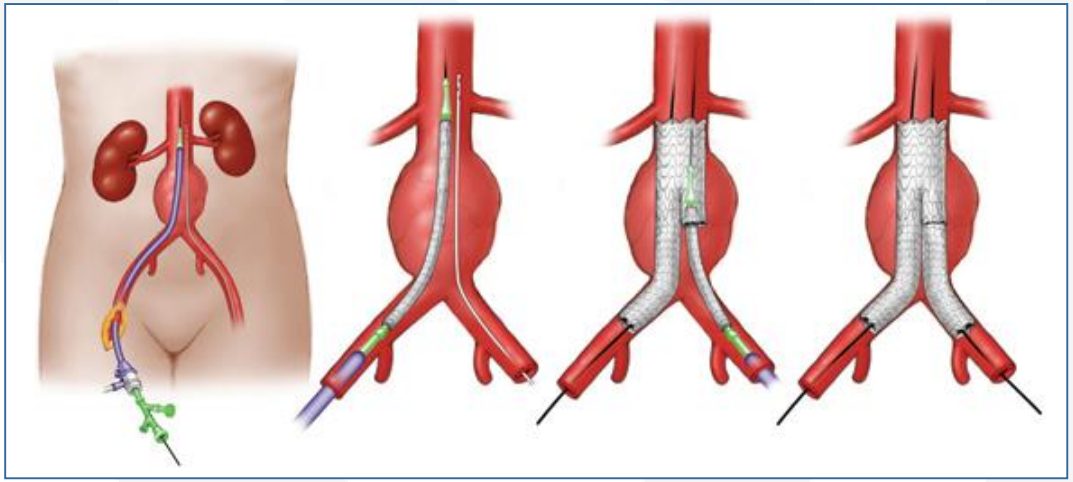
Hybrid operating room

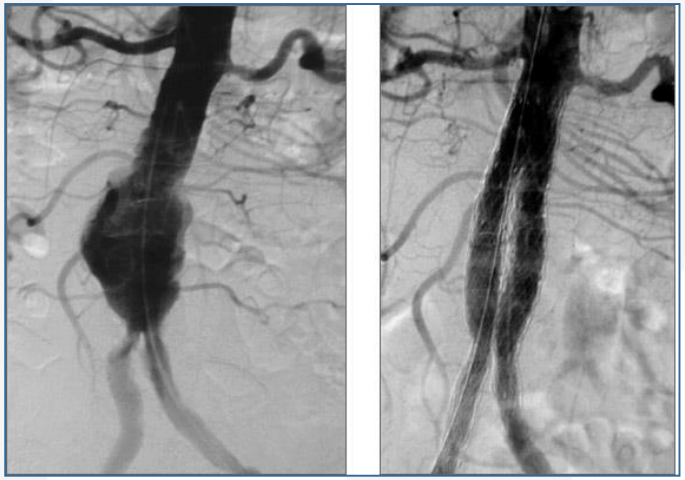
- Sterility
- Surgical equipments
- Fluoroscopy, DSA
- Endovascular devices
- Cone beam CT

Aneurysm reconstruction hybrid solution

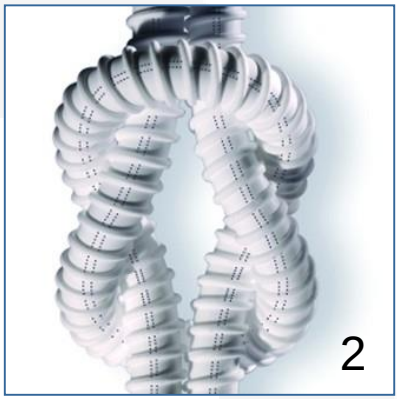
- Via peripheral artery
- Seldinger technique
- Covered, self expandable stent implantation







Vascular graft materials – prosthesis



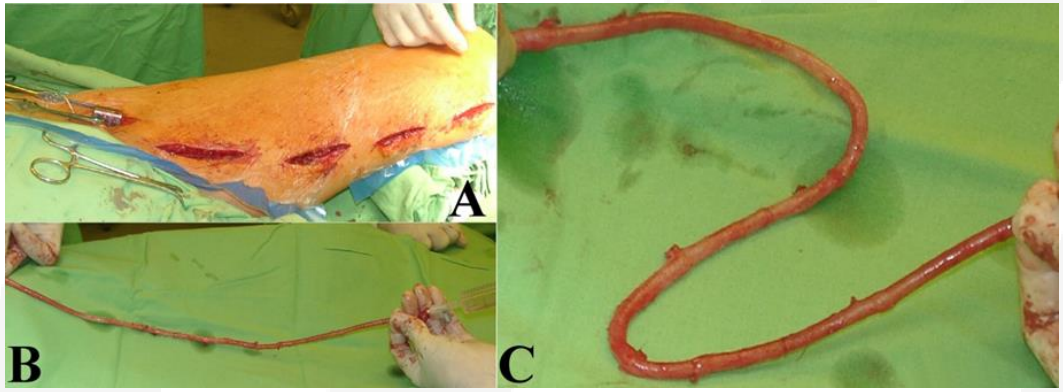
Dacron (polyethilene-terephthalate)
- the most frequently usd prosthesis
- aorto-ilio-femoral reconstructions
- patchplasty
- Dacron prosthesis **(1)**
- Silver coated Dacron prosthesis **(2)**

PTFE (Polytetrafluoroethylene)
- aka Gore-tex, Teflon
- aorto-femoro-popliteal-crural reconstruction, arteficial AV fistula
- Stretch on non-stretch
- Standard **(1)**
- Enforced with external rings **(2)**

Knitted or woven graft

Monolayer graft

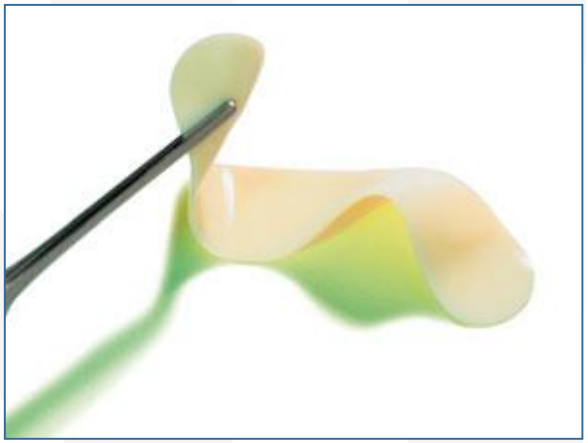
Vascular graft materials: Auto–, allo– and xenogenic grafts



