

Chronic arterial occlusions

Tomáš Novotný

II. chirurgická klinika LF MU a FN u sv. Anny

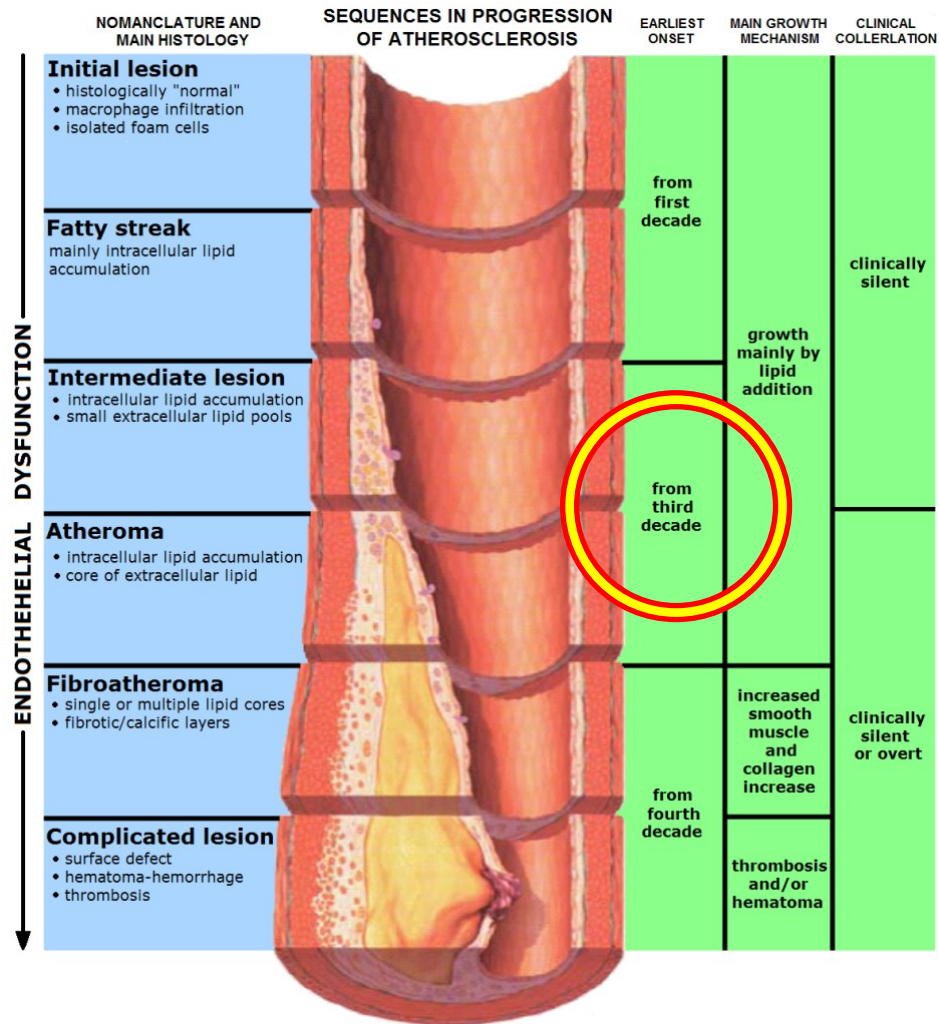


Arterial disease: atherosclerosis

- a **chronic systemic disease** leading to development of **characteristic atherosclerotic plaques**
- asymptomatic until
 - **significant narrowing** of an artery ($>70\%$)
 - **rupture** generating thrombus and/or thrombemboli



Arterial disease: atherosclerosis



Atherosclerosis risk factors

- **Conventional**

- Smoking
- Diabetes mellitus
- Hyperlipidemia
- Hypertension

- **Conditional**

- e.g. homocysteine, CRP

- **Emerging**

- **Predisposing**

- Advanced age
- Overweight and obesity
- Physical inactivity
- Gender: male sex, postmenopausal women
- Insulin resistance
- Family history and genetics
- Behavioral and socioeconomic factors



Arterial disease: atherosclerosis

- **Predilection arterial beds**
 - coronary arteries
 - **carotid arteries**
 - **lower limb arteries**
 - **mesenteric arteries**



Cerebrovascular disease

WHEN STROKE STRIKES, ACT **F.A.S.T.**

FACE.
Has their face fallen on one side? Can they smile?

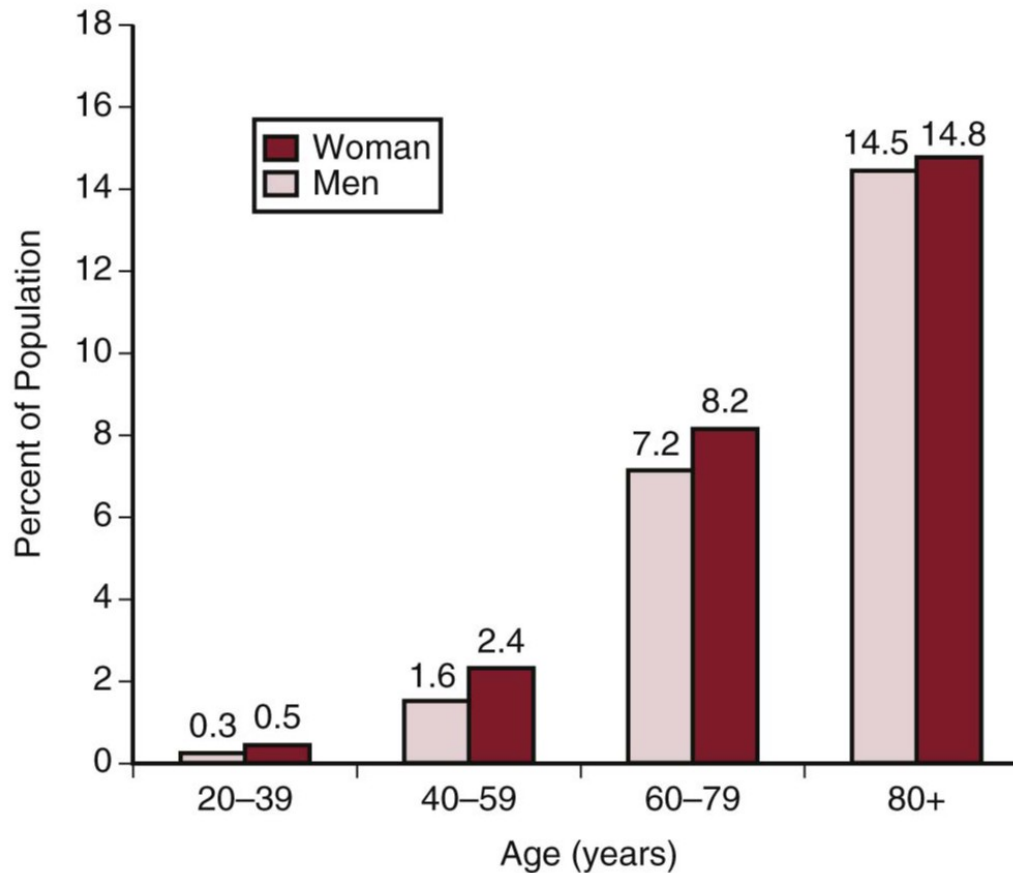
ARMS.
Can they raise both arms and keep them there?

SPEECH.
Is their speech slurred?

TIME.
Time to call **999** if you see any single one of these signs.



Epidemiology – prevalence of stroke

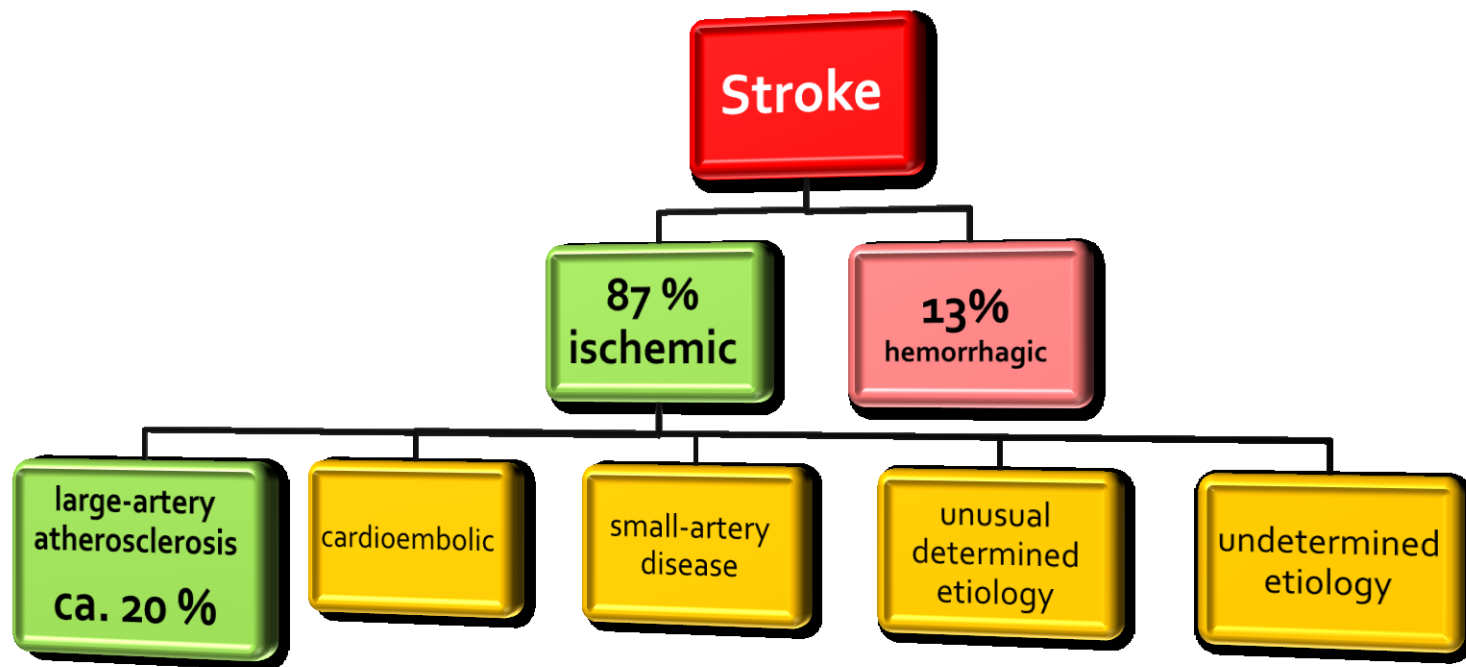


Epidemiology – stroke

- **Risk**
 - of **recurrence** 29% at 5 years
 - of **death** 53 % at 5 years
- **Stroke survivors 65+ after 6 months**
 - 50% - hemiparesis
 - 30% - unable to walk without assistance
 - 26% - dependent in daily activities
 - 19% - aphasia
 - 26% - institutionalized



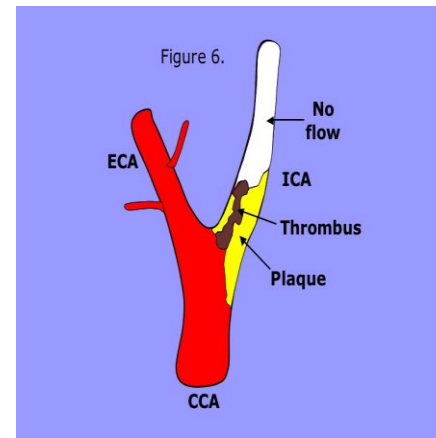
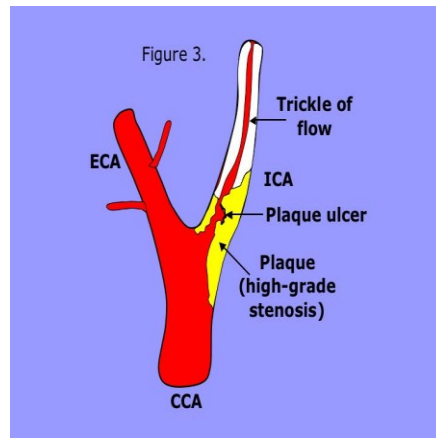
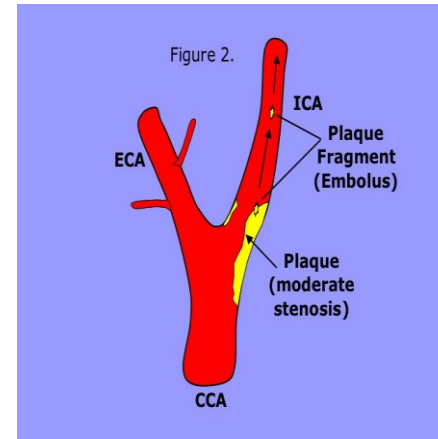
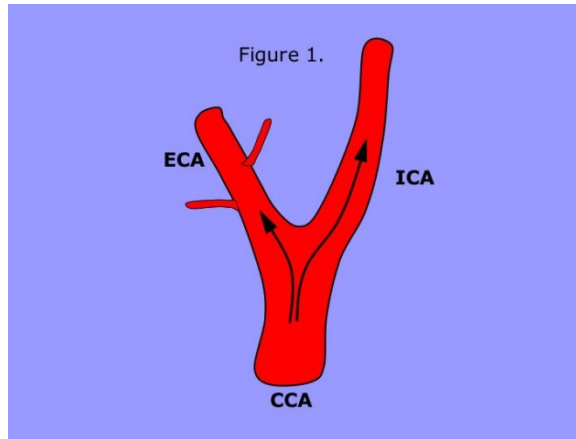
Types of stroke



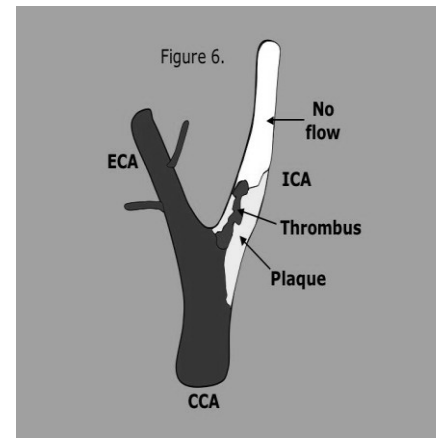
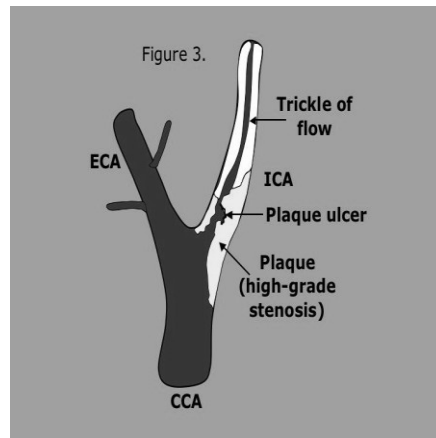
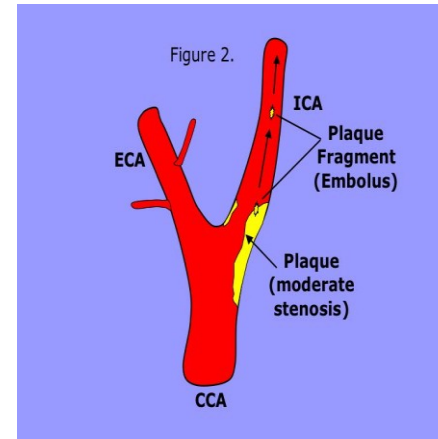
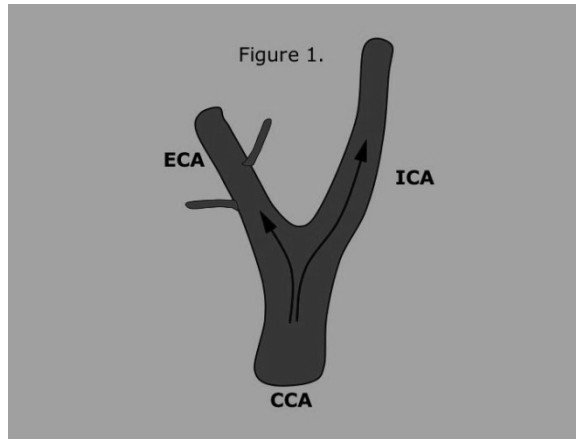
TOAST (Trial of ORG 10172 in Acute Stroke)



Pathogenesis



Pathogenesis



Clinical presentation

- **Transient ischemic attack (TIA)**
 - stroke-like symptoms lasting **less than 24 hours**
 - the vast **majority** last for **only a few minutes**
 - **30%** of patients **will suffer a stroke within 5 years**
 - is a **clinical diagnosis**
 - brain infarction on computed tomography (CT) in circa 25% of patients



Clinical presentation

- **Stroke**

- an **acute neurologic dysfunction** of vascular etiology
- **signs and symptoms lasting more than 24 hours**
- resulting from infarction of focal areas of the brain

- **Typical signs**

- sudden contralateral **motor-sensory loss**
- **speech deficit** (dysarthria, dysphasia, aphasia)
- ipsilateral **monocular blindness / field cuts**



Clinical presentation

WHEN STROKE STRIKES, ACT F.A.S.T. 



