

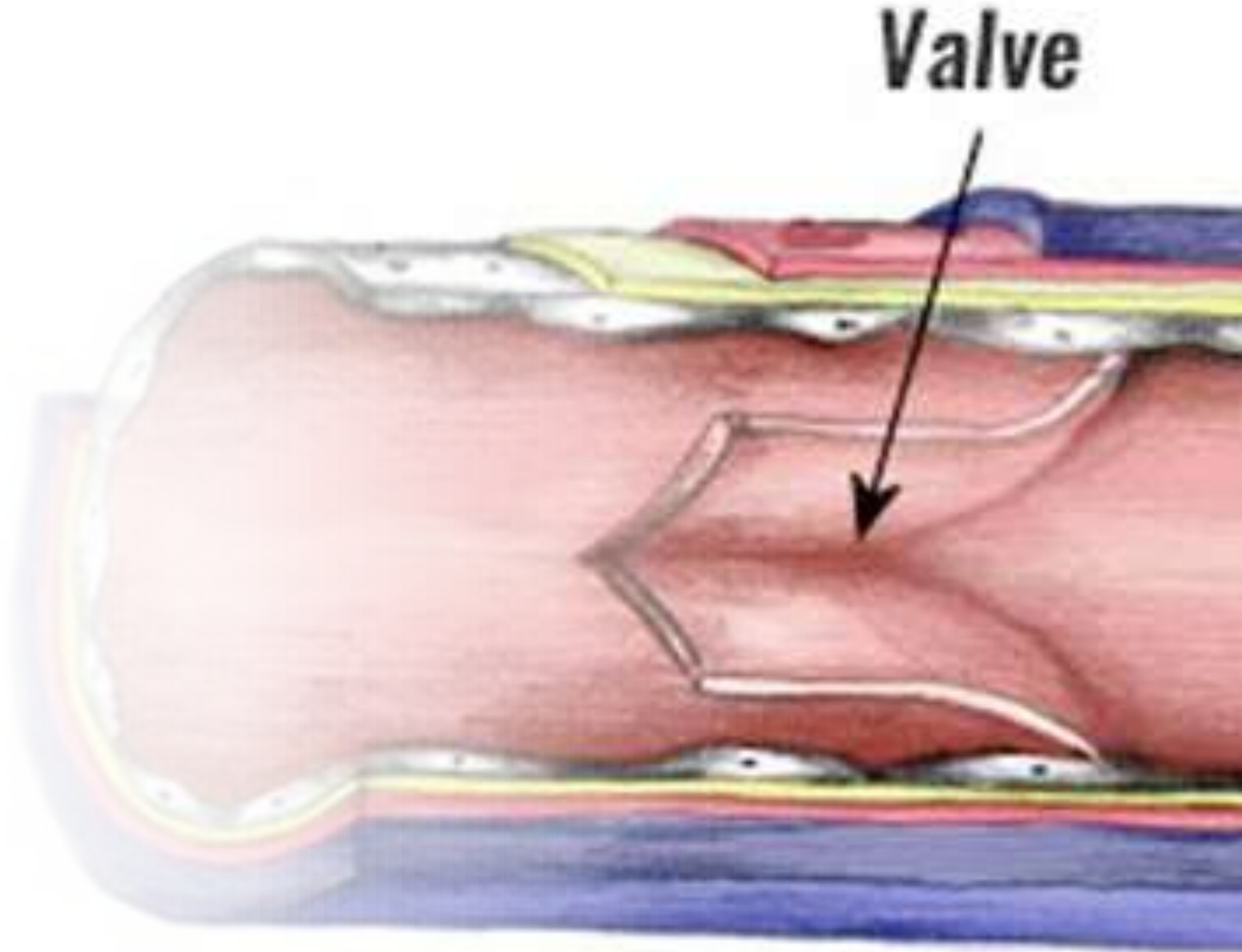
Pirogov Russian National Research Medical
University Department of General surgery

Basic principles of venous disorders diagnostic and treatment

Lecturer:

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Venous pathology

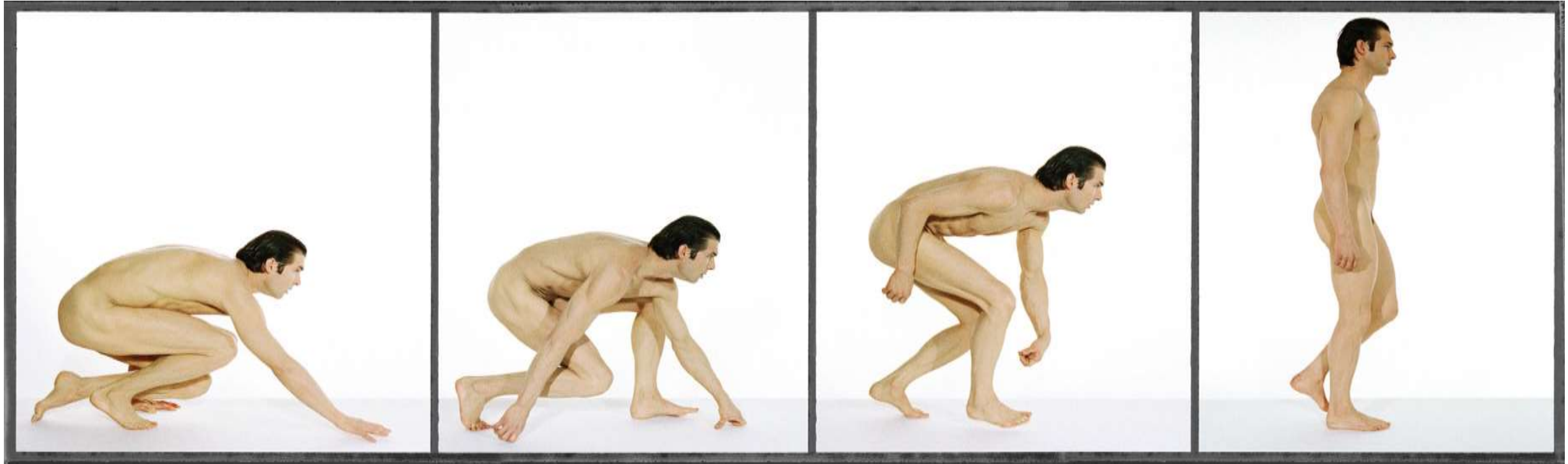
Acute (Venous thromboembolism, VTE)

- Deep vein thrombosis
- Superficial vein thrombosis (thrombophlebitis)
- Pulmonary embolism

Chronic (Chronic venous disease, CVD)

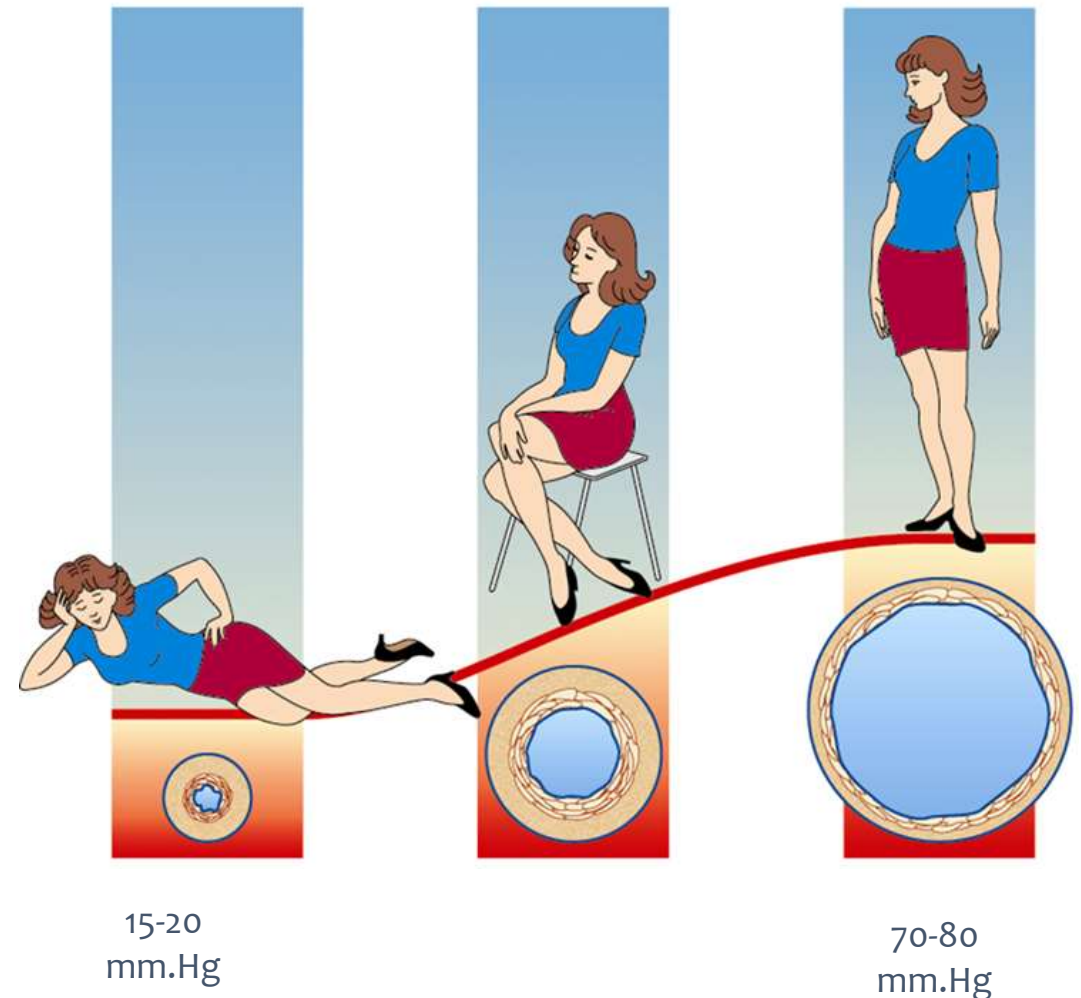
- Varicose veins
- Post-thrombotic syndrome
- Chronic vein insufficiency
- Pelvic venous insufficiency
- Chronic venous obstruction

Vein disorders of lower limbs is a payment for vertical position



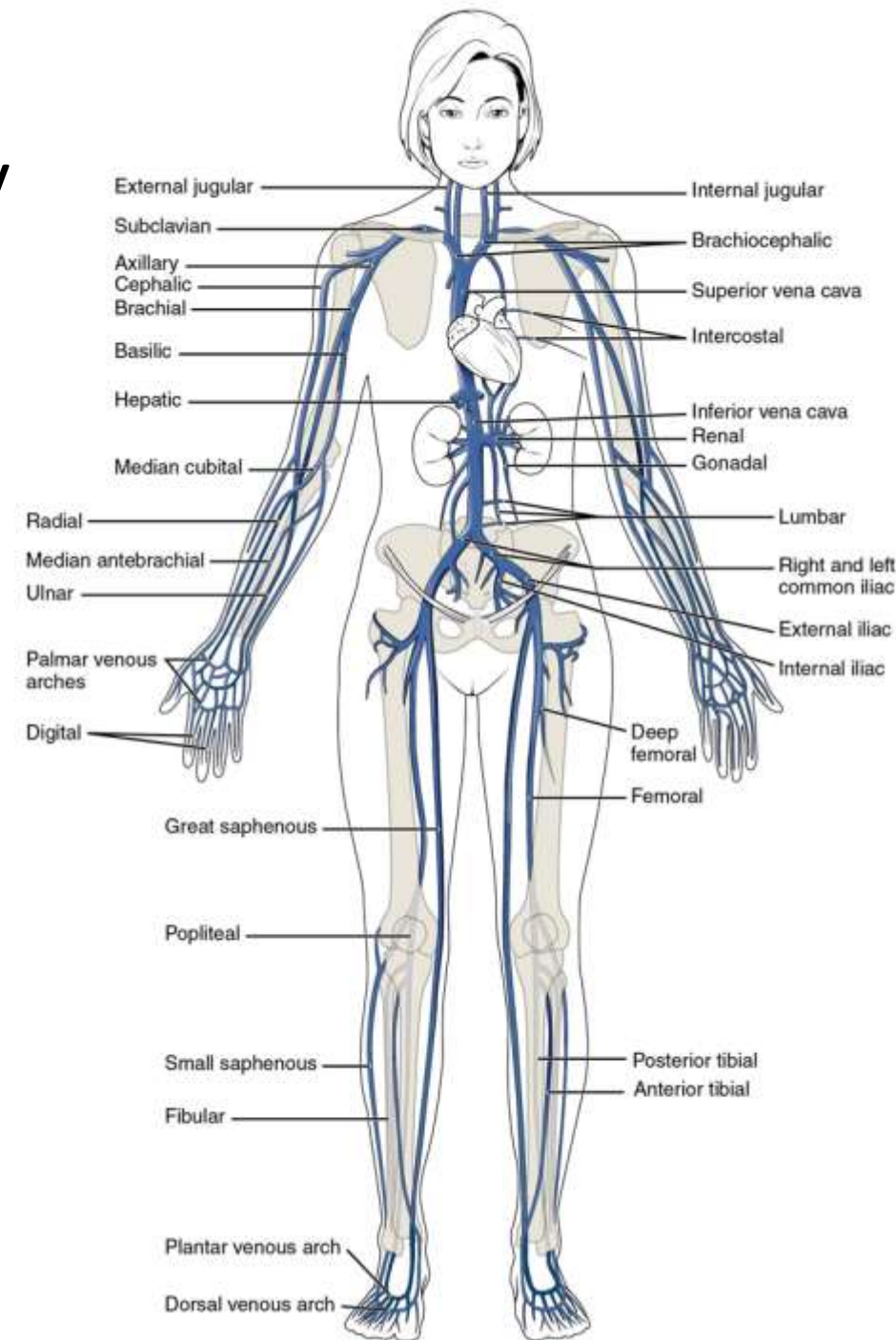
Effects of vein blood pressure

- In horizontal position venous pressure is low and veins are small
- In vertical position venous pressure increase significantly and veins come dilated
- This is an effect of hydrostatic pressure
- Muscle and elastic structures of venous wall limit dilatation



