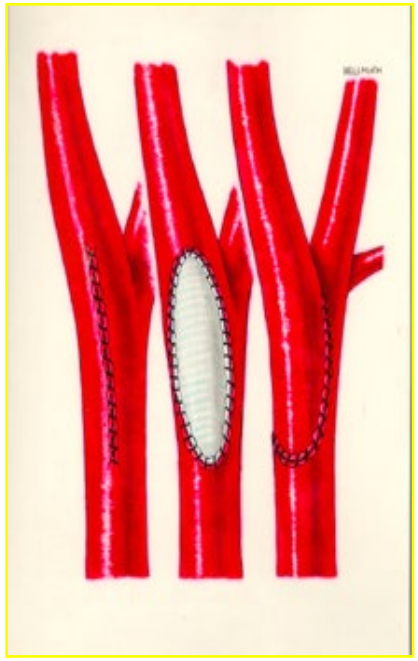

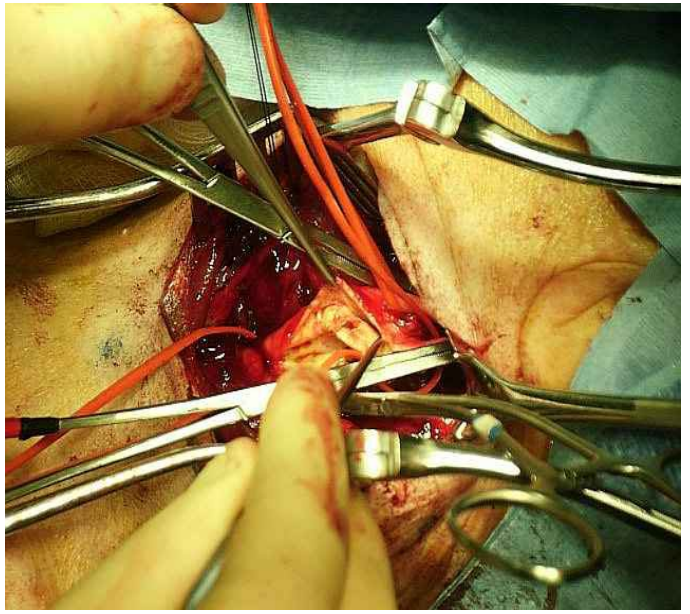

Carotid Artery Disease

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Disclosures

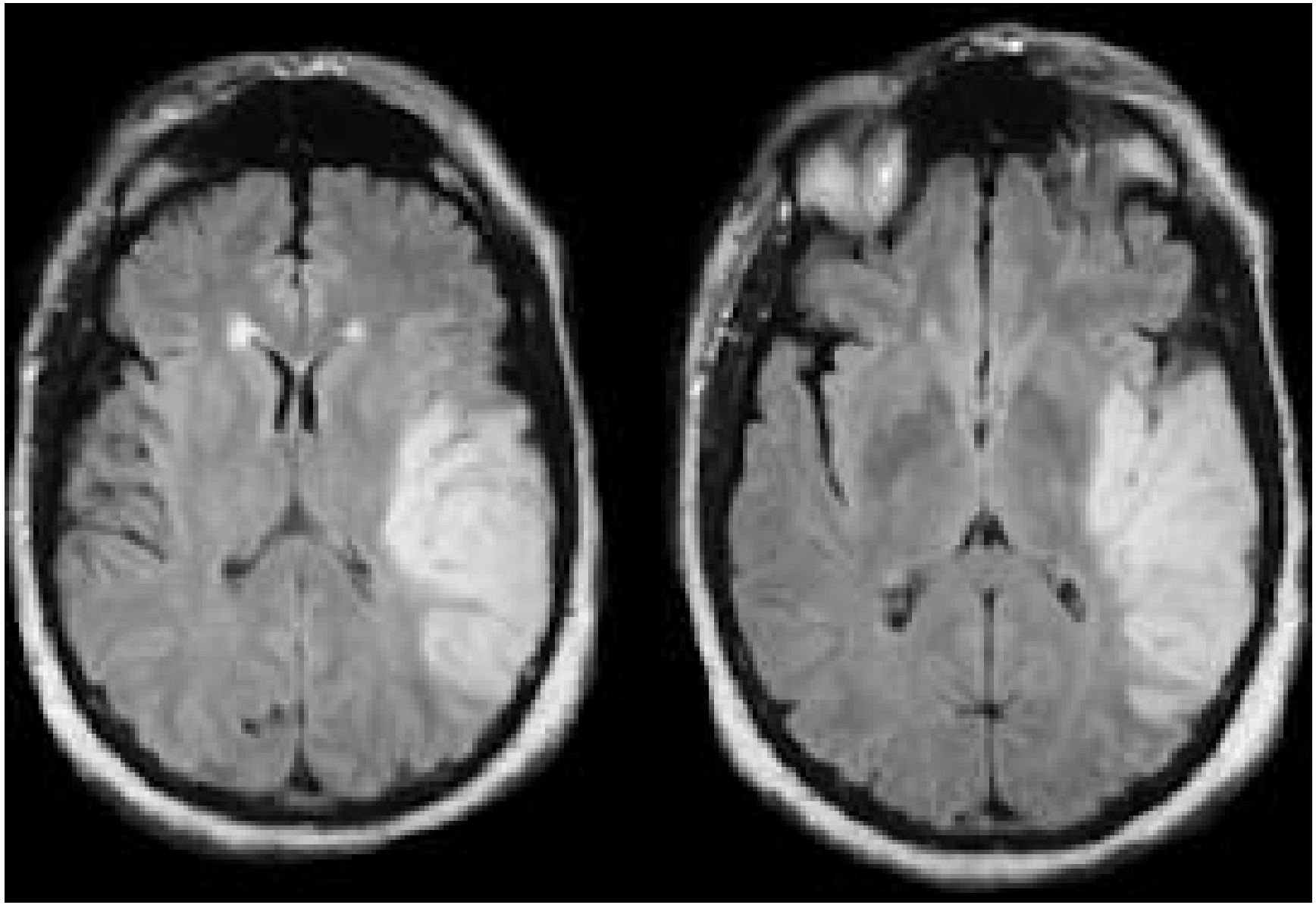
Speaker: Gore Medical, Cook Medical

Consultant: Bentley Innomed GmbH

Case Scenario

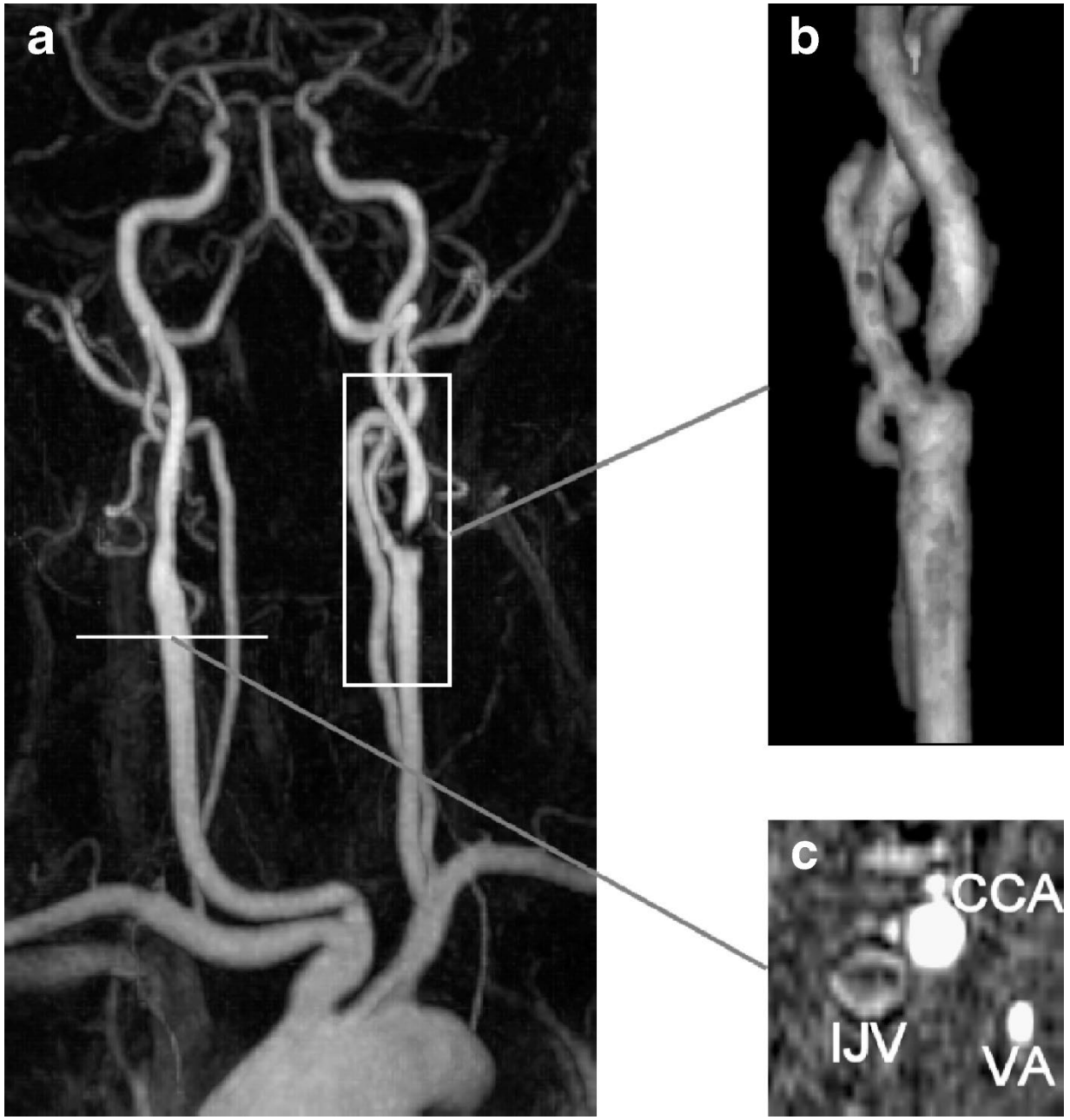
- 67 year old male
- ER with acute weakness of his right arm and leg .
- Symptoms started 12 hours ago.
- h/o of HTN and dyslipidemia
- PE: 97 pulses/min, 170/100 mmHg
- He has right sided weakness
- Cardiovascular Exam
  - Sinus rhythm
  - No chest pain
  - Left Carotid bruit

CT: Atrophy – Small Vessel Disease



MRI: Acute Infarct of the Left Middle Cerebral Artery Territory

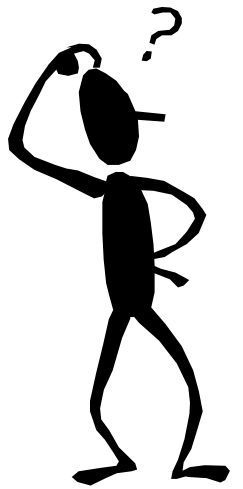
MRA: Critical Stenosis of the Left ICA



Case Scenario

- Patient is admitted to the Stroke Unit
- Blood pressure management
- Initiation of aspirin, statin and heparin
- Patient gradually recovers (72h) 80% of his functionality
- What is your suggestion?

  - *Patient is improving, so continue medical management*
  - *Carotid Endarterectomy of Left ICA*
  - *Carotid Stenting of Left ICA*



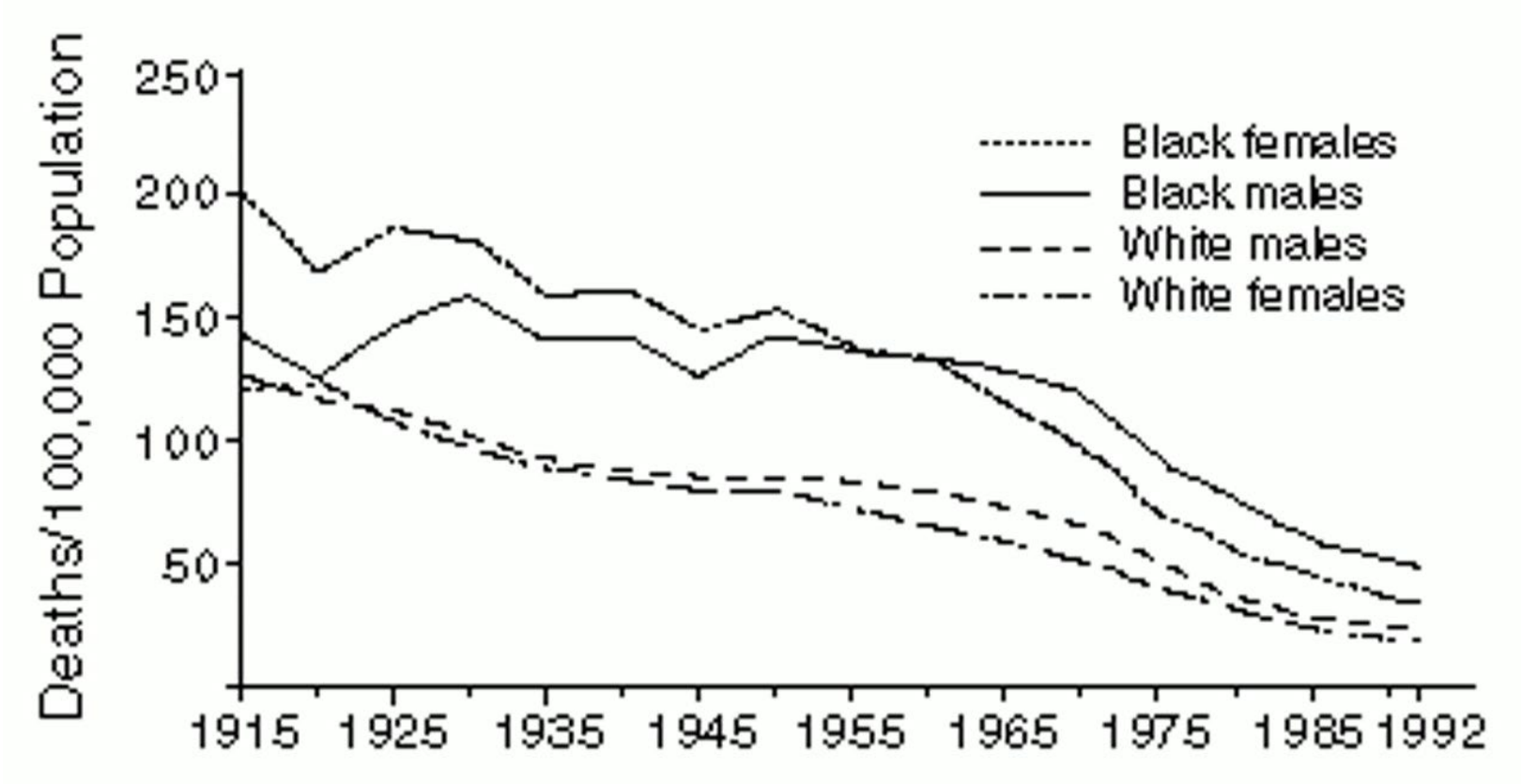
Cerebrovascular Disease

- 5th cause of death in western world
- 2nd cause of cardiovascular death
- U.S. Prevalence 2.7% → 3.9% in 2030
- Neurologic disability
- High socioeconomic impact

"Every 3 minutes and 45 seconds, someone in U.S. has a stroke, and every 4 minutes, someone dies of a stroke"

American Heart Association®

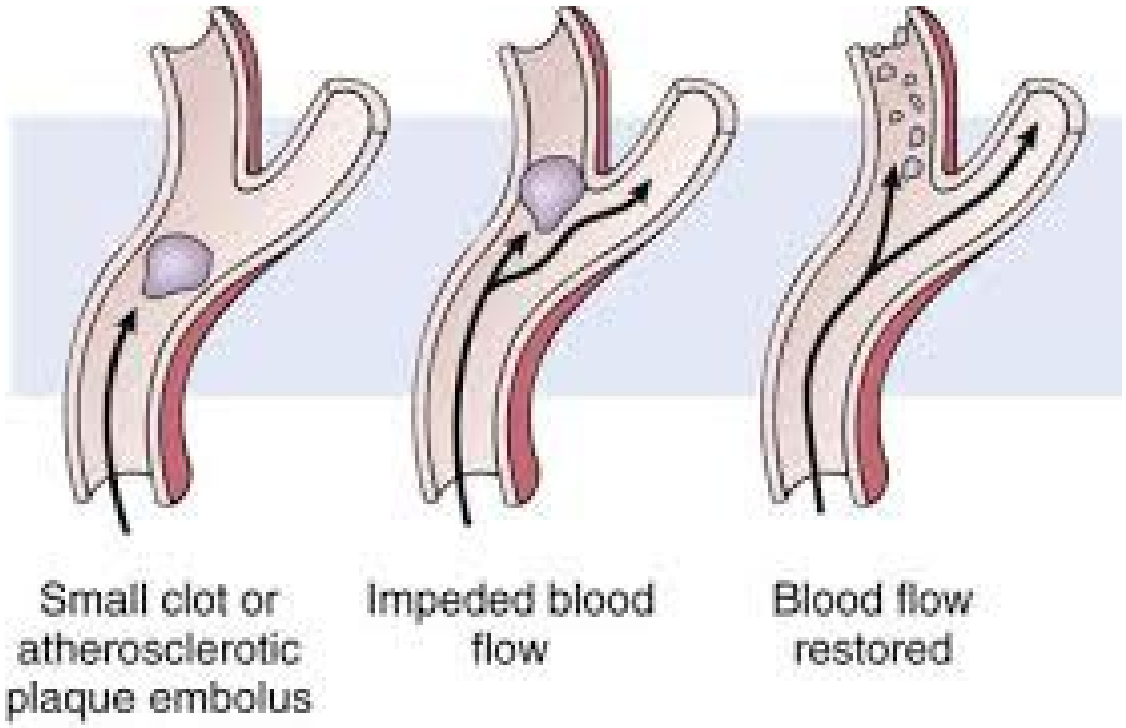
Decreasing Age-Adjusted Mortality from Stroke in USA According to Sex and Race, 1915 through 1992



Bronner, L. L. et al. N Engl J Med 1995

Cerebrovascular Event Classification

- Transient Ischemic Attack (no infarct)
- Stroke (infarct = cell death)



Transient Ischemic Attack (time-based definition)

*"Sudden, focal neurologic deficit **lasting less than 24 hours**, confined to an area of the brain or eye perfused by a specific artery."*

Transient Ischemic Attack (tissue-based definition)

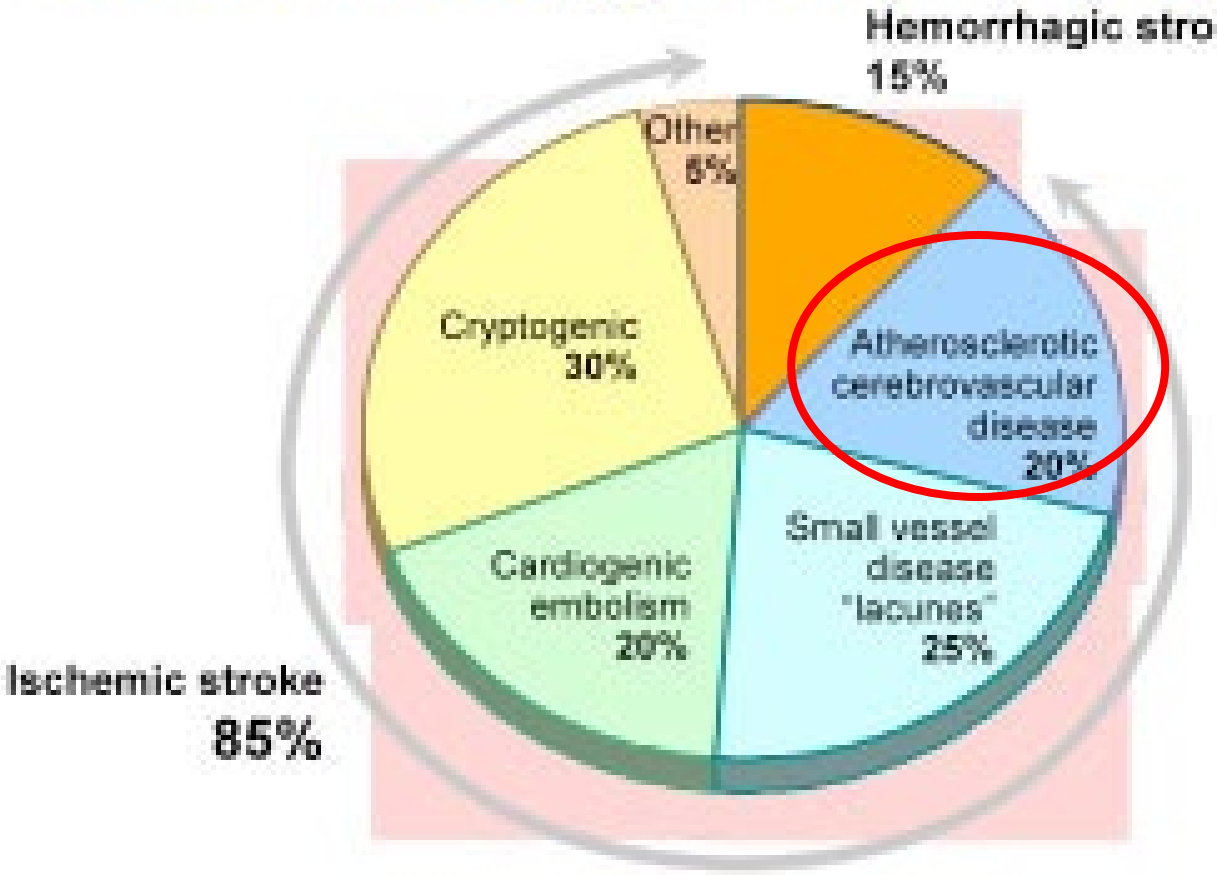
*"Brief episode of neurologic dysfunction caused by focal brain or retinal ischemia, with clinical symptoms **typically lasting less than one hour,** and **without evidence of acute infarction."***

Most TIAs last seconds to 10 minutes, with symptoms lasting greater than 1 hour in only 25% of patients

Transient Ischemic Attack Significance

- 10-15% of TIAs will be followed by a stroke within 3 months, half of them within 48 hours.
- Among those who present with a stroke the prevalence of prior TIA is reported 7-40%
  - Northern Manhattan Study
  - Harvard Stroke Registry
  - National Institute of Neurologic Disorders
  - Stroke Data Bank
  - Oxford Vascular Study

Stroke Subtypes and Incidence



Extracranial atherosclerosis

Carotid / Vertebral / Aortic Arch

Intracranial atherosclerosis

- Lacunar (small vessel)

Cardioembolic

Miscellaneous (e.g. hypercoagulability)

Cryptogenic

Albers et al. *Chest* 2004; 126 (3 Suppl): 438S–612S.