FACE
HAS IT FALLEN ON ONE SIDE?
Search 'Act Fast'

ARMS
CAN THEY RAISE THEM?

SPEECH
IS IT SLURRED?

TIME
IF YOU NOTICE ANY OF THESE SIGNS
MAKE THE CALL
DIAL 999



Clinical assessment

- **History**
- clinical presentation of present illness
- atherosclerosis
 - risk factors
- **Physical findings**
- vital signs
 - blood pressure, heart rate, rhythm
- alertness, orientation
- speech, basic motor and sensory deficits
- carotid pulse palpation and auscultation



Diagnostic evaluation

- carotid **duplex ultrasonography** with transcranial Doppler
- carotid **CT angiography**
- magnetic resonance angiography
 - price, imaging limitations
- digital subtraction angiography
 - specific indications (CT/MRI artifacts, planned endovascular intervention)



CT angiography



Treatment

- „best“ medical therapy (BMT)
- carotid endarterectomy (CEA)
- carotid stenting (CAS)



How do we choose the proper treatment?

- **symptom status** (within last 6 months)
- **degree of stenosis**
 - at present, the most reliable imaging predictor of stroke risk
- plaque progression; plaque character („vulnerable plaque“); evidence of clinically silent emboli
- 2017 Clinical Practice **Guidelines of the European Society for Vascular Surgery**



Symptomatic patient

- **Carotid endarterectomy**
 - is recommended - 70%-99% stenosis [I,A]
 - should be considered - 50-69% stenosis [IIa,A]
 - The perioperative stroke/death rate should be <6%
 - should be performed **within 2 weeks of** the last **symptoms** [I,A]



Symptomatic patient

- **Carotid stenting**

- **might be considered** in symptomatic patients aged <70 years with **50-99% stenosis** as an alternative to CEA [IIb,A]
- **is recommended** that in **patients 70+ CEA should be preferred over CAS** [I,A]
- The periprocedural stroke/death rate should be <6%
- should be performed **within 2 weeks of** the last **symptoms** [I,A]
- **CEA should be preferred** over CAS **within 2 weeks of symptoms** [I,A]



Asymptomatic patient

- **Carotid endarterectomy**
 - **should be considered** in asymptomatic patient with **60-99% stenosis** and life expectancy exceeding 5 years [IIa,B].
 - The perioperative stroke/death rate should be <3%



Asymptomatic patient

- **Carotid stenting**

- **might be considered** in asymptomatic patients with **60-99% stenosis** and life expectancy exceeding 5 years [IIb,B].
- The periprocedural stroke/death rate should be <3%
- **might be considered** in „high-risk for surgery“ patients [IIb,B]



„Best“ medical therapy

- Risk factor reduction and medical management
 - **antiplatelet therapy**
 - anticoagulation (if indicated for other condition)
 - **statin therapy**
- risk factor reduction
 - hypertension
 - diabetes mellitus
 - smoking cessation
 - alcohol cessation



Carotid endarterectomy - conventional

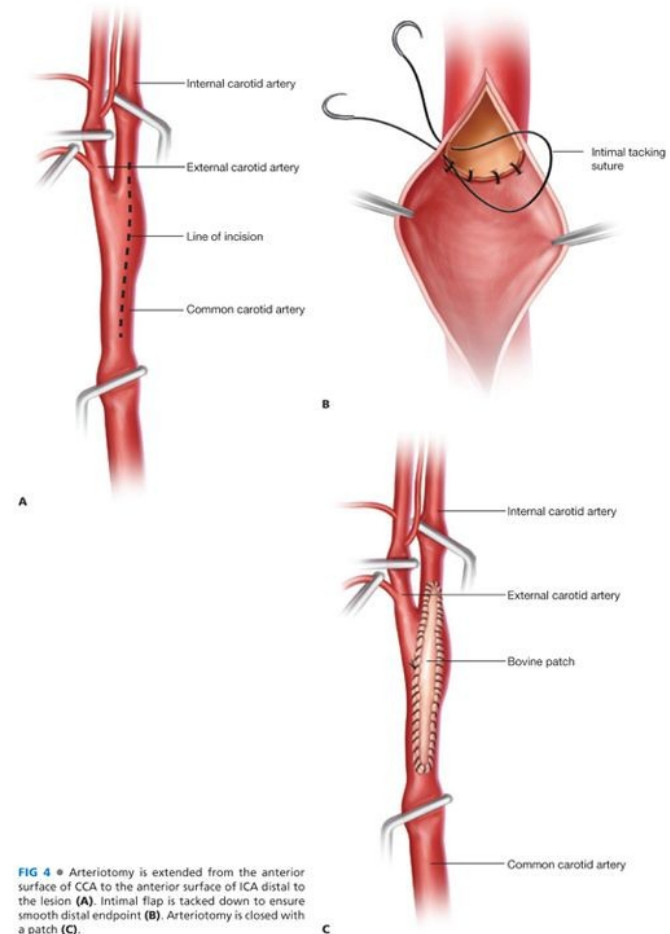
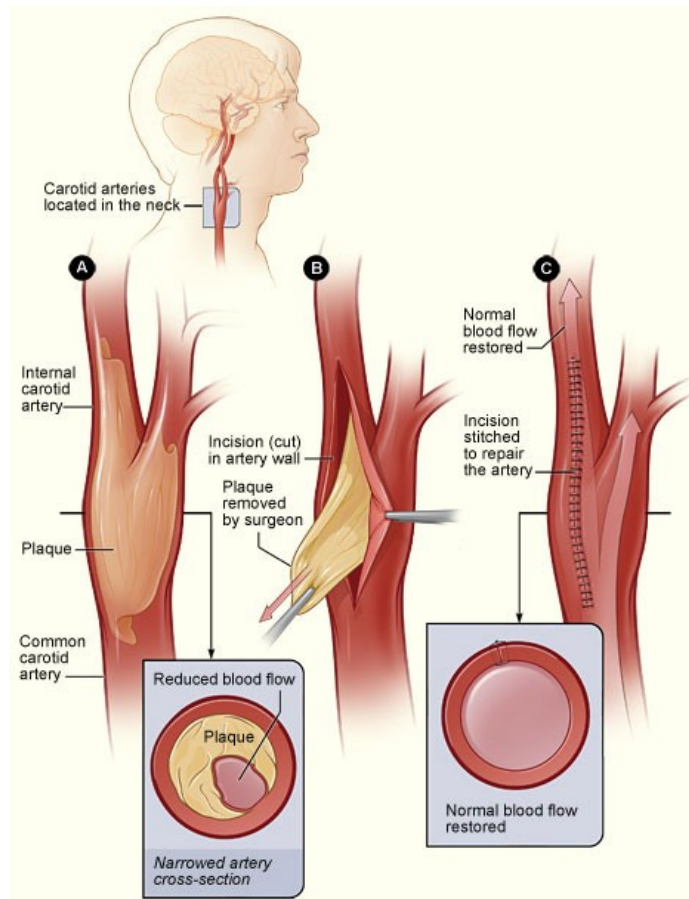
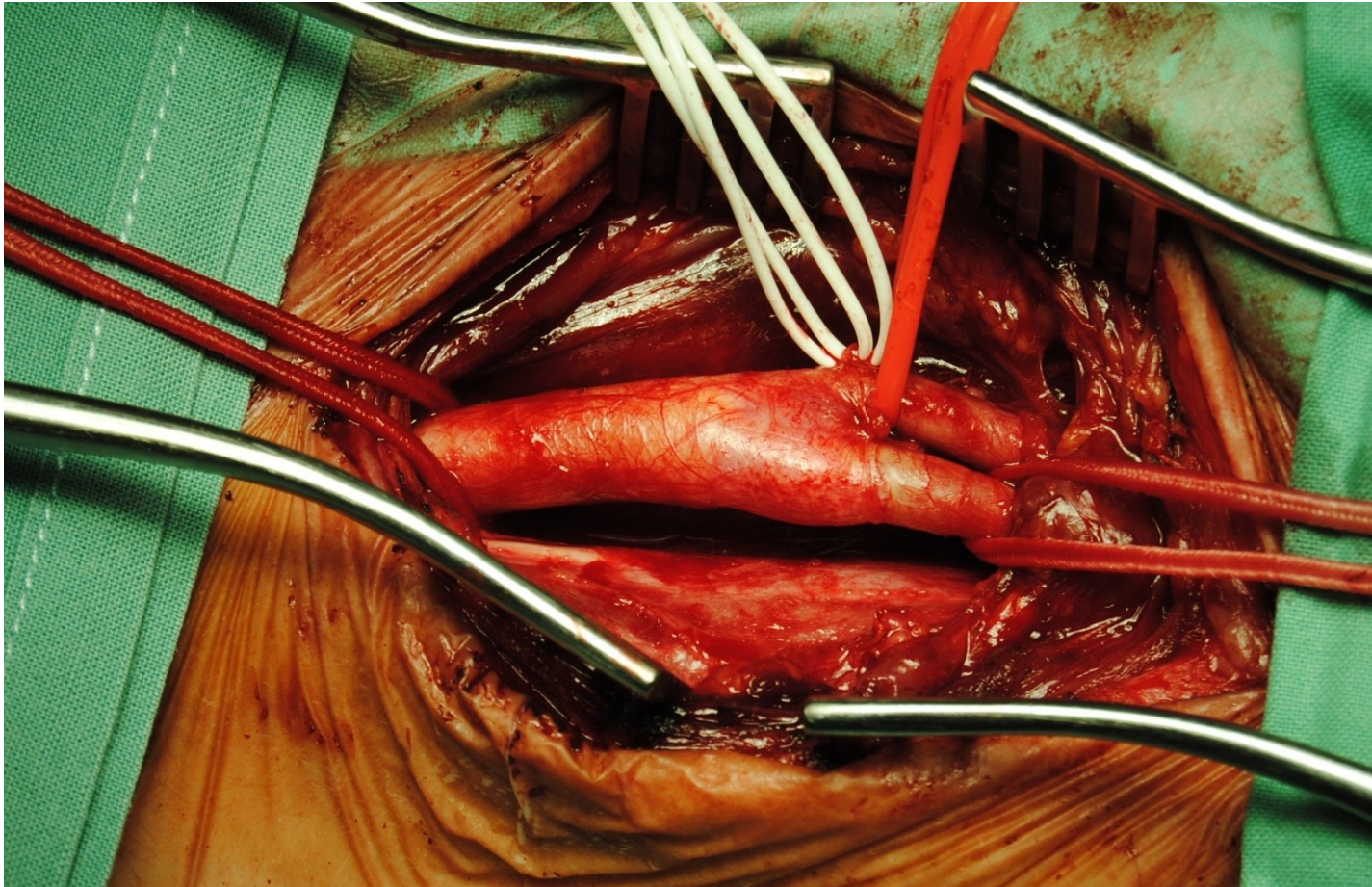


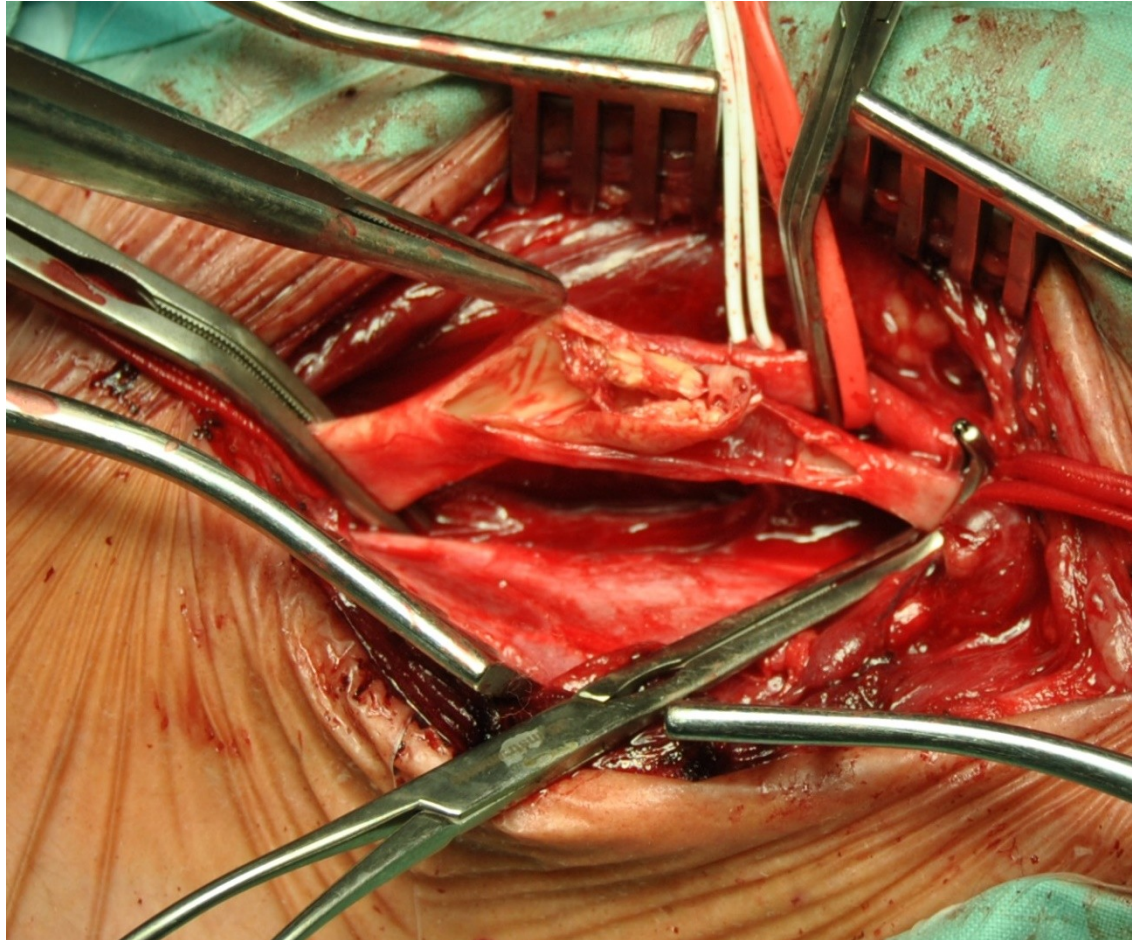
FIG 4 • Arteriotomy is extended from the anterior surface of CCA to the anterior surface of ICA distal to the lesion (**A**). Intimal flap is tacked down to ensure smooth distal endpoint (**B**). Arteriotomy is closed with a patch (**C**).