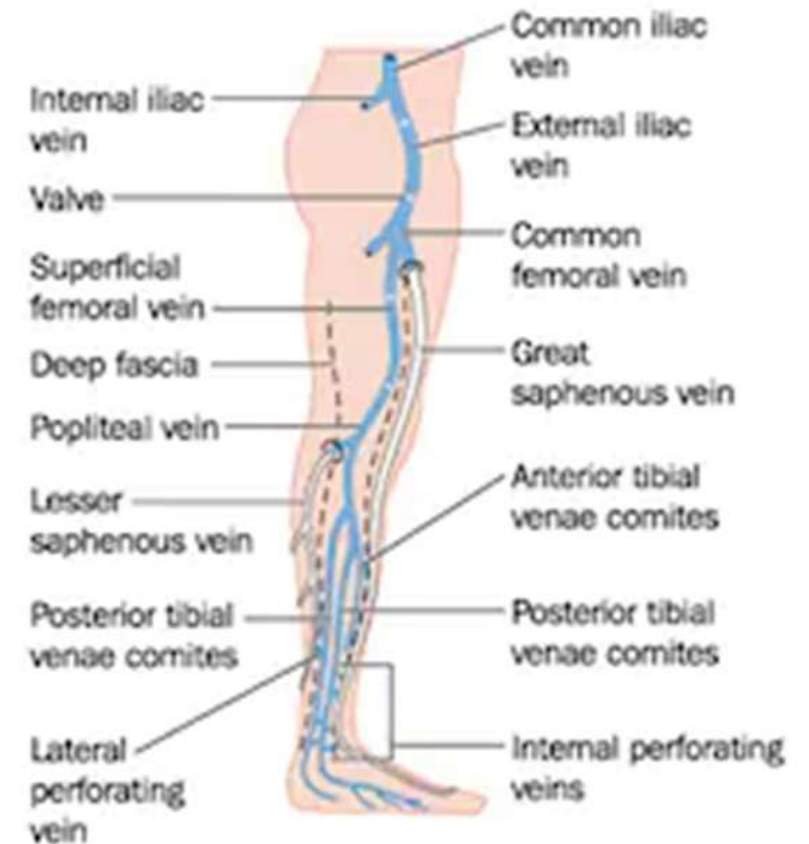
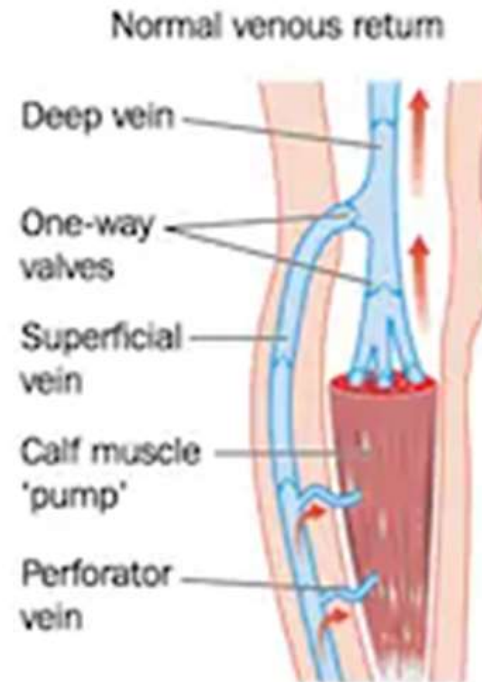
Veins anatomy

- Blood circulation system consists of arterial (resistive) and venous (capacity) departments
- In venous department there are 2/3 of circulating blood



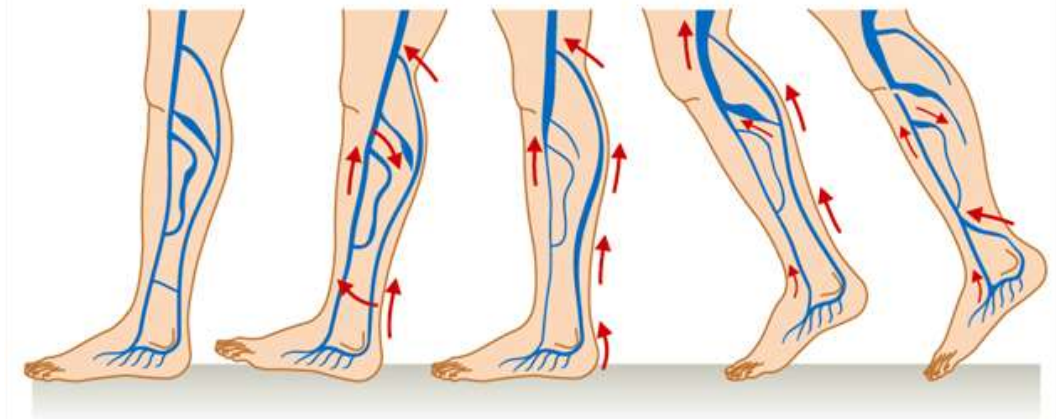
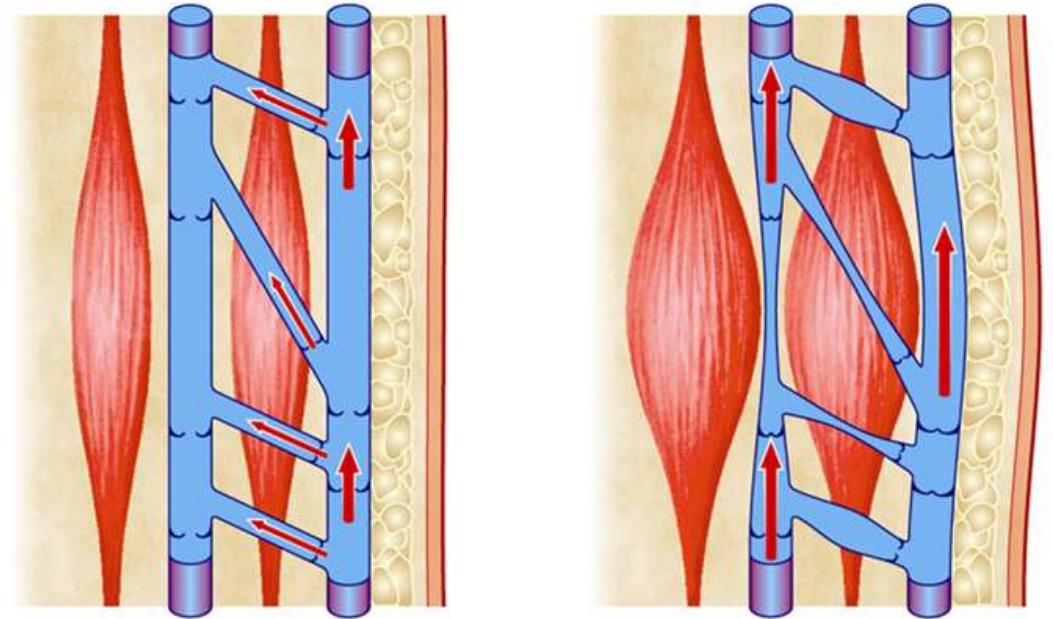
Lower limb veins

- Deep veins
 - Common femoral, femoral, popliteal, tibial, peroneal
 - Sural sinuses
- Superficial veins
 - Great saphenous vein
 - Small saphenous vein
 - Tributaries
- Perforating veins



Mechanism of venous outflow

- Muscle-venous pump:
 - Deep, superficial and perforating veins with valves
 - Muscle and fascia
 - Neighbor joints
- The general pump – calf-muscle pump – it provides 80% of venous outflow
- Others – plantar, femoral, abdominal



Mechanism of venous outflow

For venous pumping we need:

- Good vein valves, that provide antegrade blood flow (to heart)
- Good muscles
- Good joints



Valve open,
blood flow to
heart during
muscle
contraction



Valve closed;
blood can't
flow to distal
veins during
muscle
relaxation



Valve
damaged,
blood flow
to distal
veins during
muscle
contraction

Reflux – retrograde blood flow (to distal part of venous system)

- Reversible – valves not damaged, but vein dilated, valves can't close up
- Irreversible – valves not damaged, but can't close up because irreversible vein varicose transformation
- Irreversible – valves damaged and can't close up