Extracranial Atherosclerosis

The common sites include

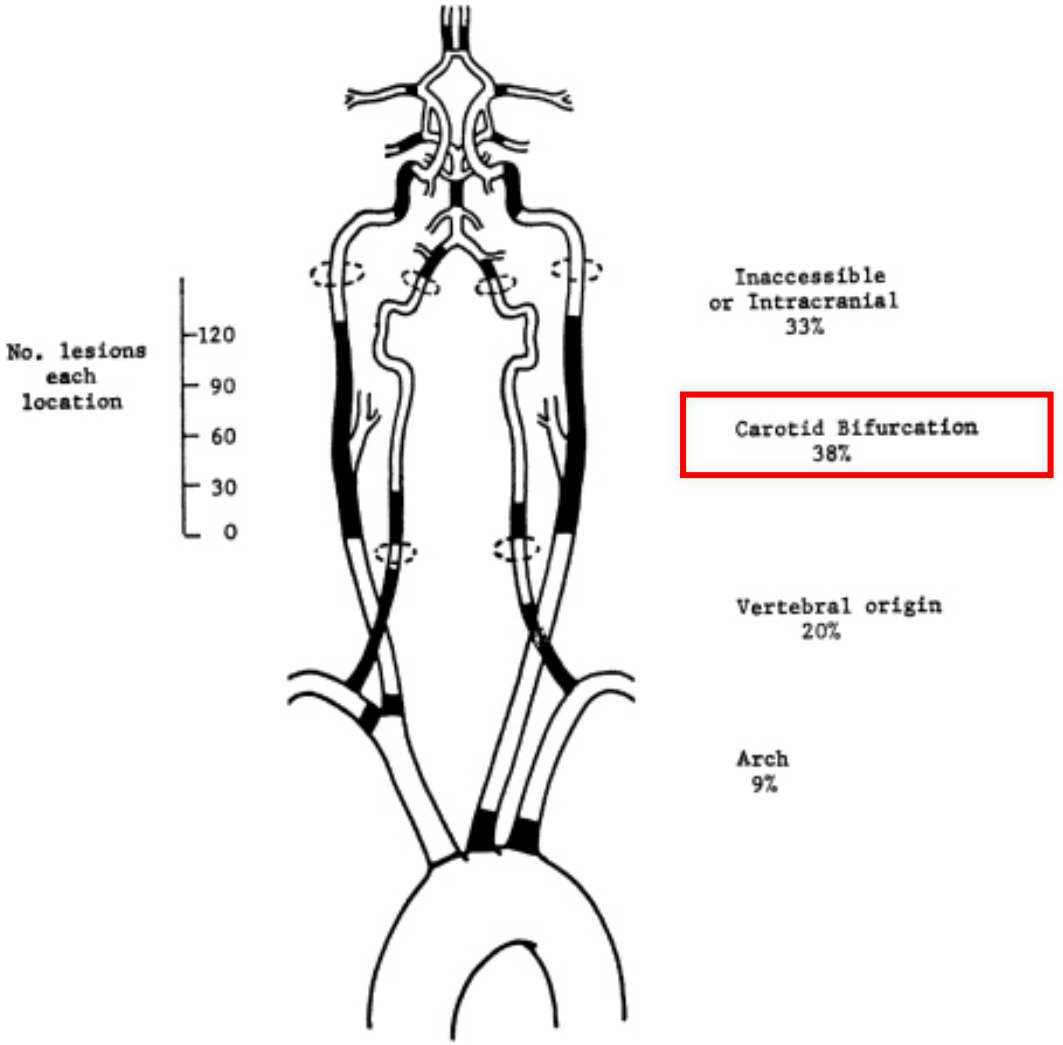
(1) the points of takeoff for the branches of the aortic arch

(2) the origins of the vertebral artery

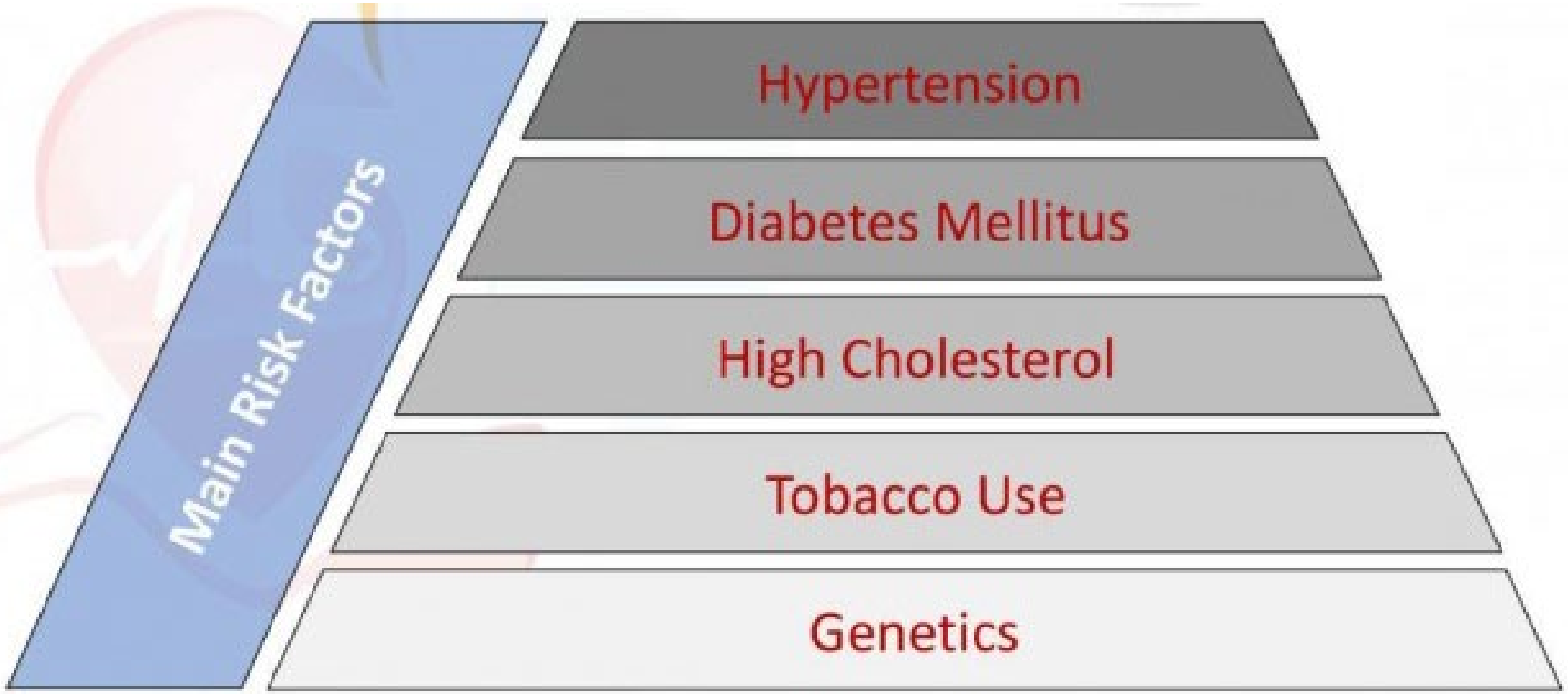
(3) the bifurcation of the common carotid artery (carotid bulb)

(4) the carotid siphon

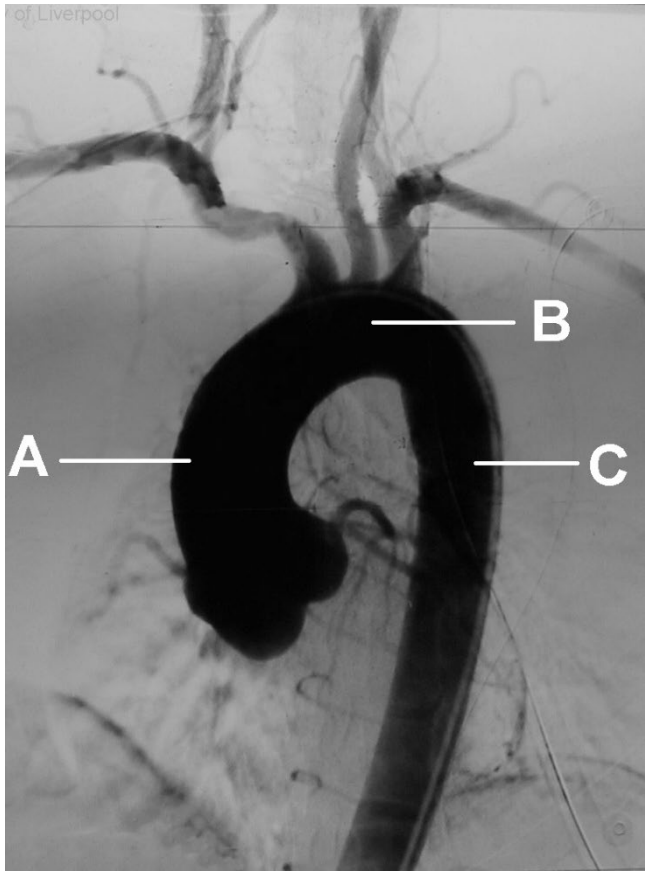
(5) the origins of the anterior and middle cerebral arteries.



Risk Factors…



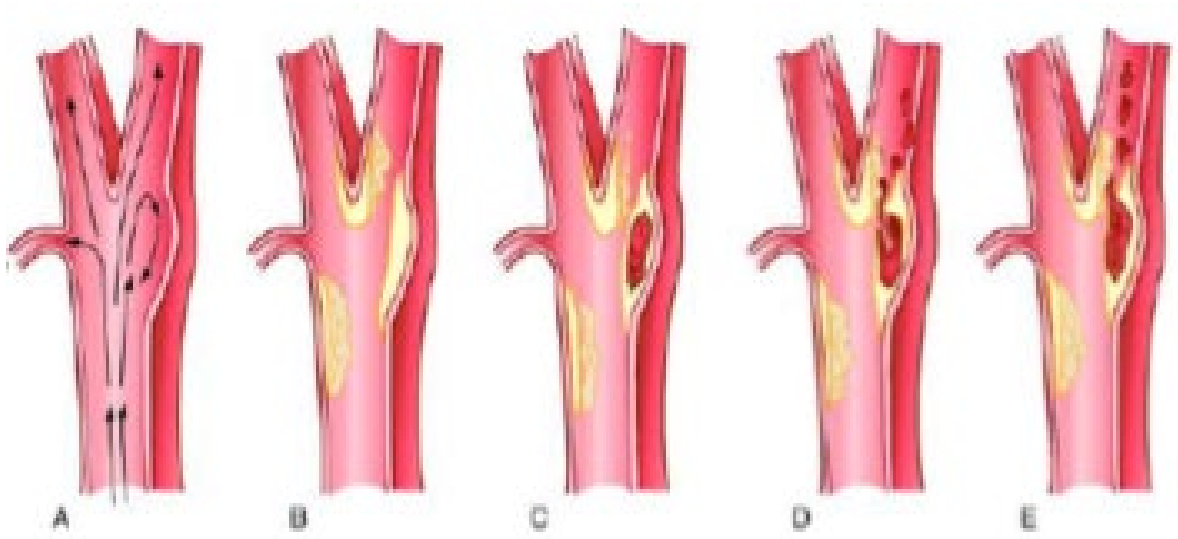
Carotid Anatomy



Carotid Artery Disease

Degree / Progression of atherosclerotic stenosis

Plaque Quality (stable vs unstable)



PLAQUE DEBRIS EMBOLIZATION

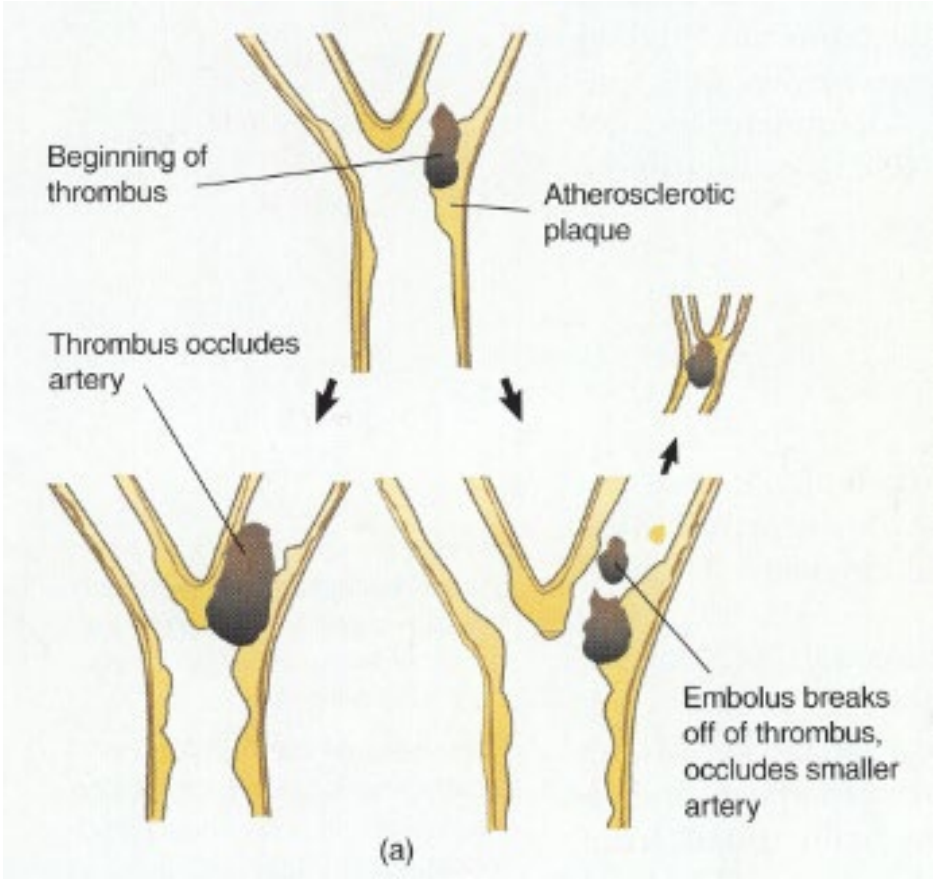
HYPOPERFUSION

TIA / STROKE

Carotid Artery Disease - Embolization

The primary mechanism responsible for episodes of TIA/STROKE is **cerebral emboli** originating from the plaque surface **:**

Atheromatous debris
Platelet aggregates
Thrombus



Carotid Artery Disease – Unstable Plaque

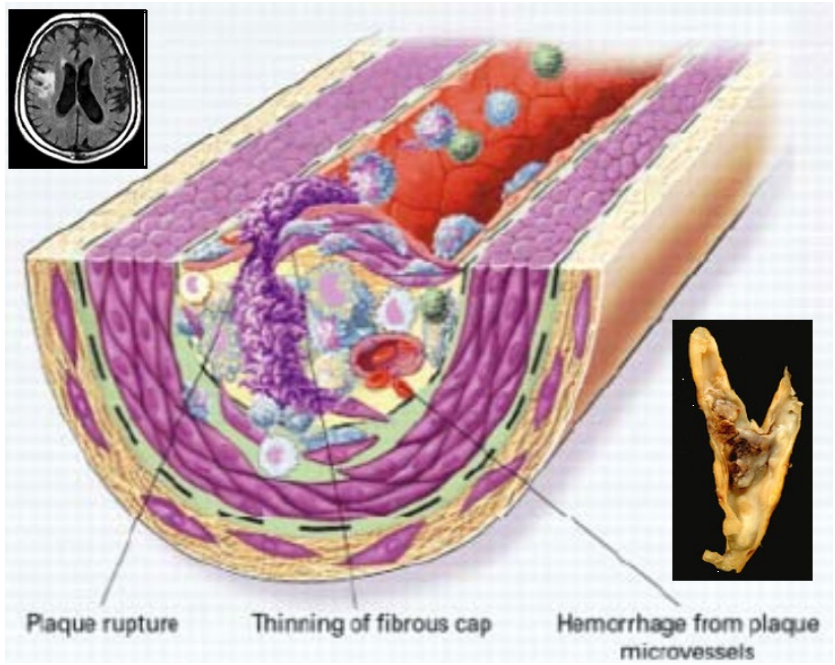
Thin or ruptured fibrous cap

Larger lipid rich or necrotic core

Intraplaque Hemorrhage

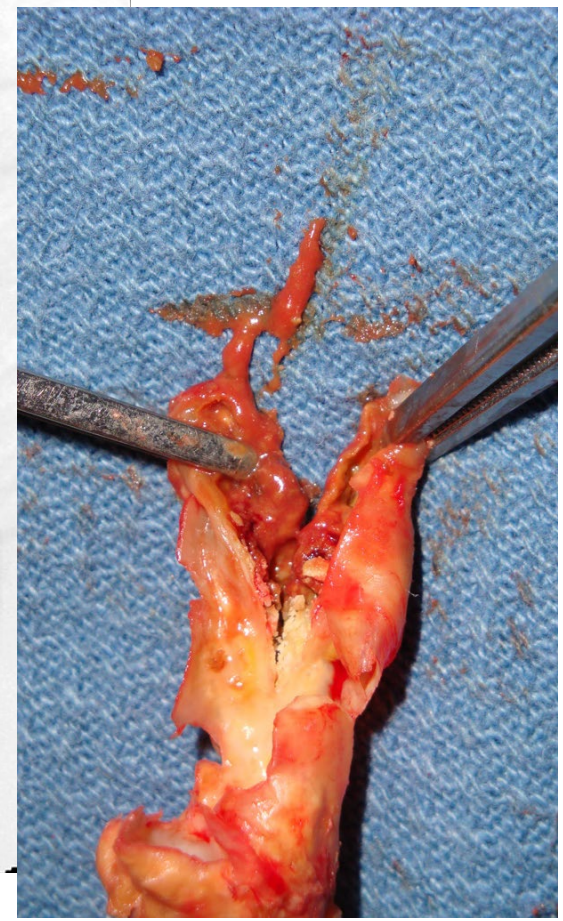
Greater maximal wall thickness

Higher MMP-9 levels and CRP



Stable plaques are unlikely to result in TIA or stroke

Unstable Plaque are mainly associated with these events

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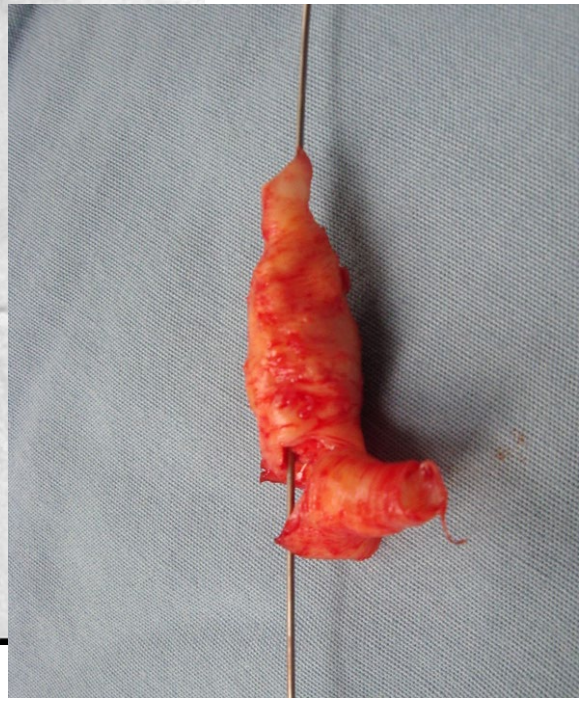
TITUTE