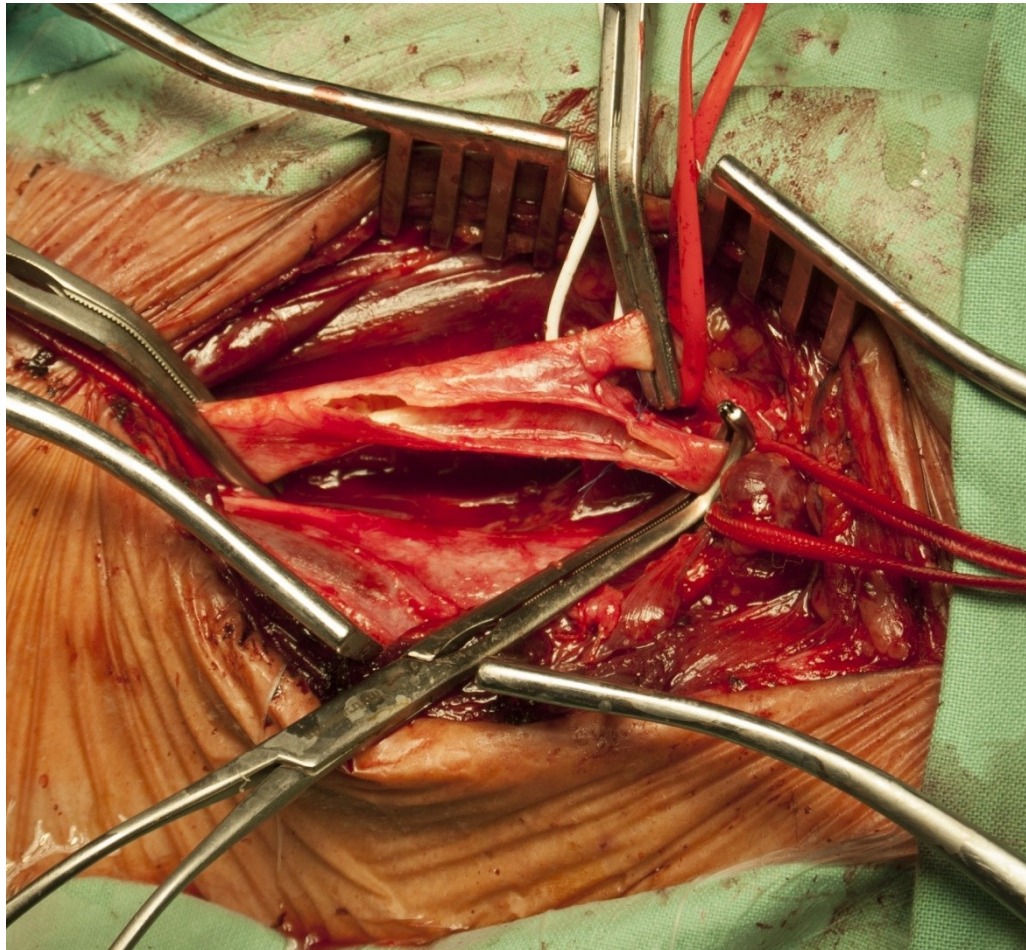
Carotid endarterectomy - conventional



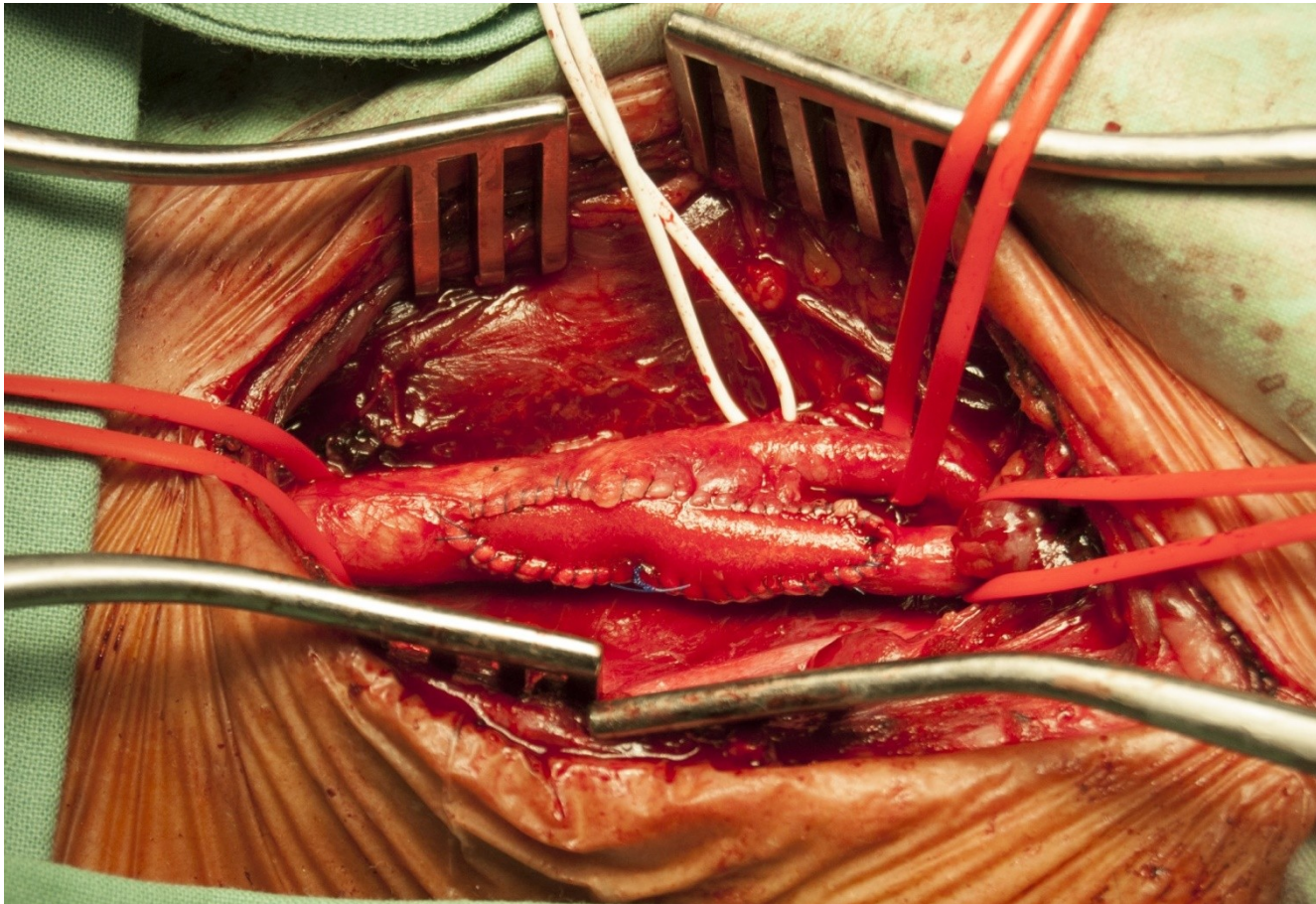
Carotid endarterectomy - conventional



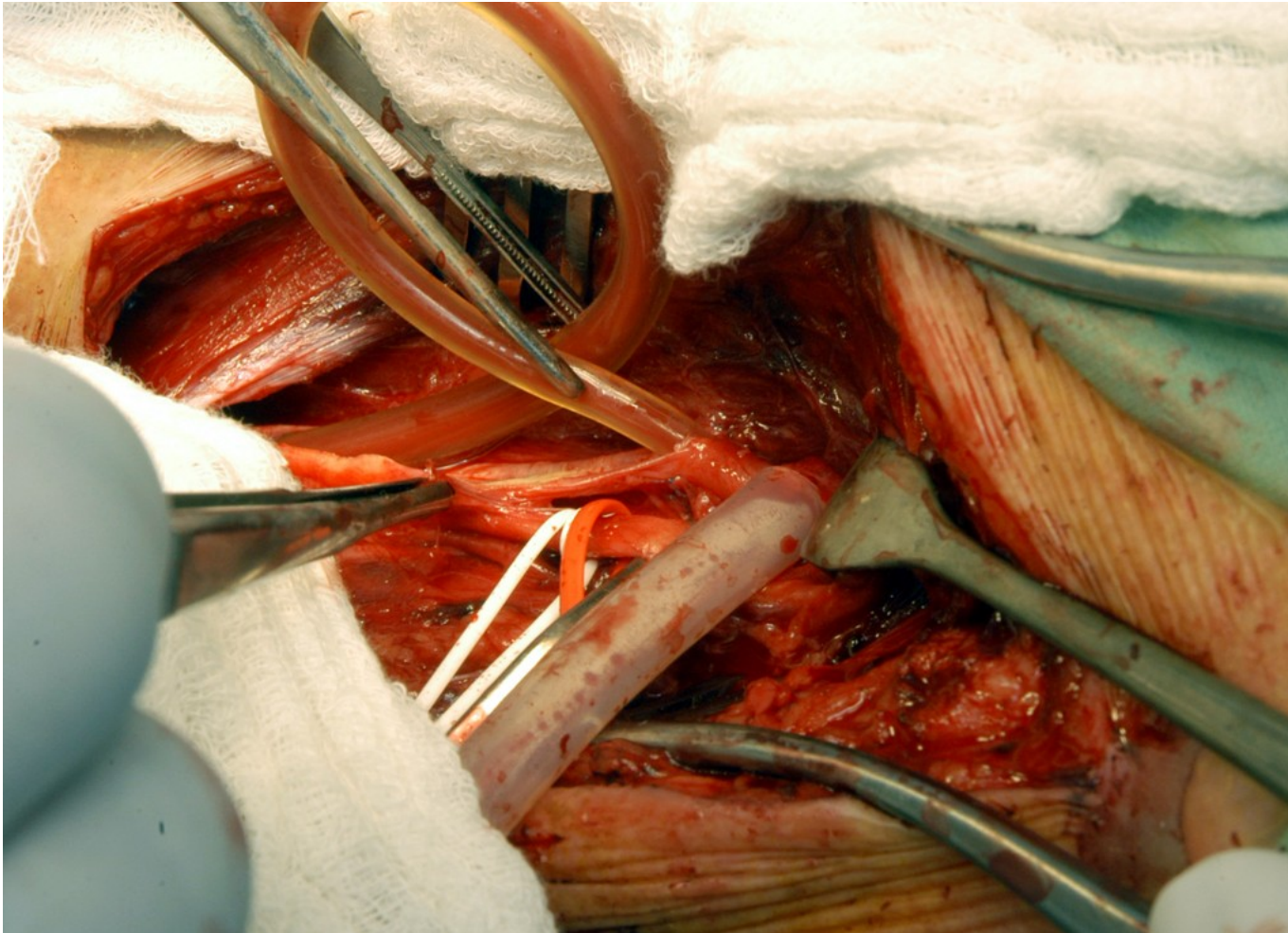
Carotid endarterectomy - conventional



Carotid endarterectomy - conventional



Carotid endarterectomy - shunting



Carotid endarterectomy - eversion

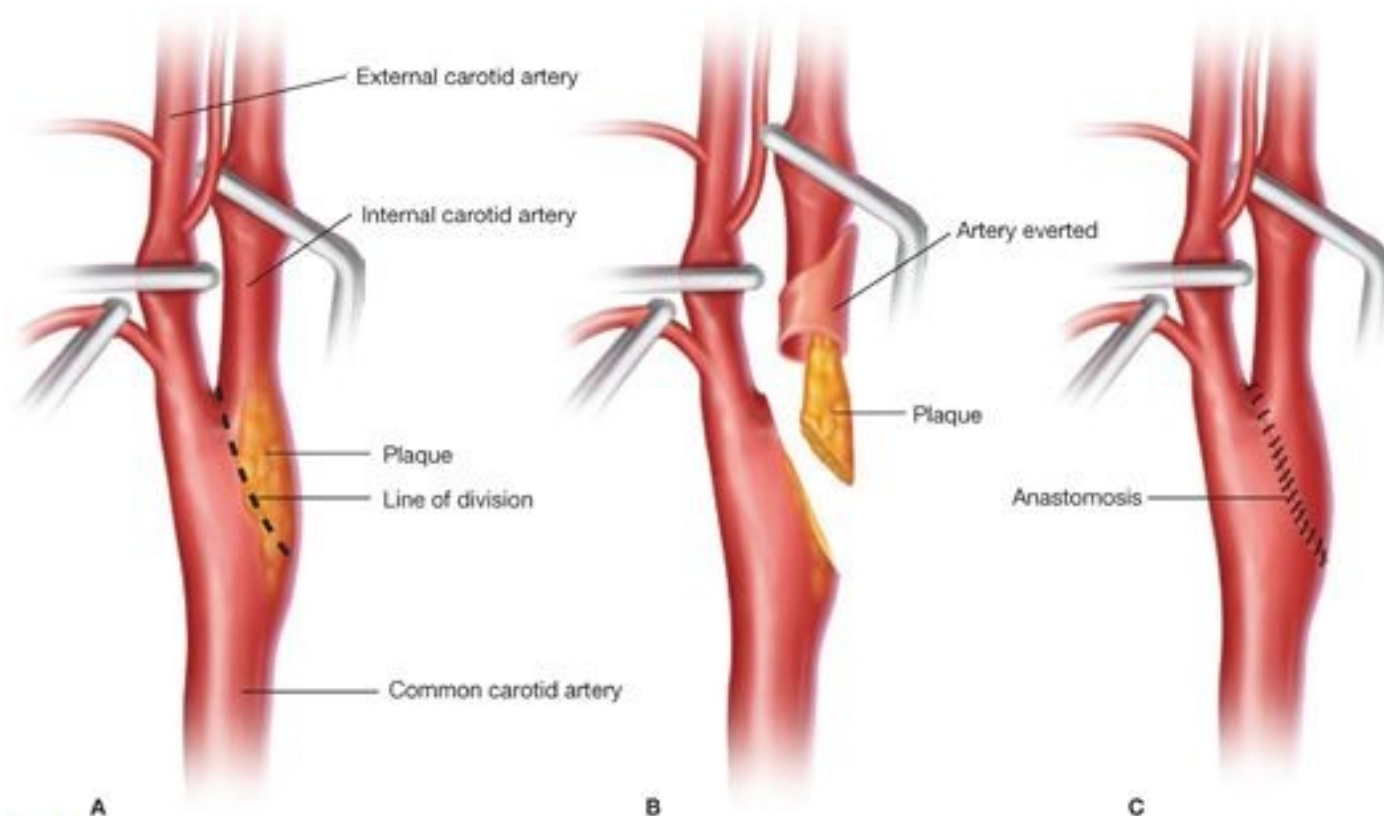
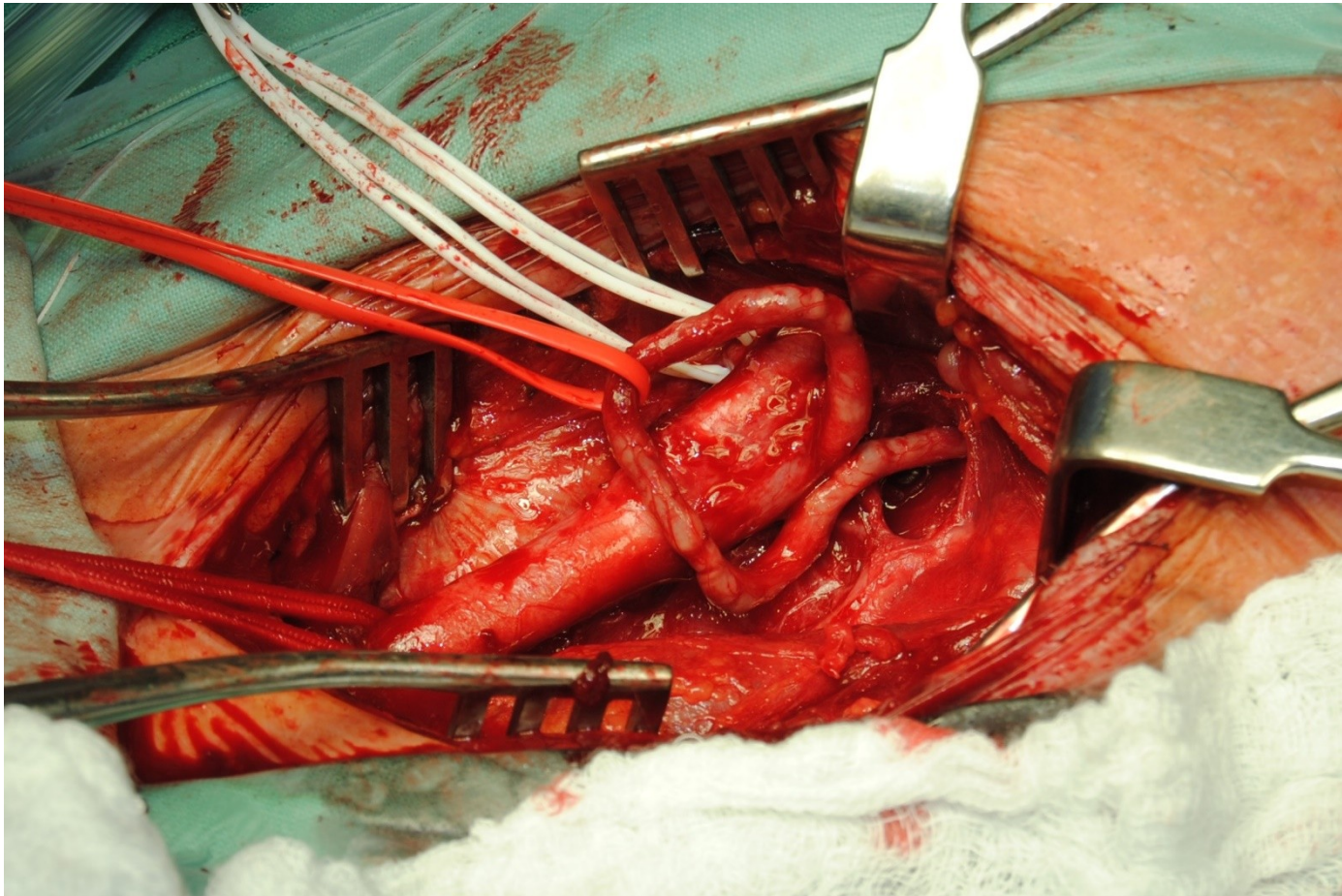


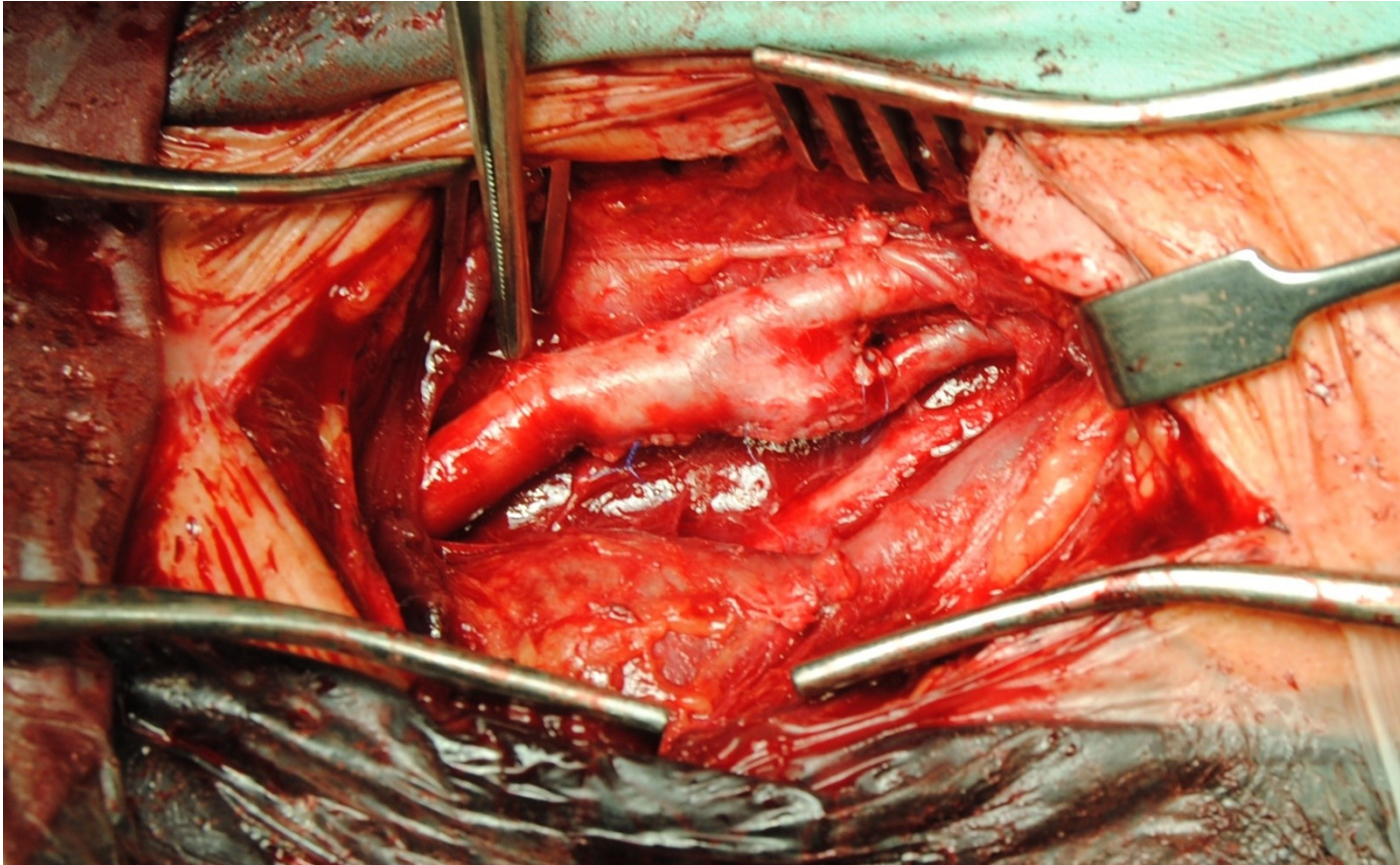
FIG 5 • Carotid eversion endarterectomy. The ICA is divided from the CCA in an oblique line **(A)**. The