Deep vein thrombosis (DVT)

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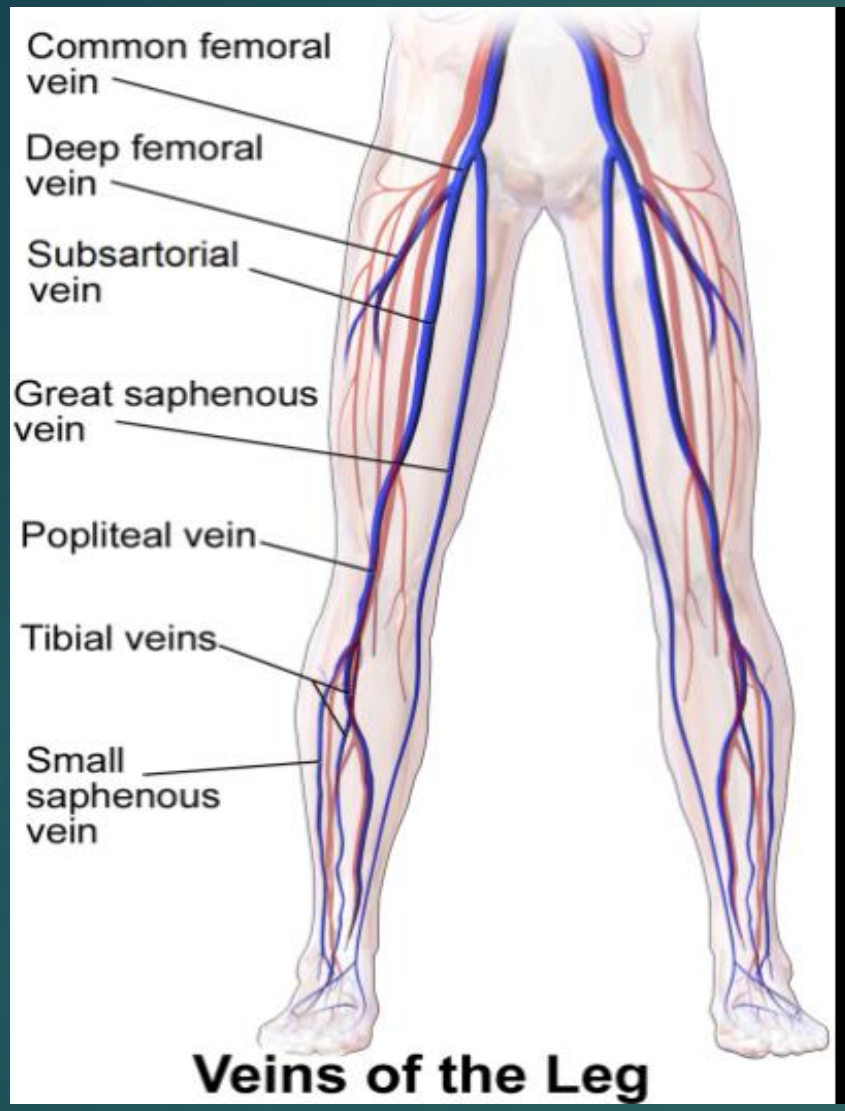
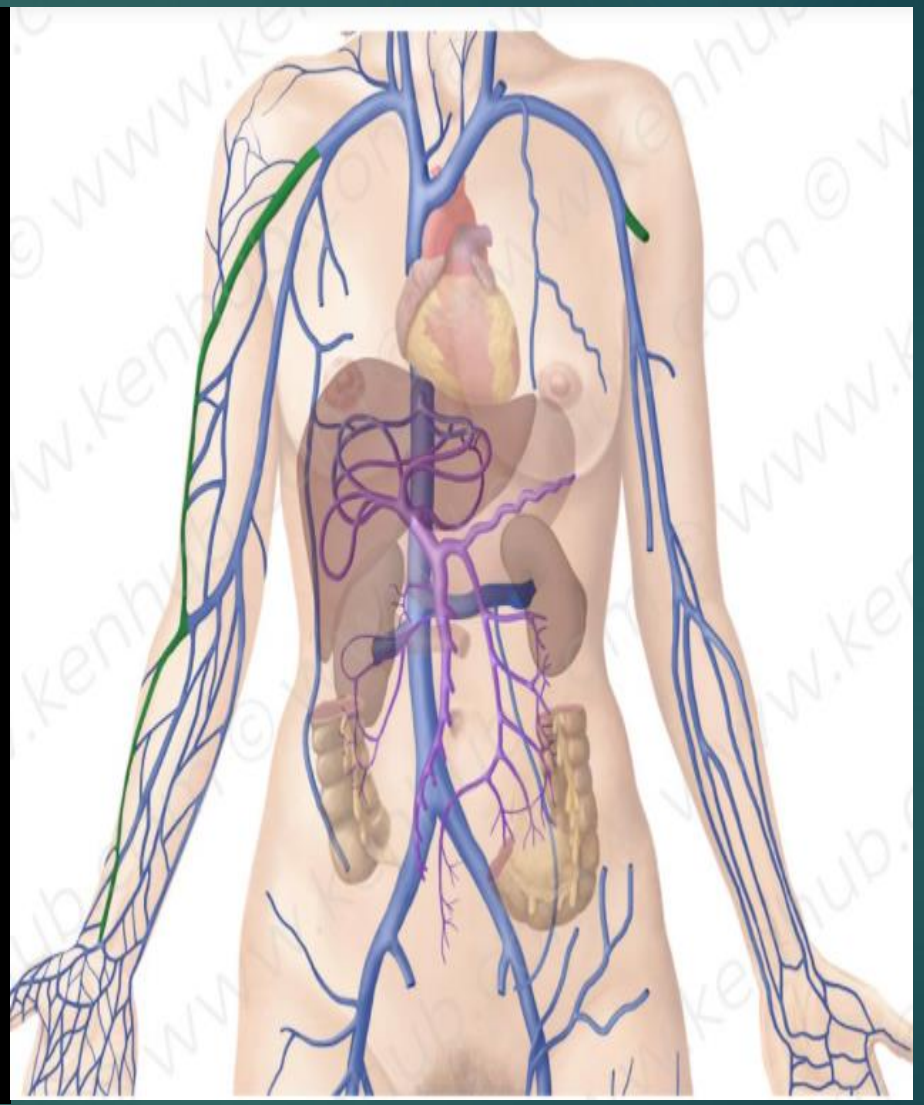
- Despite increased awareness and use of prophylactic modalities, DVT or pulmonary embolism (PE), venous thromboembolism (VTE), remain important preventable sources of morbidity and mortality, especially in the surgical patient