Carotid Artery Disease – Hypoperfusion

High grade stenosis prevents adequate brain supply particularly in pts with **multivessel** disease

Autoregulatory mechanism may fail during episodes of hypotension => syncope or near syncope

Carotid Artery Disease – Presentation

- Symptomatic CAD (TIA/Stroke)
- Asymptomatic

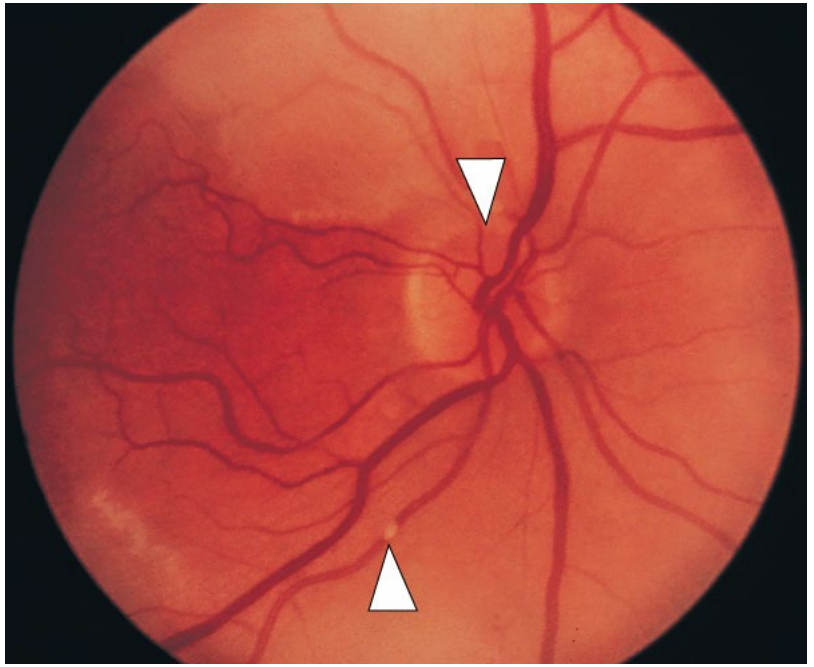
Symptomatic Carotid Artery Disease

ICA Territory - Opthalmic Artery

Amaurosis fugax

Transient monocular visual changes 3–5 min:

- Blindness
- Blurry or foggy vision
- Blind spots, colors, shapes
- Tunnel vision
- In only 10–15%, curtain-like blindness ascending or descending throughout visual field
- Rarely headaches



Symptomatic Carotid Artery Disease

ICA Territory - Middle Cerebral Artery

Symptoms:

Difficulties in comprehension or language production

Difficulties performing motor tasks or calculations

Incoordination

Numbness/tingling on one side of body

Weakness in arm and leg

Signs:

Aphasia

Head and eye deviation to lesion

Apraxia

Neglect

Anosognosia

Contralateral sensory deficit

Contralateral paresis

Confusional states

Symptomatic Carotid Artery Disease

ICA Territory - Anterior Cerebral Artery

Symptoms:

Numbness/tingling on one side of body

Weakness of leg > arm

Difficulties walking

Signs :

Contralateral sensory deficit

Contralateral paresis

Apathy

Mutism

Reduced spontaneity

Gait apraxia

Urinary incontinence

Symptomatic Carotid Artery Disease

Posterior Circulation - Uncommon

Infarct involves :

Mesencephalon

Thalamus

Occipital

Temporal

Homonymous visual field cut

Cortical blindness results from Bilateral occipital infarcts

Loss of reading (alexia)

Prosopagnosia

Changes in color perception

Confusional states

Amnesia

Visual hallucinations

Symptomatic Carotid Artery Disease

Which Carotid Stenosis is considered Clinically Significant?

Is the risk of intervention lower than the anticipated risks of the natural history?

When to intervene
(Carotid Endarterectomy or Carotid Stenting)?

ECST & NASCET

ECST	surgical risk (%)	medical risk (%)	ARR (%)	RRR (%)	NNT (%)	CVA prevent /1000 CEAs
<30%	9.8 at 5y	3.9 at 5y	-5.9			
30-49%	10.2 at 5y	8.2 at 5y	-2.0			
50-69%	15.0 at 5y	12.1 at 5y	-2.9			
70-99%	10.5 at 5y	19.0 at 5y	+8.5	45	12	83 at 5y

NASCET	surgical risk (%)	medical risk (%)	ARR (%)	RRR (%)	NNT (%)	CVA prevent /1000 CEAs
30-49%	14.9 at 5y	18.7 at 5y	+3.8			
50-69%	15.7 at 3y	22.2 at 3y	+6.5	29	15	67 at 3y
70-99%	8.9 at 3y	28.3 at 3y	+19.4	69	5	200 at 3y

ECST & NASCET

ECST	surgical risk (%)	medical risk (%)	ARR (%)	RRR (%)	NNT (%)	CVA prevent /1000 CEAs
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70-99%	8.9 at 3y	28.3 at 3y	+19.4	69	5	200 at 3y

ECST, NASCET & VA studies combined after standardisation to NASCET angiographic measurements *(n>6000)*

…any stroke at 5 years including operative risk

stenosis		CEA	BMT	ARR	NNT	strokes prev /1000 CEAs
<30%	*n=1746*	18.36%	15.71%	-2.6%	n/b	n/b
30-49%	*n=1054*	22.80%	25.50%	2.6%	38	26
50-69%	*n=2312*	20.00%	27.70%	7.8%	13	78
70-99%	*n=1344*	17.13%	32.70%	15.6%	6	156

Lancet 2004;363:915-924

Stroke 2004;35:2855-2861

Lancet 2003;361:107-116

Asymptomatic Carotid Artery Disease

Which Carotid Stenosis is considered Clinically Significant?

When to intervene
(Carotid Endarterectomy or Carotid Stenting) to prevent stroke?

Is the risk of intervention lower than the anticipated risks of the natural history?

ACAS + ACST findings

	5 year ANY stroke					
	Surgery	BMT	ARR	RRR	NNT	CVA/1000
ACAS *(n=1662)*	12.4%	17.5%	5.1%	29%	20	50
ACST *(n=3120)*	6.4%	11.8%	5.4%	46%	19	53

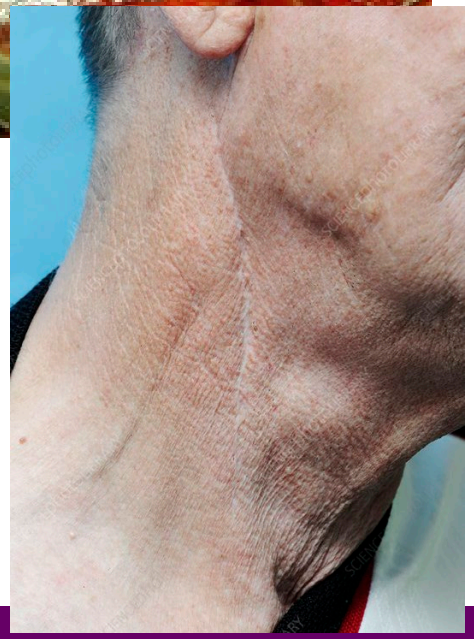
ACAS + ACST findings

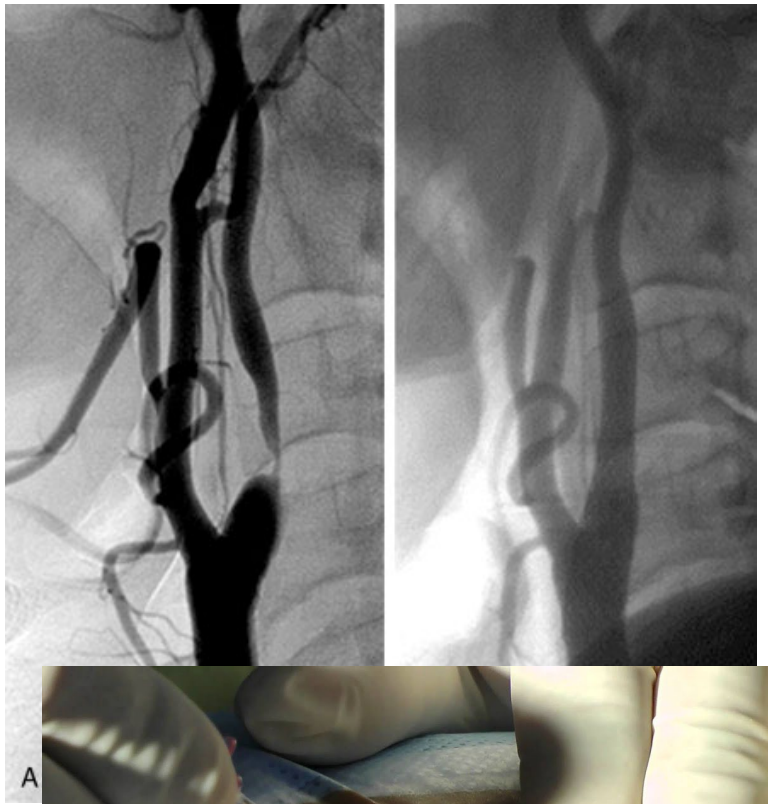
5 year ANY stroke

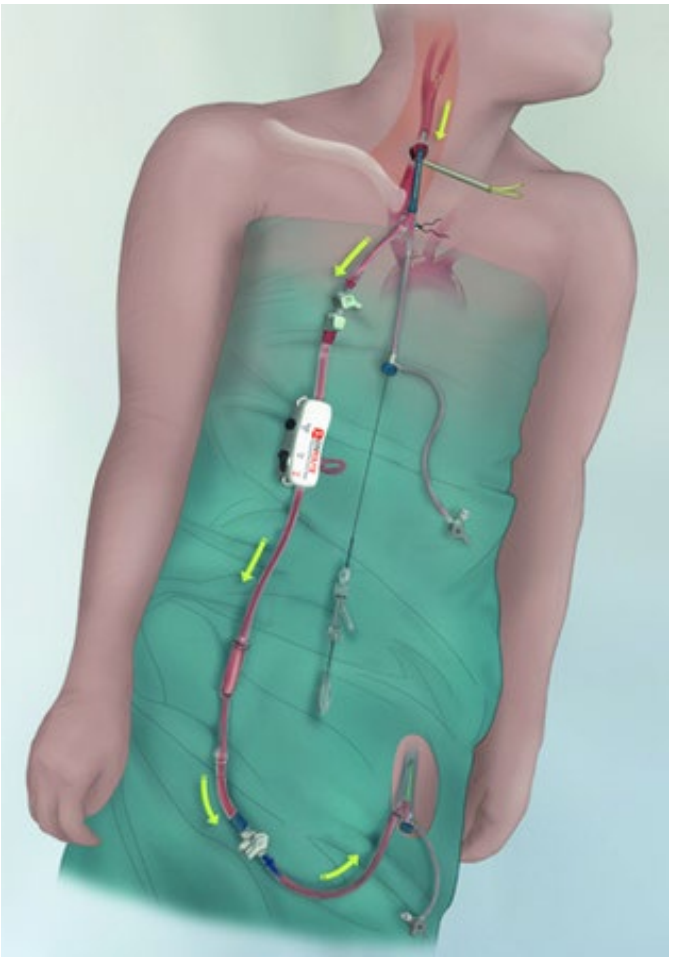
	Surgery	BMT	ARR	RRR	NNT	CVA/1000
ACAS *(n=1662)*	12.4%	17.5%	5.1%	29%	20	50
	↓ 48%	↓ 32%				
ACST *(n=3120)*	6.4%	11.8%	5.4%	46%	19	53