Great saphenous vein
- most common

Femoral vein
- septic surgery

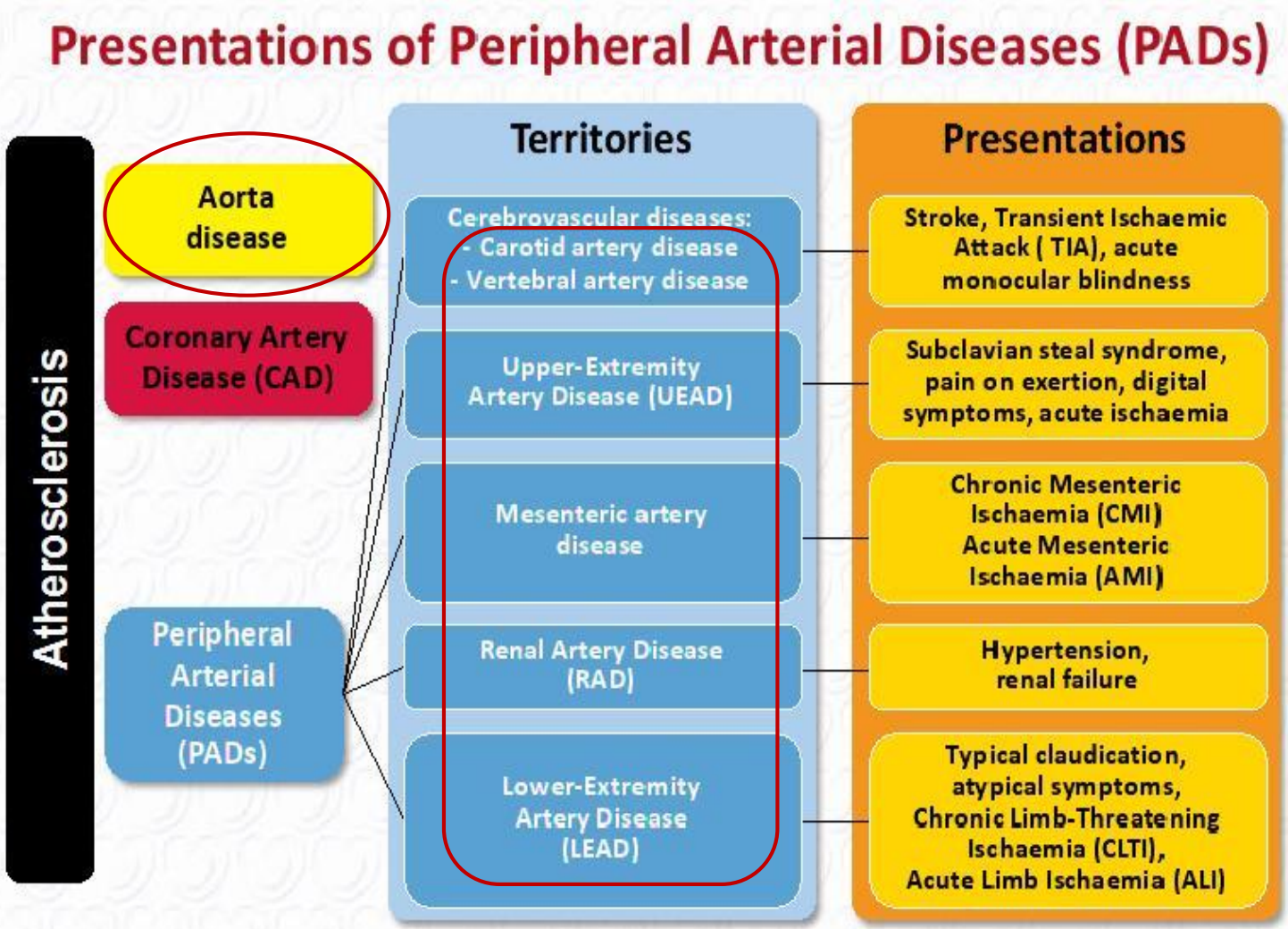
Homograft (allograft)
- septic surgery



Bovine pericardium patch

Porcine pericardium patch

Treatment of arterial diseases – anatomical regions



www.escardio.org/guidelines 2017 ESC Guidelines on the Diagnosis and Treatment of Peripheral Arterial Diseases, in collaboration with ESVS (European Heart Journal 2017; doi:10.1093/eurheartj/ehx095)

Acute arterial diseases

- **Lower extremity ischemia**
- **Symptomatic carotid stenosis**
- **Aortic aneurysm rupture**

Acute lower extremity ischemia (ALI)

- **Definition:** Significant disorder of the arterial blood supply of the lower extremity in 14 days
- **Etiology:** arterial or graft thrombosis, (cardiac) embolisation, dissection, trauma, popliteal-entrapment syndrome, phlegmasia cerulea dolens, etc.
- It may lead to irreversible tissue injury resulting AMPUTATION without ACUTE (in 6 hours) intervention

Symptoms of acute limb ischemia (ALI)

6 P-s

Pain
Pallor
Pulselessness
Paralysis
Paresthesia
Poikilothermia

Rutherford classification of ALI

TABLE 2

Clinical classification of acute limb ischemia

		Findings		Doppler signals	
Category	**Prognosis**	**Sensory loss**	**Muscle weakness**	**Artery**	**Vein**
I Viable	Not immediately threatened	None	None	Audible	Audible
II Threatened					
IIa Marginally	Salvageable if promptly treated	Minimal (toes)	None	Often inaudible	Audible
IIb Immediately	Salvageable with immediate revascularization	More than toes	Mild, moderate	Usually inaudible	Audible
III Irreversible	Major tissue loss or permanent nerve damage inevitable	Profound anesthesia	Profound paralysis	Inaudible	Inaudible

REPRINTED FROM RUTHERFORD RB, BAKER JD, ERNST C, ET AL. RECOMMENDED STANDARDS FOR REPORTS DEALING WITH LOWER EXTREMITY ISCHEMIA: REVISED VERSION. J VASC SURG 1997; 26:517–538, WITH PERMISSION FROM ELSEVIER. HTTP://WWW.SCIENCEDIRECT.COM/SCIENCE/JOURNAL/07415214.