divided ICA is everted on itself until the plaque endpoint is encountered and the plaque is removed from the ICA **(B)**. Following endarterectomy, the ICA is reverted and reattached to the CCA **(C)**.



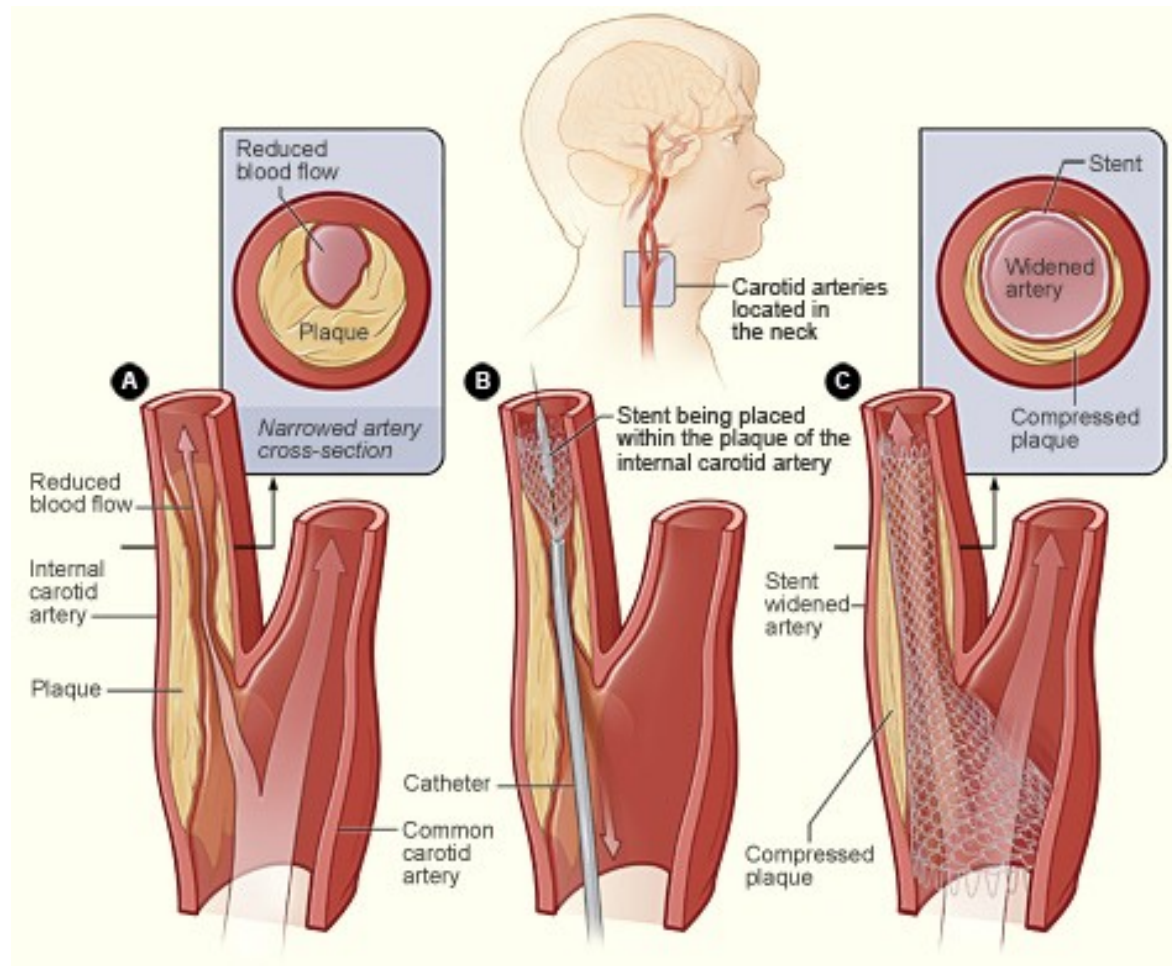
Carotid endarterectomy - eversion



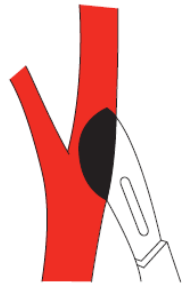
Carotid endarterectomy - eversion



Carotid artery stenting

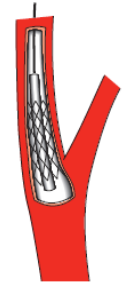


Carotid artery stenting



NIHR HTA/BUPA Foundation/University of Oxford

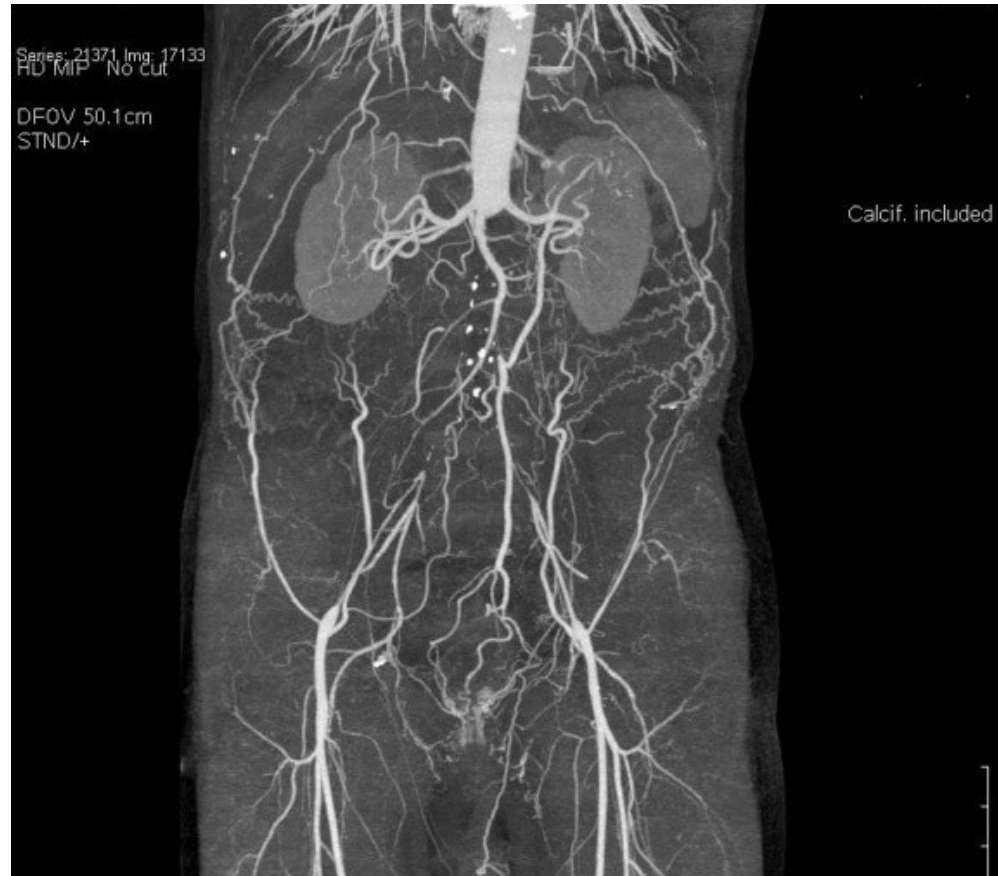
Asymptomatic Carotid Surgery Trial (ACST-2)