First stage of venous insufficiency

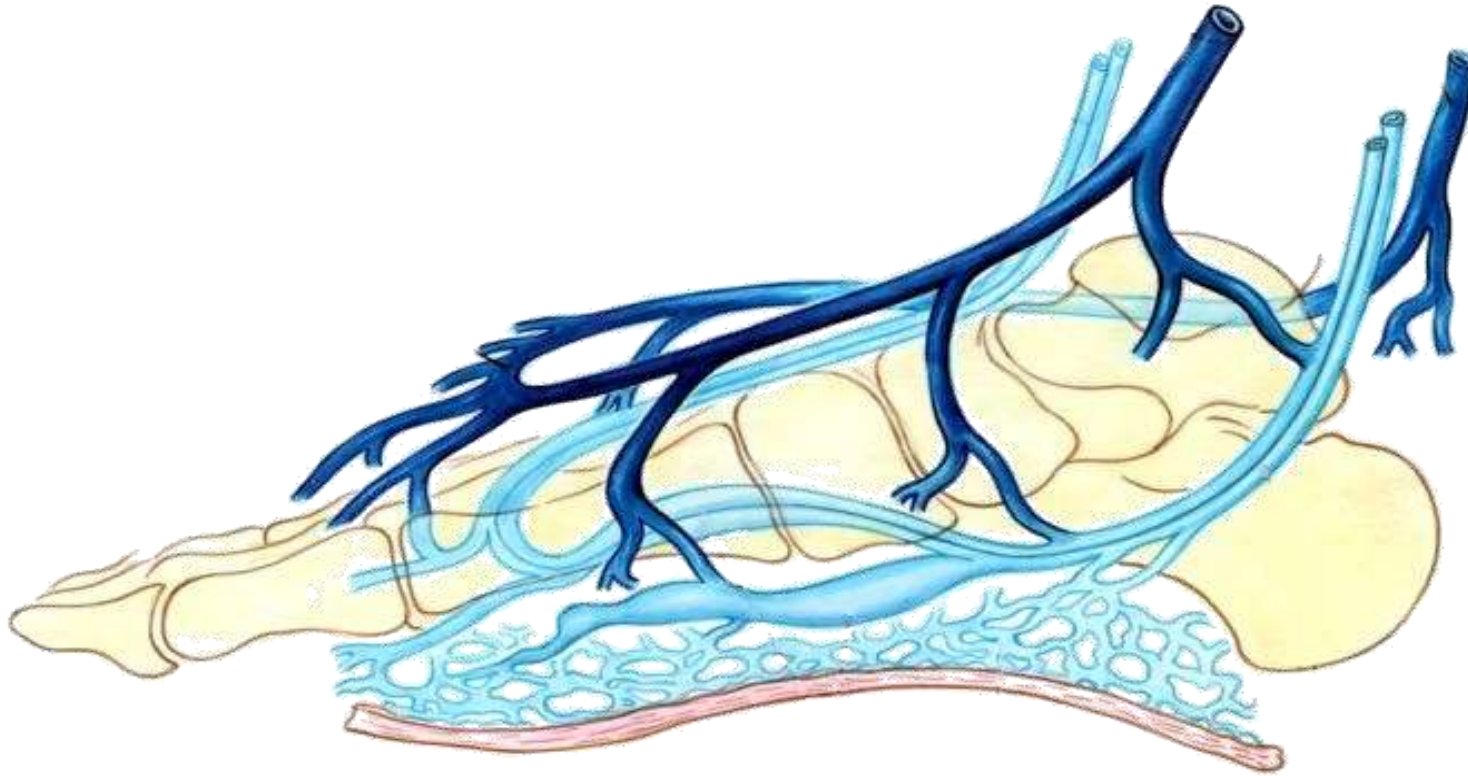


Varicose veins



Post-thrombotic syndrome

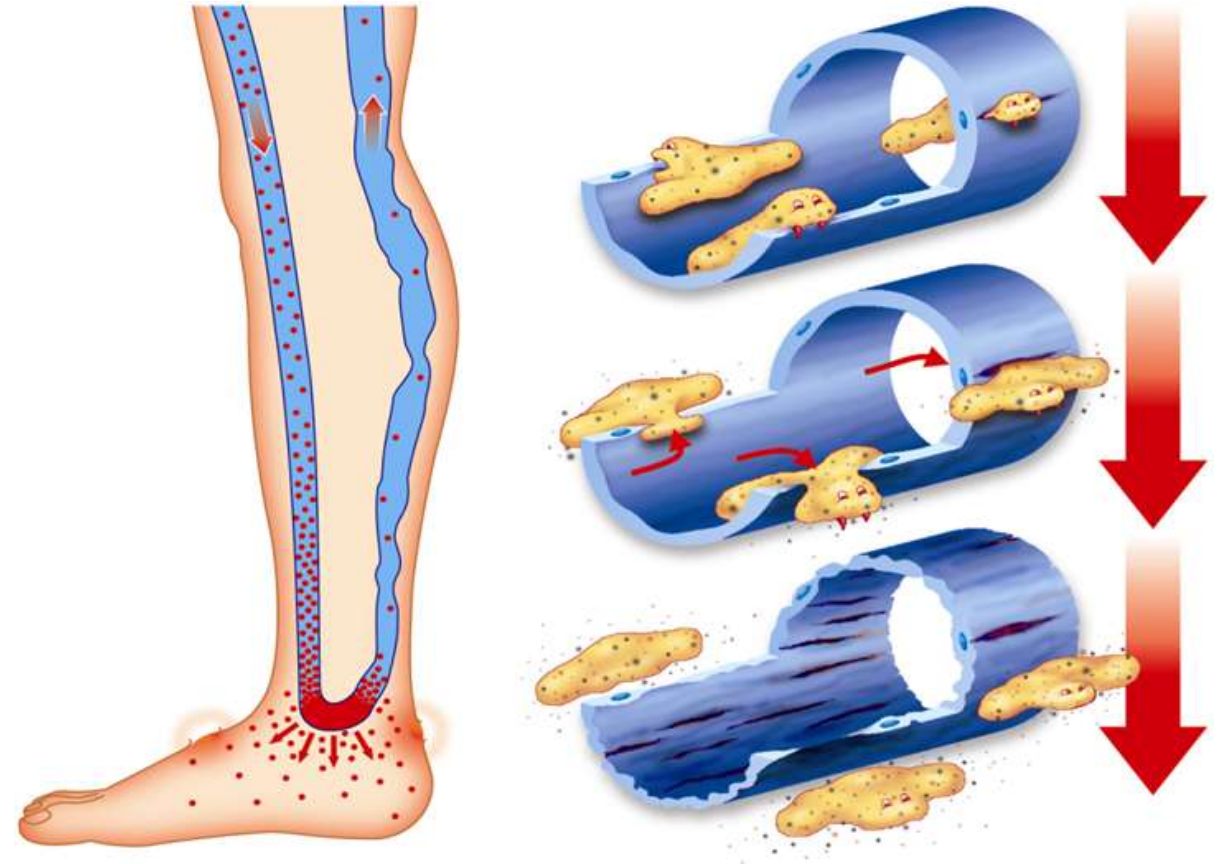
Plantar venous pump



Work because body weight press and tip-toing
Only when arches of foot are good

Pathogenesis of venous disorders

- Venous blood reflux leads to hypertension in distal veins
- Permanent hypertension leads to activation of leucocytes and increase capillary's permeability
- Leucocytes transfer from vessel to tissues and injure it
- Injure of tissue appears as skin dystrophy



Diagnostic approaches

- Complaints:
 - Leg pain
 - Leg fatigue ability
 - Leg heaviness
 - Calf cramping
 - Swelling (leg edema)
 - Leg skin cyanosis and hyperpigmentation
 - Leg ulcer
- All complaints increase after long stasis (esp. vertical) and decrease after horizontal rest

Diagnostic approaches

- Anamnesis:
 - Heredity
 - Static work (surgeon, barber, vendor)
- Clinical symptoms – decrease of venous outflow:
 - Varicose veins
 - Leg swelling
 - Cyanosis
 - Skin hyperpigmentation
 - Skin ulceration

Diagnostic approaches

- Ultrasound dopplerography / scanning
- Vein scintigraphy (isotope scanning)
- Plethysmography
- CT or MRI phlebography
- Venography (x-ray scanning)
- IVUS
- Laboratory test (esp. for thrombosis):
 - D-dimer
 - Fibrin peptide A and B
 - Fragments of prothrombin 1+2
 - Thrombine-antithrombin complex
 - Thrombodynamics

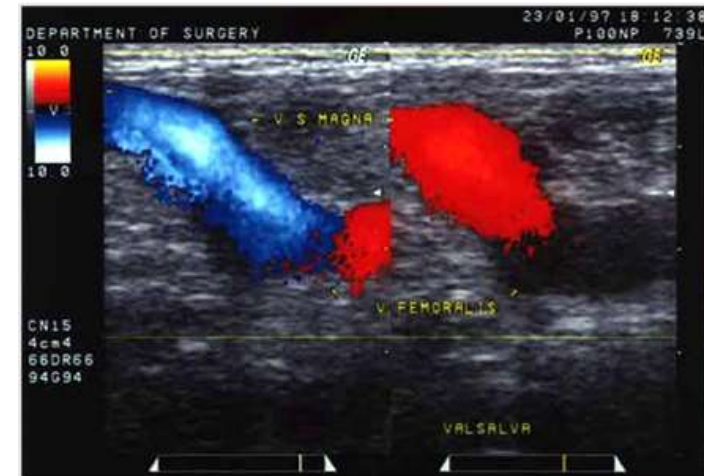
Ultrasound examination

- **Dopplerography** – method, that provide only information about blood flow, without vein visualization
- The presence of blood flow and reflux
- Simple and available



Duplex ultrasound scan

- **Complex ultrasound duplex scanning**
- Need special equipment and specialist
- Depend on skills
- Provide information about vein structure and blood flow
- **Gold method in vein diagnostic**



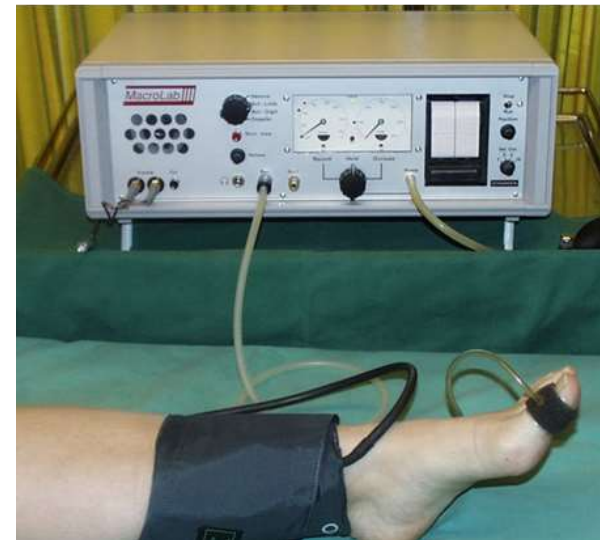
Isotope scanning

- **Phlebo scinty graphy – injection of isotope into leg veins and looking after its spreading**
- Provide more information about vein function and less information about vein structure
- Invasive method
- Need expensive equipment



Plethysmography

- Evaluation of venous volumes and function
- Evaluation of calf pump function
- Digital photoplethysmography
- Air plethysmography



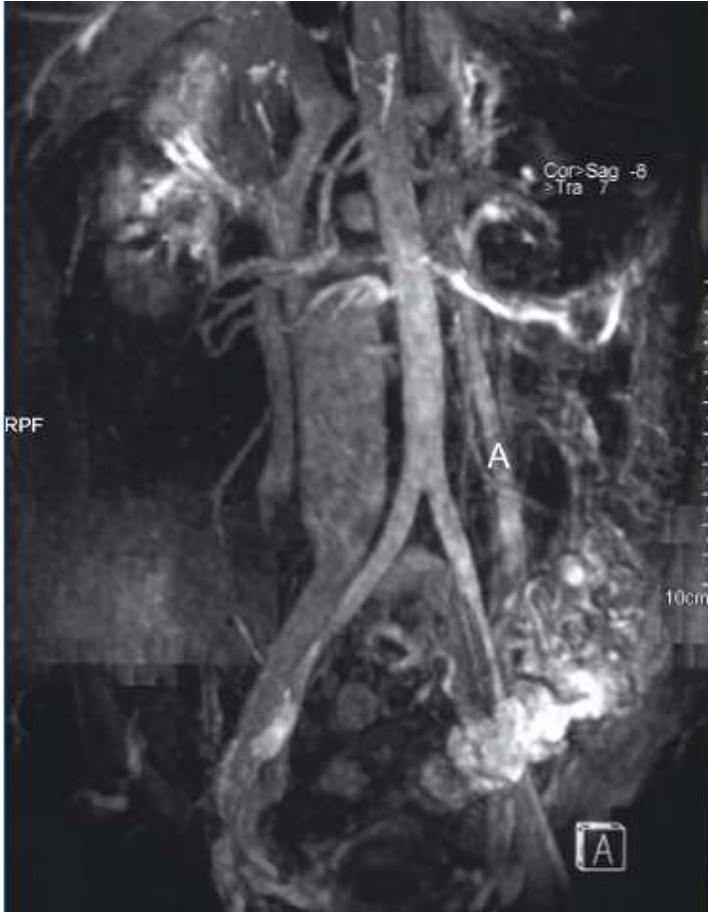
CT phlebography



IVC agenesis

- Contrast enhancing (iodine contrast)
- Accurate vein anatomy (3D)
- Thrombus extension
- Compression syndromes
- Surrounding tissues
- Vascular wall
- No vascular lumen
- Radiation exposure

MRI phlebography



Pelvic vein insufficiency

- Possible contrast enhancing (gadolinium)
- Accurate vein anatomy (3D)
- Thrombus extension and maturity
- Compression syndromes
- Surrounding tissues
- No vascular wall
- Vascular lumen
- No radiation exposure

Direct phlebography

- Contrast enhancing (iodine contrast or CO2)
- Accurate vein anatomy
- Thrombus extension
- Compression syndromes
- No surrounding tissues
- No vascular wall
- No vascular lumen
- Radiation exposure
- Treatment modalities



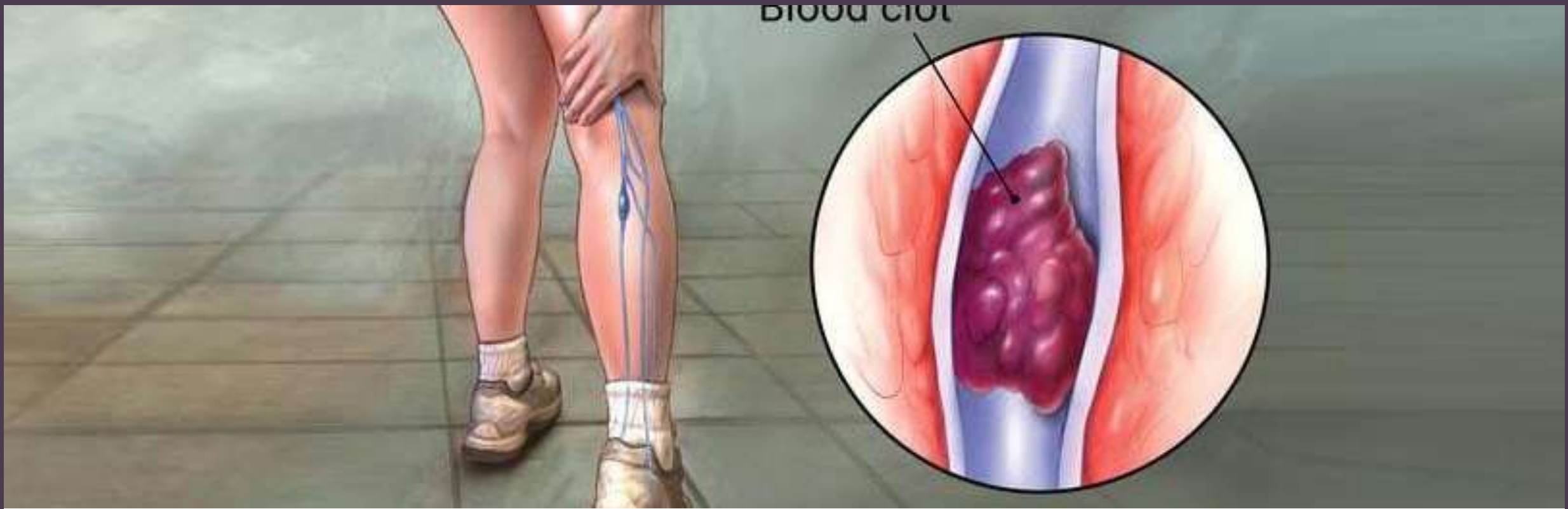
Iliac vein thrombosis

IVUS



Iliac vein obstruction

- Invasive
- Ultrasound from the vessel lumen
- Compression syndromes
- Post thrombotic changes
- Vessel wall
- Most accurate diagnostic for obstruction degree