ALI – Acute treatment

- **Acute conservative treatment**: i.v. Heparin, pain management, oxygen

- **Individual decision making:**

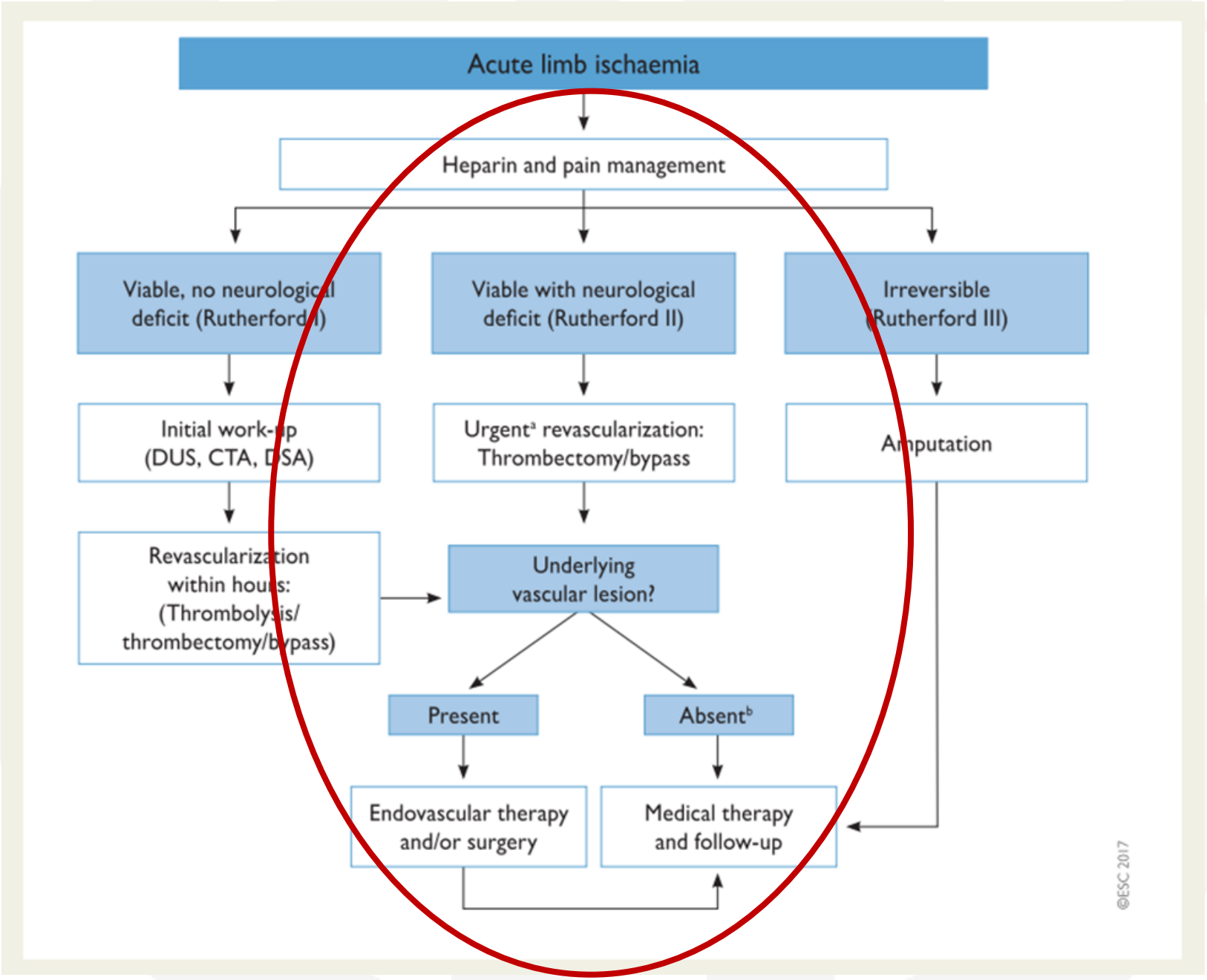
Open surgery

- Embolectomy
- Thrombendarterectomy
- Patchplasty
- Bypass

Percutaneous intervention

- Intraarterial selective catheter thrombolysis
- thrombus aspiration with catheter
- PTA (percutan transluminal angioplasty)
- Stent implantation

Algorythm of treating ALI



Acute arterial diseases

- Lower extremity ischemia
- **Symptomatic carotid stenosis**
- Aortic aneurysm rupture

Carotid stenosis - symptom - urgency

- Asymptomatic (≥60% - elective surgery) (???)
- Symptomatic: TIA or stroke in 6 months
- Urgent surgery: symptoms in 2 weeks
  - **Stroke in evolution/recurrent TIA**
- Timing of acute surgery: 2-14 days
- Main factors influencing the indication of surgery:

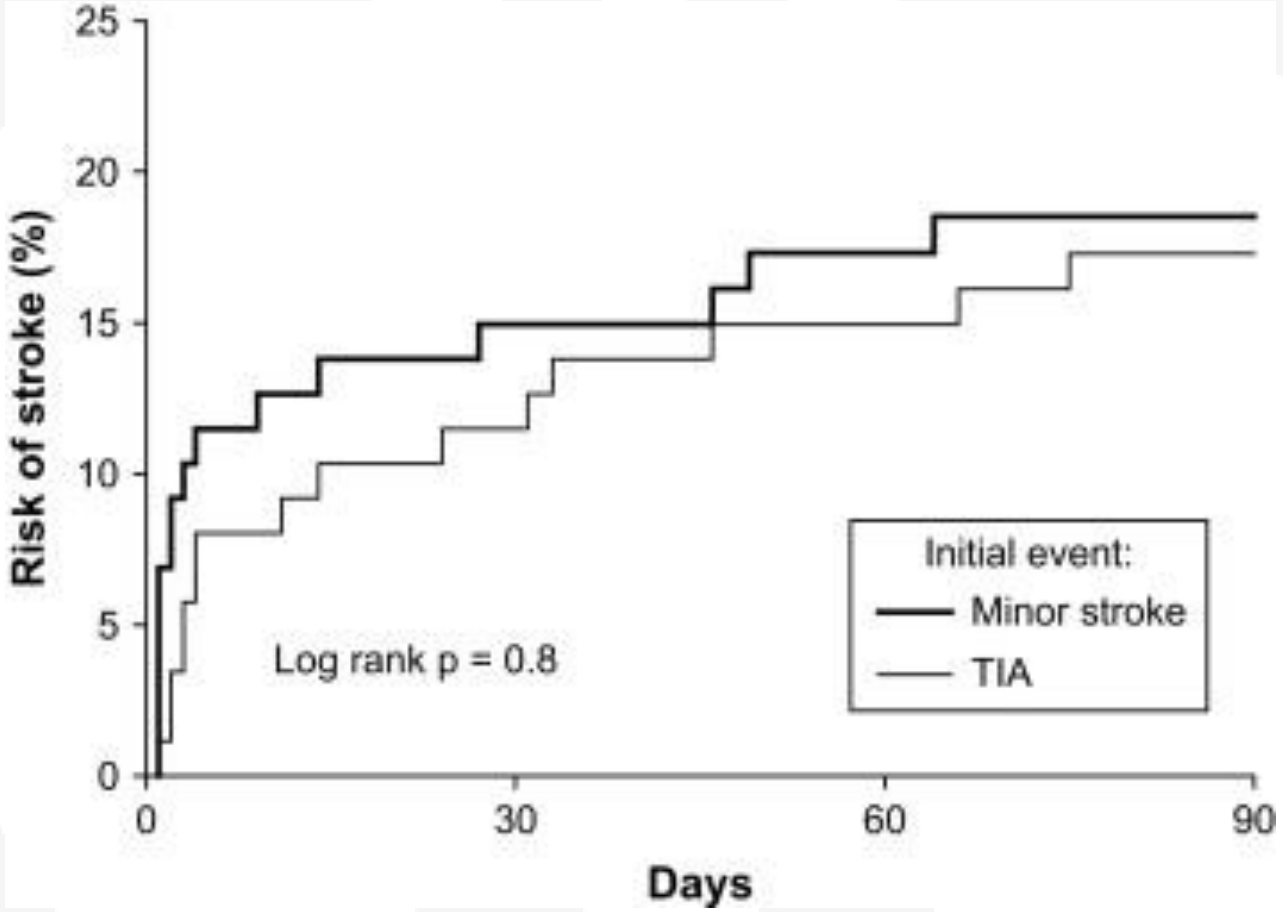
  - **Degree of stenosis**

  - Plaque morphology (soft plaque, floating thrombus)

  - Intracerebral lesion (size of new ischemic lesion, ≥3 cm)

Time is money! - Time is brain!

Risk of stroke following TIA / stroke



Timing of CEA (endarterectomy) following TIA or stroke

- There is a 30 day-stroke reduction in symptomatic 70%-os ACI stenosis, if CEA is performed:
  - within 2 weeks: 30%
  - 2-4 weeks: 18%
  - 4-12 weeks: 11%

AHA guideline: CEA in 2 weeks, if there is no contraindication (Class IIa; Level of Evidence B)

Acute arterial diseases

- Lower extremity ischemia
- Symptomatic carotid stenosis
- **Aortic aneurysm rupture**

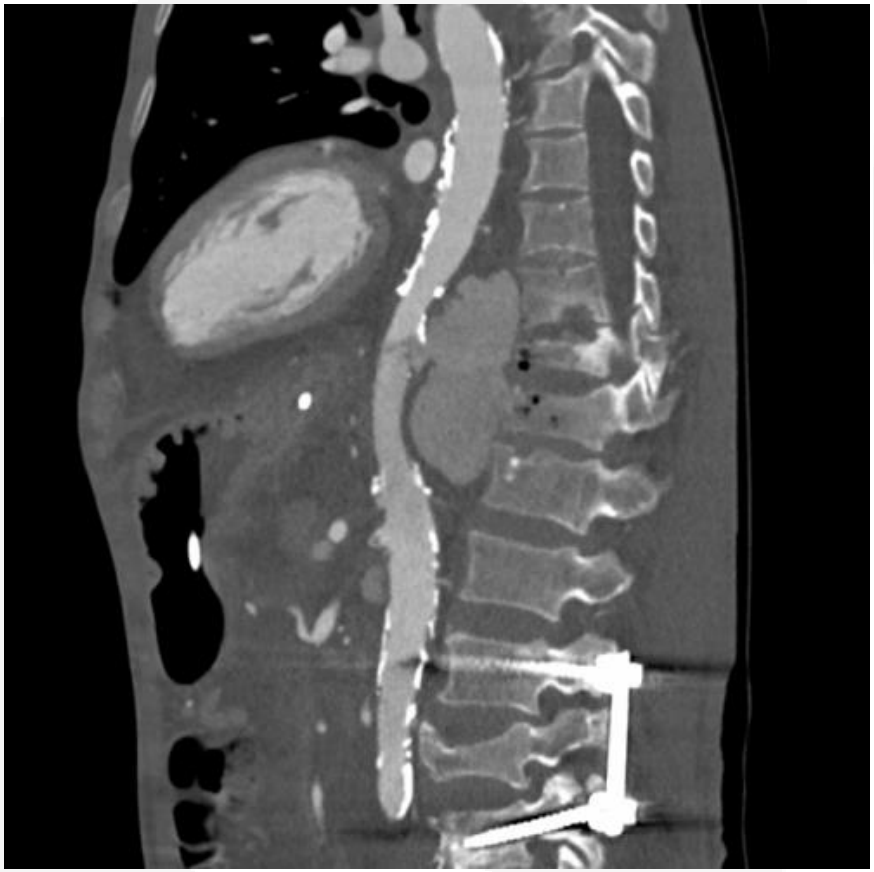
European Guideline (ESVS) 2019

Recommendation 4	Class	Level
Abdominal aortic aneurysm repair should not be performed in centres with a yearly case load <20.	III	B

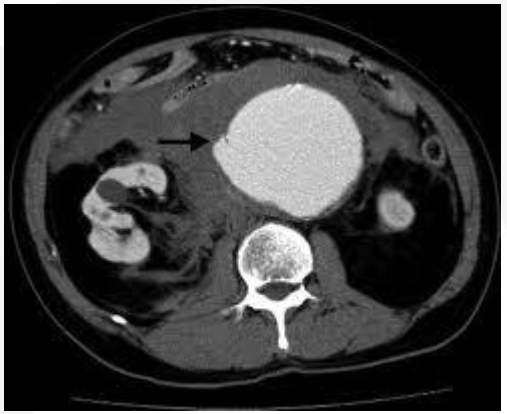
ESVS Guideline 2019

Recommendation 63	Class	Level
In haemodynamically stable patients with suspected ruptured abdominal aortic aneurysm, a prompt thoracoabdominal computed tomography angiography is recommended as the imaging modality of choice.	I	B