- The incidence of VTE is approximately 100 per 100,000 people per year in the general population, with 20% of the diagnoses made within 3 months of a surgical procedure
- Of the symptomatic patients, one-third will present with PE and two-thirds with DVT

- A more recent study noted a high (15.2%) rate of DVT in critically ill trauma patients within the first week that did not vary regardless of whether or not prophylaxis was used


Common femoral vein
Deep femoral vein
Subsartorial vein
Great saphenous vein
Popliteal vein
Tibial veins
Small saphenous vein
Veins of the Leg



Risk factors for venous thromboembolism

Acquired

Advanced age
Hospitalization/immobilization
Hormone replacement therapy and oral contraceptive use
Pregnancy and puerperium
Prior venous thromboembolism
Malignancy
Major surgery
Obesity
Nephrotic syndrome
Trauma or spinal cord injury
Long-haul travel (>6 hours)
Varicose veins
Antiphospholipid antibody syndrome
Myeloproliferative disease
Polycythemia

Inherited

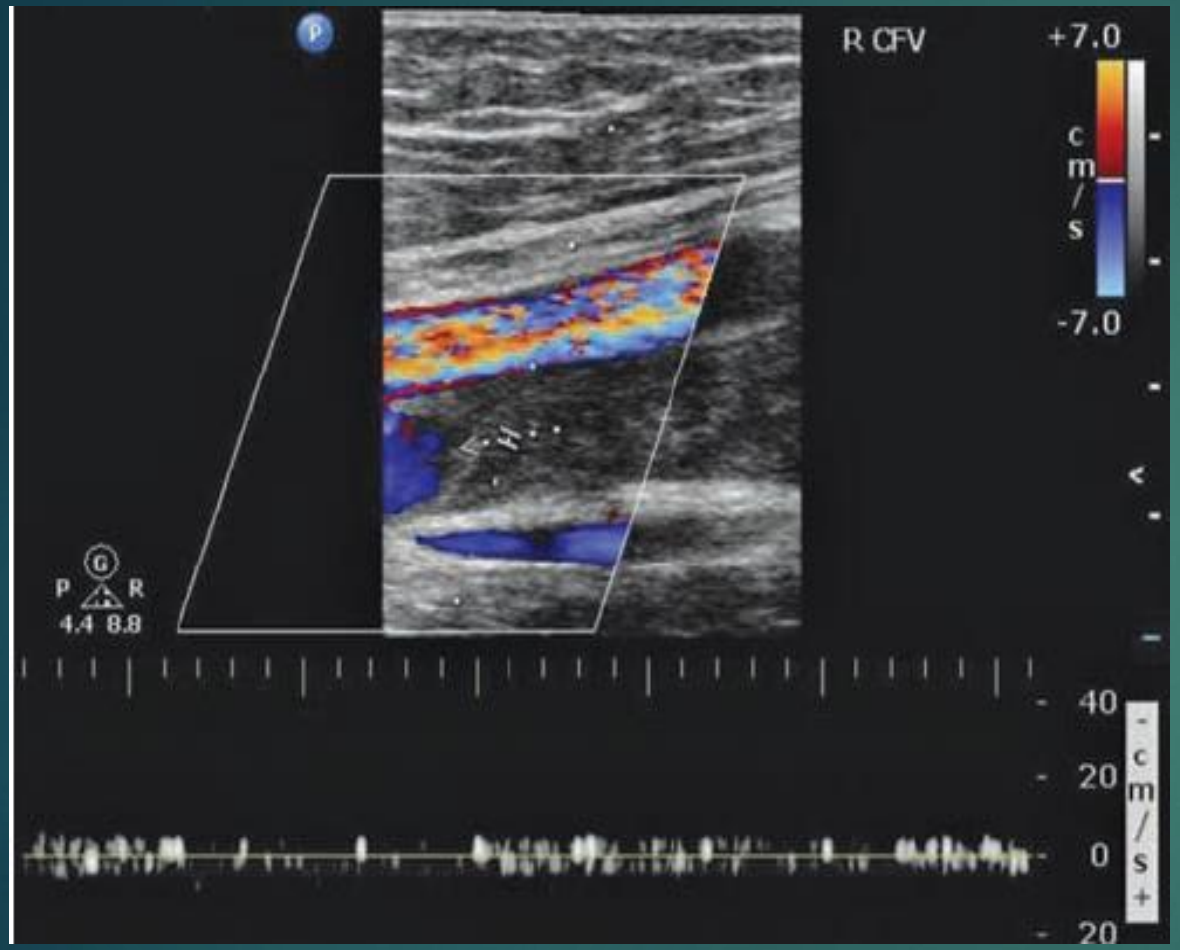
Factor V Leiden
Prothrombin 20210A
Antithrombin deficiency
Protein C deficiency
Protein S deficiency
Factor XI elevation
Dysfibrinogenemia