Deep vein thrombosis

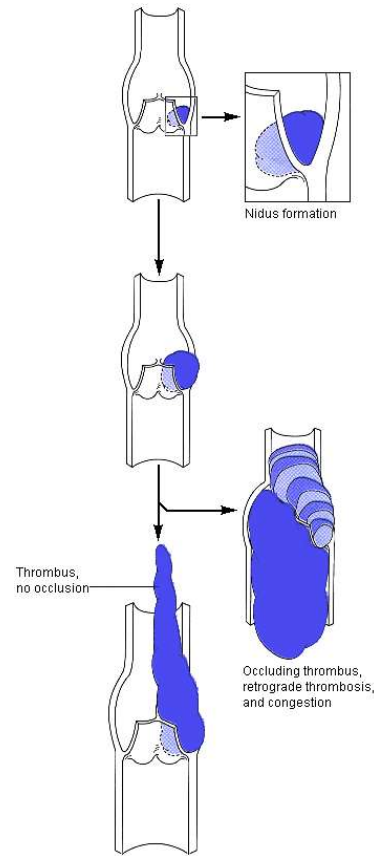
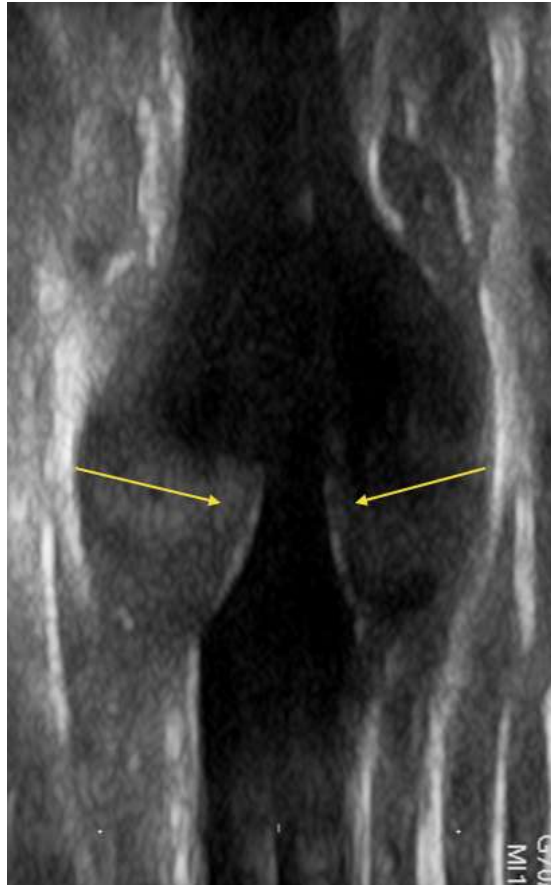
Etiology

Blood stasis	Lower limb immobility
	Lower limb paralysis
	Varicose veins
	Obesity
	Heart insufficiency
Hypercoagulation	Long travel
	Thrombophilia
	Malignant tumor
	Oral contraceptives
	Pregnancy
	Surgery
Vessel's wall damage	Trauma
	Vein catheterization
	Sepsis



Virchow's trine

Deep vein thrombosis (DVT)



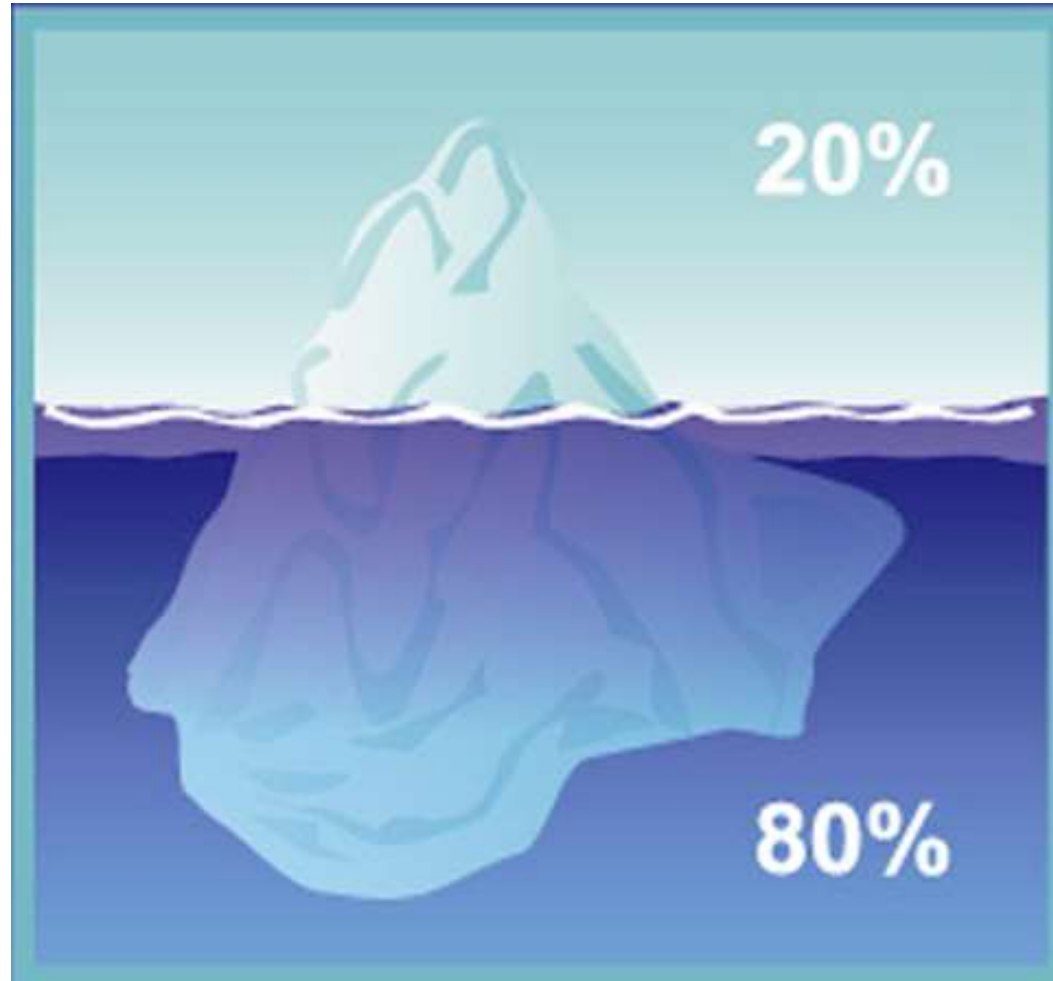
In lower limbs thrombosis usually begin in sural sinus and femoral vein valves and then progress to heart direction

DVT symptoms

- Acute appearance of symptoms
- Permanent leg pain
- Permanent edema, increase of leg's diameter
- Skin cyanosis
- Swelling of superficial veins
- Unilateral process



DVT



80% of DVT have no symptoms

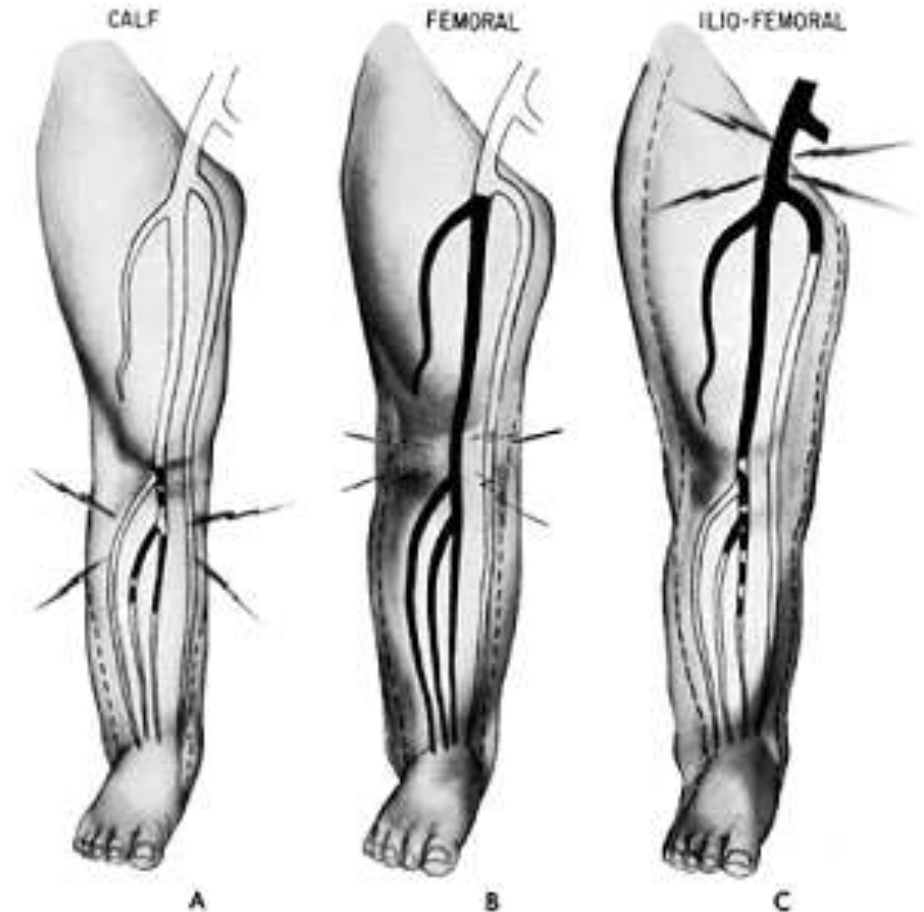
DVT

The level of leg edema due to the level of thrombotic occlusion

A – one-vein below knee occlusion

B – occlusion up to femoral vein

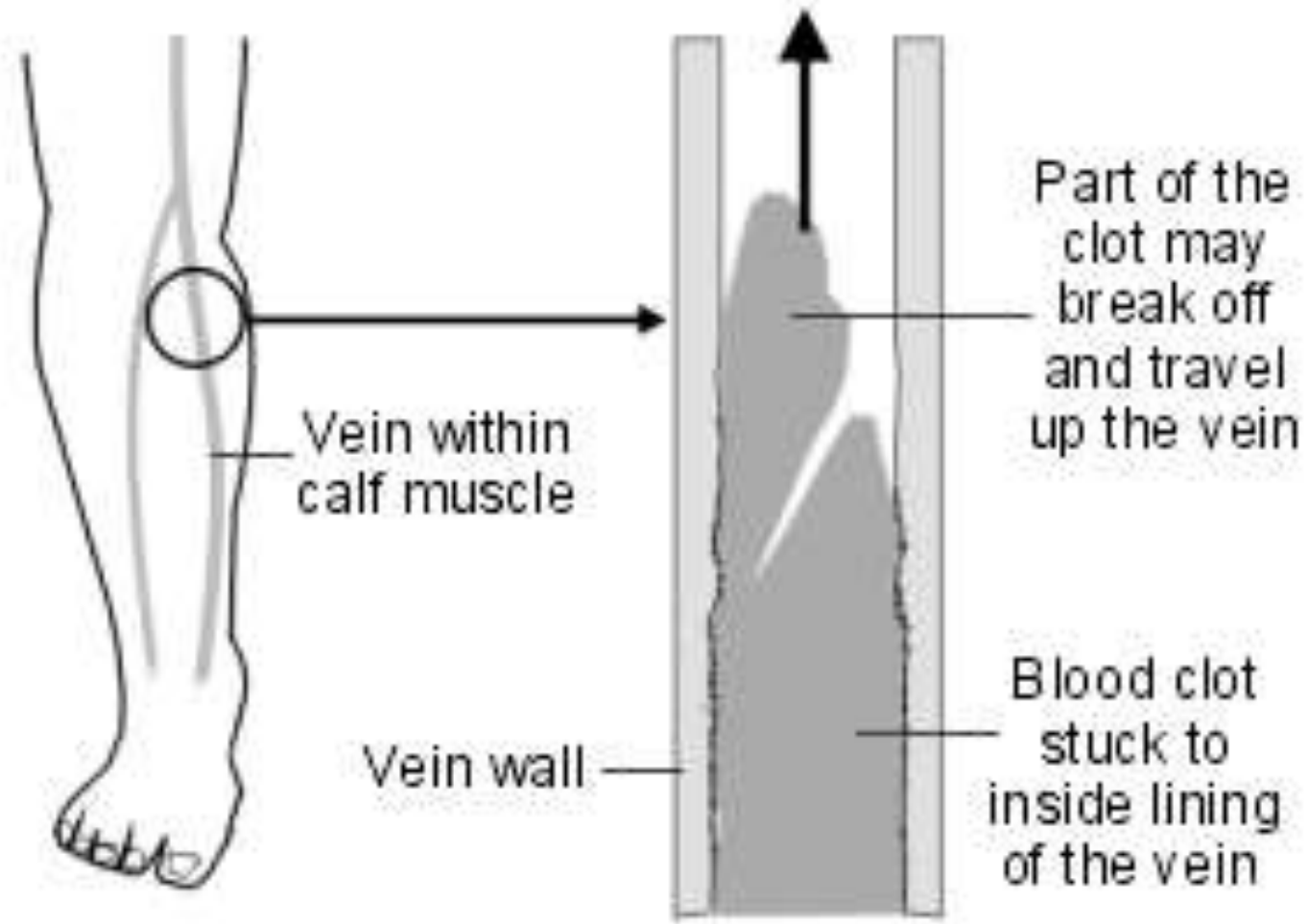
C - occlusion up to iliac vein



DVT

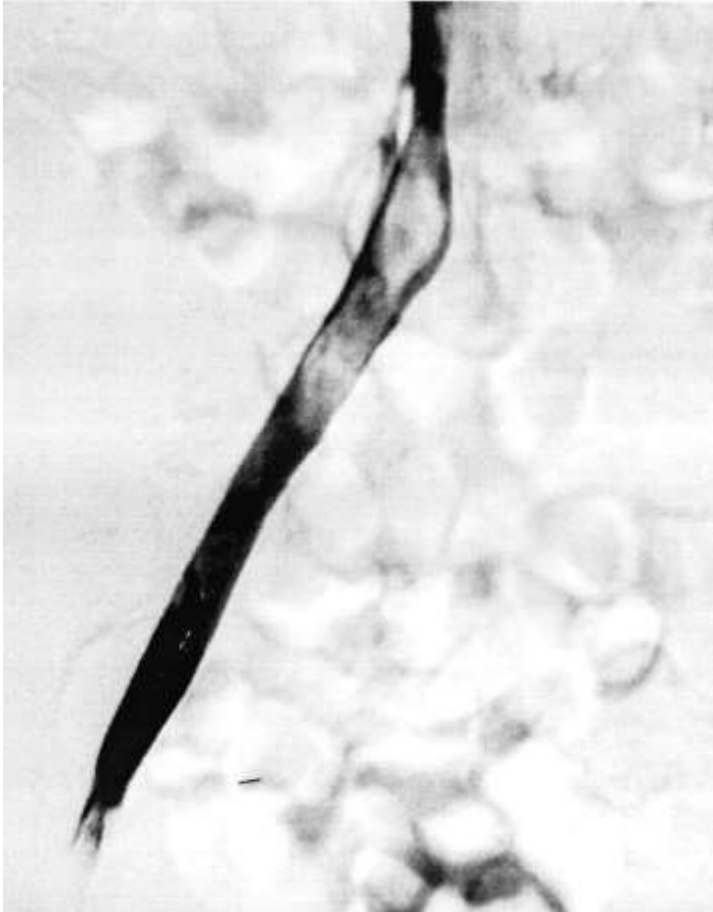
- Instrumental diagnostic of DVT aimed to:
 - Confirm presence of DVT
 - Determine level of DVT
 - Evaluate the risk of pulmonary embolism:
 - Occlusive thrombosis
 - Non-occlusive:
 - Fix to vein wall
 - Not-fixed (floating)
- Treatment control