in the 9 yrs between ACAS publishing in 1995 & ACST in 2004

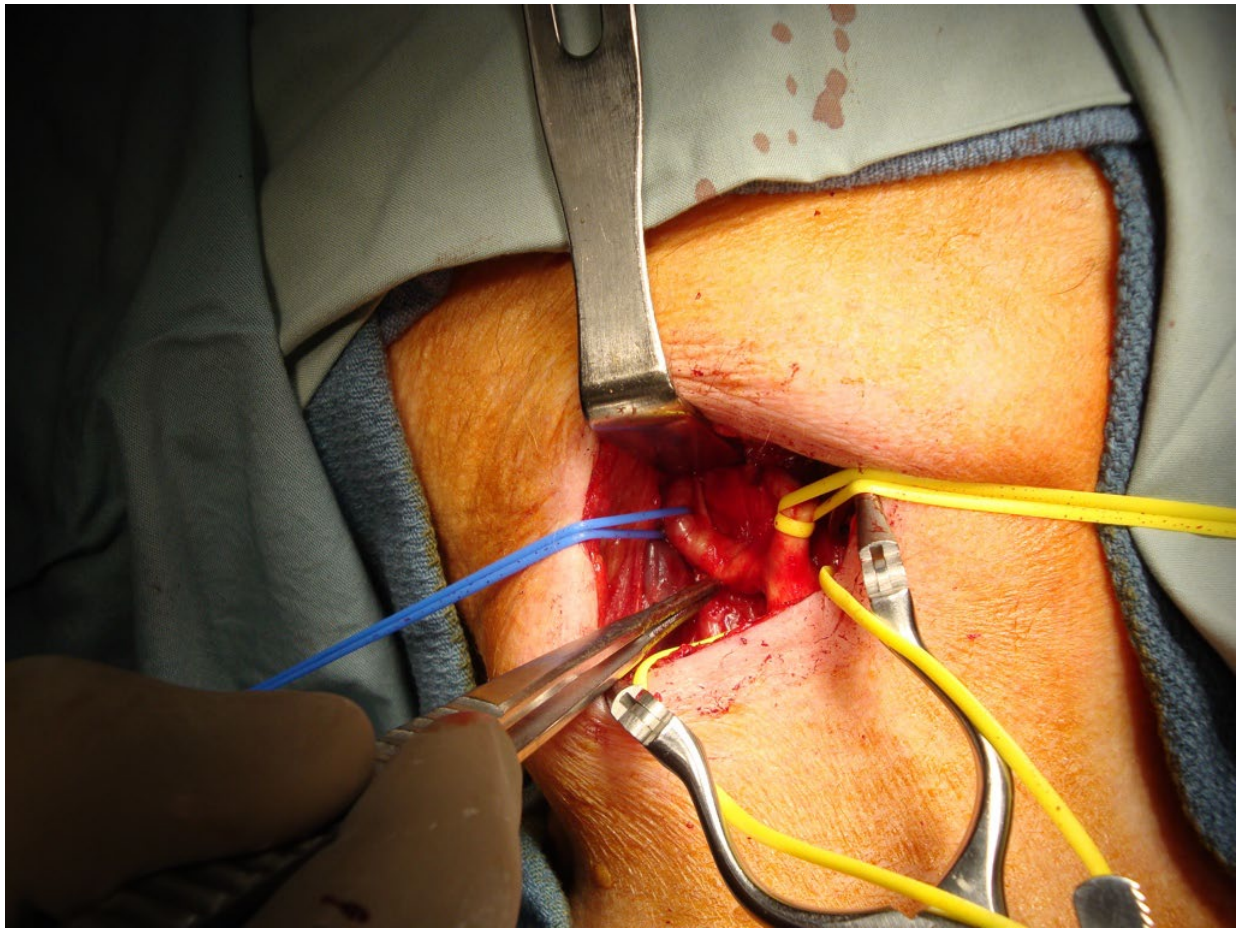
Carotid Interventions

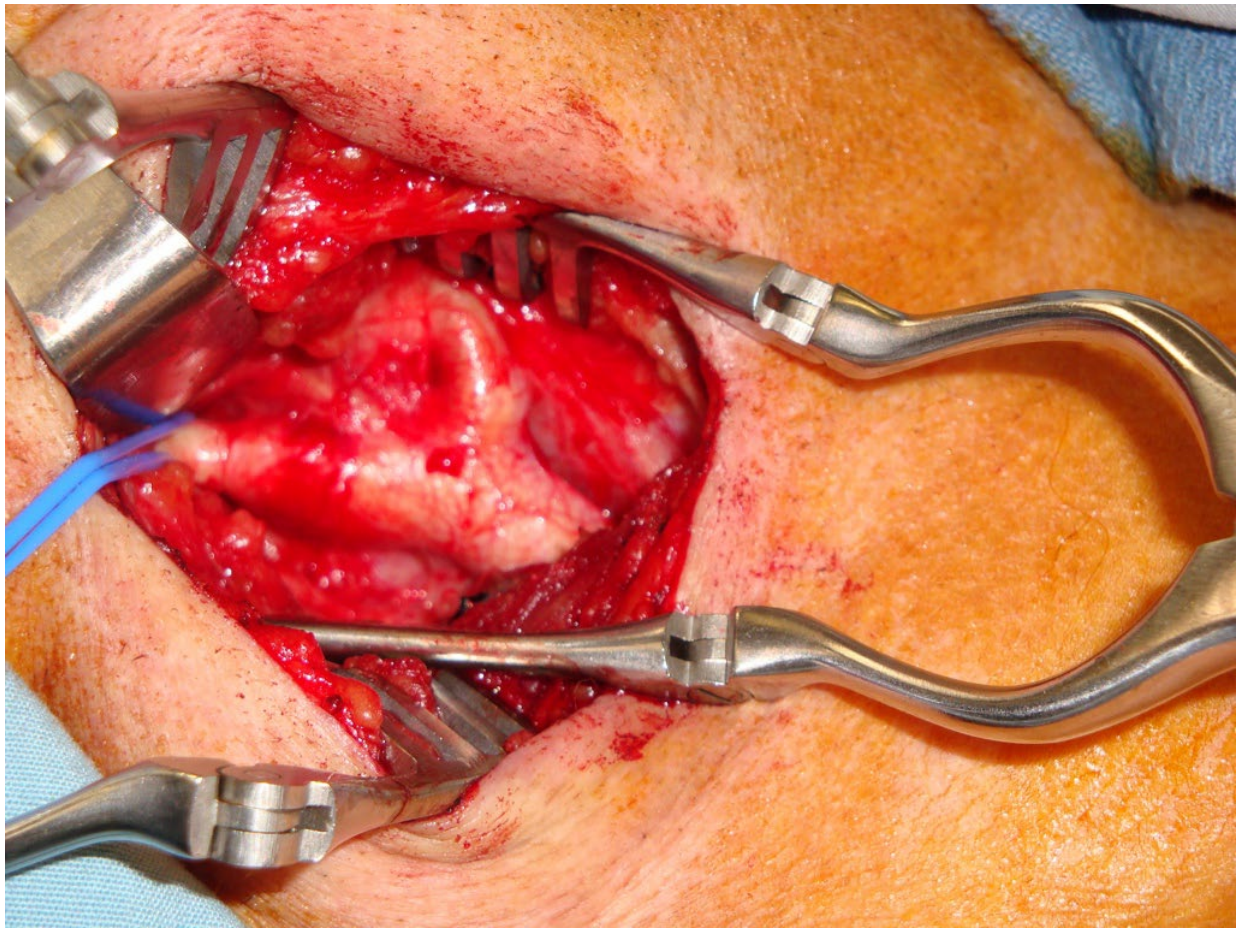




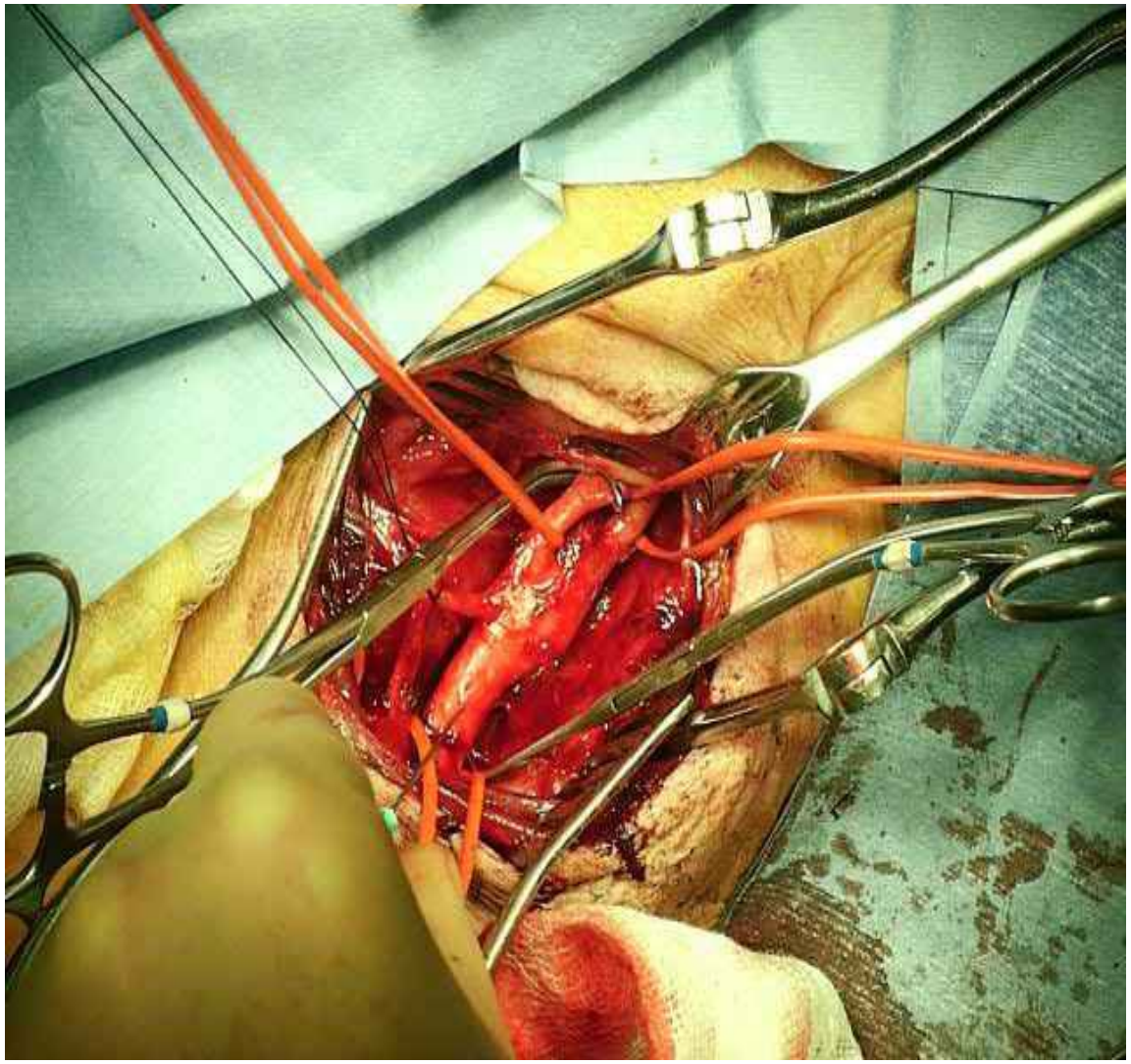


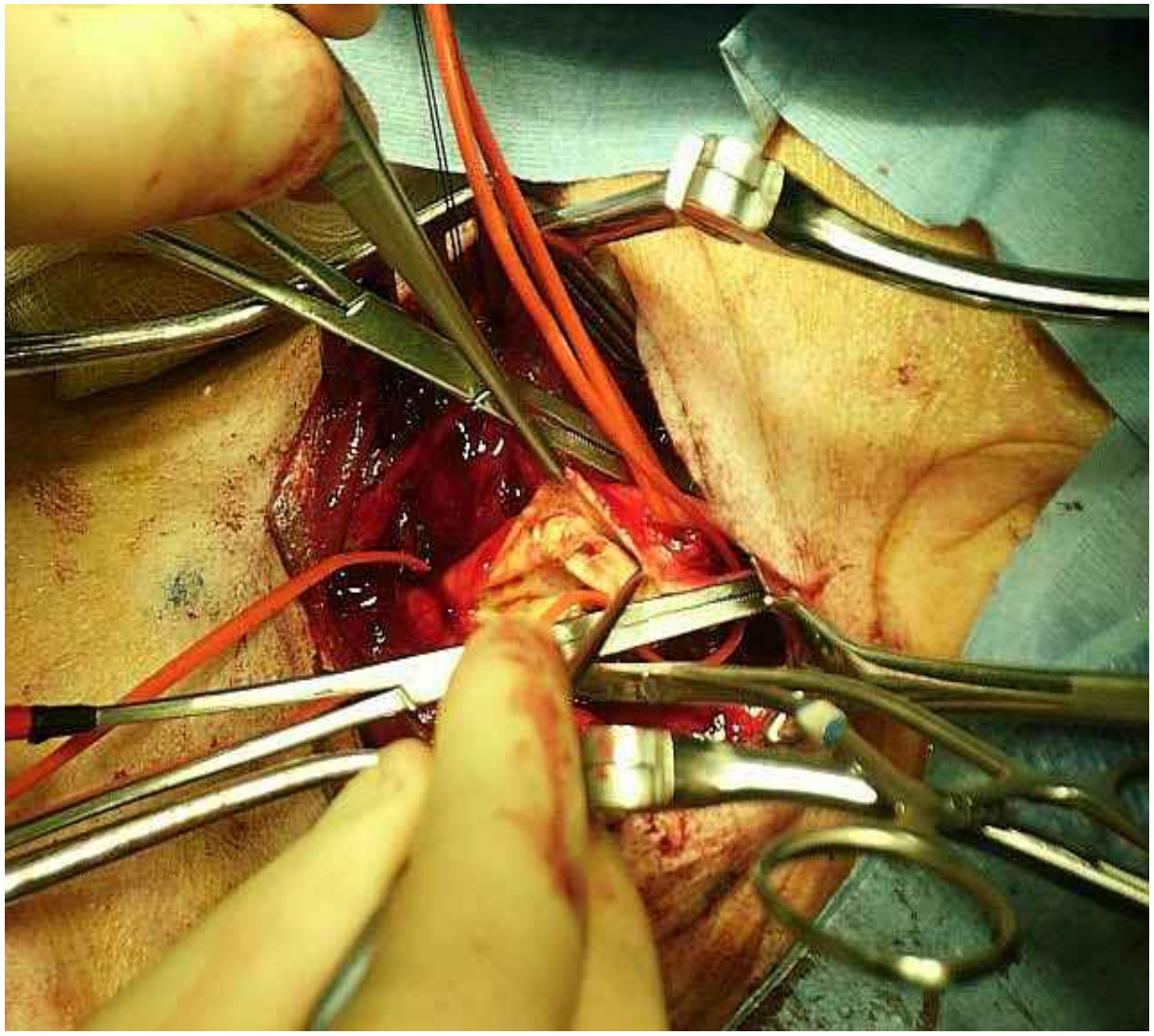
Carotid Endarterectomy



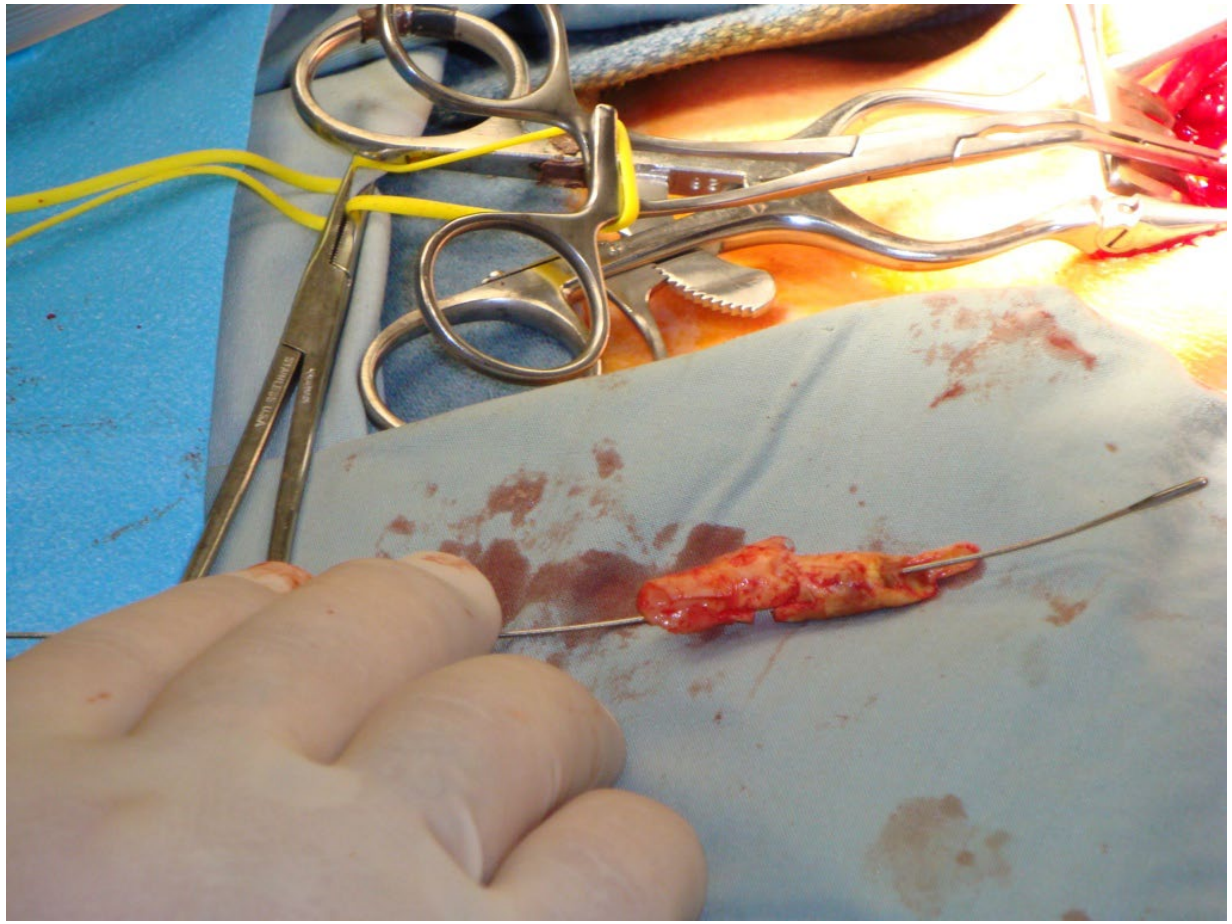


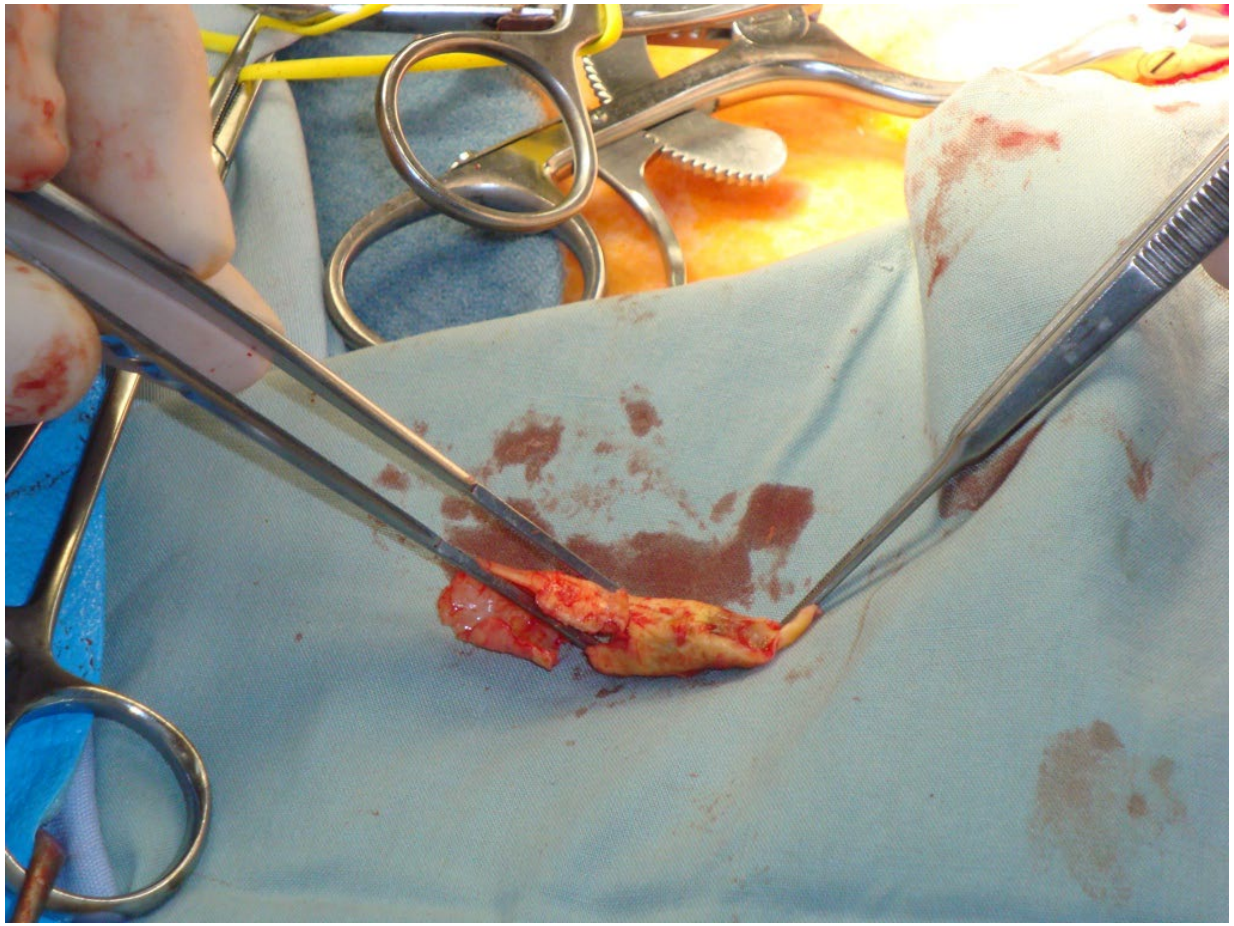
Carotid Endarterectomy



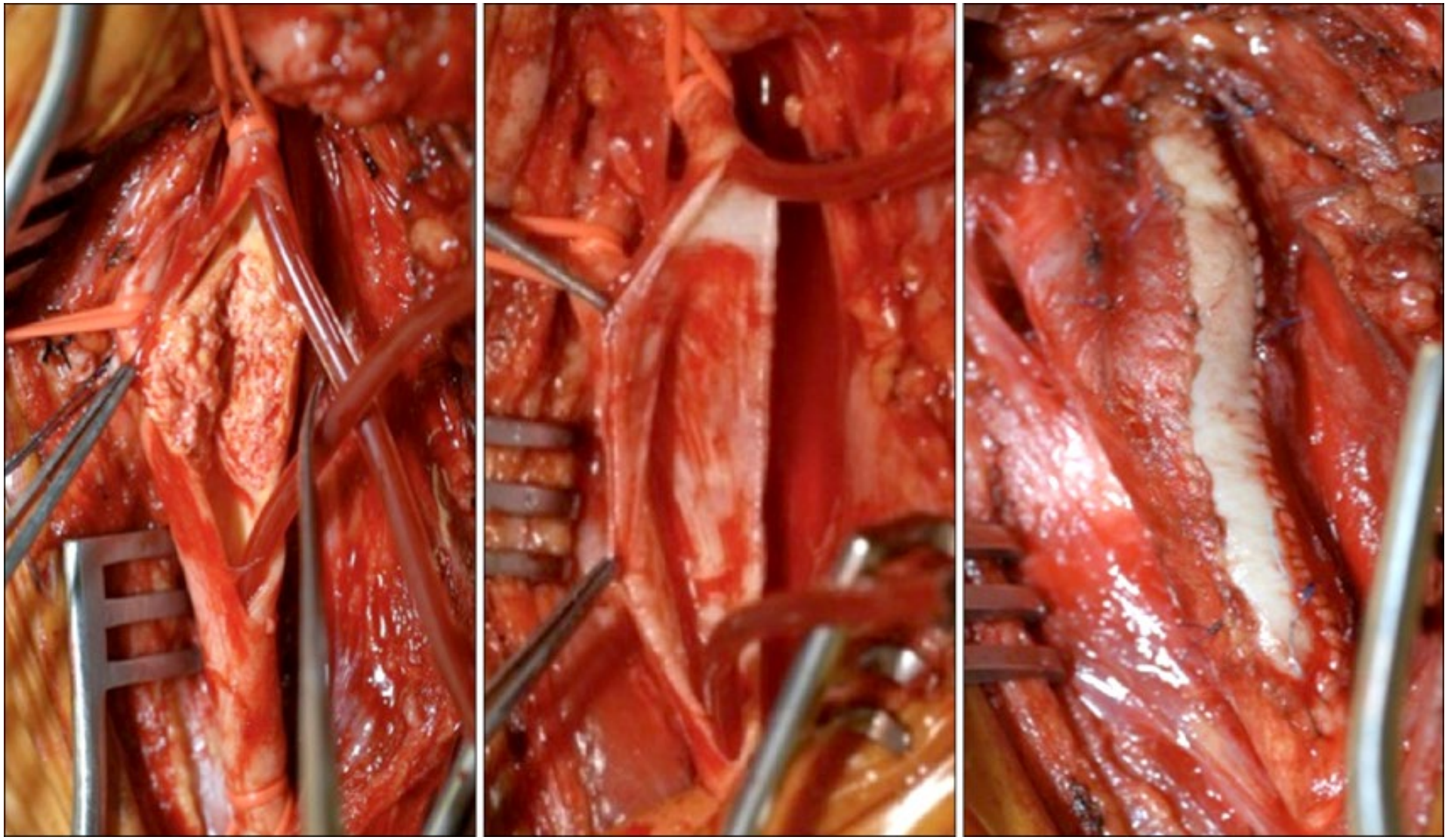