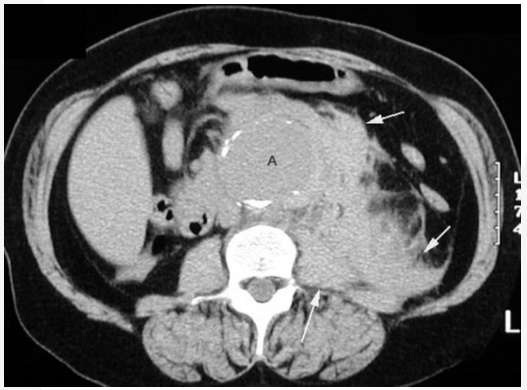
Ruptured abdominal aortic aneurysm (rAAA) – imaging - CTA



Contained aortic rupture



Rupture into the peritoneal cavity



Retroperitoneal rupture (most common)

ESVS Guideline 2019

Recommendation 65	Class	Level
Symptomatic non-ruptured abdominal aortic aneurysms should be considered for deferred urgent repair ideally under elective repair conditions.	IIa	B

ESVS Guideline 2019

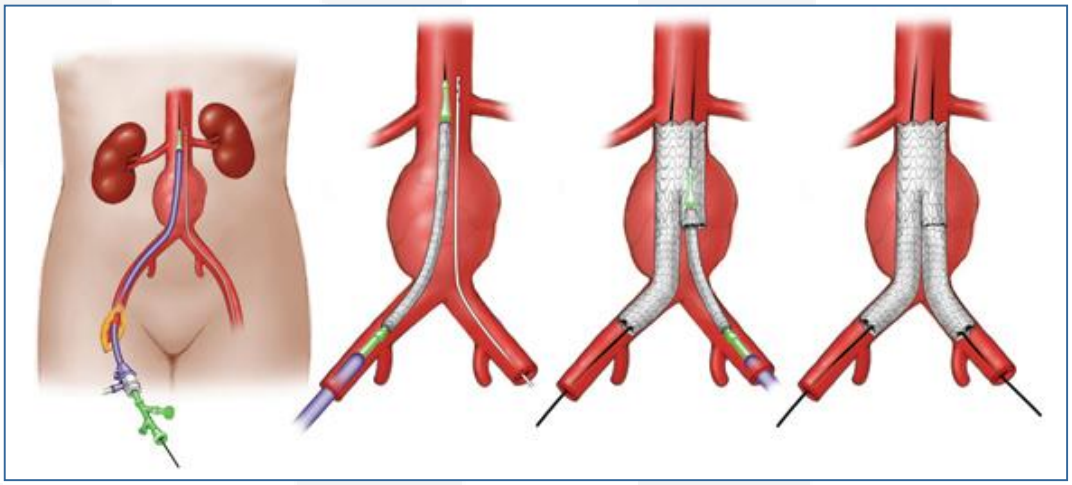
Recommendation 66	Class	Level
In patients with ruptured abdominal aortic aneurysm, a policy of permissive hypotension, by restricting fluid resuscitation, is recommended in the conscious patient.	I	B

ESVS Guideline 2019

Recommendation 70	Class	Level
Selection of patients with ruptured abdominal aortic aneurysm for palliation based entirely on scoring systems or solely on advanced age is not recommended.	III	B

ESVS Guideline 2019

Recommendation 74	Class I	Level
In patients with ruptured abdominal aortic aneurysm and suitable anatomy endovascular repair is recommended as a first option.	I	B



Elective AAA treatment

- Indication for elective AAA surgery: in men 5.5 cm, in women 5.0 cm

- Urgent surgery is indicated:
  - large size (above 8 cm in diameter)
  - saccular morphology
  - **symptoms**
  - signs of infection or inflammation
  - rapid growth

Treatment of chronic critical limb ischemia (CLTI) and diabetic foot

Fontaine classification

Stage	Symptoms
I	Asymptomatic
II	Claudication
IIa	Pain-free, claudication walking >200 m
IIb	Pain-free, claudication walking <200 m
III	Rest/nocturnal pain
IV	Necrosis/gangrene

CLTI –WIfI - classification

Estimate risk of amputation at 1 year for each combination																
	Ischaemia - 0				Ischaemia - 1				Ischaemia - 2				Ischaemia - 3			
W-0	VL	VL	L	M	VL	L	M	H	L	L	M	M	L	M	M	H
W-1	VL	VL	L	M	VL	L	M	H	L	M	H	H	M	M	H	H
W-2	L	L	M	H	M	M	H	H	M	H	H	H	H	H	H	H
W-3	M	M	H	H	H	H	H	H	H	H	H	H	H	H	H	H
	fI-0	fI-1	fI-2	fI-3	fI-0	fI-1	fI-2	fI-3	fI-0	fI-1	fI-2	fI-3	fI-0	fI-1	fI-2	fI-3

fI = foot infection; H = high-risk; L = low-risk; M = moderate risk; VL = very low risk; W = wound.

www.escardio.org/guidelines 2017 ESC Guidelines on the Diagnosis and Treatment of Peripheral Arterial Diseases, in collaboration with ESVS (European Heart Journal 2017; doi:10.1093/eurheartj/ehx095)