DVT



Deep vein thrombosis

Free-floating thrombus

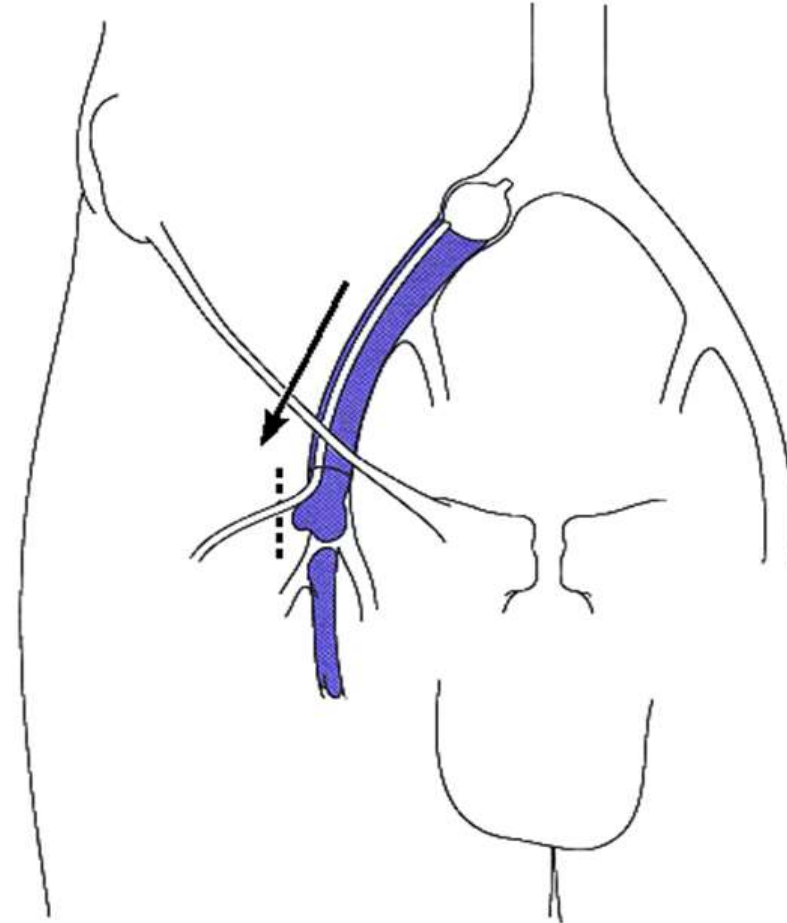


DVT treatment

- Anticoagulant therapy: stop thrombosis progression
 - Direct anticoagulants
 - Heparin
 - Low-molecular heparin
 - Fondaparinux,
 - DOACs: rivaroxaban, dabigatran, apixaban, edoxaban
 - Indirect anticoagulants:
 - Vit. K antagonists
- Vein recanalization
 - Thrombolysis
 - Local
 - Regional
 - System
 - Thrombectomy
 - Open
 - Endovascular
- Surgical prevention of pulmonary embolism
 - IVC filter

DVT surgical management

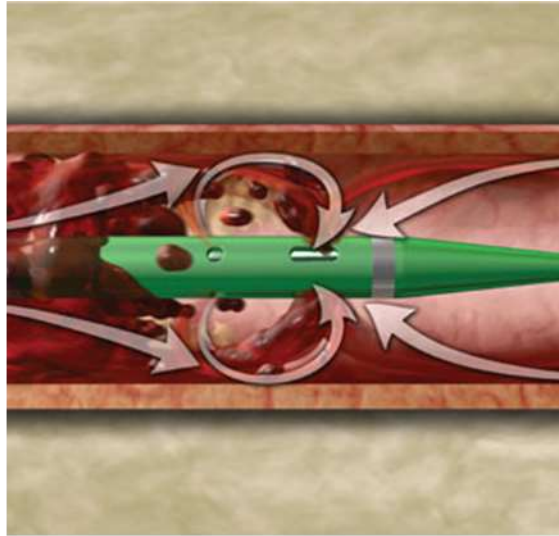
- Thrombectomy from iliaca vein with balloon catheter with next vein ligation
- Ligation of v.femoralis propria under v.femoralis profunda



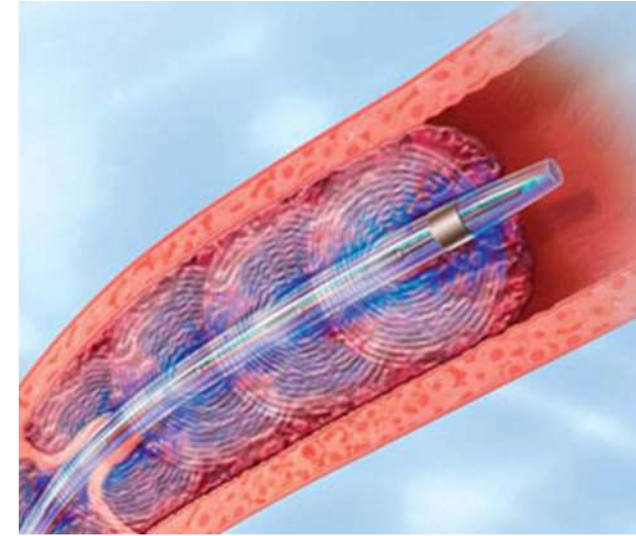
Mechanical and pharmaco-mechanical endovascular techniques



Aspirex



AngioJet



EKOS

PE prophylaxis

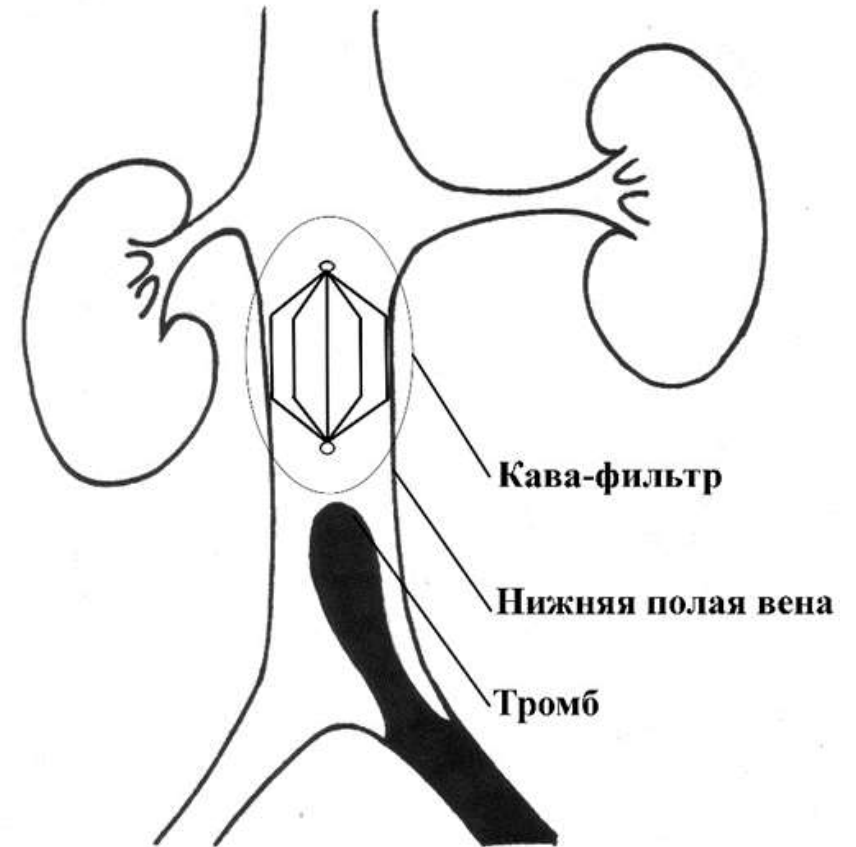
Implantation of cava-filter – endovascular procedure

Under X-Rays with vein contrasting

Does not protect for PE 100%

Indication:

- Contraindication for AC
- Thrombus progression at the top of AC
- Free-floating thrombosis with head over 7 cm
- Recurrent PE from unknown source

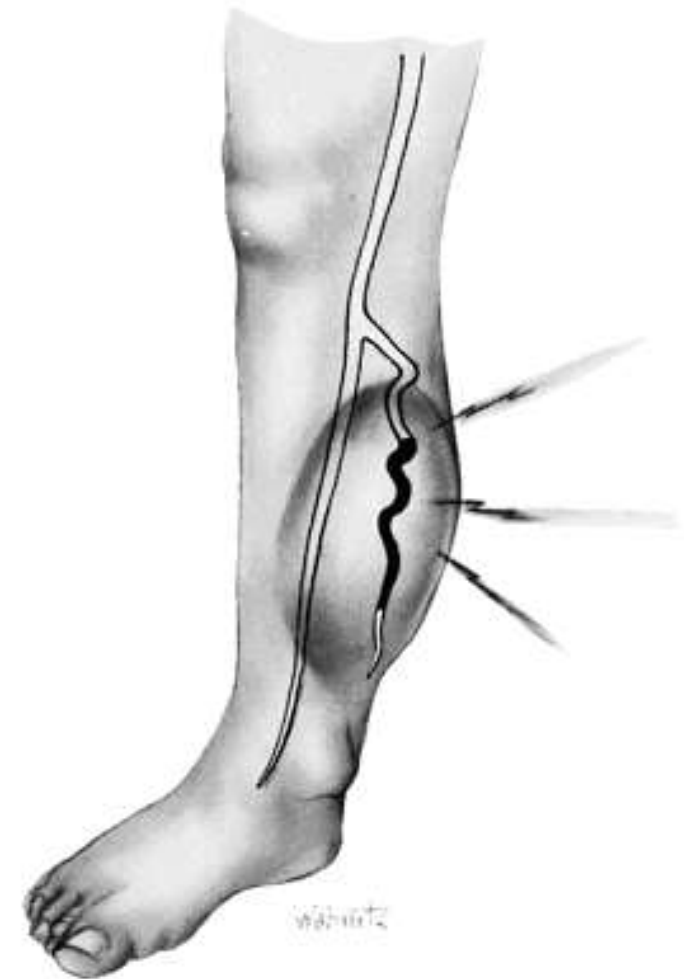




Superficial vein thrombosis

Superficial vein thrombosis

- Acute inflammation of superficial vein and soft tissues.
- Redness, tenderness and swelling surrounding a palpable thrombosed superficial vein
- Thrombophlebitis can lead to PE
- Most danger – thrombophlebitis on hip



SVT treatment

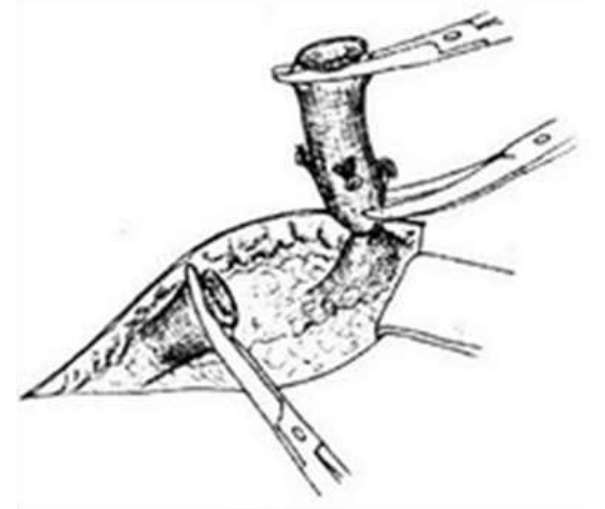
- Far away from deep veins (low VTE risk):
 - Ultrasound examination
 - Systemic NSAIDs
 - Elastic compression
 - Local heparins and NSAIDs
 - Venoactive drugs (diosmin)
- Near to deep veins (increased VTE risk):
 - Ultrasound examination
 - Anticoagulation
 - High ligation if AC contraindicated