Carotid Endarterectomy





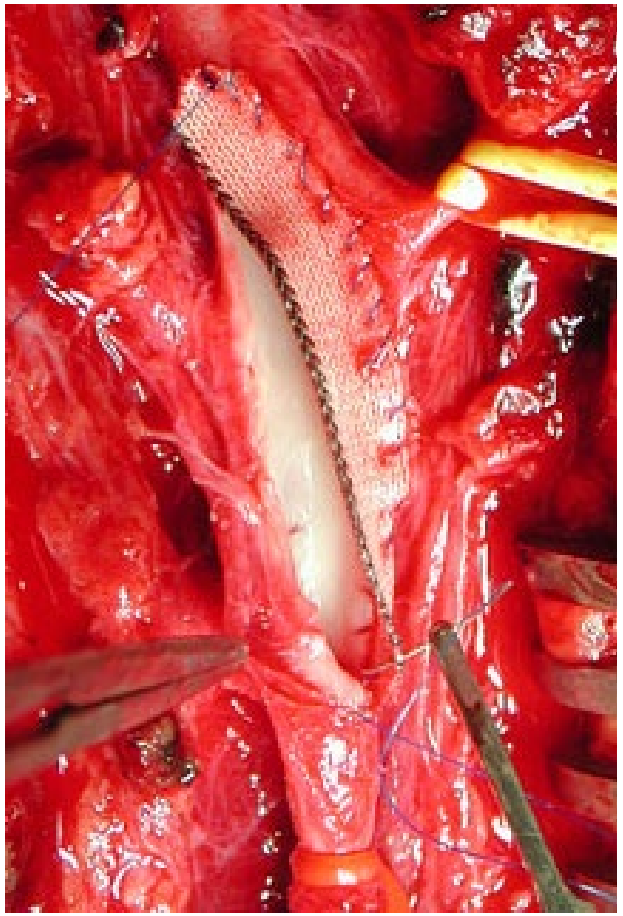
Carotid Endarterectomy



Carotid Endarterectomy – Closure Techniques

Primary Closure

Patch Closure



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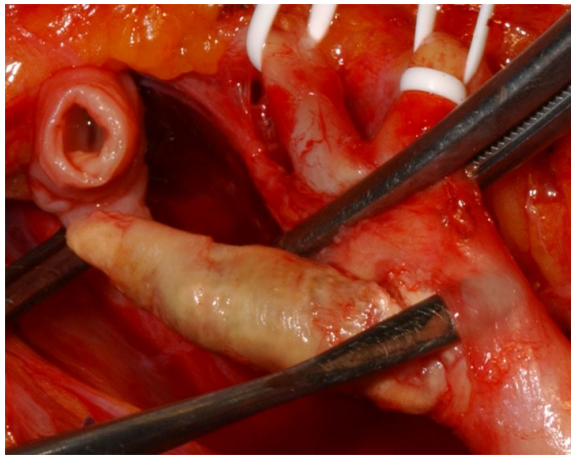
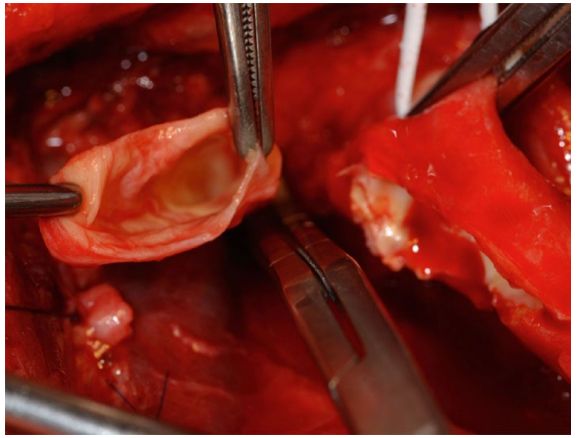
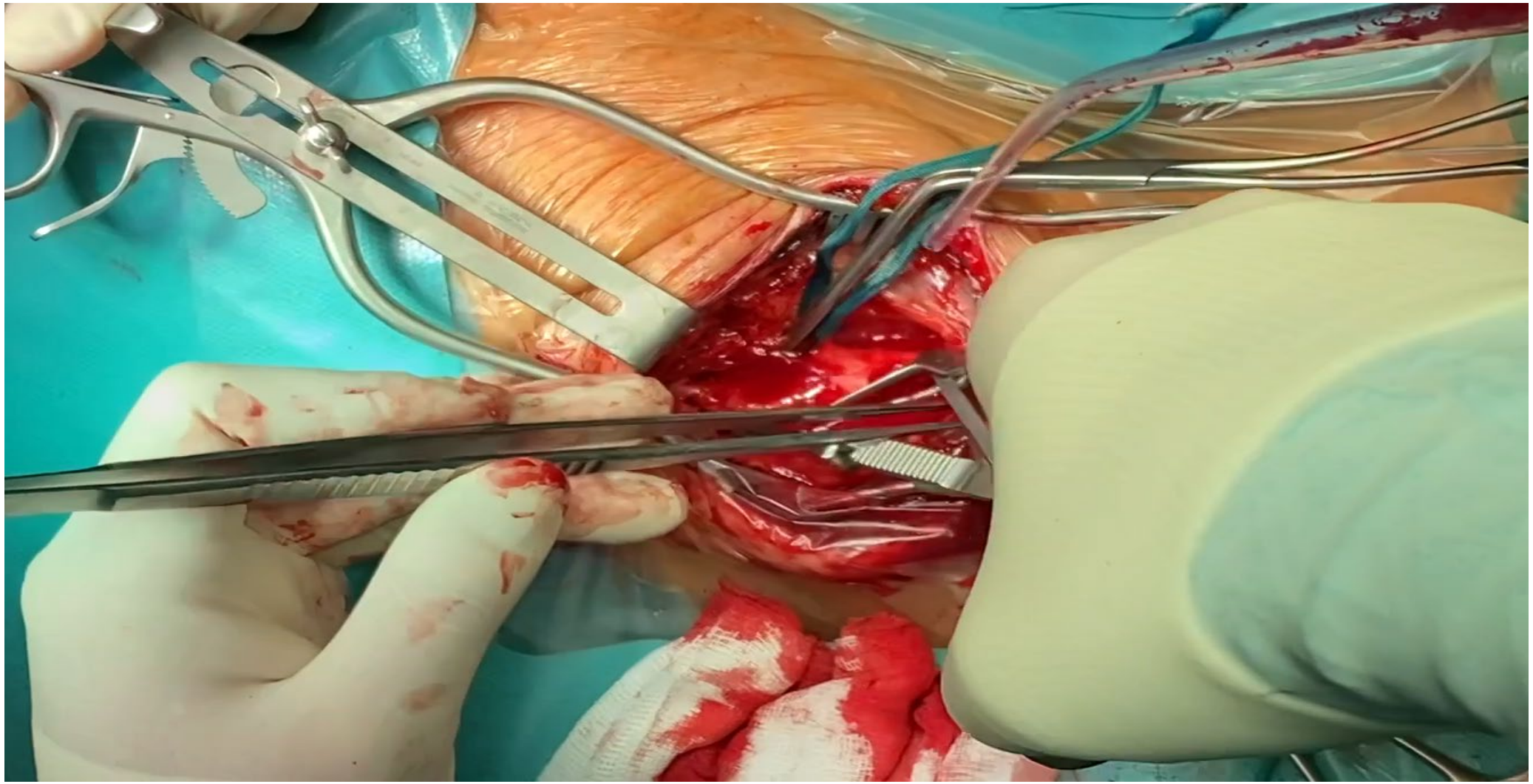
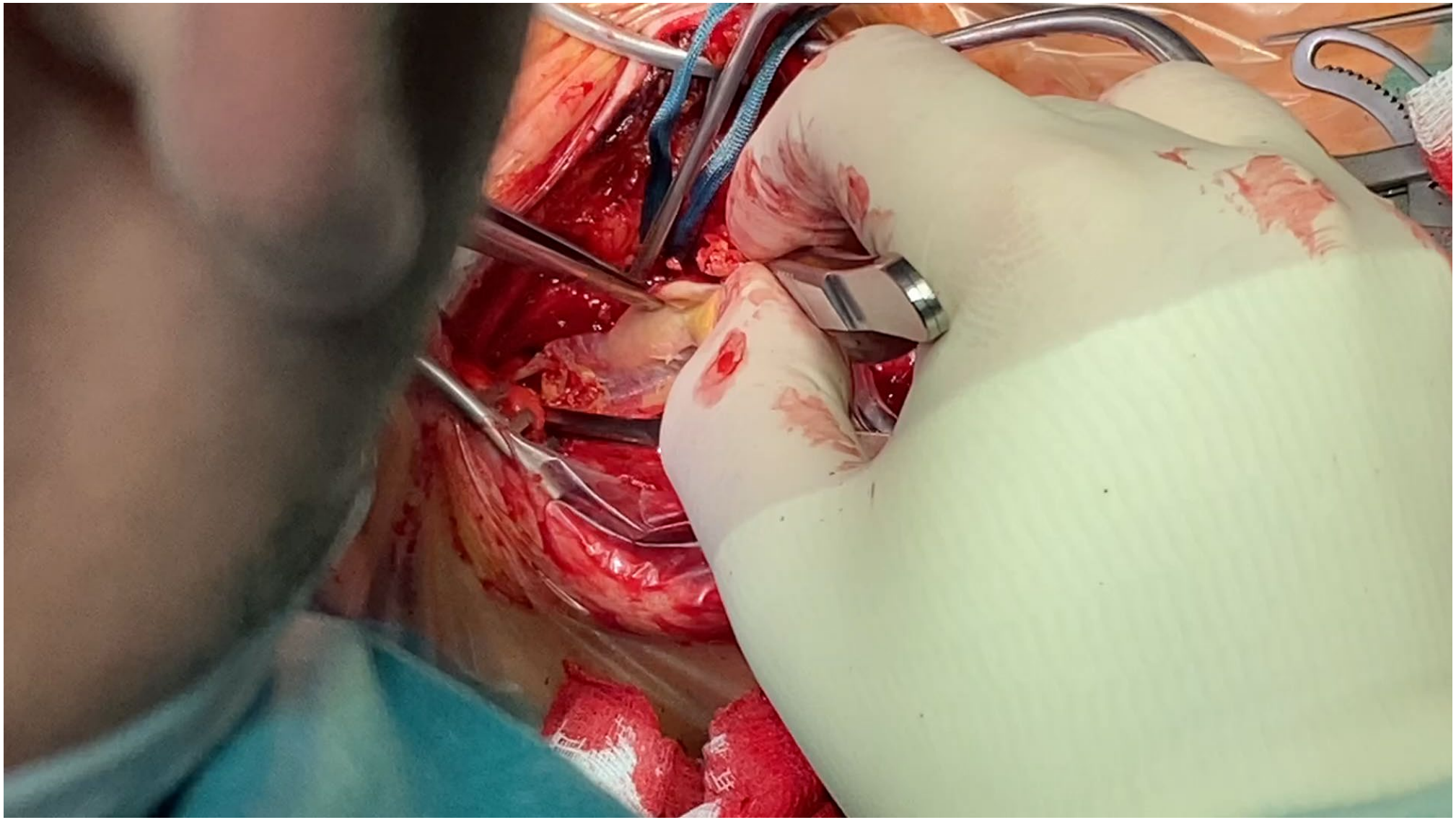