A large, simple randomised trial to compare carotid endarterectomy versus carotid artery stenting to prevent stroke



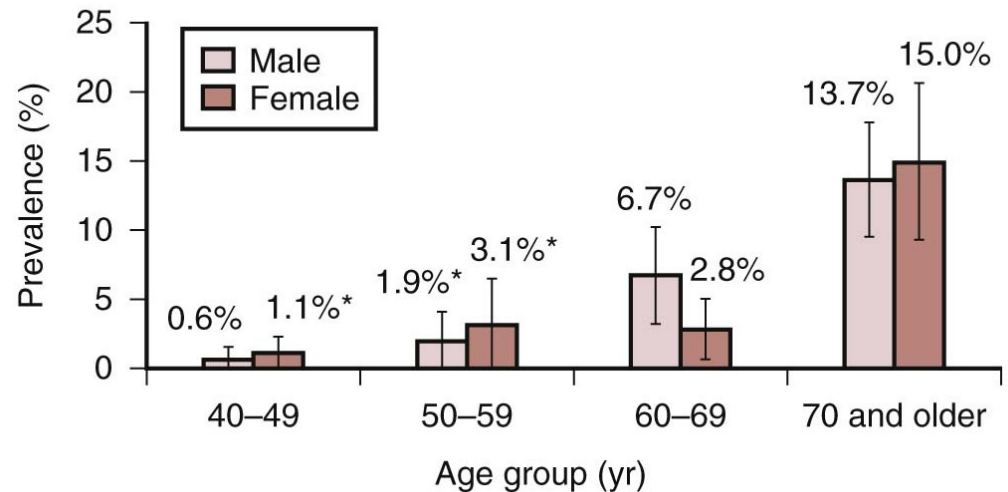
Peripheral artery disease (PAD)



Epidemiology

- **Prevalence of PAD based on ABI**

- 0.9% in <50yo
- 14.5% in >70yo



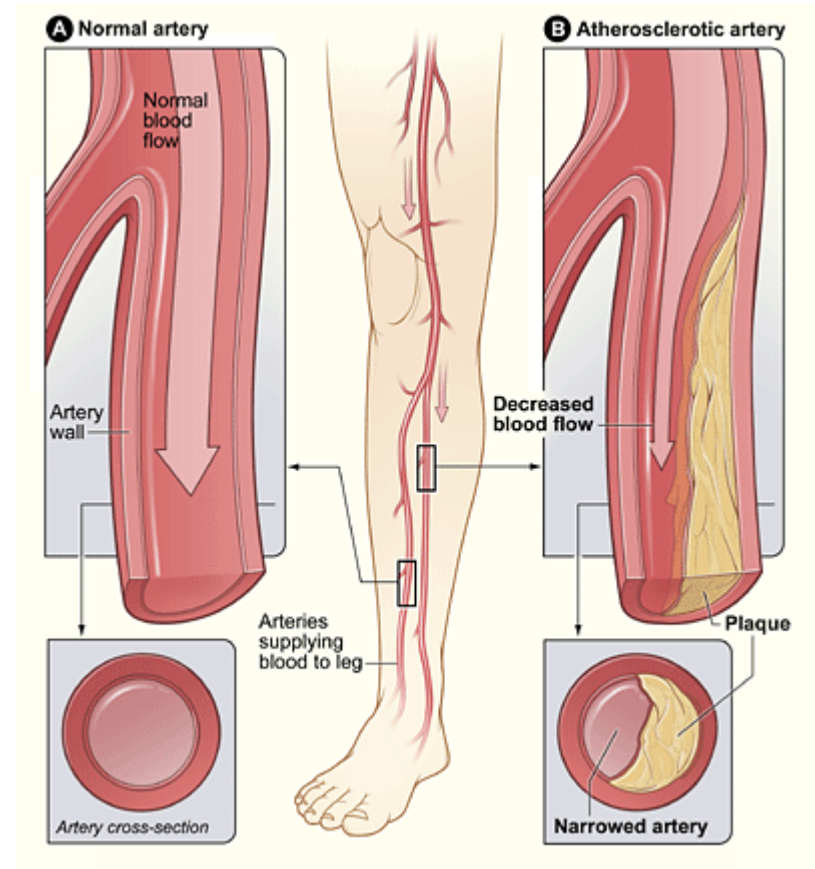
- **Prevalence of intermittent claudication**

- symptomatic to asymptomatic ratio is **1:3-4**



Pathogenesis

- **narrowed arteries** (most commonly due to atherosclerosis) **limit blood flow** to extremities
- extremities (usually legs) don't receive enough blood to keep up with demand, especially during physical exertion



Clinical presentation

- **I. Asymptomatic**
 - **II. Intermittent claudication (IC)**
-

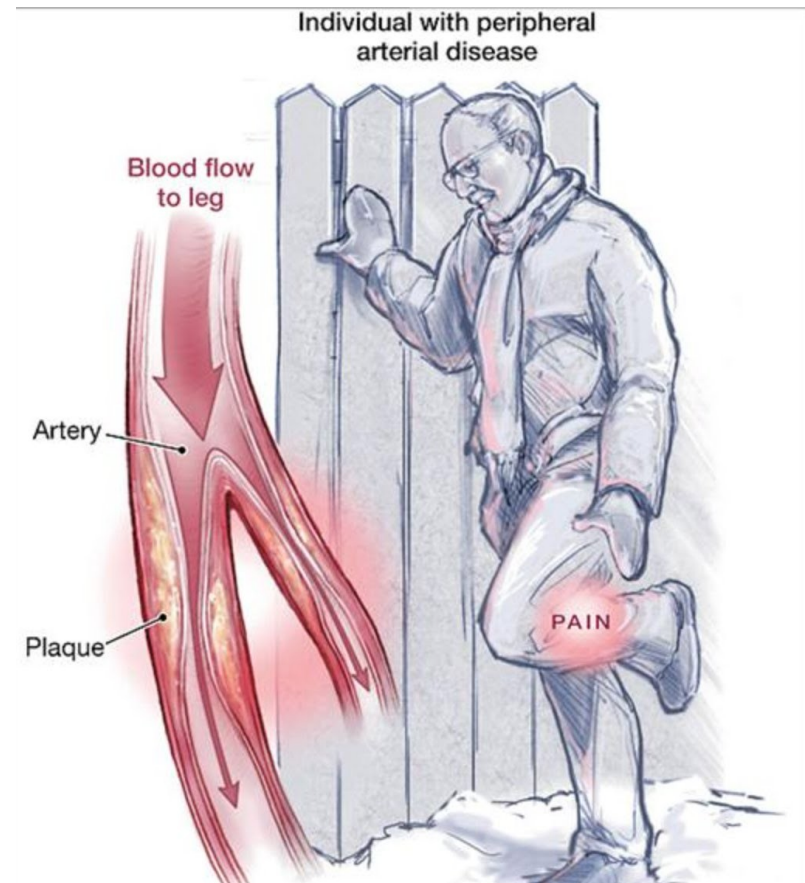
Critical limb threatening ischemia (CLTI)

- **III. Ischemic rest pain**
- **IV. Ulceration or gangrene**



Claudication

- described as **pain, discomfort**, numbness, or tiredness in the legs that occurs **during walking**
- **relieved by rest** (minutes)
- in the
 - calf
 - buttocks
 - hips
 - thighs
 - feet



Clinical presentation

- I. Asymptomatic
 - II. Intermittent claudication
-

CLTI

- III. Ischemic rest pain
- IV. Ulceration or gangrene



Fontaine vs. Rutherford classification

Fontaine		Rutherford		
Stage	Clinical	Grade	Category	Clinical
I	Asymptomatic	0	0	Asymptomatic
IIa	Mild claudication	I	1	Mild claudication
IIb	Moderate to severe claudication	I	2	Moderate claudication
		I	3	Severe claudication
III	Ischemic rest pain	II	4	Ischemic rest pain
IV	Ulceration or gangrene	III	5	Minor tissue loss
		III	6	Major tissue loss



Fate of the leg

- **Asymptomatic**

- **progression of PAD is identical to patients with intermittent claudication**
- symptomatology depends on the level of activity of the subject
- **should be managed medically in the same way** as those with symptoms of intermittent claudication



Fate of the leg

- **Intermittent claudication / asymptomatic**
 - **PAD is progressive**
 - **clinical course is surprisingly stable**
 - **only 25% of patients with IC deteriorate**
 - **major amputation is a relatively rare outcome**
 - less than 5% over a 5-year period.



Fate of the leg

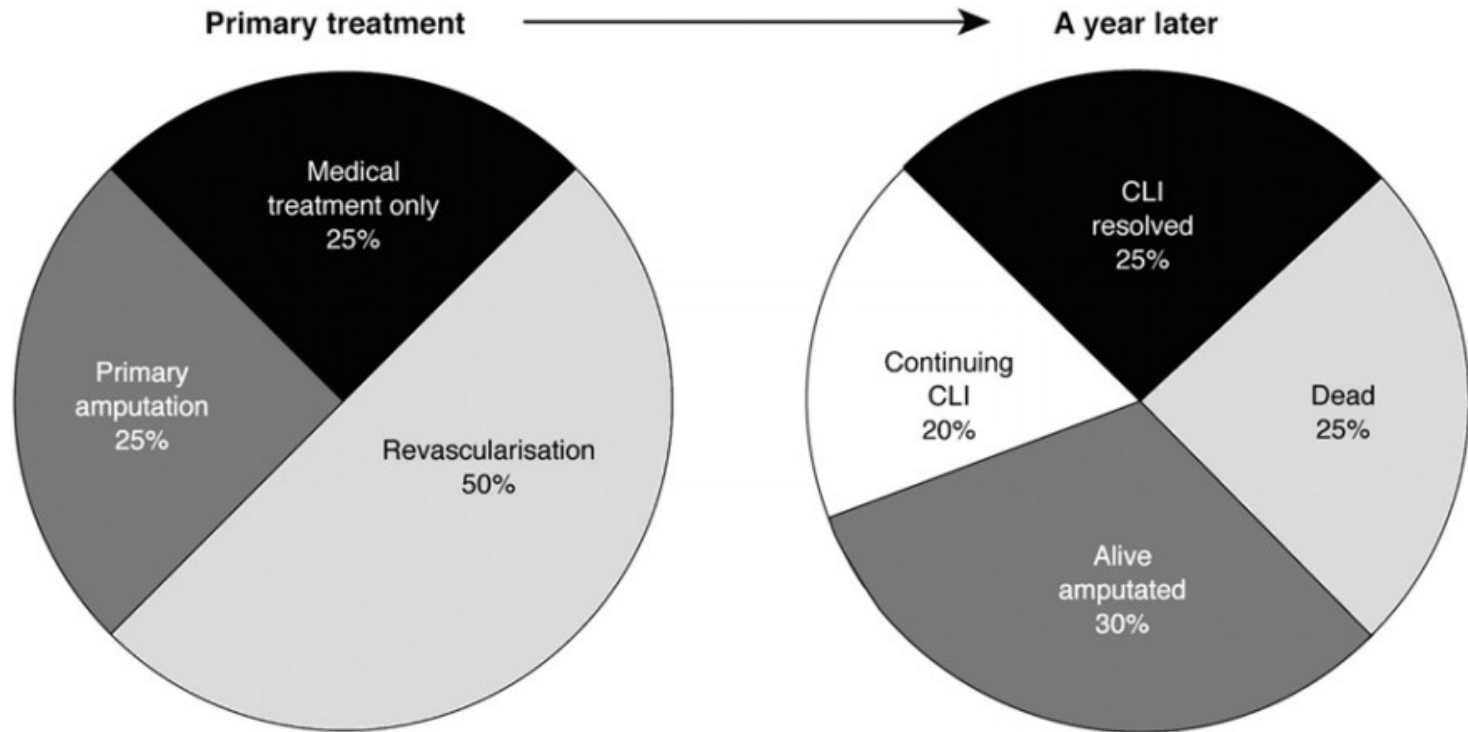


Fig. A5. Fate of the patients presenting with chronic critical leg ischemia. CLI – critical limb ischemia.