High ligation

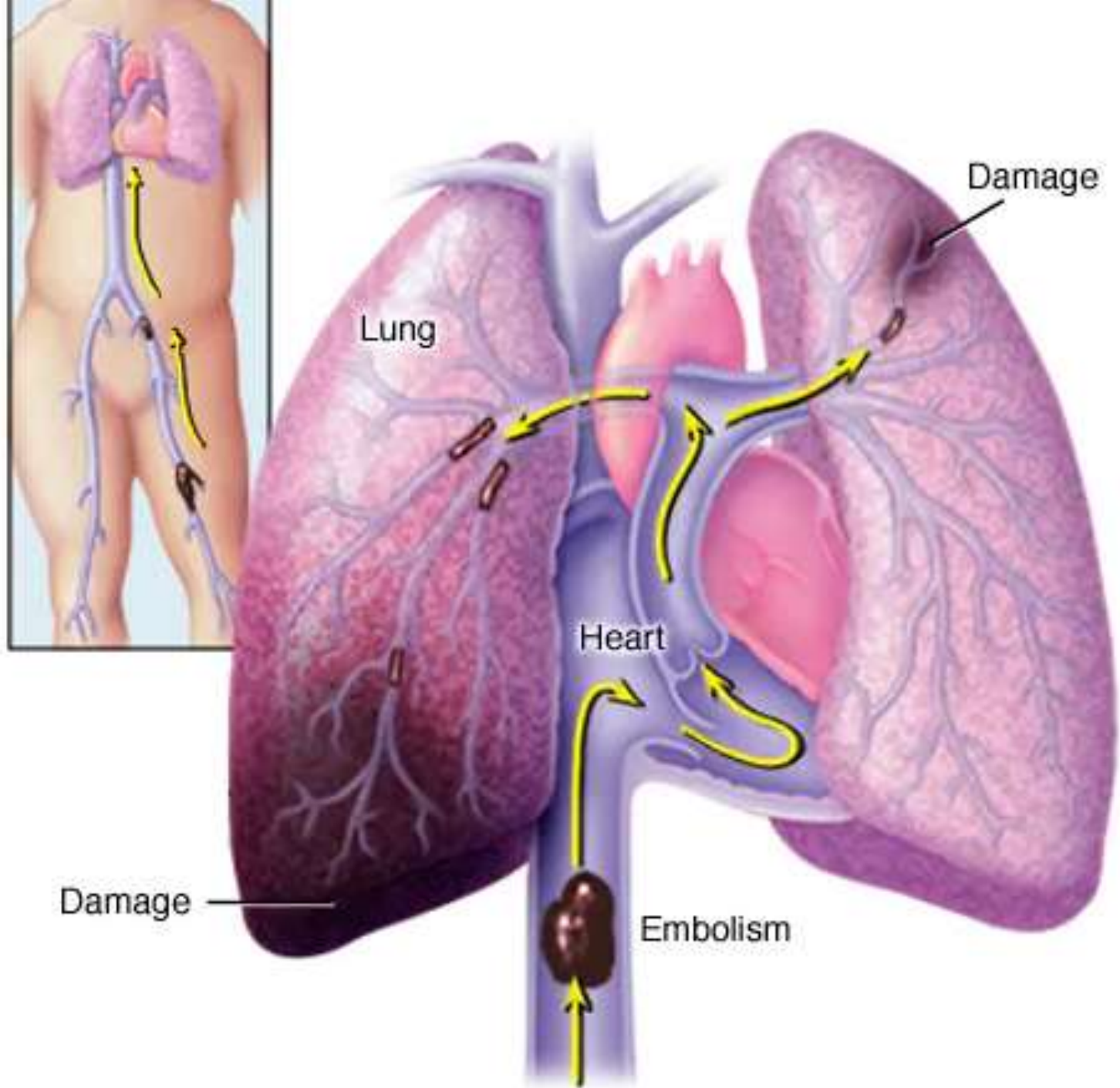
Great saphenous vein ligation
under its junction – prevention
of PE in thrombophlebitis

With or without thrombectomy
from femoral vein.

Increases VTE risk without AC!



Pulmonary embolism



Pulmonary embolism

Etiology

- Deep and superficial vein thrombosis
- Pelvic vein thrombosis
- Upper limbs vein thrombosis (rare)
- Right heart thrombus

Symptoms

- Sudden dyspnea
- Cough
- Chest pain
- Skin cyanosis
- V.jugularis swelling and hypertension
- Increase heart rate
- Decrease arterial blood pressure

PE diagnosis

- D-dimer: non-specific sign of thrombosis and lysis
 - PE exclusion if negative (99.5%)
- Natriuretic peptide, troponin – sign of right ventricular hypertension and damage
- ECG – signs of right ventricular failure
- Heart ultrasound examination – right ventricular and pulmonary artery hypertension
- Chest X-ray – signs of lung hypoperfusion and atelectasis
- Isotope lung scanning – arterial hypoperfusion
- Computer Tomography PA (CTPA) – gold standard
- MRI PA
- Pulmonary arteriography (PA)