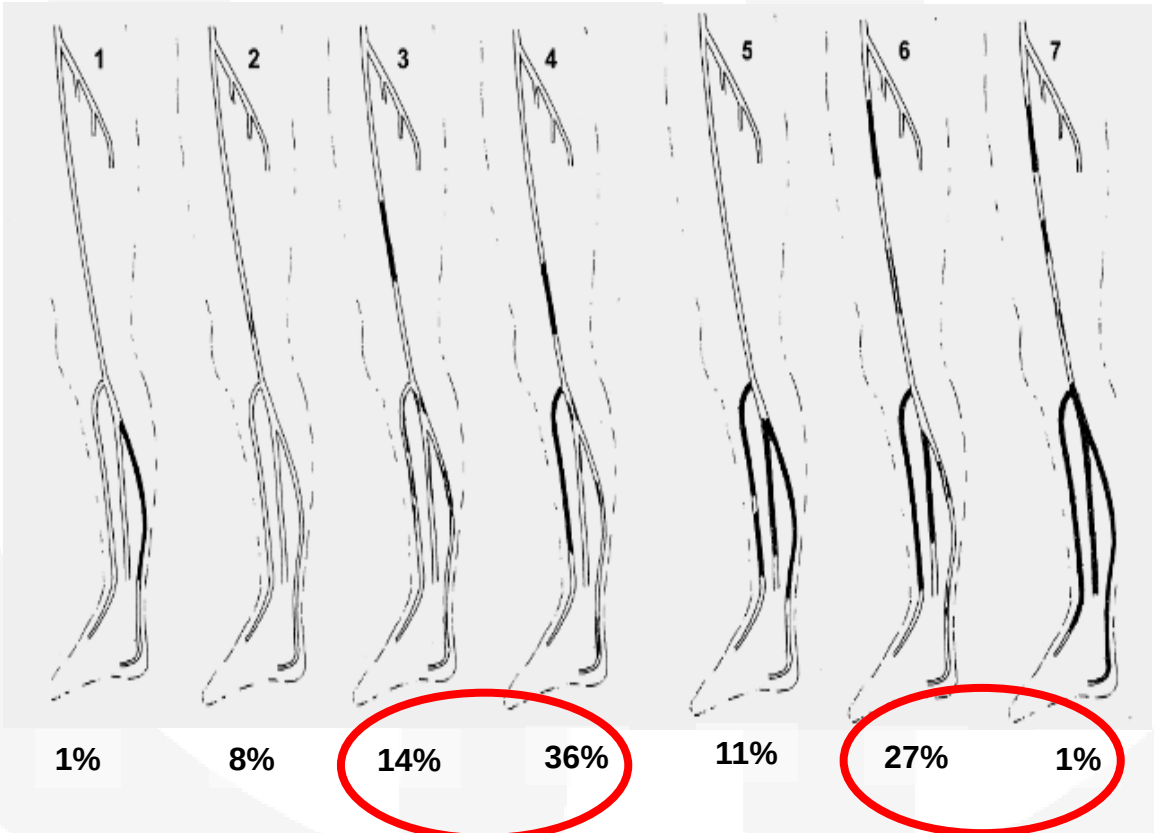
W- wound, I – ischemia, fI – foot infection

Localization of lower limb disease

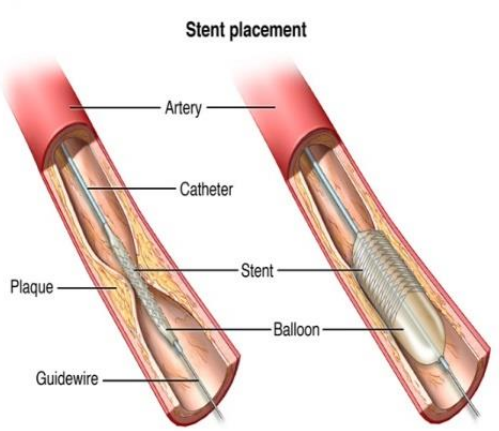
In 78% the lesions are multilevel!

Below the knee (BTK) lesions are common (74%)

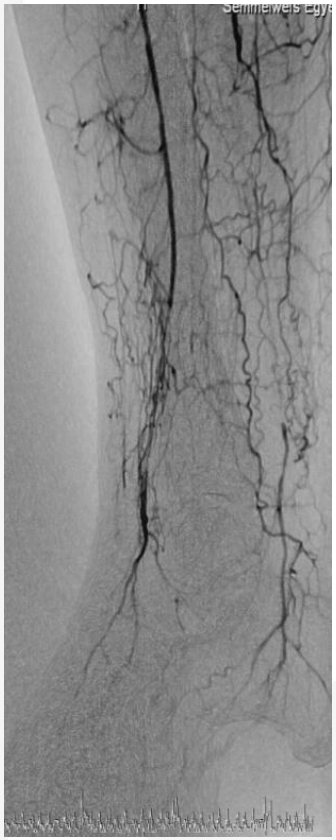
Mostly diffuse disease, long stenoses and occlusions (66% occlusion, 50% occlusion >10 cm)