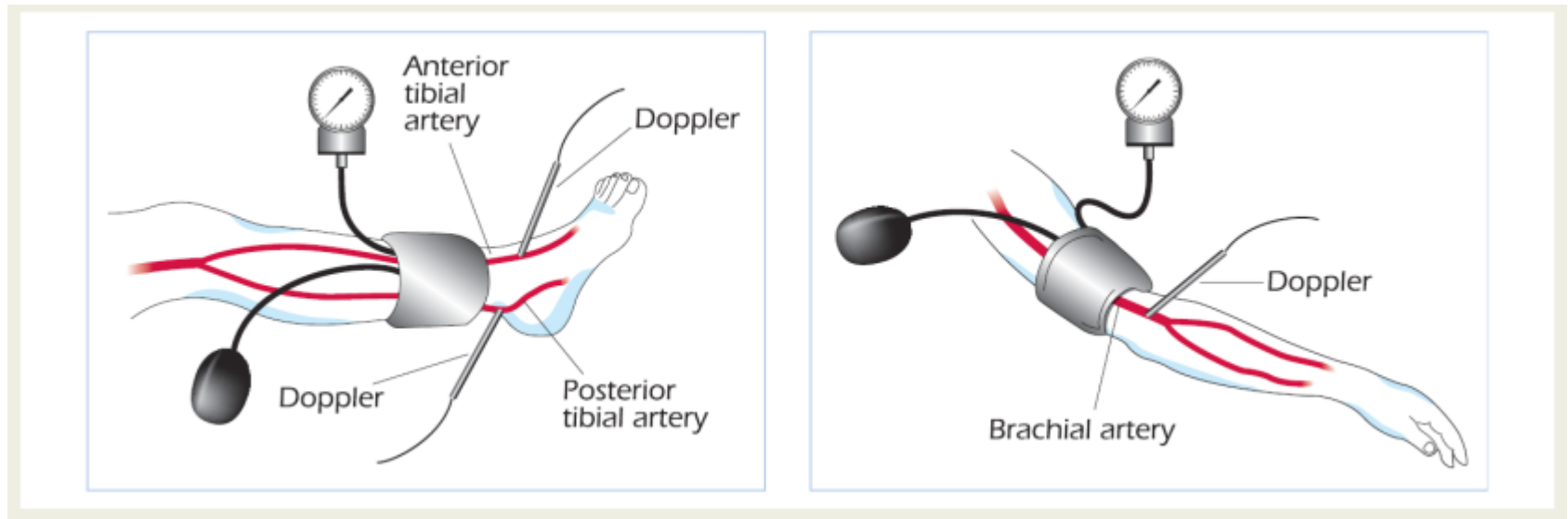


Clinical assessment

- **History**
- clinical presentation of illness
 - claudication
 - rest pain
 - ulcers
- atherosclerosis
 - risk factors
- **Physical findings**
- lower limb examination
 - pulses (bruits & thrills)
 - sensory and motor functions
 - ulcers / gangrenes / infection
 - foot color and temperature
 - capillary refill
 - Buerger's test
- ABI measurement



Ankle-brachial index - ABI



Ankle-brachial index - ABI

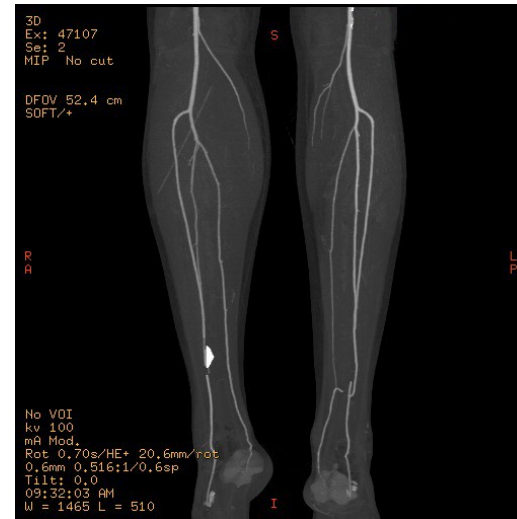
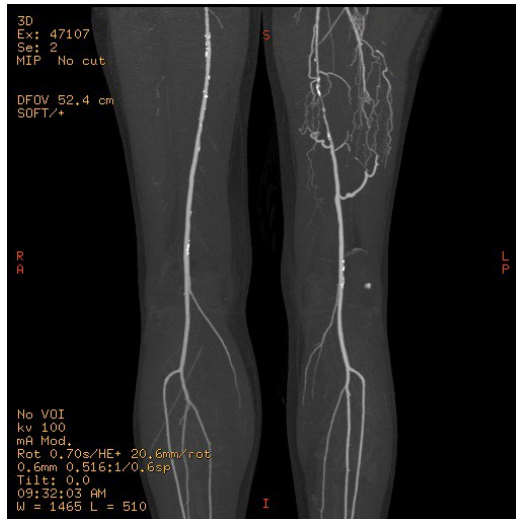
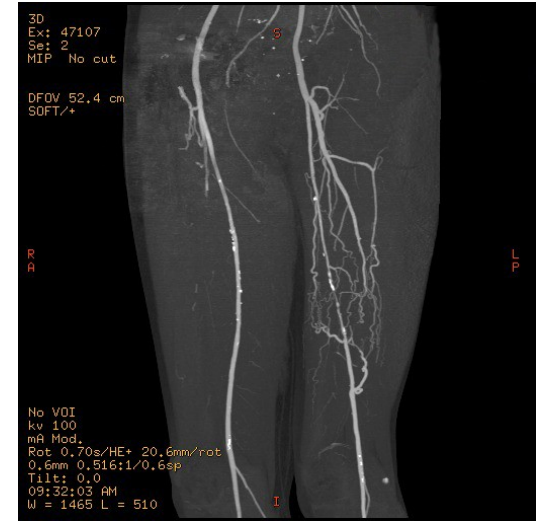
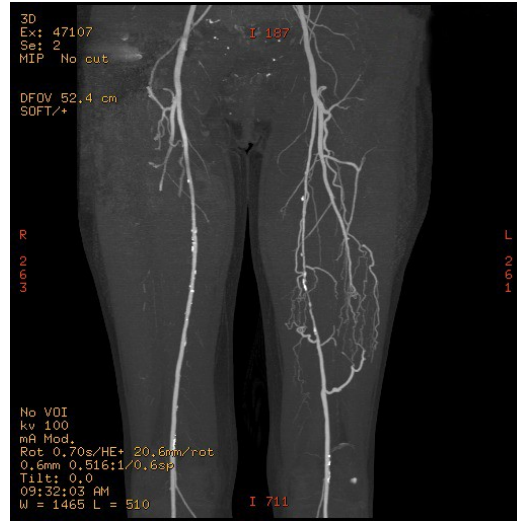
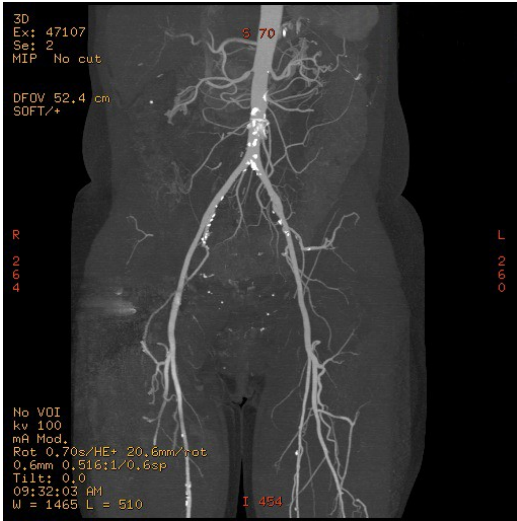


Diagnosis

- **duplex ultrasonography**
- **CT angiography**
- magnetic resonance angiography
 - price, availability, imaging limitations
- **digital subtraction angiography**
 - specific indications (CT/MRI artifacts, below the knee arteries, planned endovascular intervention)



CT angiography



Treatment

- „best“ medical therapy
- endovascular interventions
- surgical procedures



How do we choose the proper treatment?

- **symptoms** – significant disability, presence of critical ischemia
- **functional status** of the patient
- **comorbid conditions**

- **favorable risk-benefit ratio** (anatomical pattern of disease, target vessel, conduit availability)

- **patient preferences**
- **expected durability of offered procedures!!!**



How do we choose the proper treatment?

- 2017 **ESC Guidelines** on the Diagnosis and Treatment of Peripheral Arterial Diseases, **in collaboration with the European Society for Vascular Surgery**



Intermittent claudication

- **Supervised exercise training is recommended** [I,A]
- **Unsupervised exercise training is recommended** when supervised exercise training is not feasible or available. [I,C]
- **When daily life activities are compromised** despite exercise therapy, **revascularization should be considered.** [IIa,C]
- **When daily life activities are severely compromised,** **revascularization should be considered** in association with exercise therapy. [IIa,B]



Chronic limb-threatening ischemia

- for limb salvage, **revascularization is indicated whenever feasible** [I,B]
- for **infra-popliteal revascularization**
 - **bypass using the great saphenous vein** is indicated [I,A]
 - **endovascular therapy should be considered** [IIa,B]
- **stem cell/gene therapy is not indicated** [III,B]



„Best“ medical therapy

- Risk factor reduction and medical management
 - antiplatelet therapy
 - anticoagulation (if indicated for other condition)
 - statin therapy
 - **exercise therapy !!!**
 - **vasodilators**
- risk factor reduction
 - hypertension
 - diabetes mellitus
 - smoking cessation
 - alcohol cessation



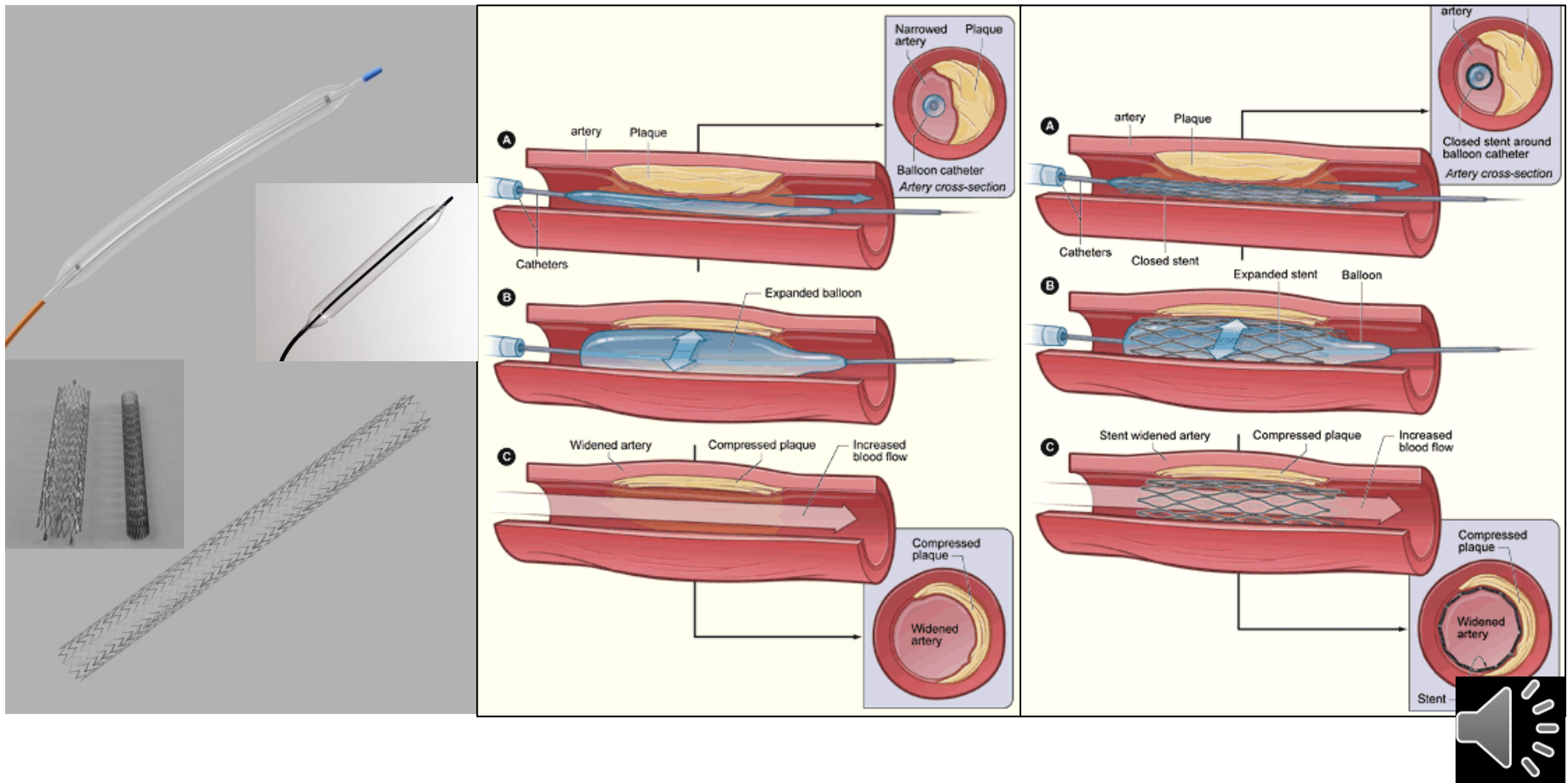
Structured exercise therapy

- involves **intermittent bouts of walking** to moderate-to-maximum claudication, alternating with periods of rest
- is performed for a **minimum of 30–45 min/session**; sessions are performed **at least 3 times/wk** for a **minimum of 12 wk**
- **two options**
 - Supervised exercise program
 - Structured community- or home-based exercise program