Chest X-ray

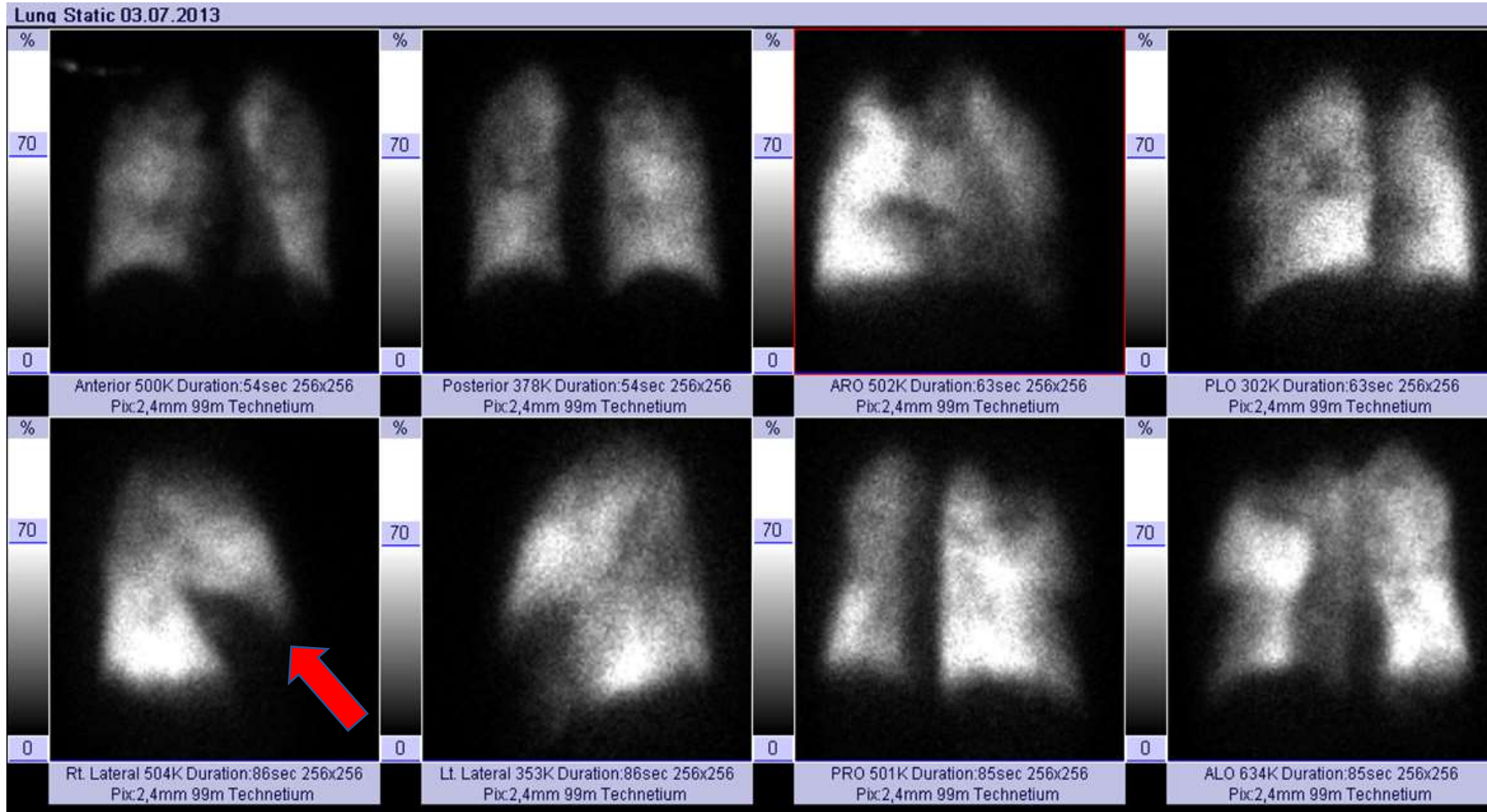


At the onset of PE – no specific changes

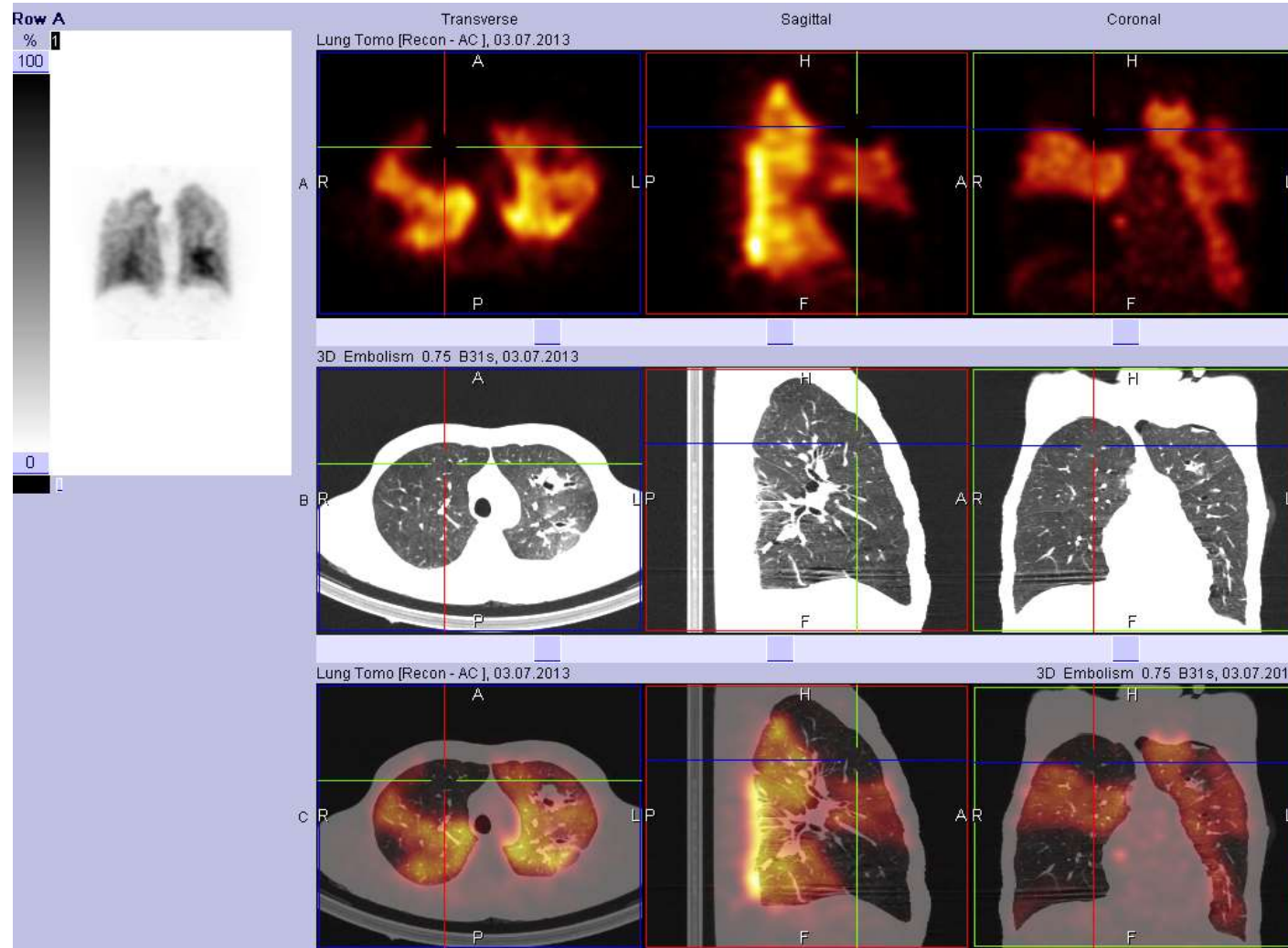


Lung atelectasis – the late sign of PE

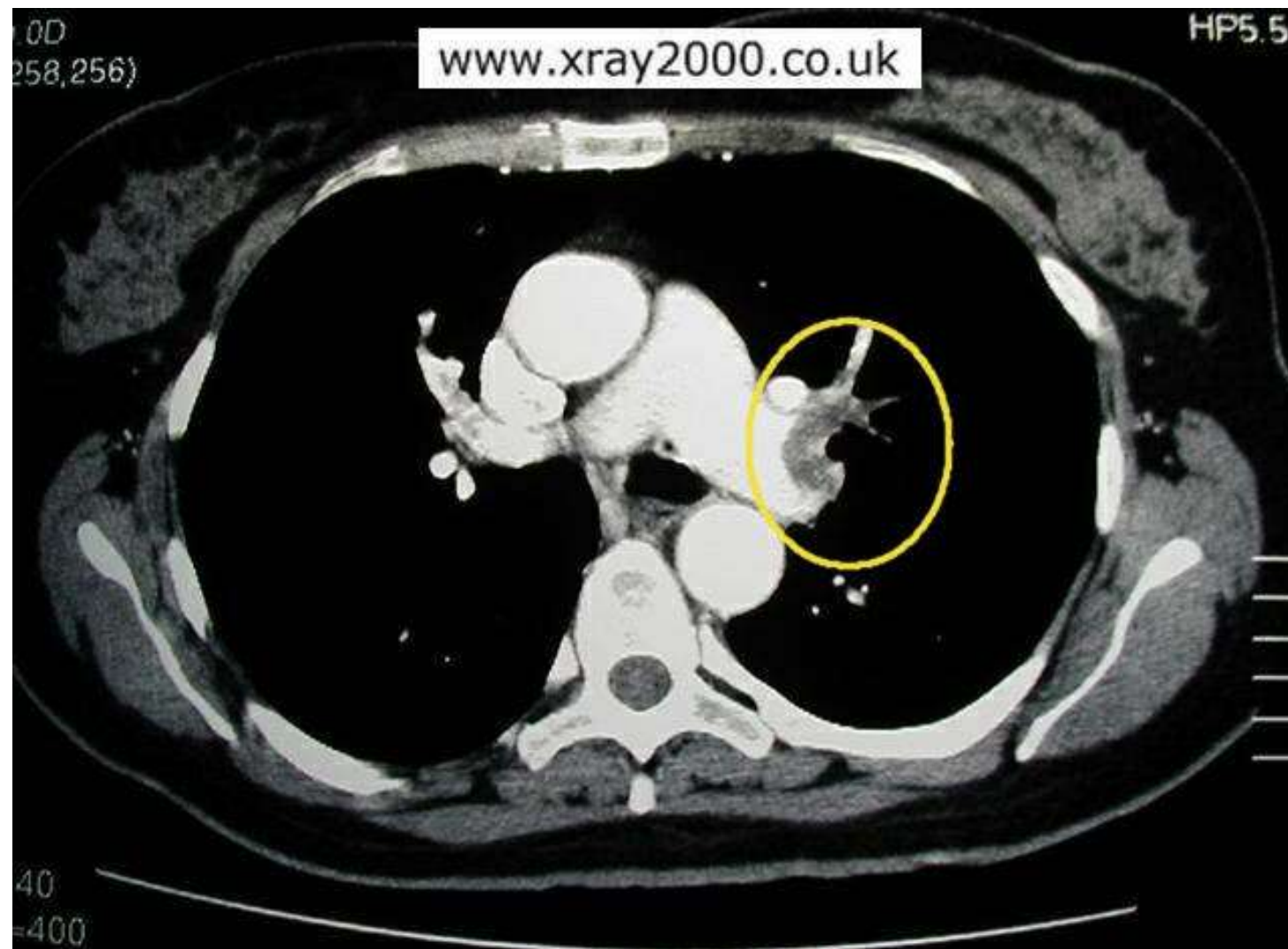
Isotope scanning



SPECT/CT

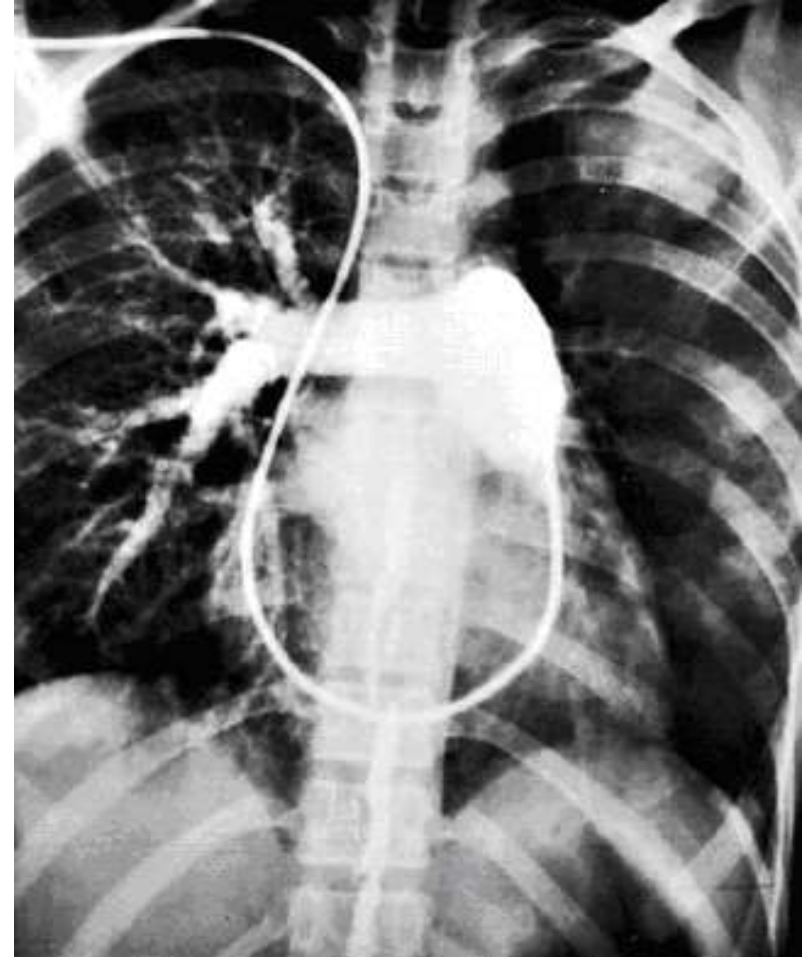


CTPA



Pulmonary angiography

A selective pulmonary angiogram demonstrating absence of filling of left pulmonary arterial branches because of a large embolus obstructing the left main pulmonary artery



PE treatment

- Anticoagulation
- Systemic thrombolysis
- Thrombus extraction
 - Open (sternotomy, cardiac arrest)
 - Endovascular
 - Catheter-directed thrombolysis
 - Mechanical thromextomy
- Cardiac and respiratory support
- Prevention of PE recurrence in long term

PE treatment

Risk of death	Shock	PESI score	Dilatation of right chambers	Troponin	Treatment
High	+	(+)	(+)	(+)	Systemic thrombolysis, Open thrombectomy Endovascular treatment
Intermediate-high	-	+	+	+	Anticoagulation, systemic thrombolysis may be required
Intermediate-low	-	+	+	-	Anticoagulation
Low	-	-	-	-	Anticoagulation



Chronic venous disease

Chronic venous disease

- The most common vascular disorder in the world
- Affects up to 85% people in the world

Chronic vein pathology classification - CEAP

Clinical		Etiology	Anatomy	Pathology
0	No visible sign	Congenital	Superficial veins	Reflex
1	Telangiectasia and reticular veins	Primary	Deep veins	Occlusion
2	Varicose veins	Secondary	Perforant vein	
2r	Recurrent varicose veins			
3	Edema			
4	Skin dystrophy			
4a	Hyperpigmentation or eczema			
4b	Sclerosis and atrophy			
4c	Corona phlebectatica			
5	Healed leg ulcer			
6	Open leg ulcer			
a – no symptoms				
s – symptoms				

C0

- No visible signs of disease
- May be heavyness, fatigueability, cramping (C0s)



C1



Varicose transformation of small intradermal veins and capillary - **telangiectasia (spider veins)**



Varicose transformation of big intradermal vein – **reticular varicosis**

C2



Varicose transformation of subdermal veins – big and small saphenouse veins and their branches because of blood reflux through junctions and communicant veins



C2r



Recurrent varicose veins after previous treatment



C3



- Leg edema
- Swelling of soft tissues or muscles
- Distal localization
- May be unilateral

C4



C4a – skin hyperpigmentation and eczematous inflammation (dermatitis)



C4b – soft tissues sclerosis (induration) and white spots (atrophy)



C4c



Corona phlebectatica

C5



Healed venous leg ulcer

C6



Open venous leg ulcer

- Typically – near medial ankle in the lower third of shin
- Around – skin induration, hyperpigmentation, inflammation
- Usually, varicose veins present on leg

C6r

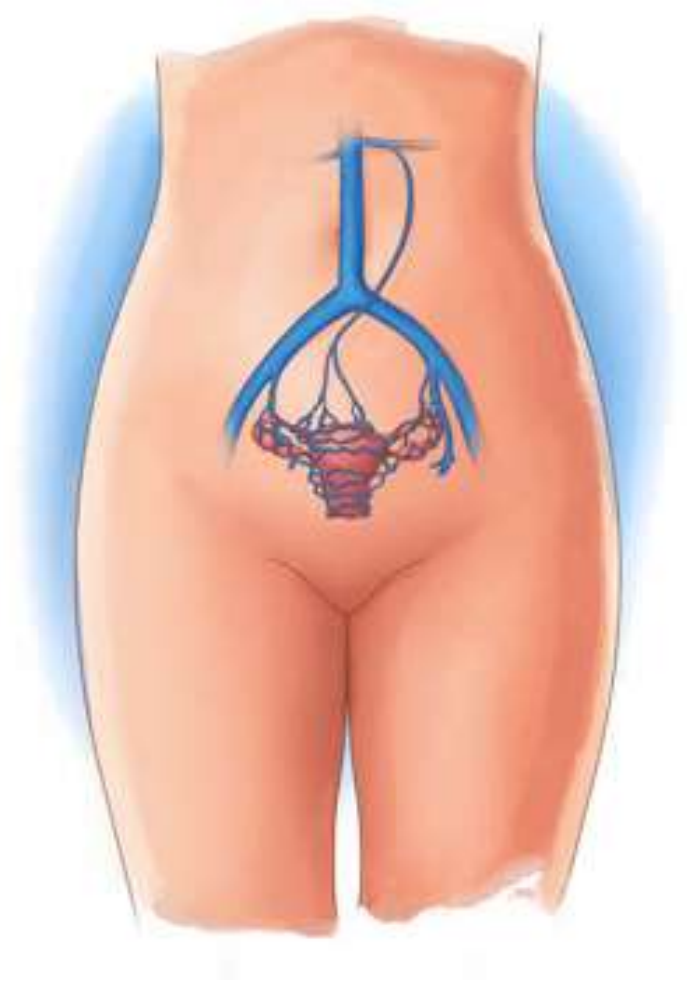


Recurrent venous leg ulcer

Pelvic varicose veins

Varicose veins of ovary and uterus in pelvis

- Vulvar varicose veins
- Perineal varicose veins
- Gluteal varicose veins
- Leg varicose veins



Lymphedema (elephantiasis)

- Secondary lymphedema – long term complication of venous insufficiency
- Because of lymphatic vessels obstruction and sclerosis
- The cause of this – long loading of lymphatic system with high protein transudate
- The edema is irreversible because of tissues sclerosis



Stemmer's symptom – the foot's back edema

CVD treatment

- Life-style correction
- Elastic compression
- Physiotherapy
- Venoactive drugs
- Sclerotherapy
- Surgery

Life-style correction

- Avoid long standing
- Sitting with strength legs
- Walking every 1 hour while sitting work
- Leg exercises
- Wearing shoes with heel 4-6 cm long
- Sleeping with elevated legs
- Avoid thermal procedures on legs
- Contrast shower on legs daily
- Prevention of obstipation



Compression therapy

- Decrease venous volume
- Increase blood flow velocity
- Improve valve function
- Prevent fluid transudation
- Removing of edema
- Activation of fibrinolytic system



Elastic compression

Compression bandage

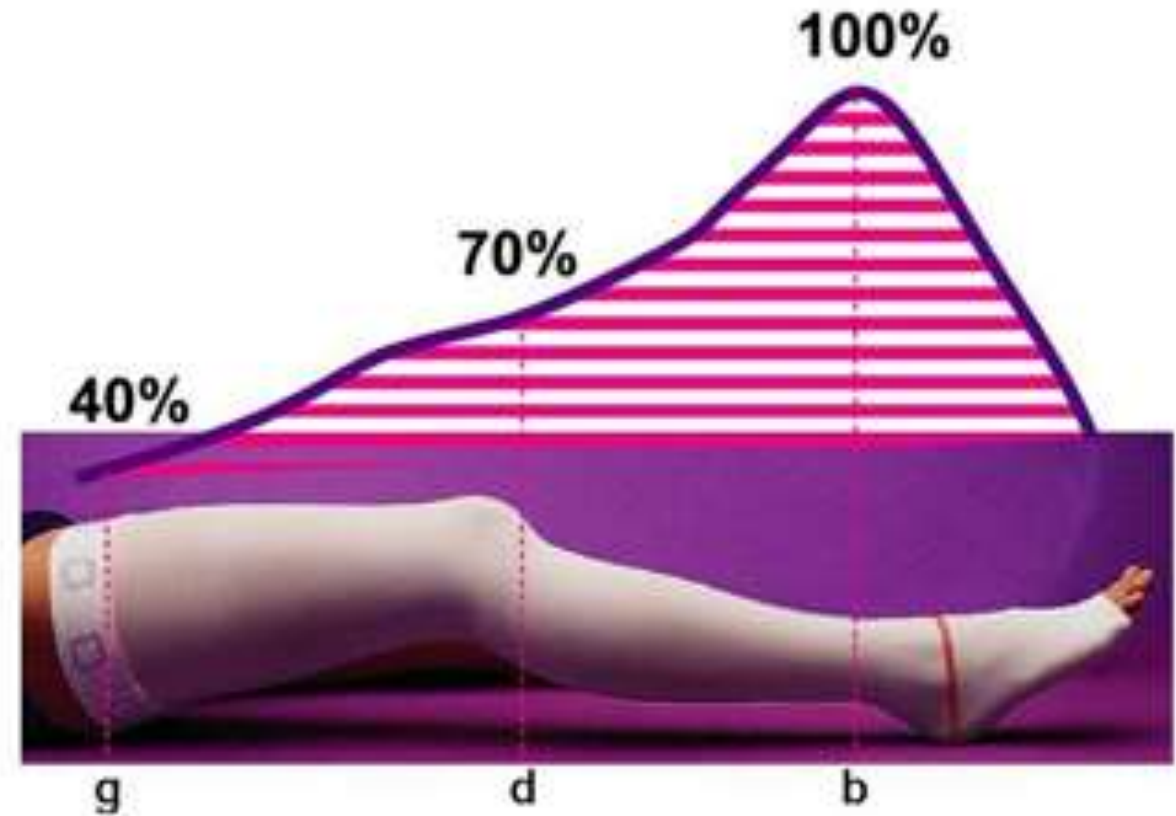


Medical stockings



Elastic compression

- Compression should be GRADUATED
- Bandage – pressure graduate by leg anatomy and stuff's skill
- Stockings – graduation provides by production technique and size matching