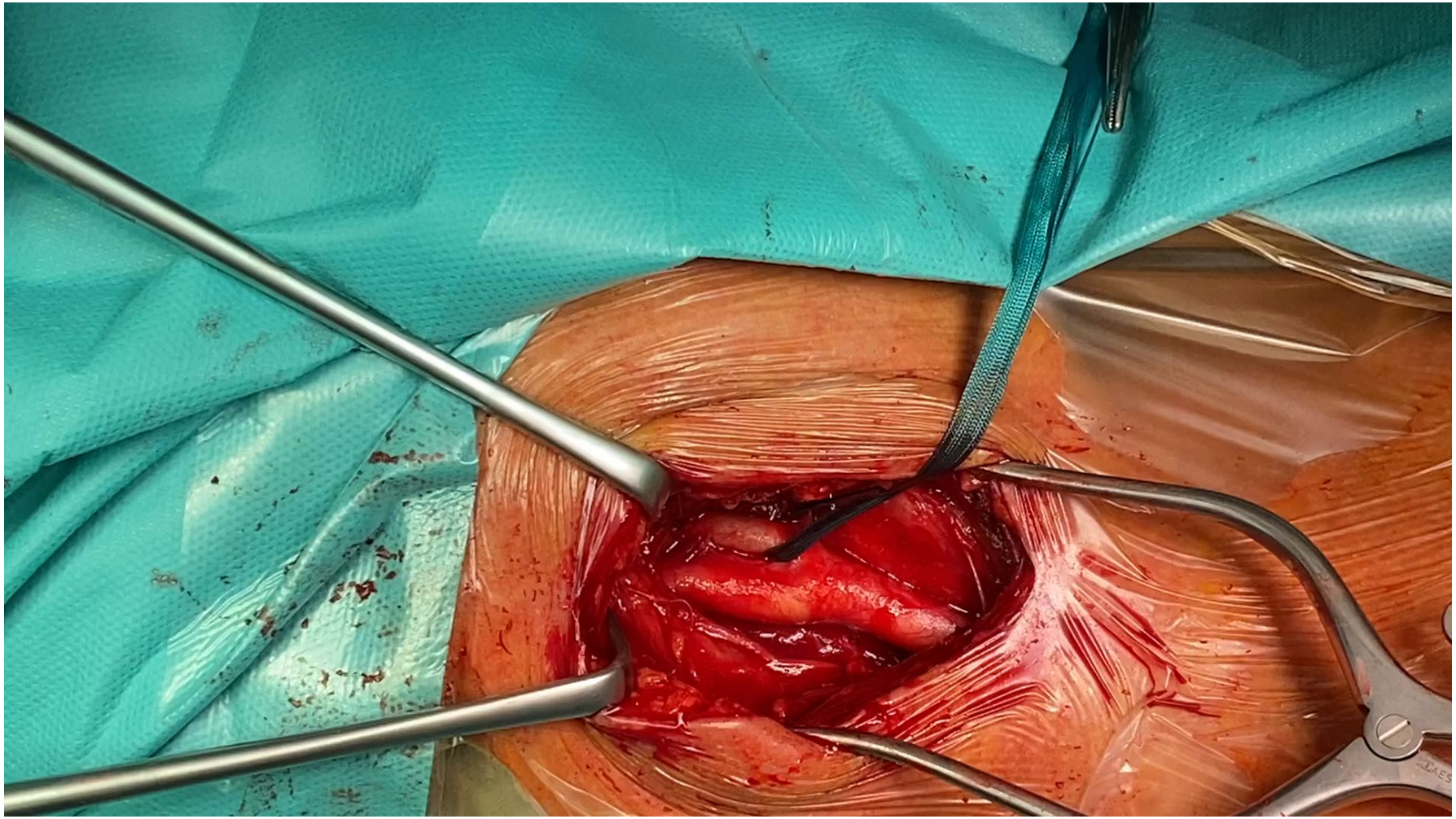


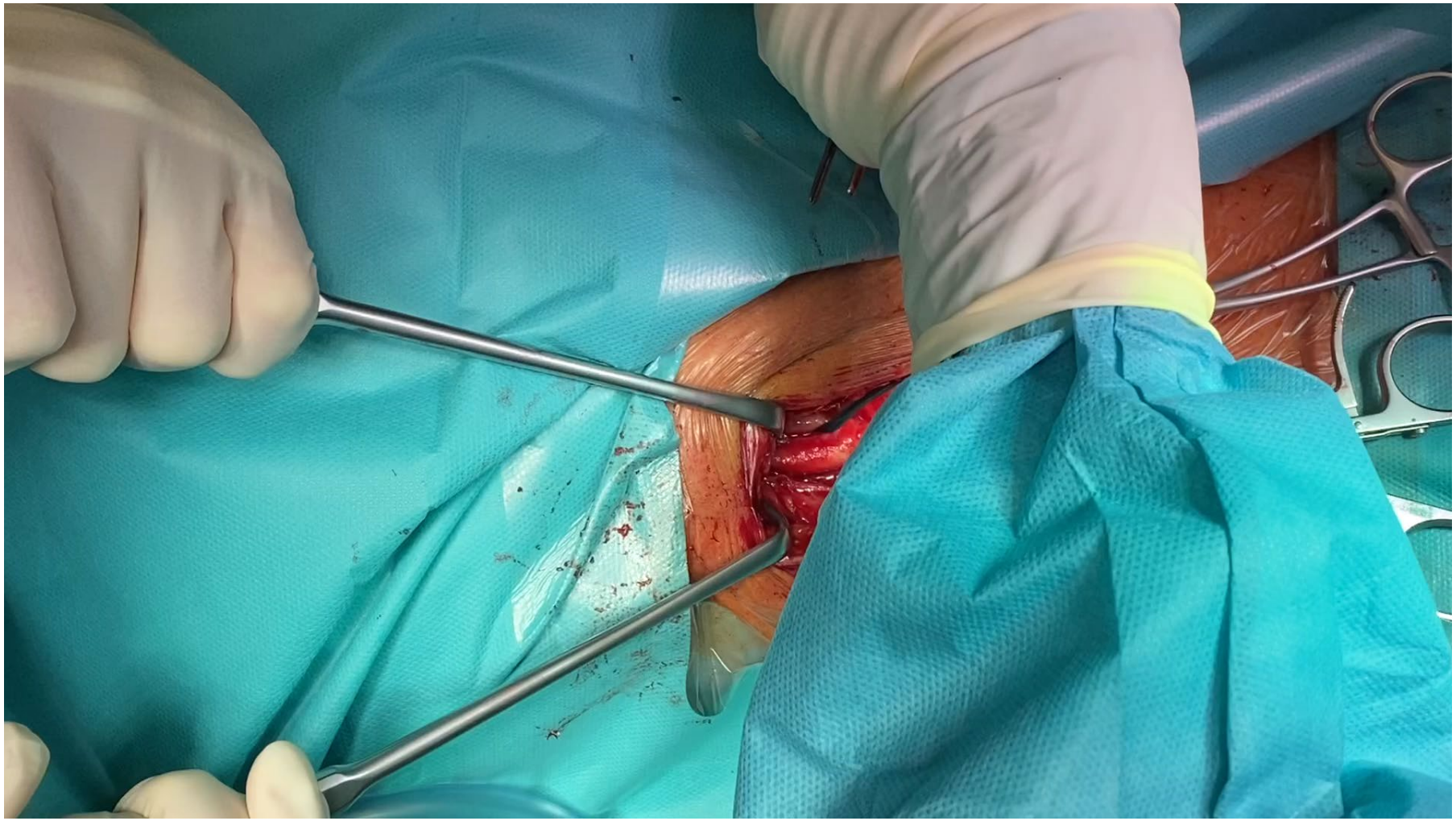
CEA

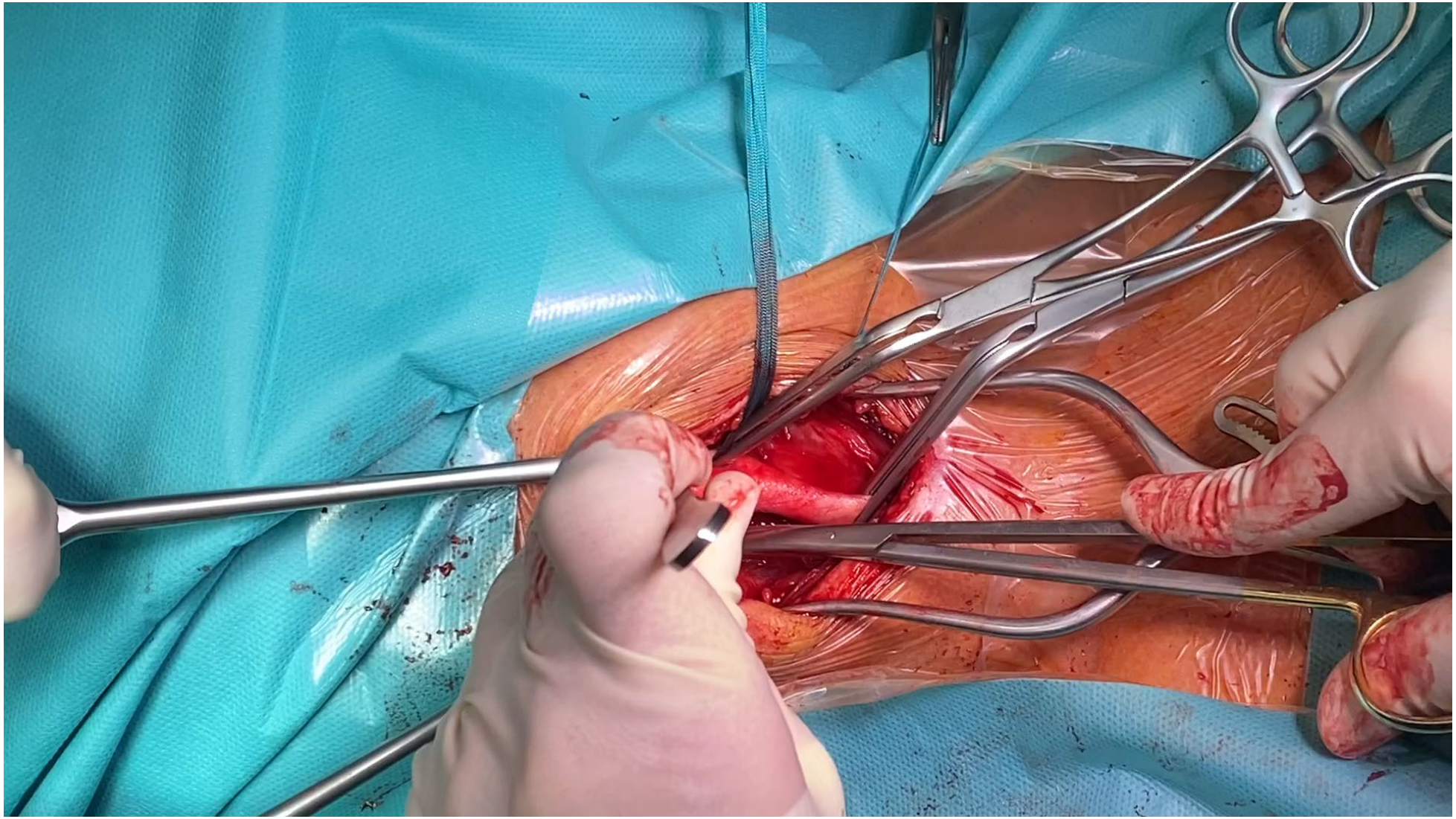


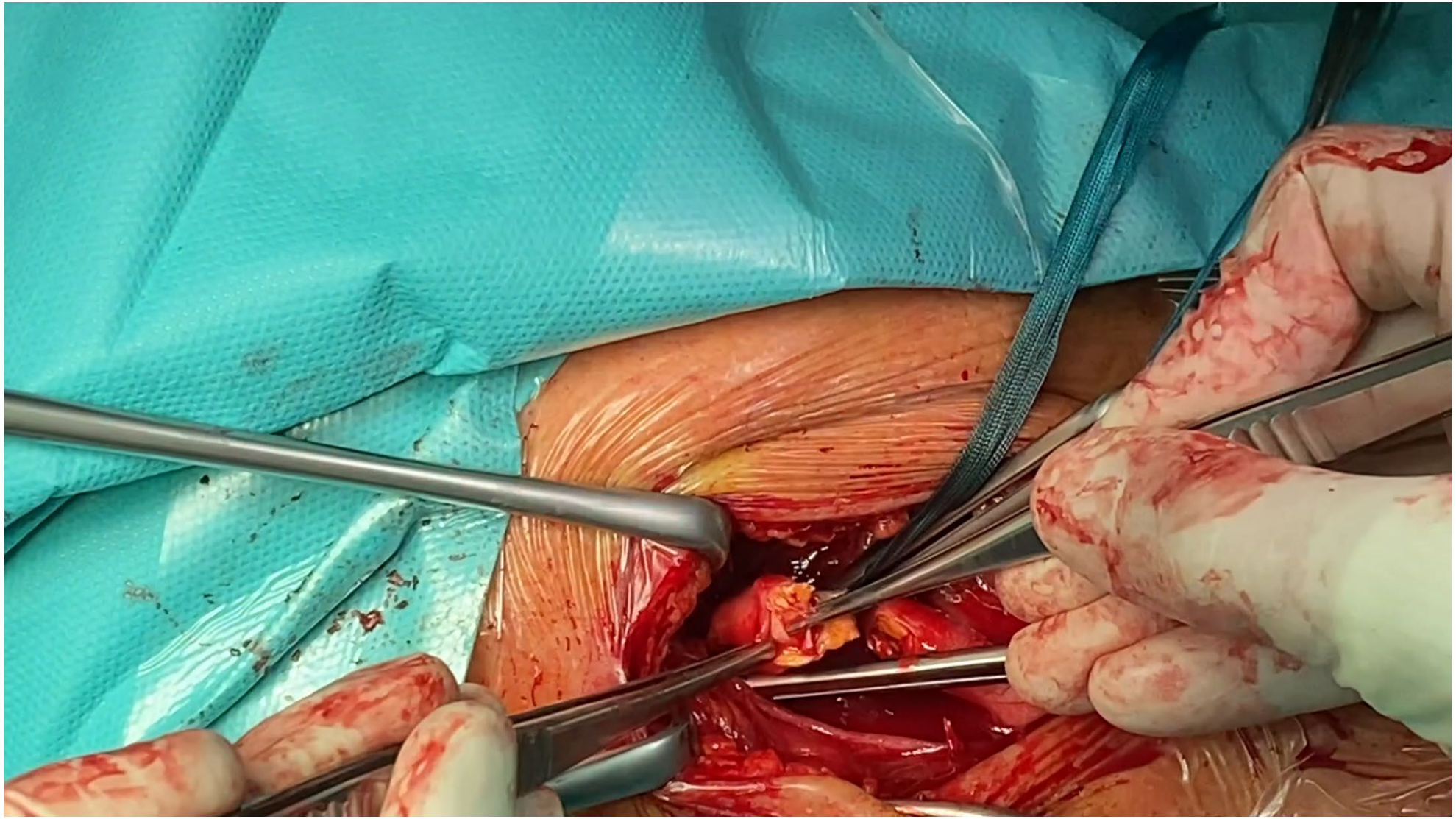


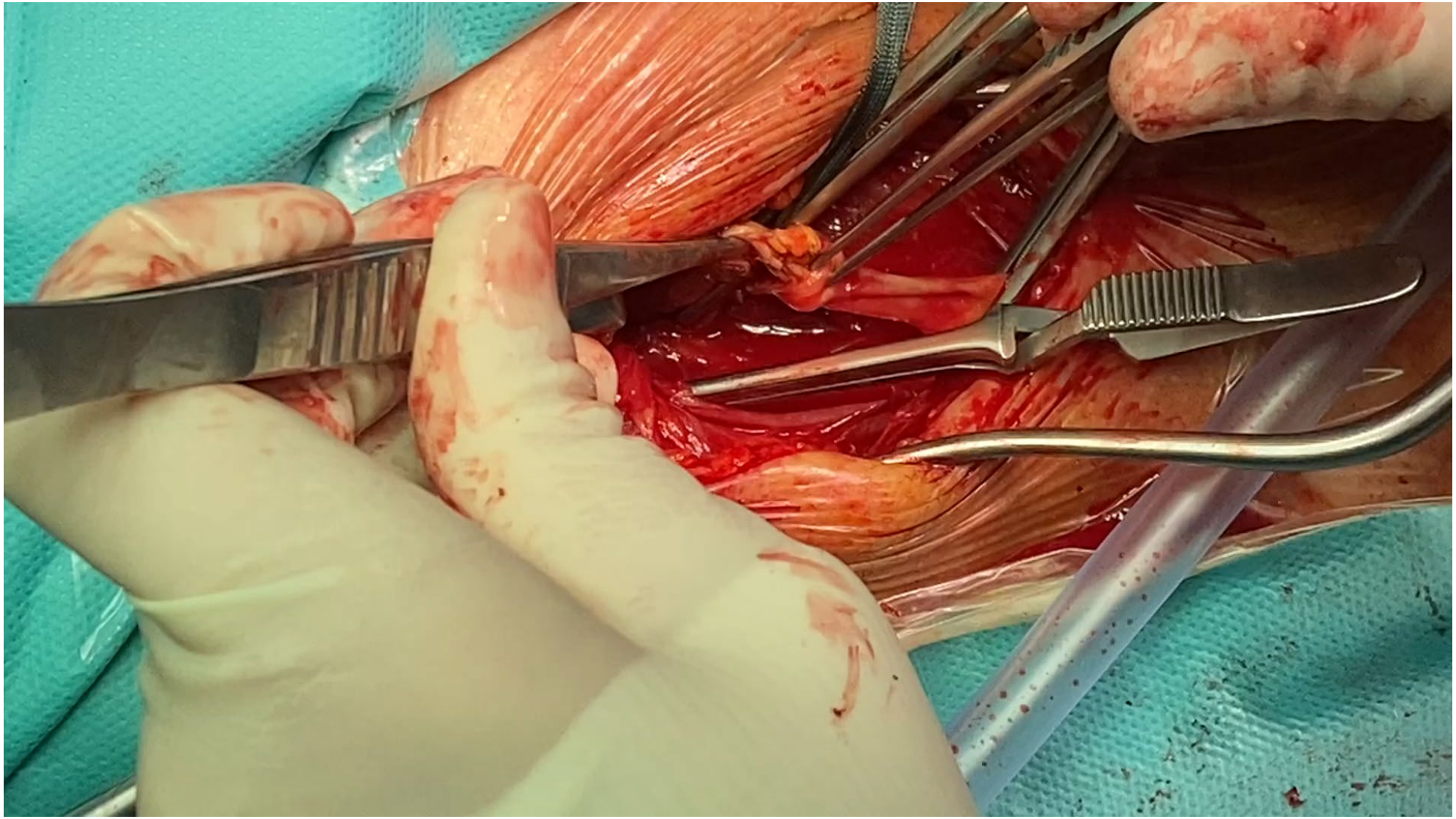
EVERSION

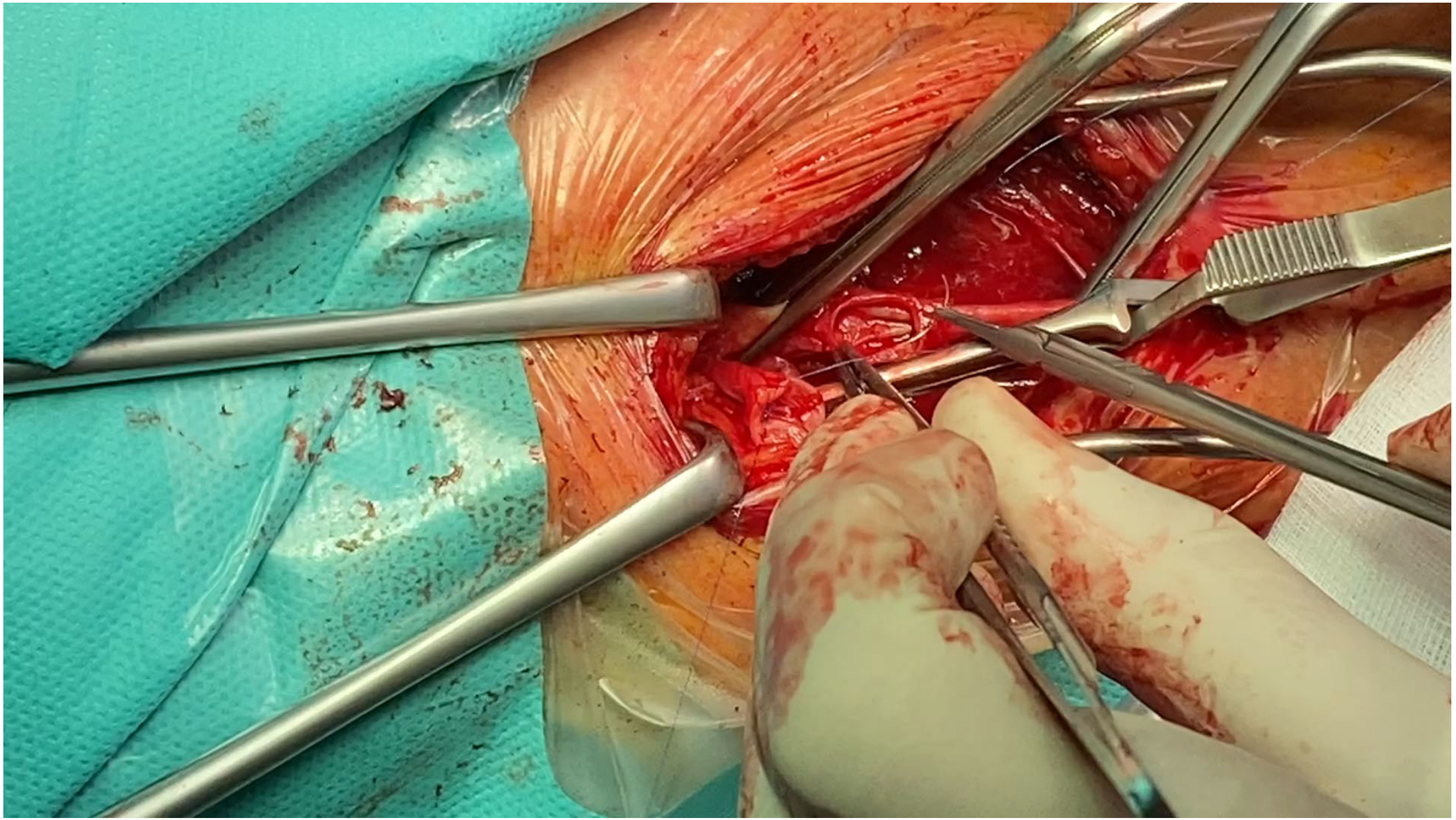


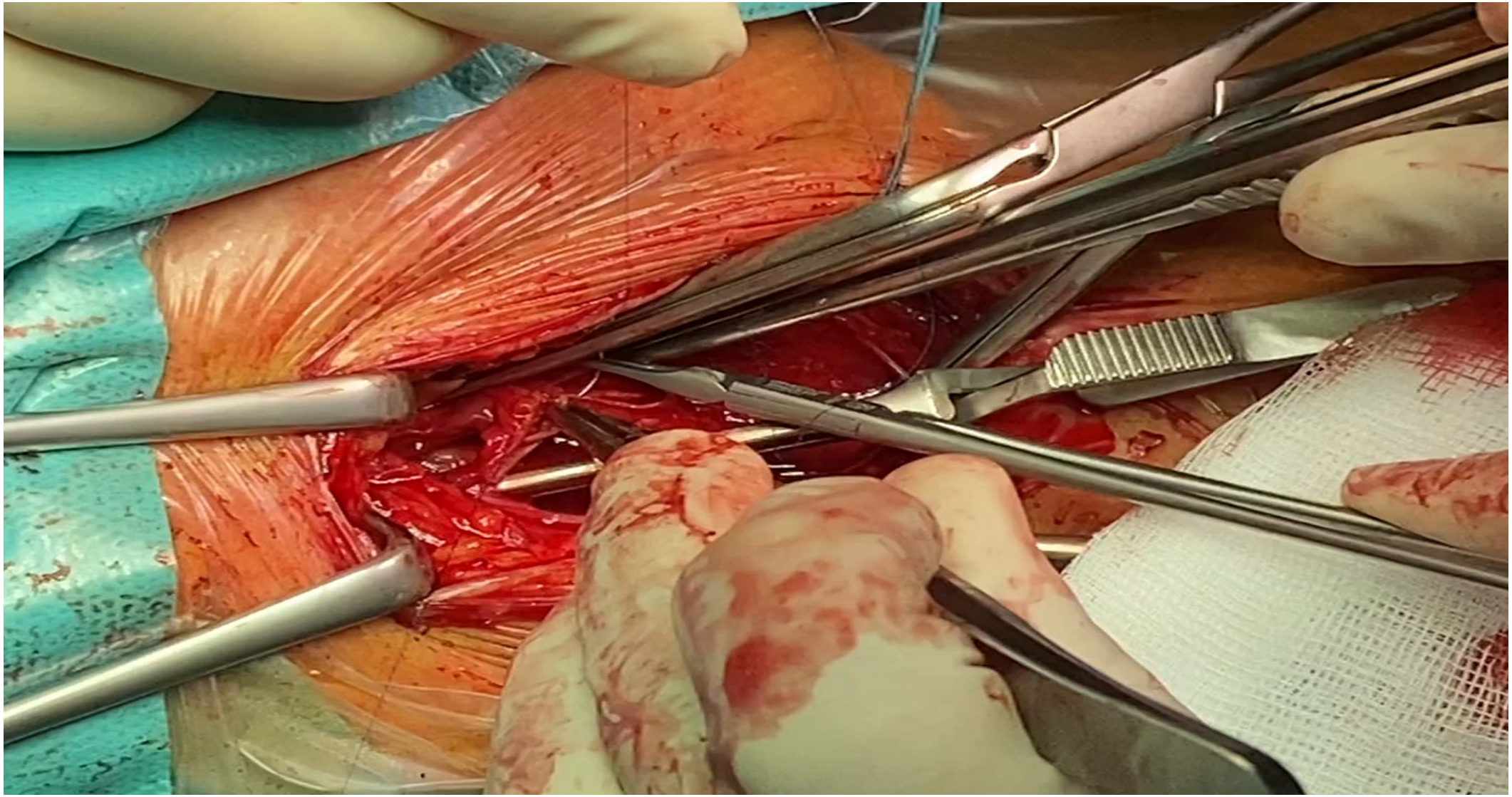


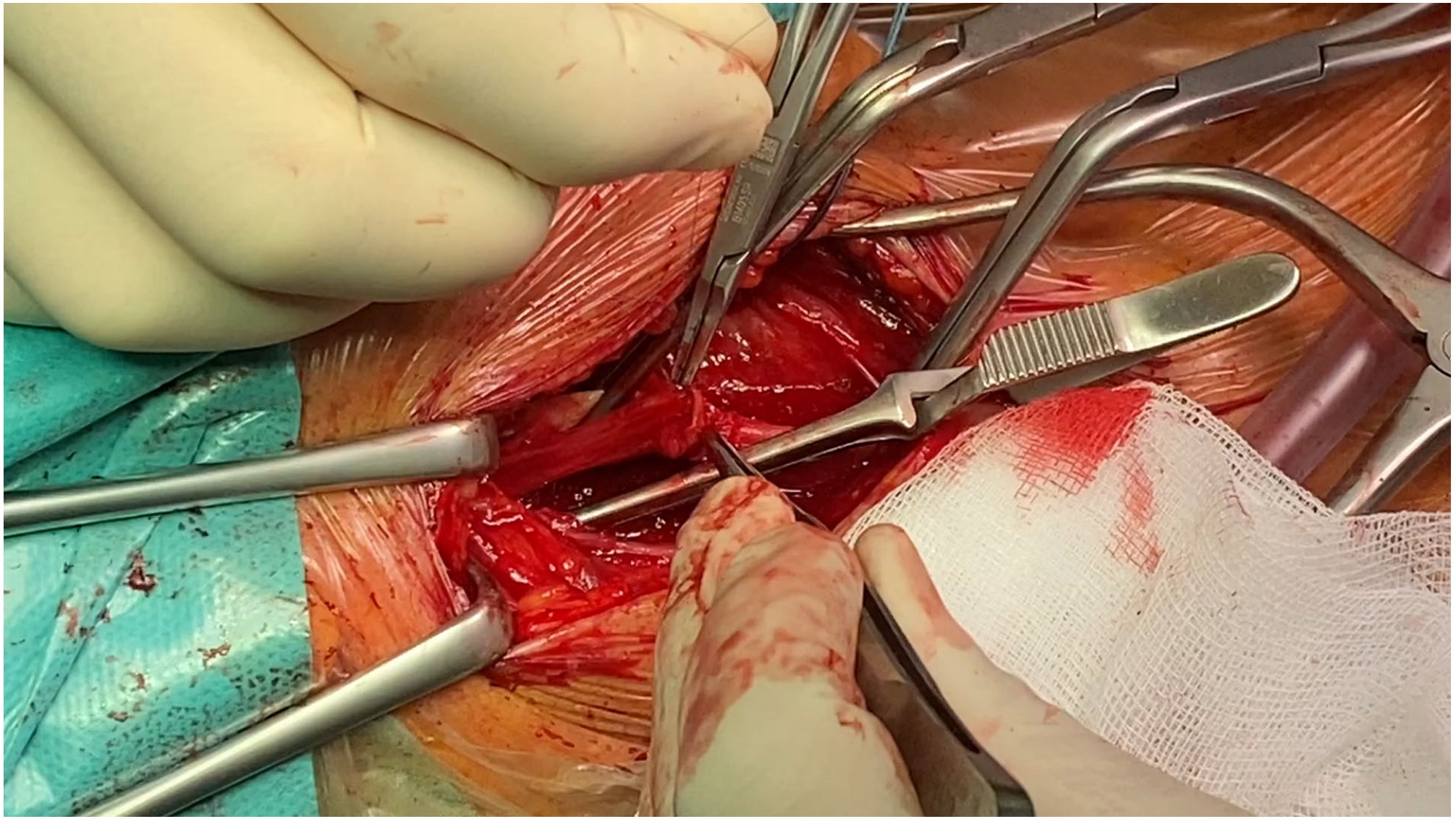


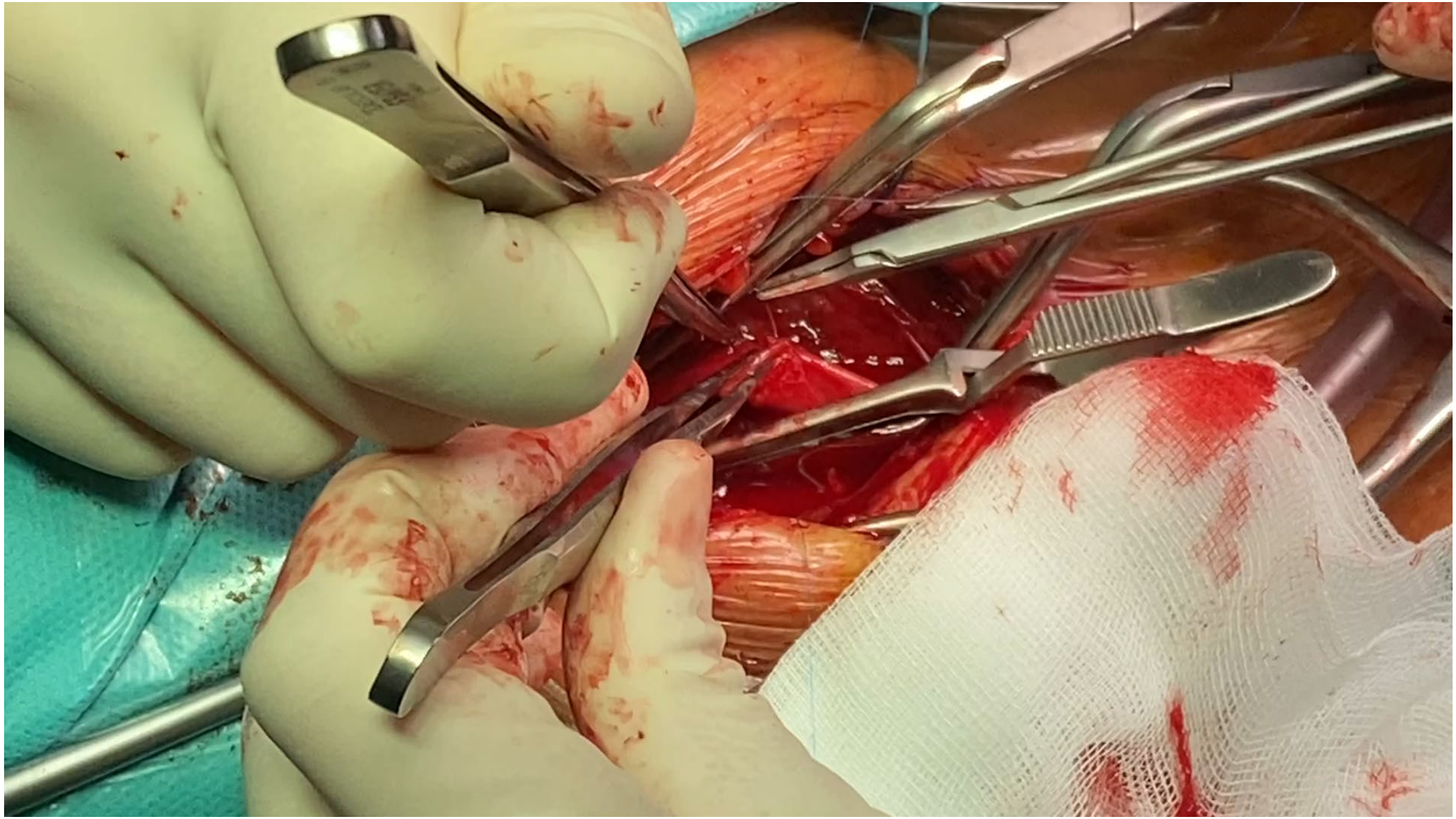


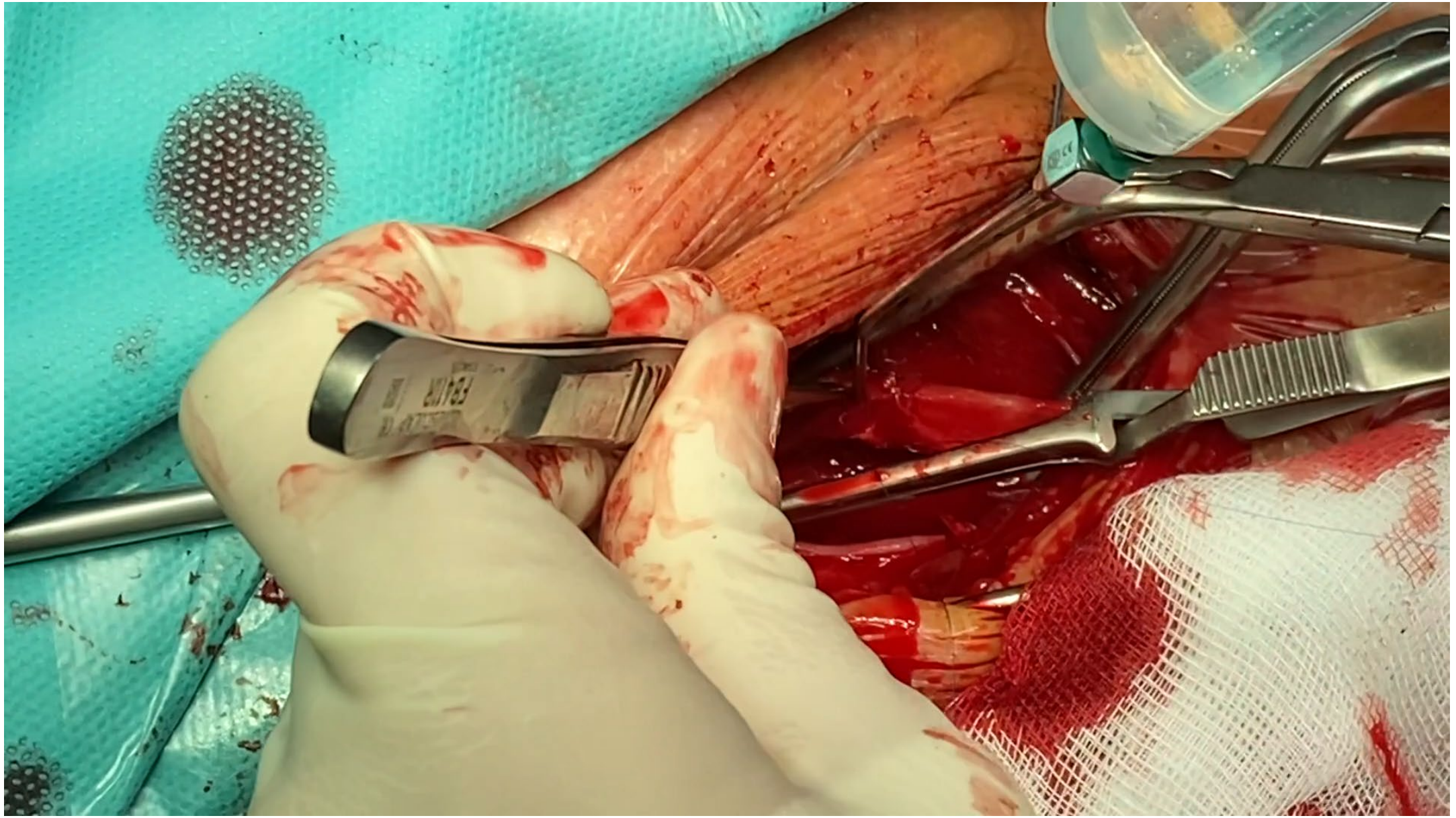


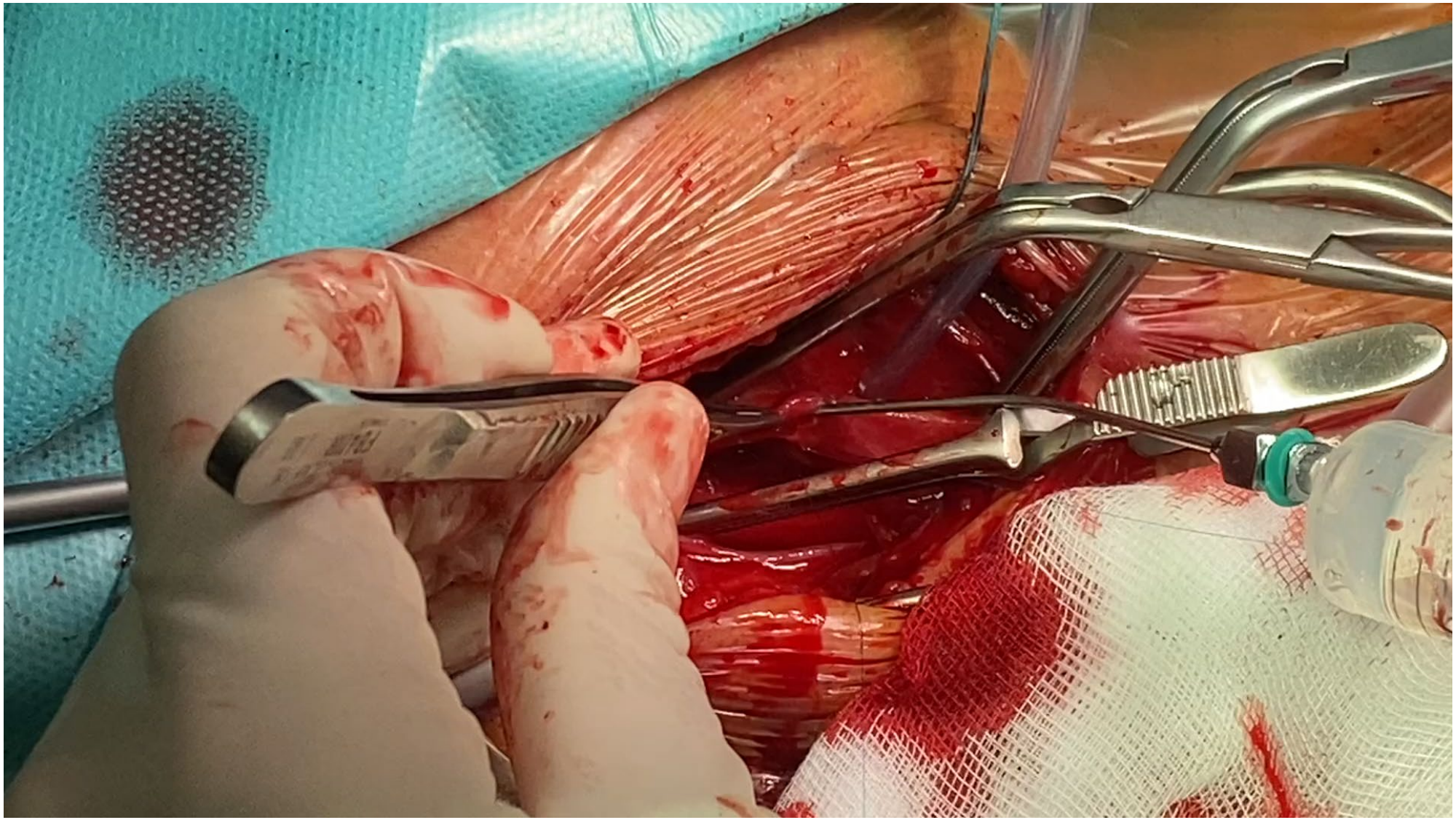


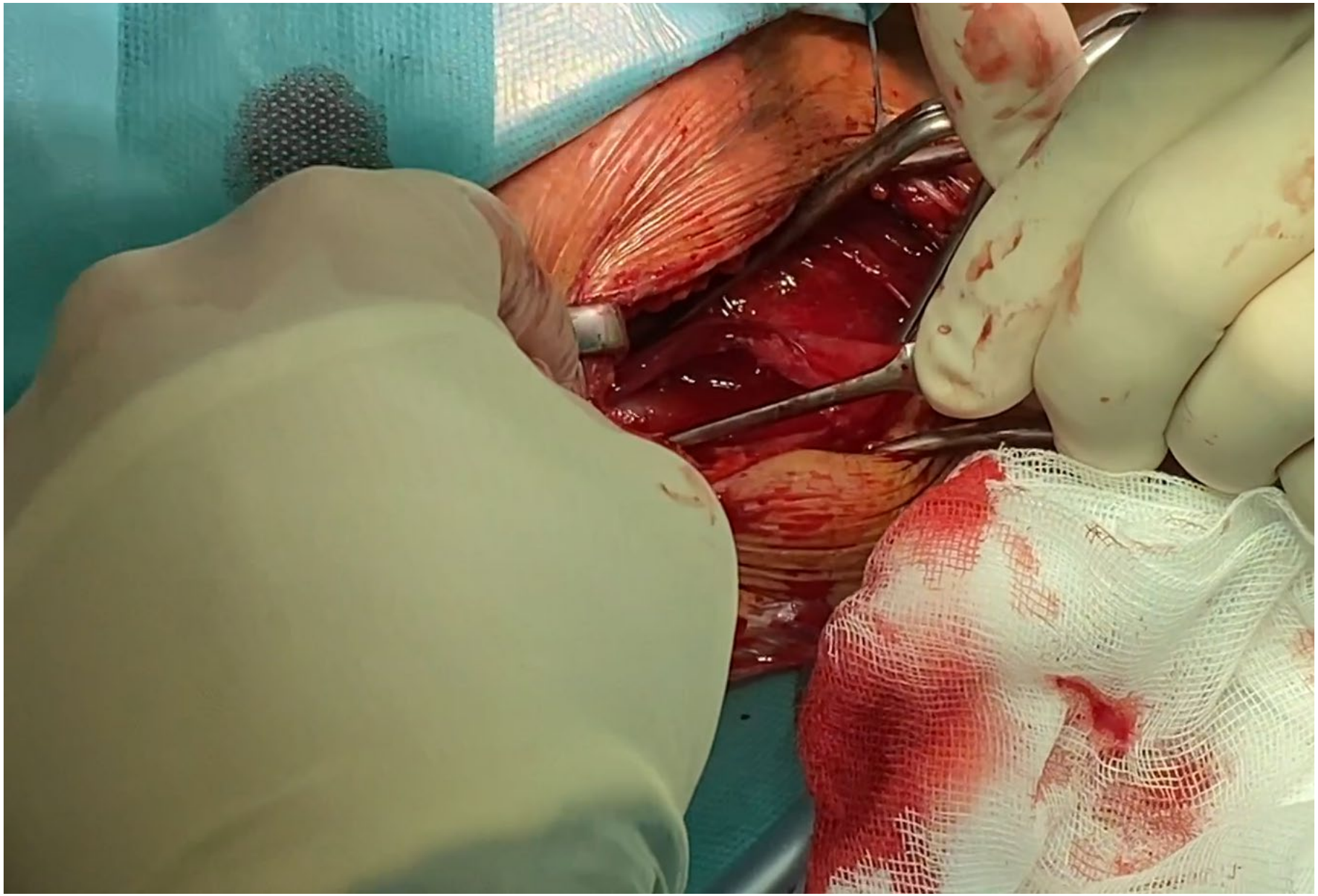


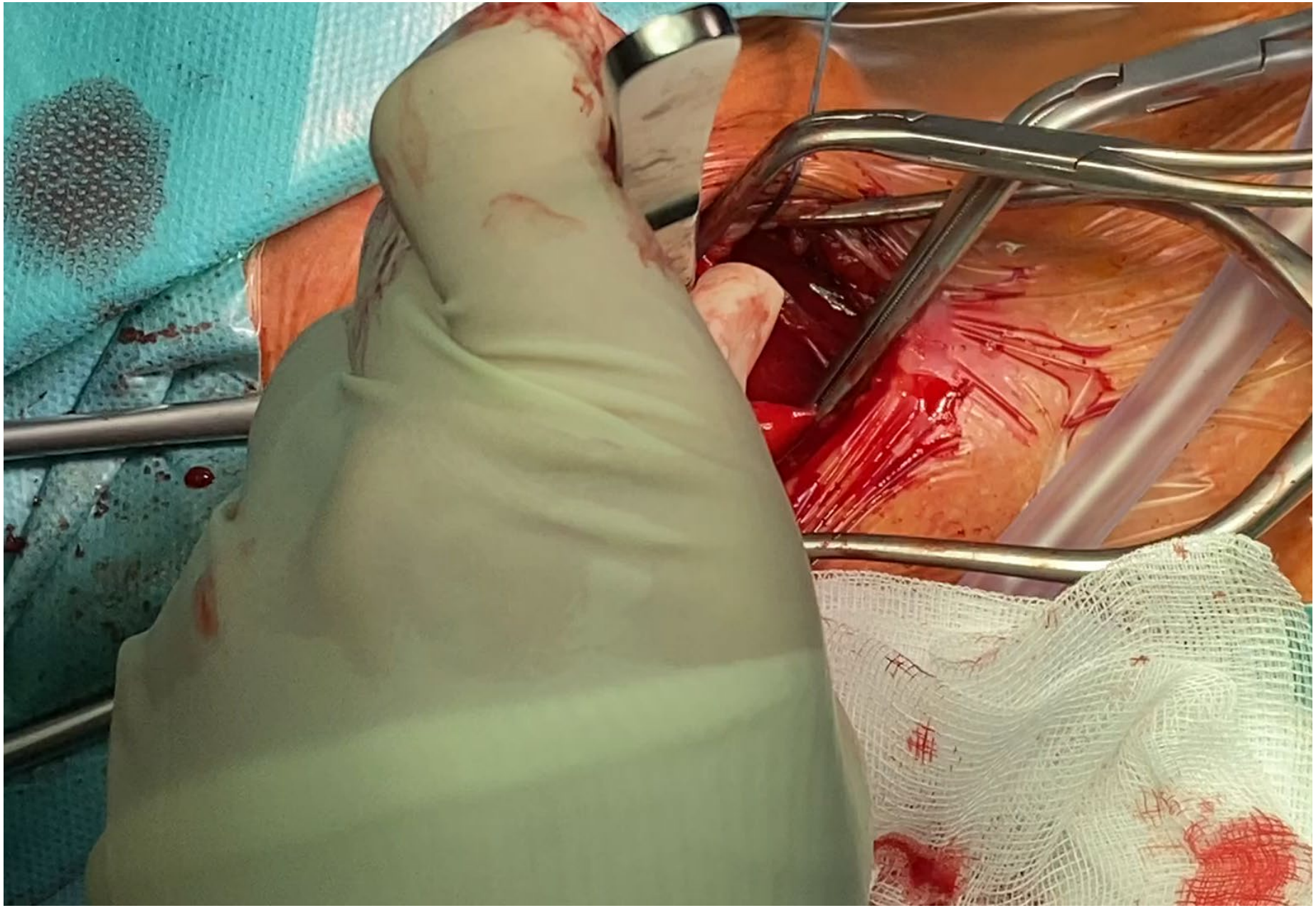




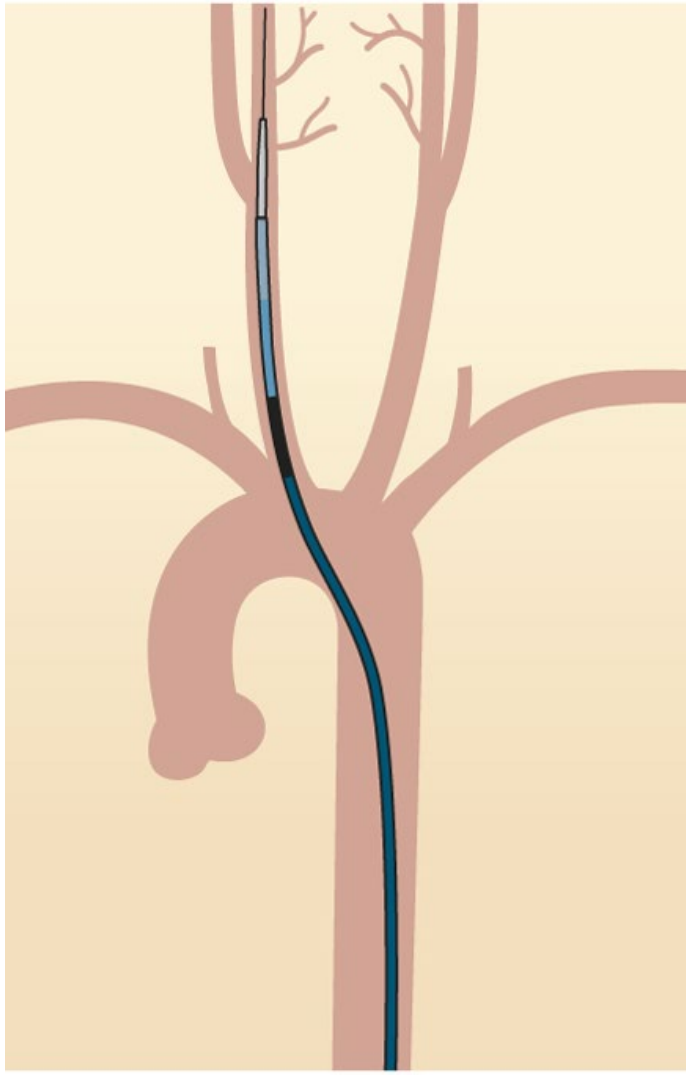