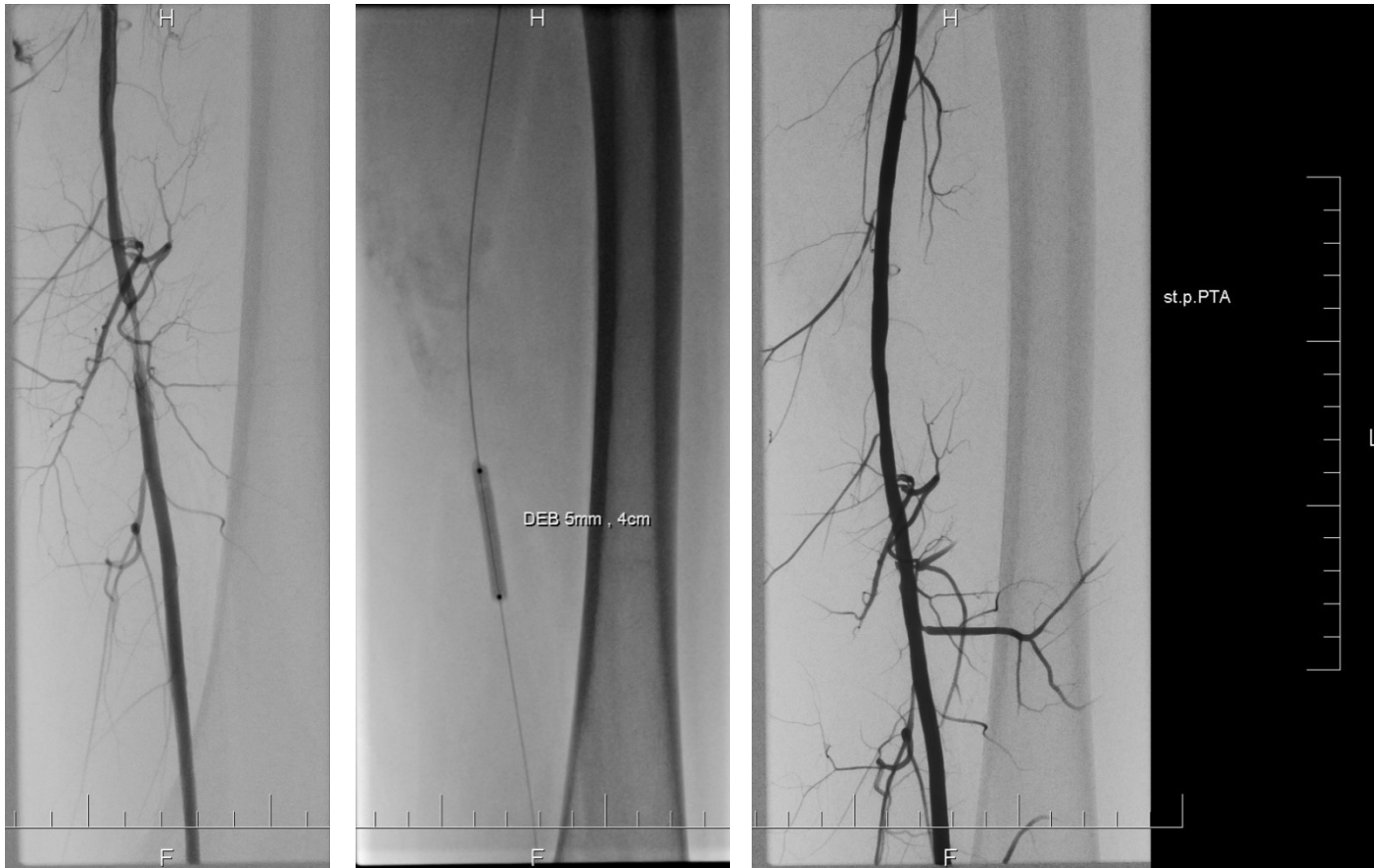


Endovascular interventions

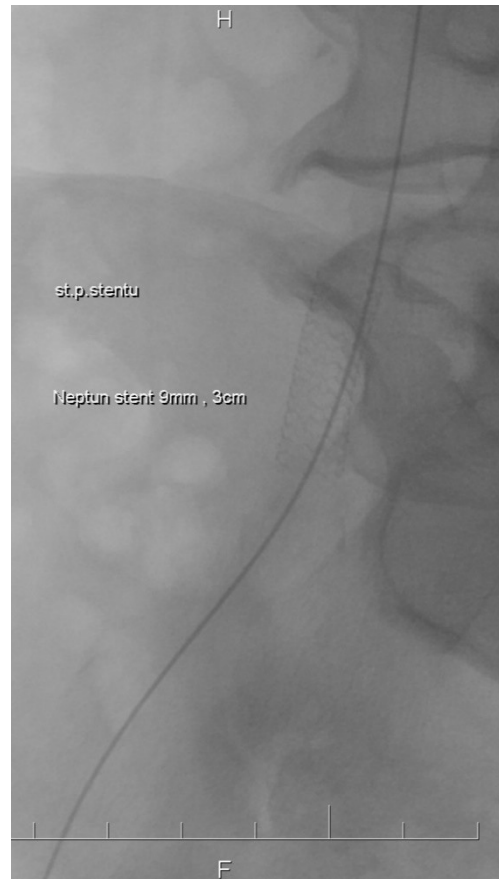
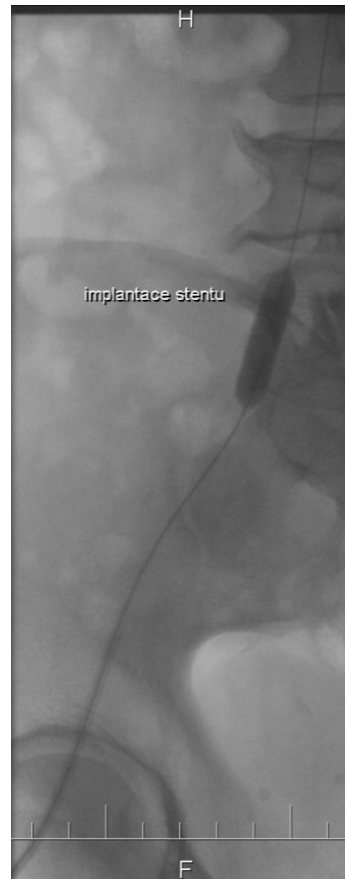
- PTA or PTA + stenting



PTA



PTA (Stenting)



Surgical procedures

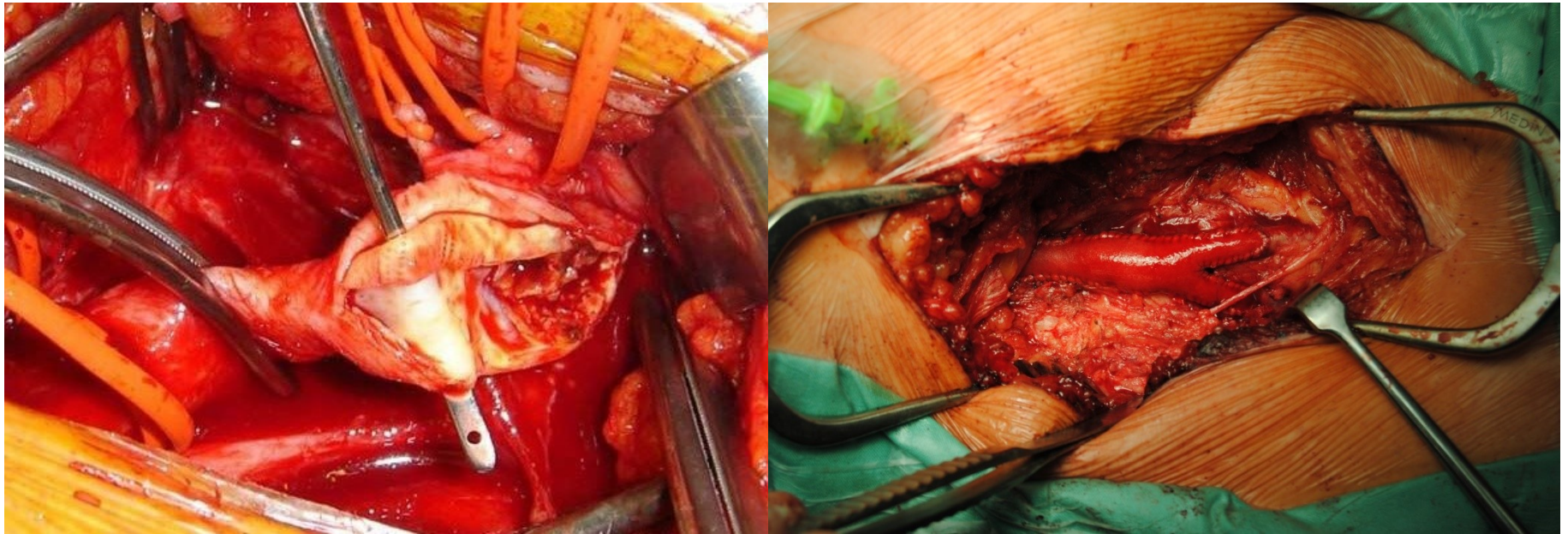
- Endarterectomy
- Patch angioplasty

- Bypass
 - anatomic
 - extraanatomic

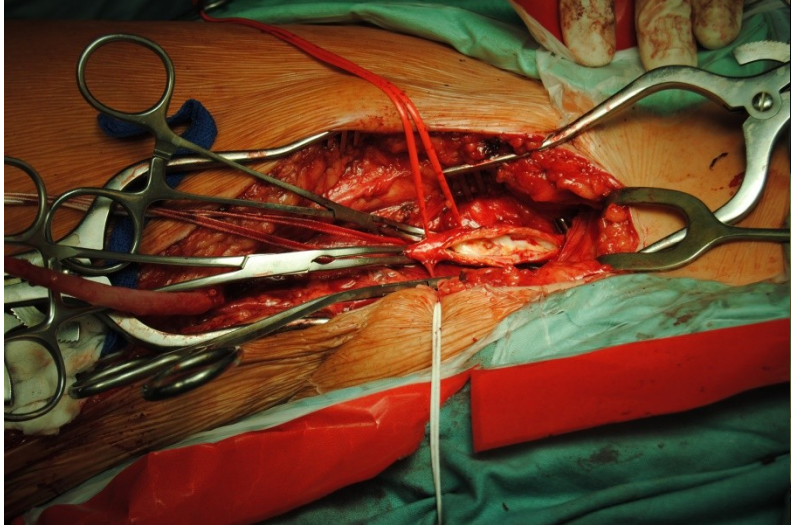
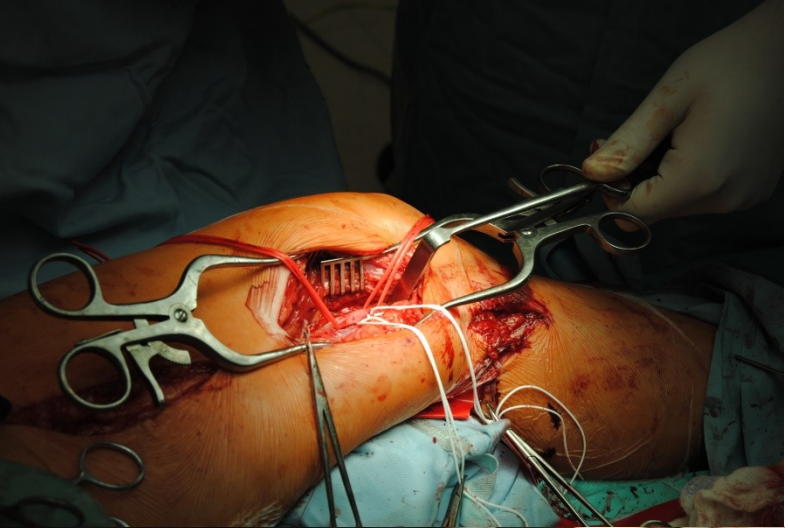
- Hybrid procedures



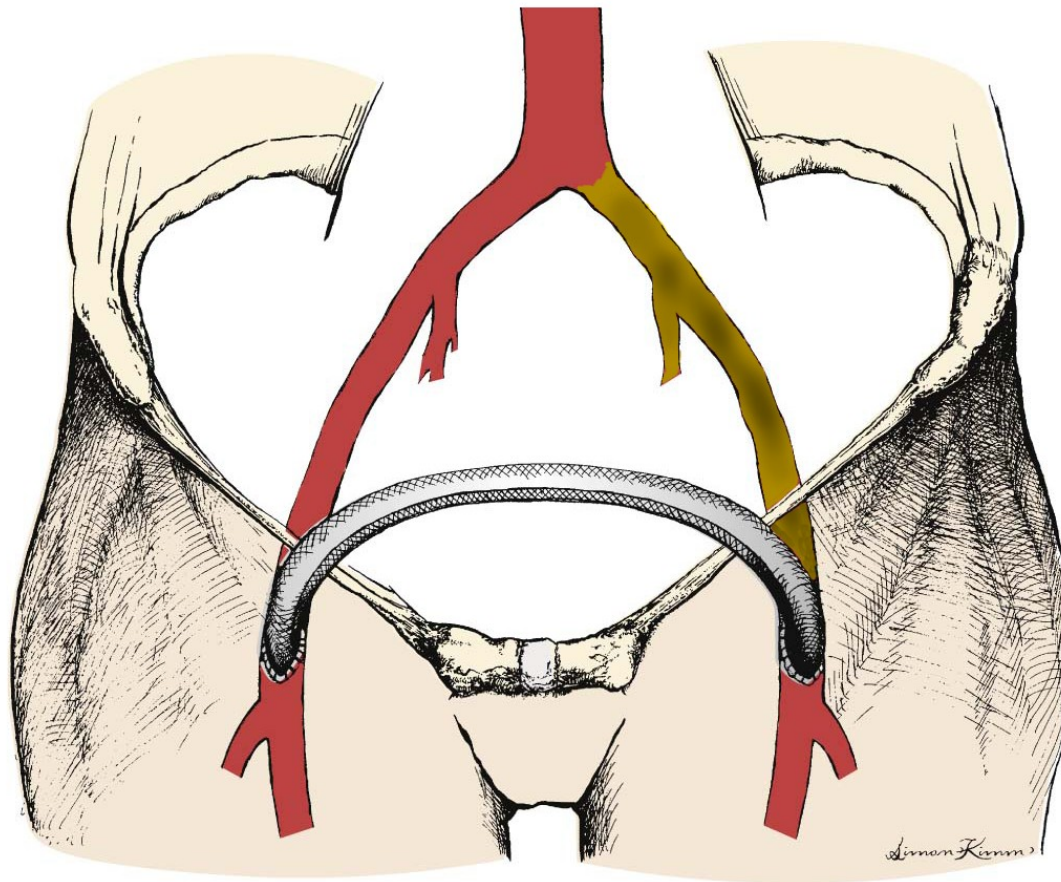
Endarterectomy & patch angioplasty



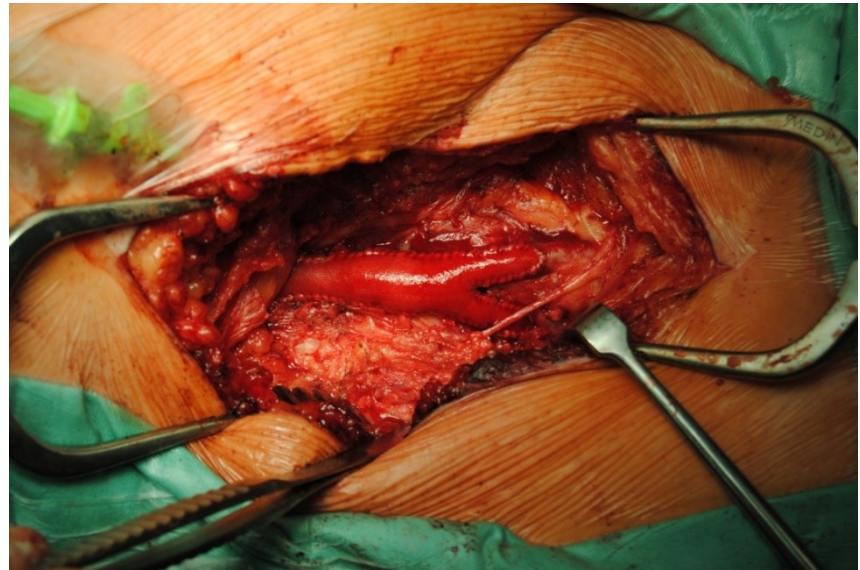
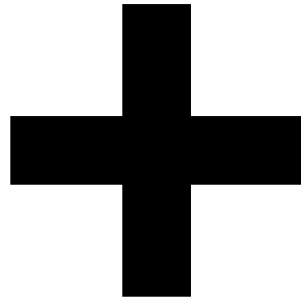
Proximal femoropopliteal bypass