Invasive treatment of CLTI



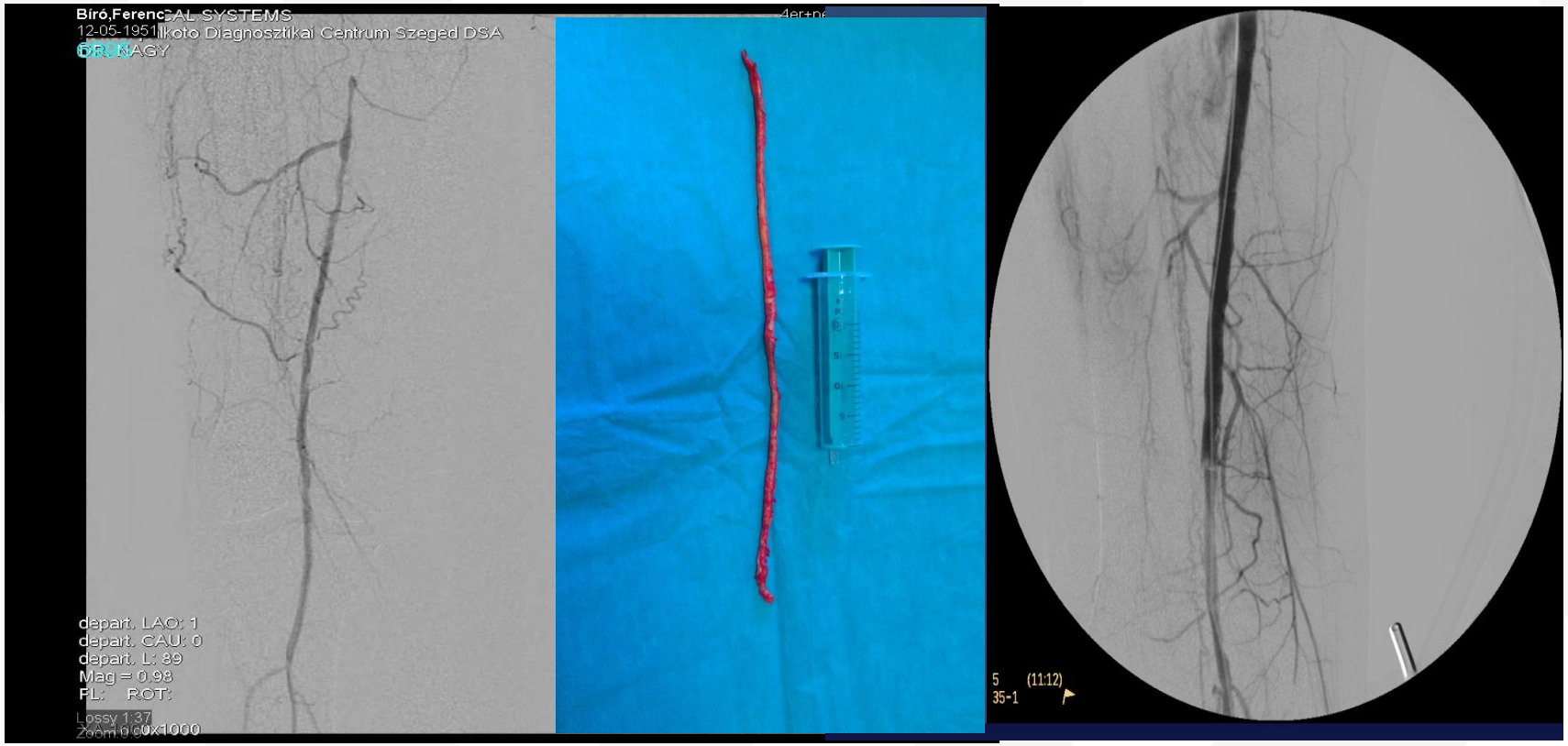
- Many patients are not suitable for open surgery *(No saphenous vein, severe comorbities).*
- Endovascular techniques has less morbidity, is less invasive, can be repeated
- High succes rate of peripheral intervention with good indication
- GSV is saved for later
- Consider long term treatment!



Distal crural (ADP) bypass

Hybrid (endo+open) surgery

-”Multilevel disease” may require complicated one stage surgery –
Alternative solution if percutanous or open surgery is impossible or dangerous (TASC C, D lesions)



Surgical treatment of venous diseases

- Varicose veins: endovenous surgery, varicectomy
- Thrombophlebitis: GSV, LSV ligation
- Proximal (ilio-femoral) deep vein thrombosis
- Superior vena cava – PTA, stent
- Inferior vena cava:
  - Acute thrombosis: lysis, thrombus aspiratio, cava filter
  - Chronic stenosis/occlusion – PTA, stent
  - Tumor thrombus – cava thrombectomy

International Consensus
CEAP

Symptoms | **Clinical signs**

C0S

Heavy legs, pains in the legs, pruritus... But no clinical or palpable signs of venous disease

▸ read more

C1

Telangiectasia or reticular veins

▸ read more

C2

Visible and palpable varicose veins

▸ read more

C3

Venous oedema (without trophic changes)

▸ read more

C4

Trophic changes of venous origin : atrophie blanche, pigmented purpuric dermatitis, varicose eczema

▸ read more

C5

healed ulcer with trophic changes

▸ read more

C6

Presence of one or more active venous leg ulcers, often accompanied by trophic changes

▸ read more

C0 - C6 : description of the progression of the disease on the basis of the clinical signs present

C : clinical signs E : etiological classification A : anatomical distribution P : pathophysiological dysfunction

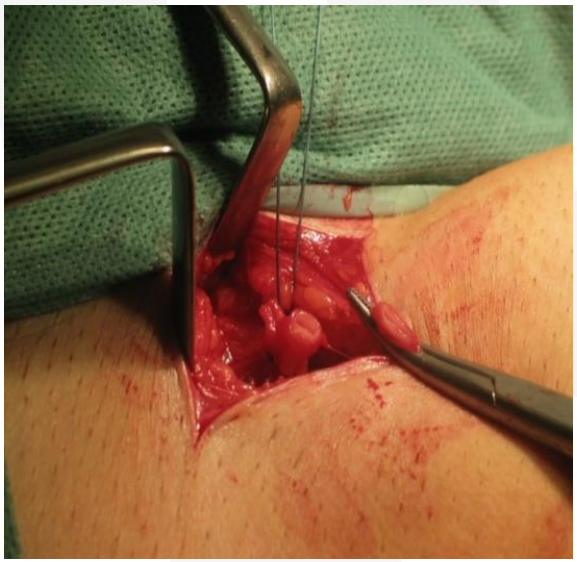
CLASSIFICATION

- **(CEAP) classification from the American Venous Forum, last revised 2004.**

Clinical	Etiologic	Anatomic	Pathophysiologic
• C_0 - No visible or palpable signs of venous disease	• Ec – Congenital	• As - Superficial veins	• Pr – Reflux
• C_1 - Telangiectases or reticular veins	• Ep – Primary	• Ap - Perforator veins	• Po – Obstruction
• C_2 - Varicose veins	• Es - Secondary (post-thrombotic)	• Ad - Deep veins	• Pr,o – Reflux and obstruction
• C_3 - Edema	• En - No venous cause identified	• An - No venous location identified	• Pn - No venous pathophysiology identifiable
• C_{4a} - Pigmentation or eczema			
• C_{4b} - Lipodermatosclerosis or atrophie blanche			
• C_5 - Healed venous ulcer			
• C_6 - Active venous ulcer			

Traditional varicectomy

- Crossectomy
- Stripping
- Perforant vein ligation
- Side branch removal



Contemporary varicose vein surgery

Thermal procedures

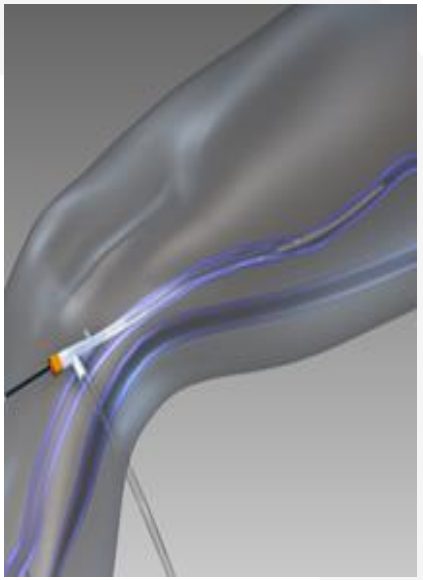
- ***Radiofrequency***
  - monopolar/bipolar
- ***Laser***
  - Different wavelength
  - linear/radial fiber
- Steam
- Cryostripping