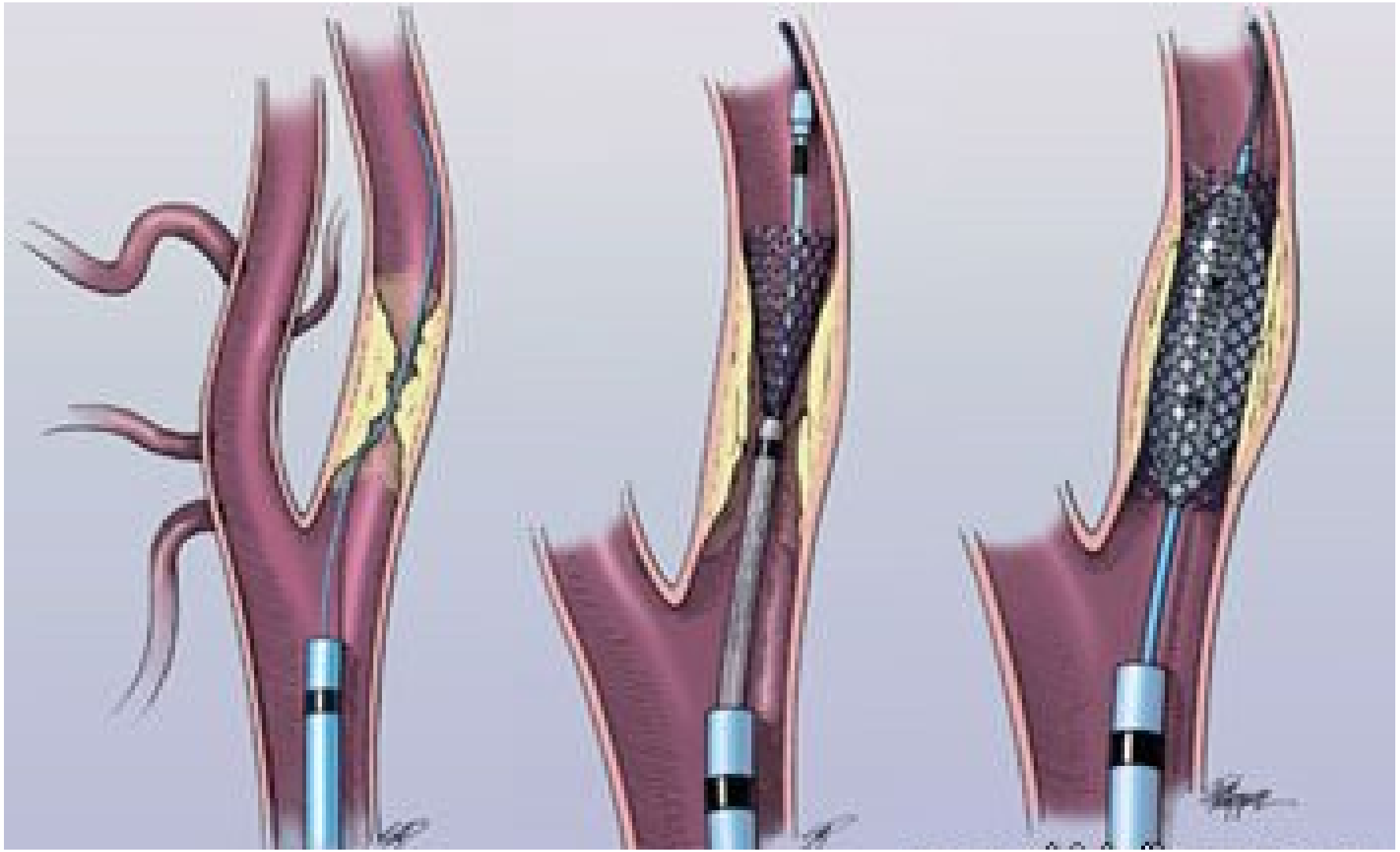




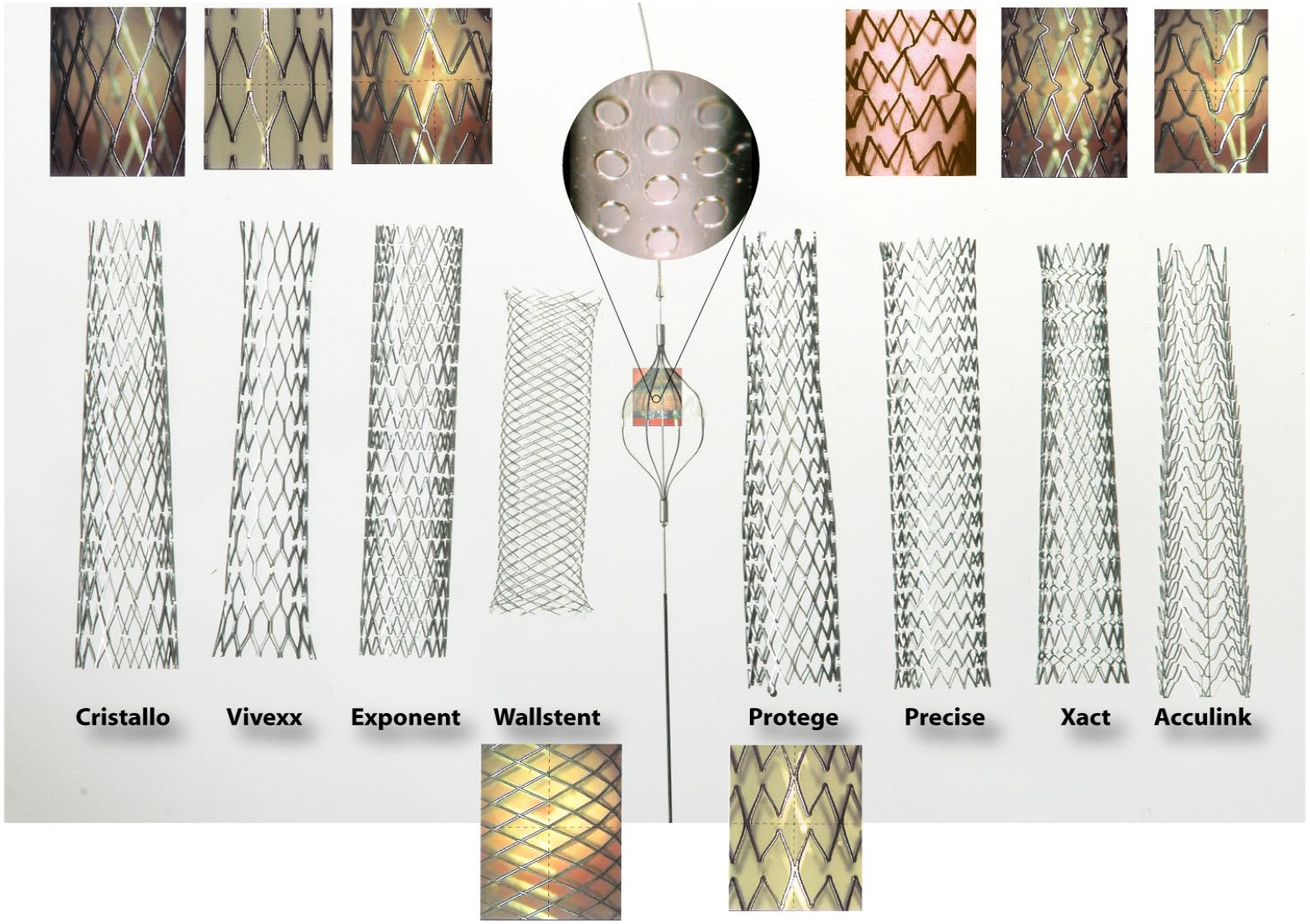


Carotid Stenting (Transfemoral)

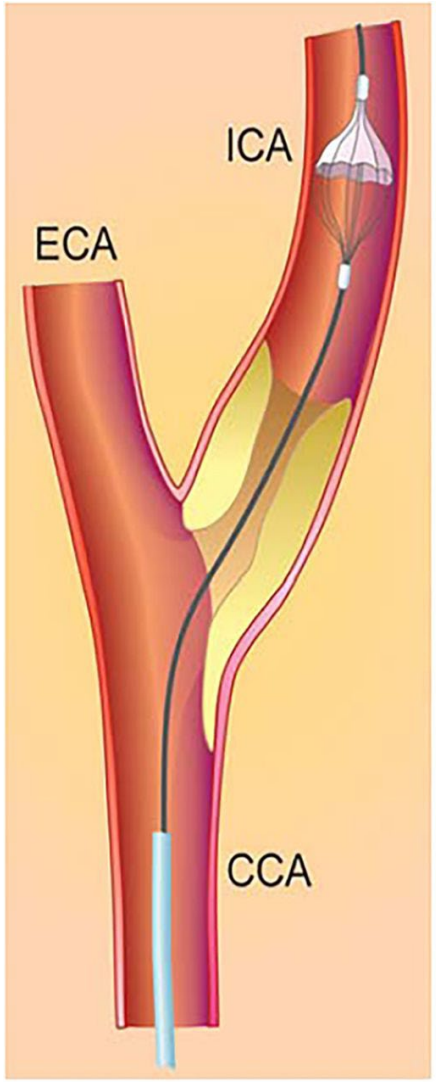


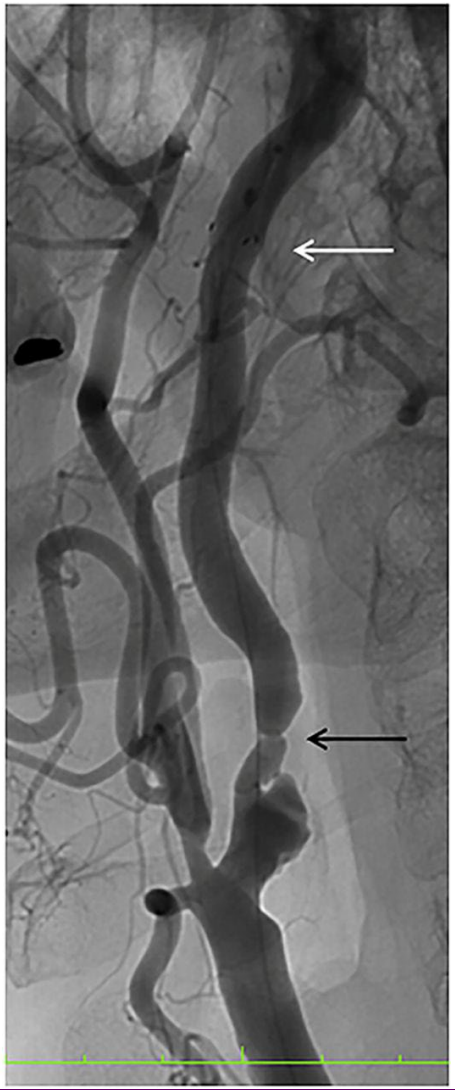


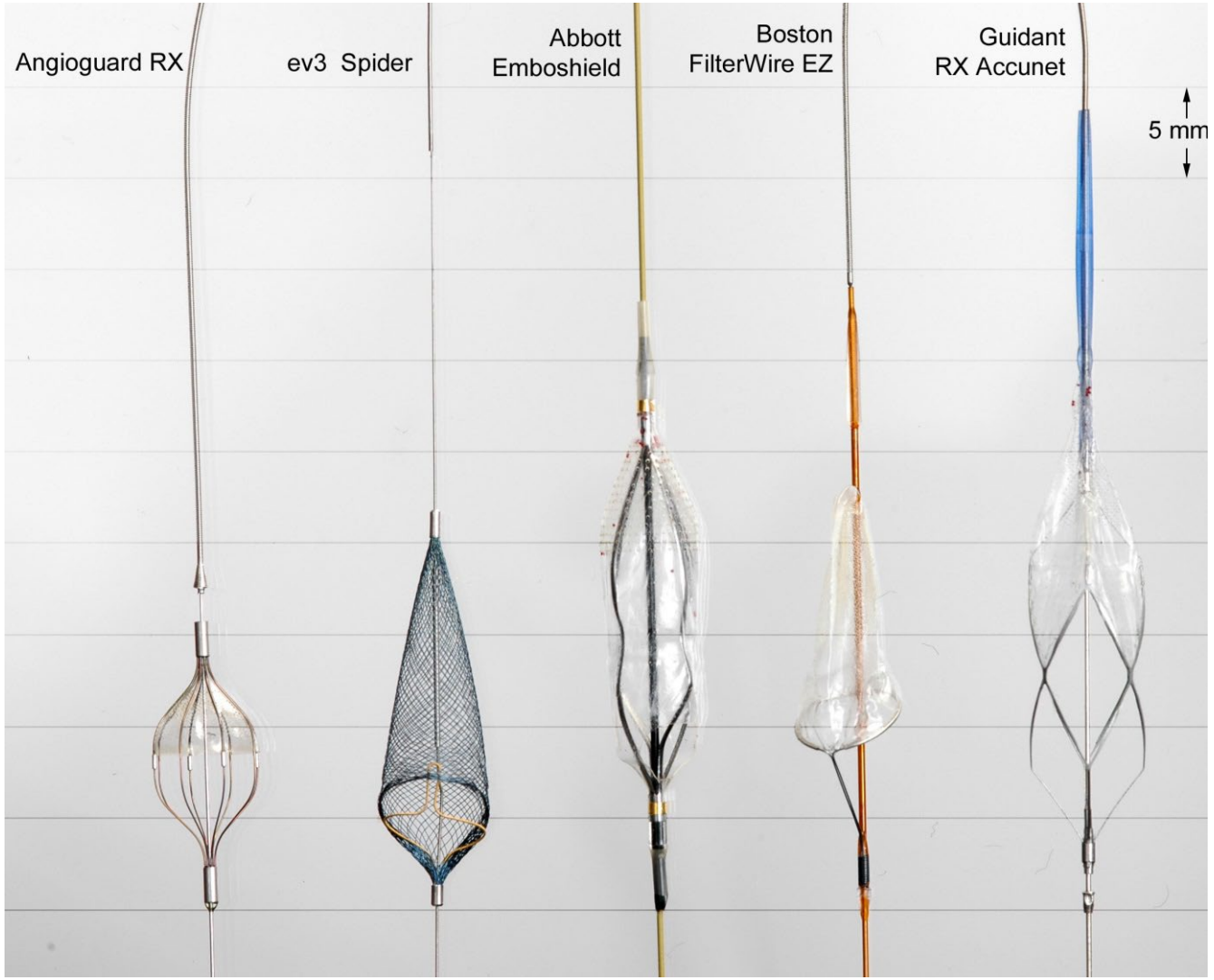
Carotid Stenting - Stents



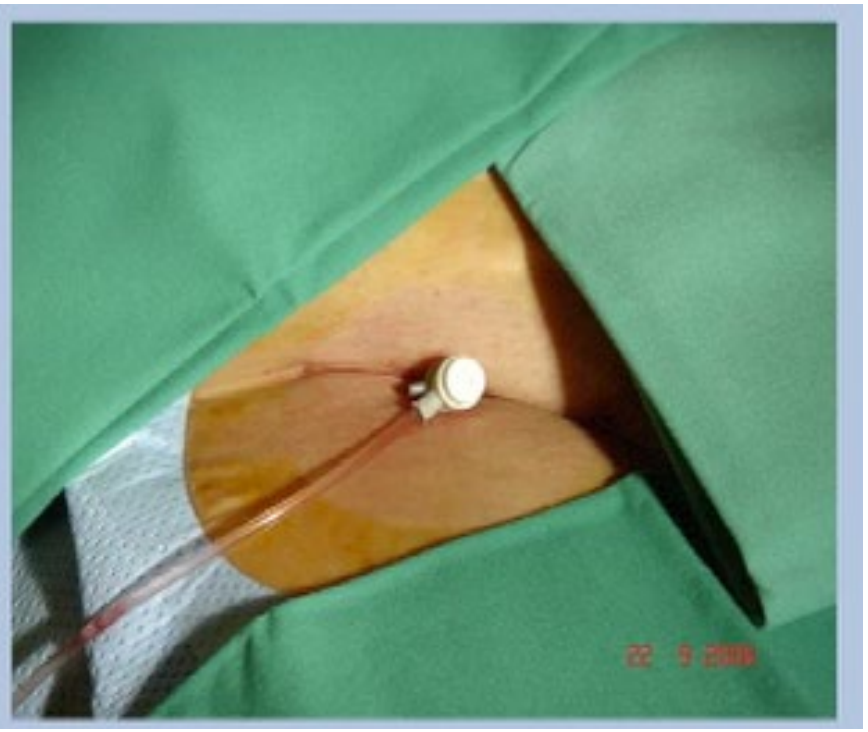
Carotid Stenting – Embolic Protection Filters



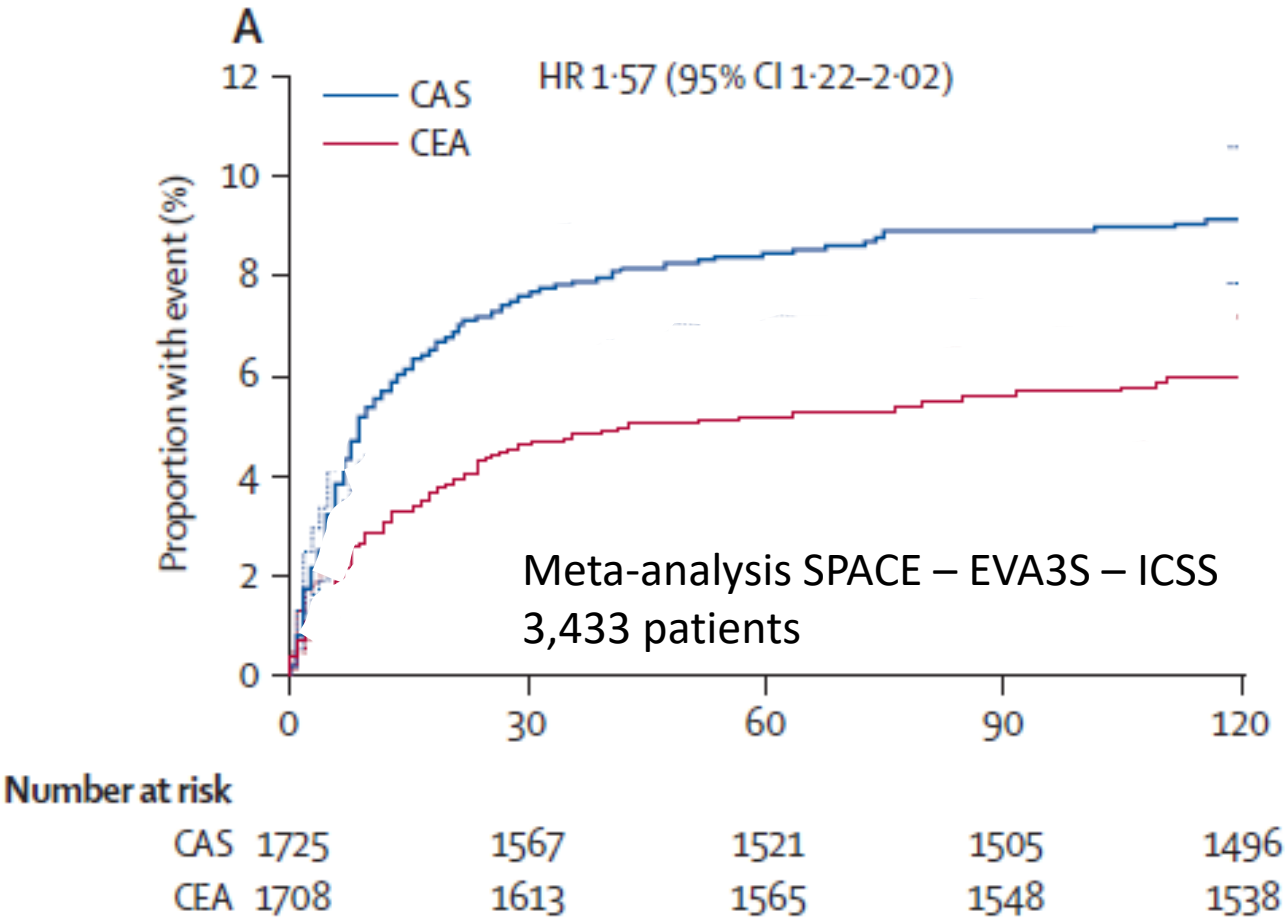




CEA vs CAS



CEA vs CAS – 30 day Stroke or Death in Sx Patients



CSTC. Lancet 2010

CEA is superior to CAS in the primary end-point of death or any stroke (8.9% vs. 5.8%; p = 0.0006).