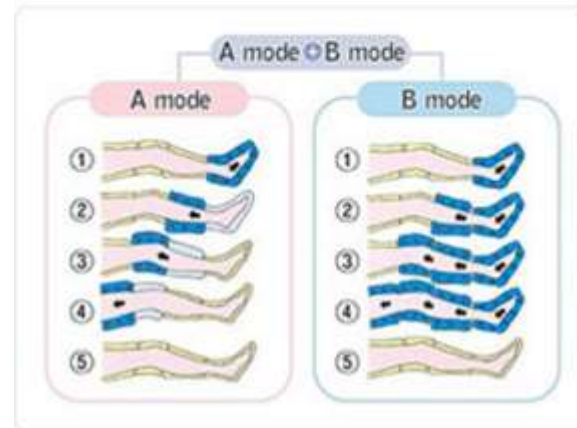


Compression level

Compression level		Indications	RAL-GZ stocking class
Mild	10-20 mm Hg	VTE prevention CVD prophylaxis in risk groups	1 class
Medium	20-40 mm Hg	Varicose veins Leg edema Sclerotherapy Acute DVT and thrombophlebitis CVD prophylaxis in pregnancy	2 class
Strong	40-60 mm Hg	Skin dystrophy Healed leg ulcer Open leg ulcer Post thrombotic syndrome	3-4 class Special kits for ulcer treatment
Very strong	More than 60 mm Hg	Open leg ulcer Lymphedema	-

Intermittent pneumatic compression

- Special cuffs put on leg and fill with air under high pressure (40-120 mm.hr) for short time
- Significant increase of blood flow
- Treatment of severe venous and lymphatic insufficiency



Electric calf stimulation

- Activation of calf pump
- Improving valve function
- Significant increase of blood velocity
- Emptying of all shin veins and sinuses
- Not depend on valves, muscles and joint condition



Pharmacological treatment

Targets:

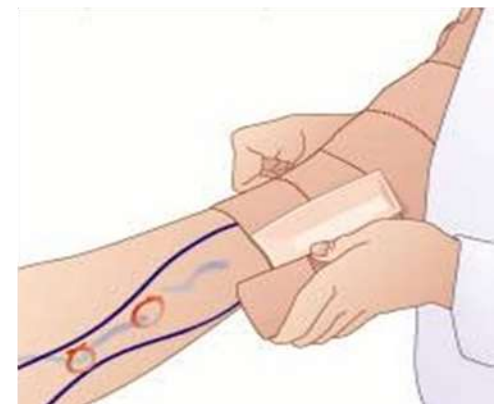
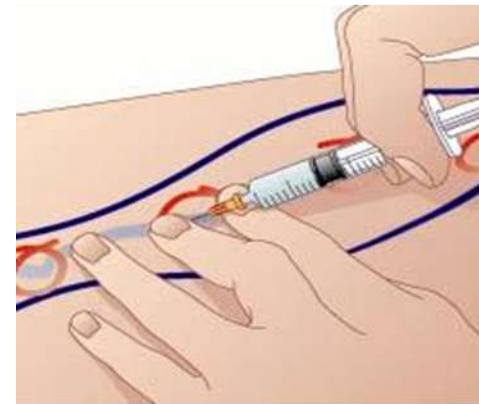
- Increase of vein tone
- Protect vein wall, valves and tissues from leucocyte aggression
- Improve lymph outflow
- Improve microcirculation and tissue trophy
- Correct coagulation and aggregation
- Reduce inflammation

A blank sheet of white paper with a light gray grid pattern. The grid consists of horizontal and vertical lines forming small squares. There are faint, large, stylized letters 'OOF' and 'EDICA' visible in the background, likely from the reverse side of the paper. A horizontal line runs across the middle of the page, and another horizontal line runs near the bottom edge.

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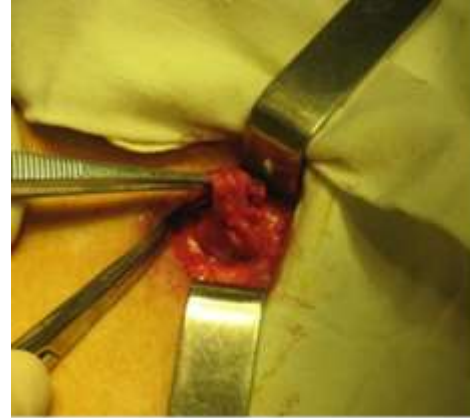
Sclerotherapy

- Intravenous injection of special agents, which lead to endotelium desquamation and vein obliteration with next involution
- Optimal method for removing of small veins, branches of GSV, SSV
- May be liquid and foam-form agent
- After injection need compression at least for 7 days



Surgery

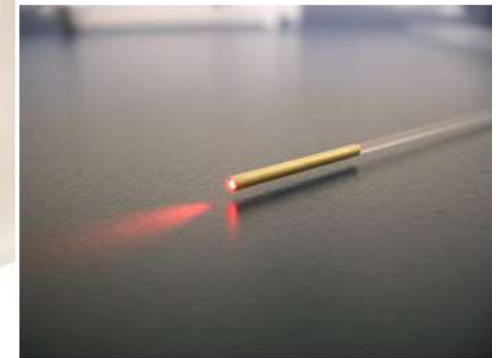
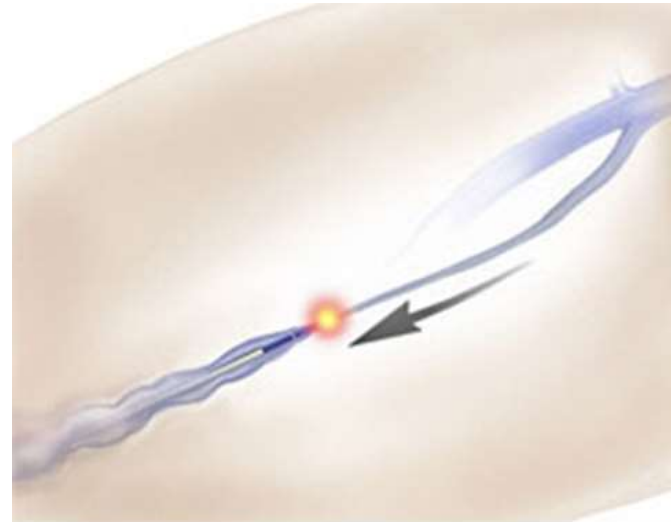
- Removing of reflux in junction and communicant veins
- Removing of varicose veins – GSV, SSV and branches
- The most radical treatment
 1. High ligation – ligation of GSV/SSV and all its brunches near junction
 2. Stripping – removing of GSV/SSV truncus with special probe
 3. Mini phlebectomy – removing of varicose brunches through mini-incisions



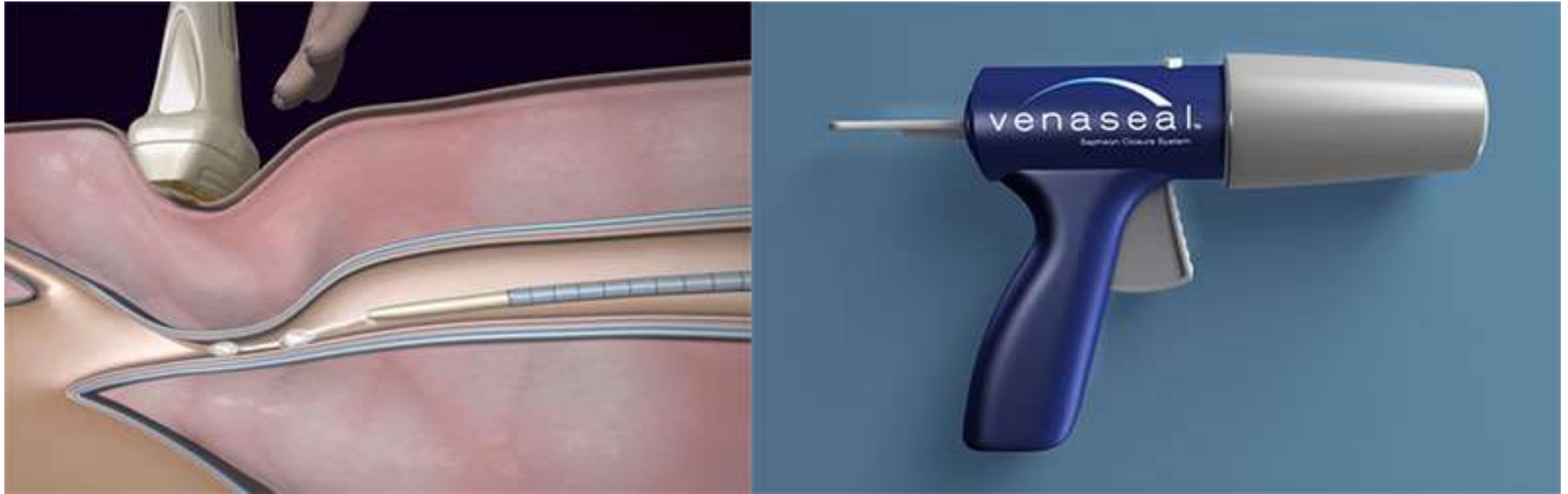
Endovenous thermal ablation

- Endovascular laser/radiofrequency treatment (EVLT/RFA)
- Removing of reflux in GSV and SSV by means of vein thermal obliteration with further vein involution
- Local anesthesia, ambulatory procedure
- Need ultrasound navigation

Under ultrasound navigation a special light guide insert into vein lumen and move up to sapheno-femoral junction. Laser energy absorb by Hb and heat the vein wall. Moving the light guide allow to heat even wall along all vein. After heating we can see vein obstruction and obliteration and the involution.

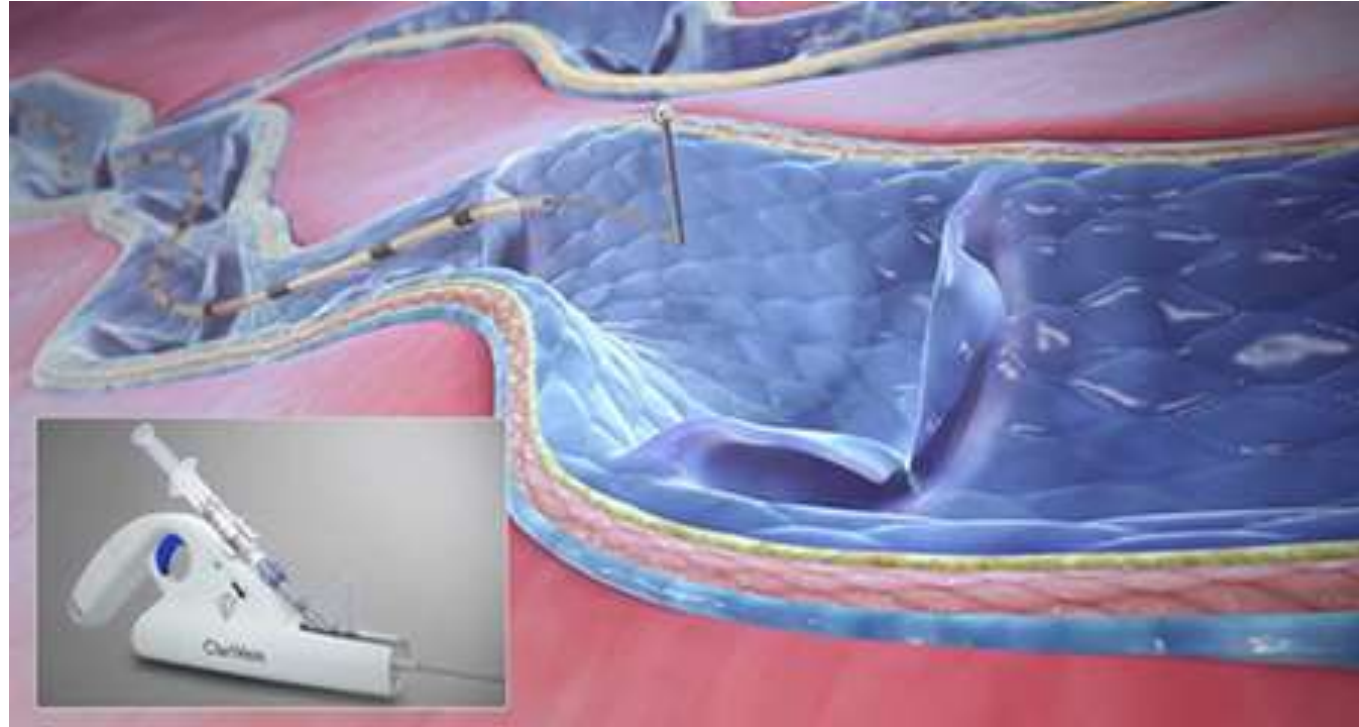


Non-thermal ablation



VenaSeal – cyanoacrylate glue ablation that does not require local anesthesia

Non-thermal ablation



ClariVein – mechanical damage of endothelium plus liquid sclerotherapy that does not require local anesthesia