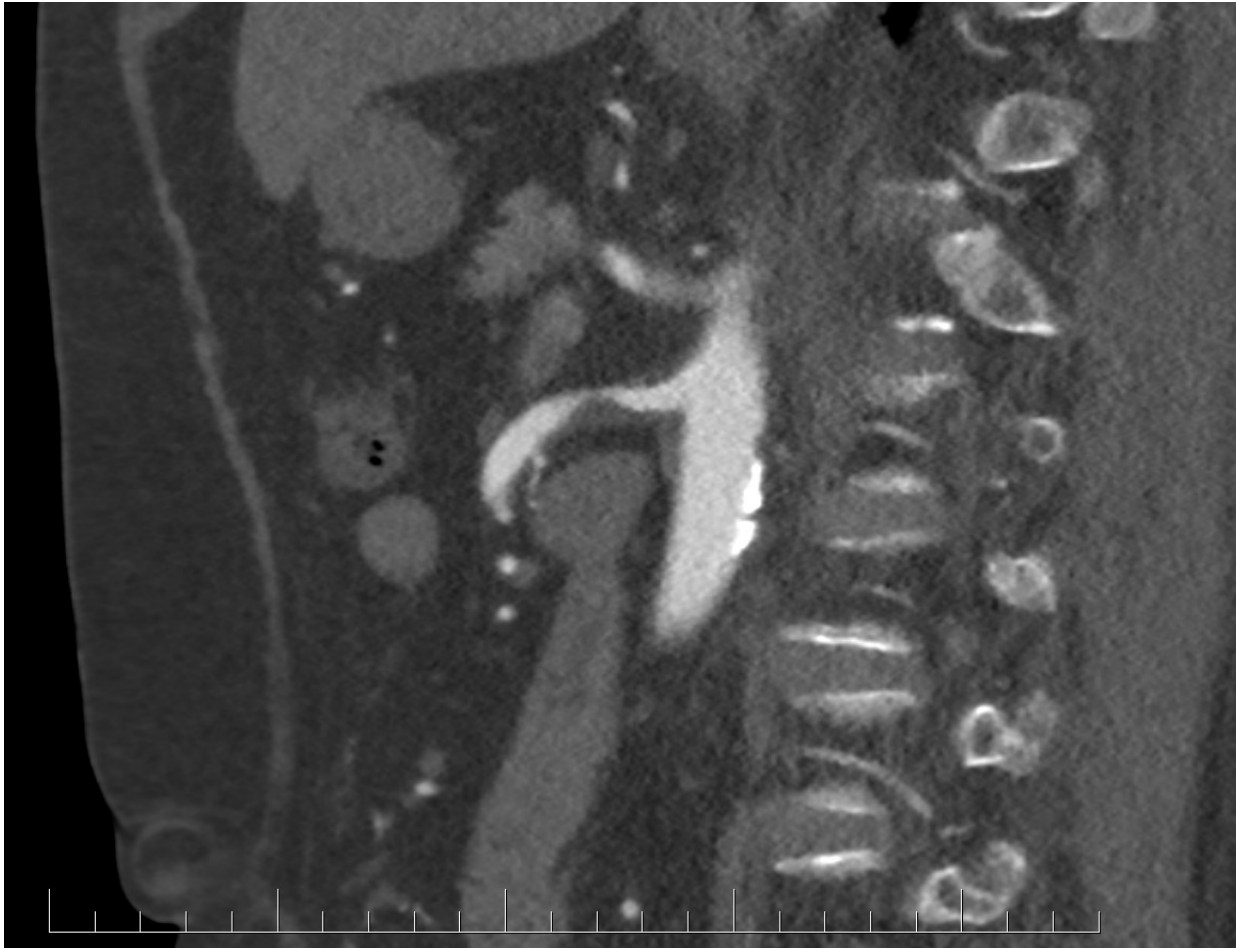
Bypass extranatomic



Hybrid procedure =



Chronic mesenteric ischemia (CMI)



Epidemiology

- **asymptomatic occlusive disease** of the visceral arteries is a **common finding in elderly patients**
- **estimated the prevalence 6 to 10 %**
- the exact **incidence of chronic mesenteric ischemia** is **not known**



Pathophysiology

- **atherosclerosis** is the most common cause
- **median arcuate ligament syndrome**
 - a separate entity that may lead to symptoms of CMI
 - compression of the celiac artery by the median arcuate ligament
- **majority of patients with symptoms** of CMI have significant **stenosis or occlusion of at least two** of the three **mesenteric arteries**



Pathophysiology

- **20% of the cardiac output** goes through the **mesenteric arteries** under normal conditions
- **after** the ingestion of a **meal blood flow is elevated** during the next 3 to 6 (up to 2000 mL/min)
- **duration** of these responses **depend on the type and quantity of a meal**



Clinical presentation

- **postprandial abdominal pain**
 - often occurs 15 to 45 minutes after a meal
 - patients typically develop **“food fear”**
- **progressive weight loss**
 - is a common finding
 - changes in bowel habits, nausea, and vomiting are less common



Clinical presentation

- **physical examination is usually nonspecific**
 - **undernourishment or cachexia**
 - **an abdominal bruit** can sometimes be auscultated
 - bowel sounds are frequently hyperactive
 - guarding and rebound tenderness are usually absent
- **typical patient**
 - female with a median age 65 (40-90)
 - 3-4 : 1 female-to-male ratio



Clinical assessment

- **History**
- clinical presentation of present illness
- atherosclerosis
 - risk factors
- **Physical findings**
- cachexia
- abdominal bruit (up to 50 % of patients)
- female with a median age 65 (40-90)



Diagnosis

- **DUS**

- useful tool for diagnosis of visceral ischemic syndromes
- excellent for median arcuate ligament syndrome as well

- **CT**

- accurate imaging modality
- can rule out other diagnoses
- important for intervention planning

- **MRI**



Diagnosis

- **digital subtraction angiography**
 - usually for planned endovascular intervention
- endoscopy
- gastric tonometry



Treatment

- conservative
 - no role in symptomatic mesenteric artery disease
- **endovascular interventions**
- **surgical procedures**
- 2017 Clinical Practice **Guidelines of the European Society of Vascular Surgery**
- 2017 **ESC Guidelines** on the Diagnosis and Treatment of Peripheral Arterial Diseases, **in collaboration with the European Society for Vascular Surgery**



Treatment

- In patients with suspected CMI, occlusive **disease of a single mesenteric artery makes the diagnosis unlikely** and a careful search for alternative causes should be considered. [IIa,C]
- In patients with **symptomatic multivessel CMI, revascularization is recommended** [I,C/B]
- In patients with symptomatic multivessel CMI, it is **not recommended to delay revascularization** in order to improve the nutritional status. [III,C]

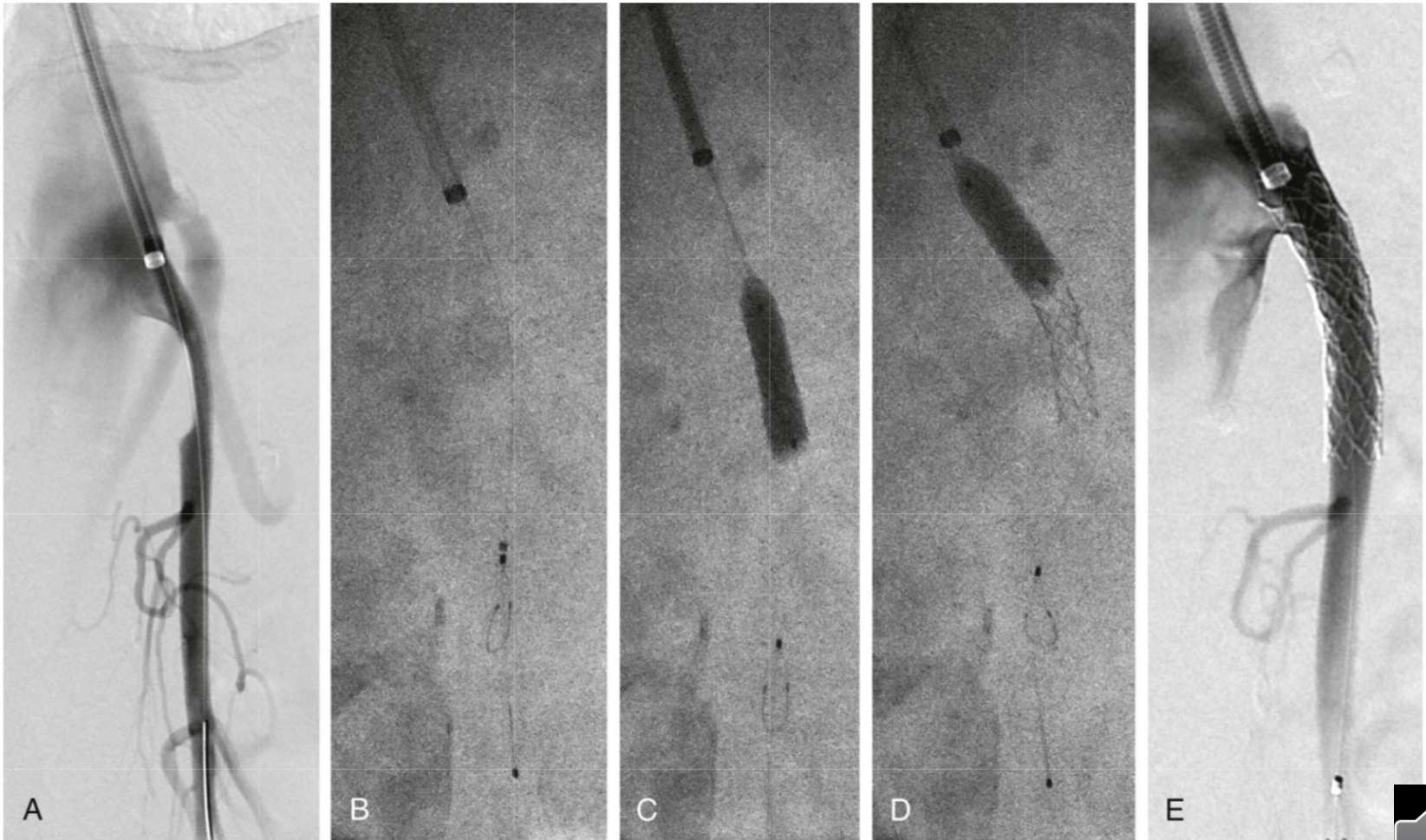


Treatment

- In patients with CMI, needing revascularization, the **superior long term results of open surgery must be offset against a possible early benefit of endovascular intervention** with regard to peri-procedural mortality and morbidity. [I,B]



PTA + stenting

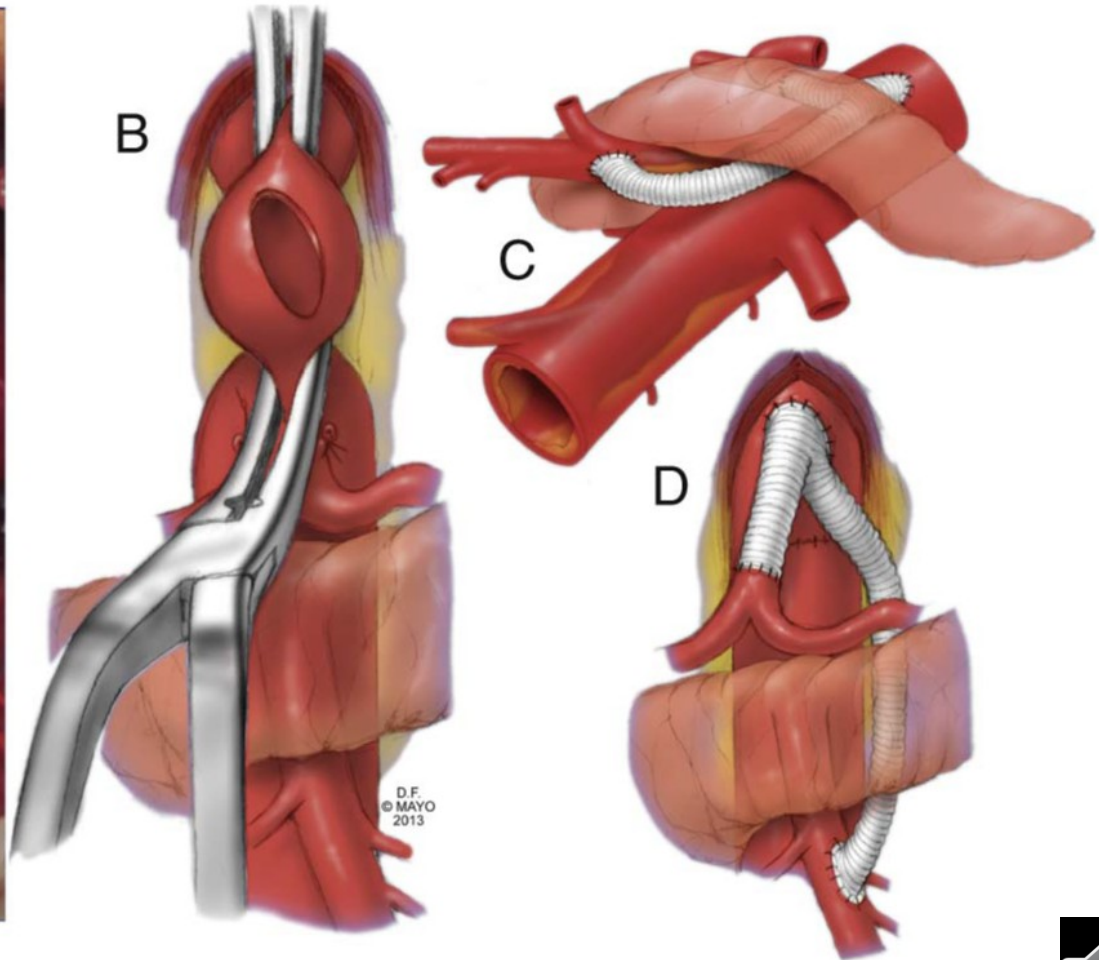
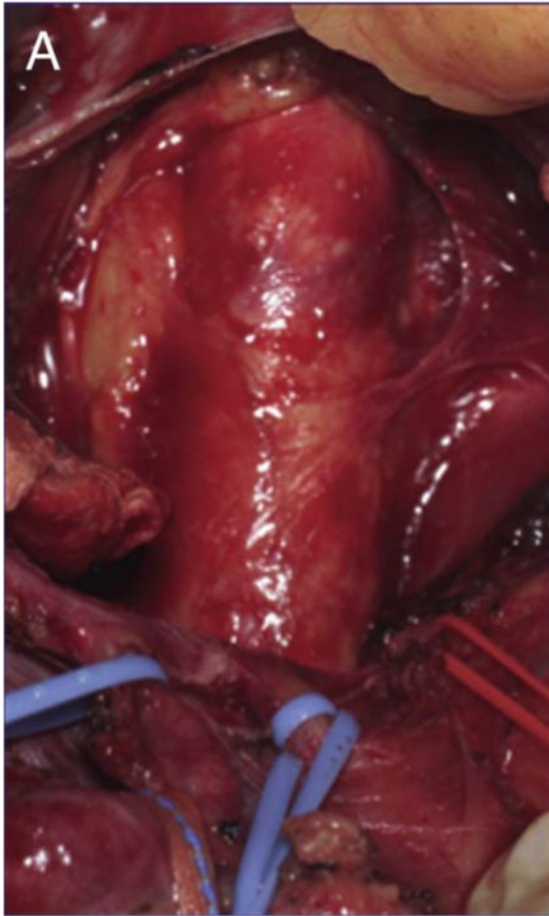


Surgical procedures

- **Antegrade Mesenteric Bypass**
- **Retrograde Mesenteric Bypass**
- **Mesenteric bypass offers**
 - improved patency
 - lower rates of re-interventions
 - better freedom from recurrent symptoms
- **Transaortic endarterectomy – rare**



Antegrade mesenteric bypass



Retrograde mesenteric bypass



Thank you for your attention!