Age was the only variable that modified the effect:

120-day risk was higher in CAS (12%) vs. CEA (5.9%) in patients >70 years

But not
In patients ≤70 years CAS 5.8% vs. CEA 5.7%

CAS for Sx patients should be avoided in older, but might be as safe as CEA in younger patients.

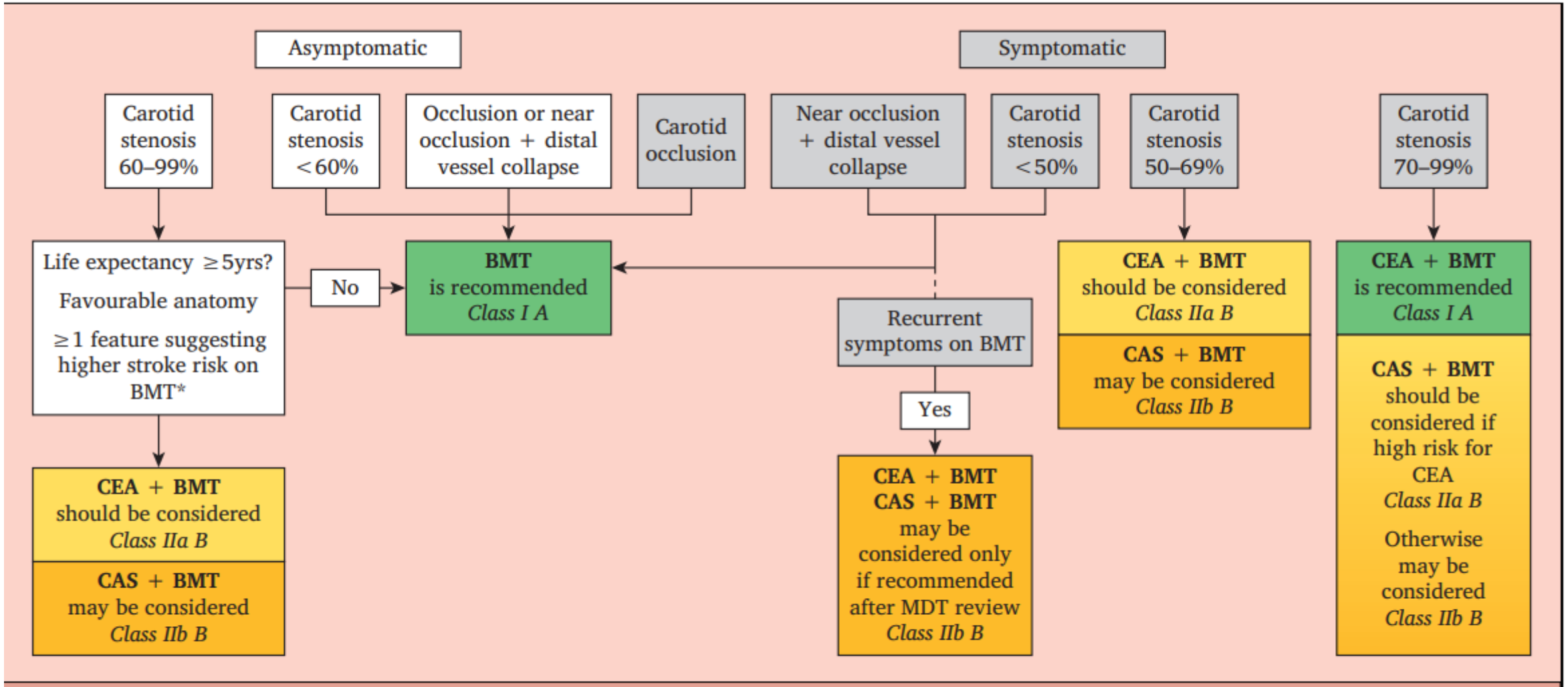


Figure 2. Management of "average risk" patients with asymptomatic and symptomatic carotid stenoses with best medical therapy (BMT), carotid endarterectomy (CEA), and/or carotid artery stenting (CAS). *See Table 8 for imaging/clinical criteria that confer an increased risk of stroke on BMT.