Non-thermal procedures

- ***Foam sclerotherapy***
- ***Mechanochemical ablation***
- ***Glue (cyanoacrylate)***

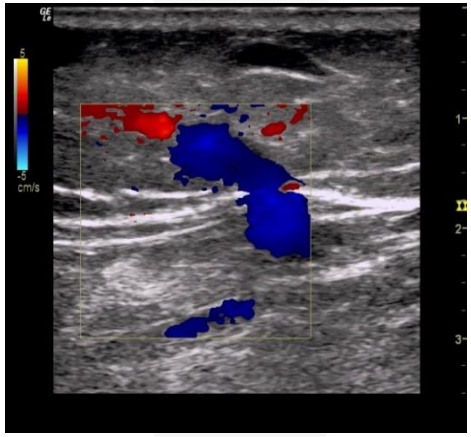
Radiofrequency catheter ablation

- RF energy affect collagen in vein wall
  - fast ablation
- Lumen decreases, vein closure and scarring



Treatment of incompetent perforant veins

- Laser ablation
- Radiofrequency ablation
- Foam sclerotherapy
- SEPS (endoscopic)

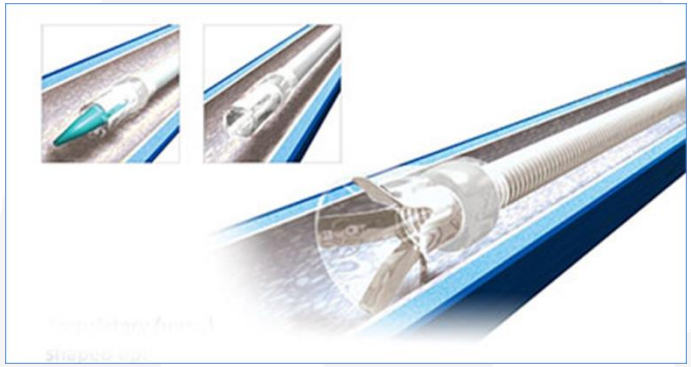


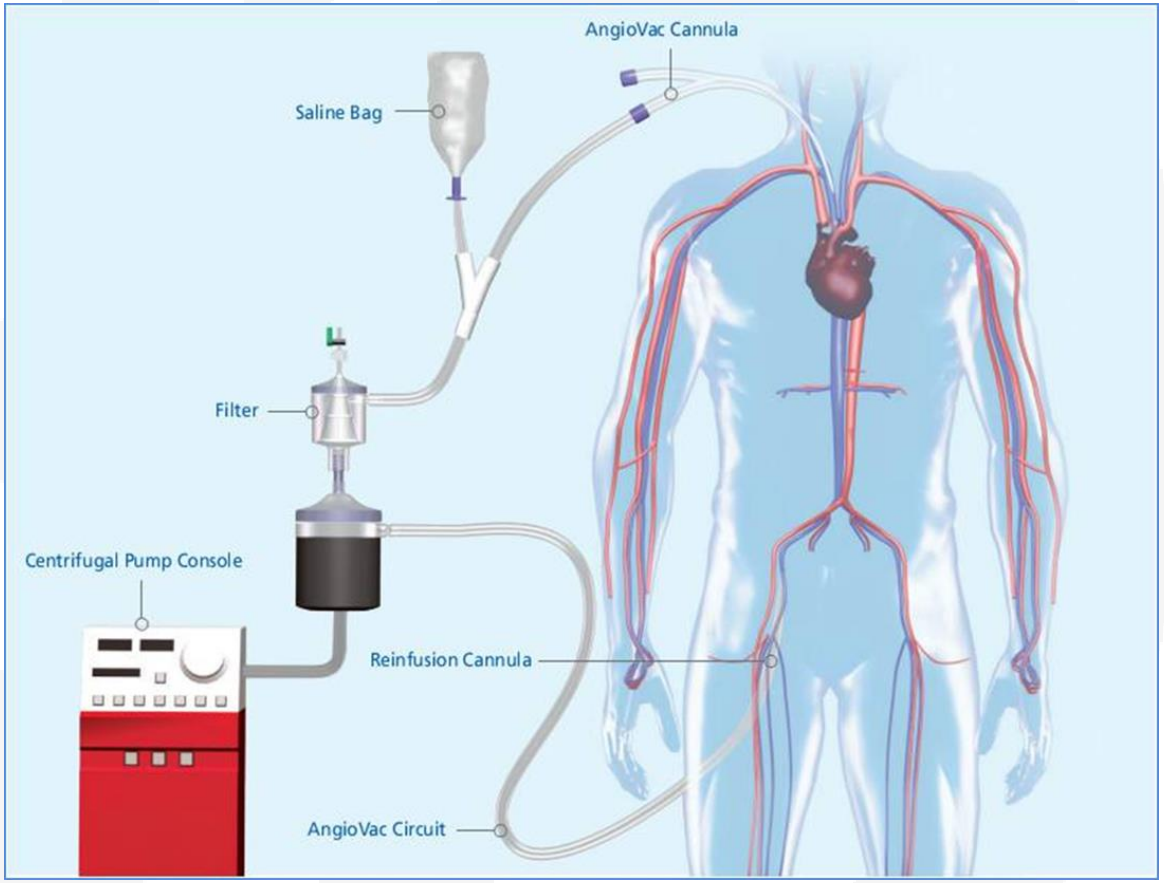
Treatment of acute spf. thrombophlebitis

- Ambulation
- Local Heparin cream
- Compression stockings
- Venotonic drugs
- NSAD
- **Ascending GSV or LSV thrombophlebitis require anticoagulation (therapeutic LMWH) or high ligation**

- **Not required**: bedrest, antibiotic (only in infection)

Angio Vac – system
Inferior vena cava hybrid surgery for thrombosis





Indication for cava filter implantation

- contraindication to therapeutic anticoagulation
- complication of anticoagulation
- failure of anticoagulation (pulmonary embolism)