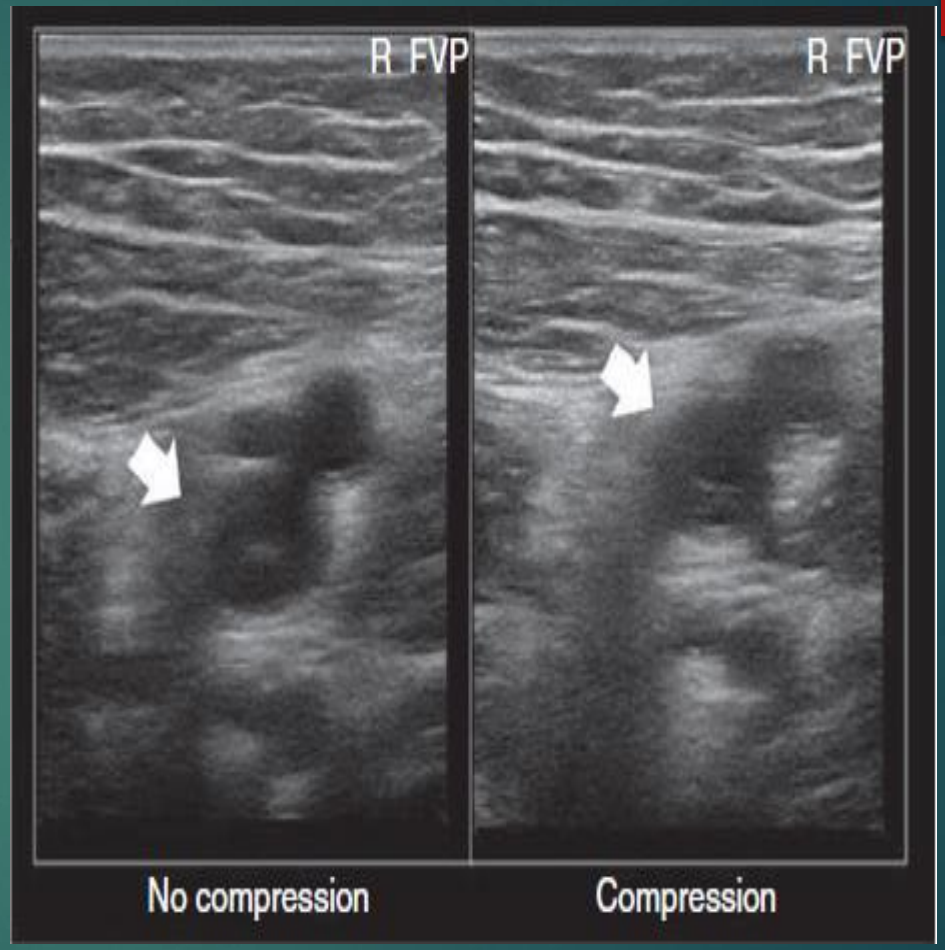
Mixed Etiology

Homocysteinemia
Factors VII, VIII, IX, XI elevation
Hyperfibrinogenemia
Activated protein C resistance without factor V Leiden

Active cancer Treatment or palliation within 6 months	**No 0**	Yes +1
Bedridden recently >3 days or major surgery within 12 weeks	**No 0**	Yes +1
Calf swelling >3 cm compared to the other leg Measured 10 cm below tibial tuberosity	**No 0**	Yes +1
Collateral (nonvaricose) superficial veins present	**No 0**	Yes +1
Entire leg swollen	**No 0**	Yes +1
Localized tenderness along the deep venous system	**No 0**	Yes +1
Pitting edema, confined to symptomatic leg	**No 0**	Yes +1
Paralysis, paresis, or recent plaster immobilization of the lower extremity	**No 0**	Yes +1
Previously documented DVT	**No 0**	Yes +1
Alternative diagnosis to DVT as likely or more likely	**No 0**	Yes -2

- Duplex ultrasonography (DUS)
- Magnetic resonance venography(MRV)
- Computed tomography (CT) venography


R CFV
+7.0
cm/s
-7.0
P R
4.4 8.8
40
20
0
20
cm/s


R FVP
R FVP
No compression
Compression

Anticoagulation

- Anticoagulation should be initiated as soon as there is a high level of suspicion for DVT and should not be delayed for confirmation with objective imaging

- to prevent thrombus extension and embolization
- to permit the body's natural fibrinolytic system to dissolve fibrin using anticoagulant therapy

Contraindications for outpatient treatment

- Active or high risk bleeding
- Severe symptomatic venous obstruction
- Thrombocytopenia
- Poor hepatic function, unstable renal function
- Noncompliance,a poor support environment at home

- Intravenous or subcutaneous UFH followed by warfarin
- Subcutaneous low-molecular-weight heparin (LMWH)
- Subcutaneous pentasaccharide (fondaparinux)
- Intravenous direct thrombin inhibitors (DTIs)
- Direct-acting oral anticoagulants (DOACs)

Unfractionated heparin (UFH)

- Monitoring is necessary
- The need for hospitalization
- Frequent blood draws, variable response
- Difficulties in promptly achieving the target therapeutic range
- The potential for life-threatening allergenic response causing heparin induced thrombocytopenia (HIT)

- An initial bolus of 5000 units or 80 U/kg followed by an infusion of 18 U/kg per hour
- 1 mg of protamine sulfate neutralizes 100 units of heparin

Perioperative Management

- When given subcutaneously for thromboprophylaxis, the last dose of heparin should be administered at least 2 hours before surgery
- Full-dose intravenous heparin should be stopped 4 to 6 hours before surgery
- Low-dose heparin can be restarted 12 to 24 hours after surgery
- Resumption of full-dose heparin should be delayed until hemostasis is secure

Low-Molecular-Weight Heparin

- enoxaparin, tinzaparin, and dalteparin
- Recommend LMWH over VKA or DOACs for the initial 3 months of treatment of acute VTE associated with cancer
- LMWH monitoring include renal insufficiency, obesity, and pregnancy

Perioperative Management

- Prophylactic doses, the last dose of LMWH should be given at least 12 hours before surgery
- Treatment doses of LMWH, the drug should be held for 24 hours before surgery
- Thromboprophylaxis with LMWH can be started 12 to 24 hours after surgery
- Resumption of full-dose LMWH should be delayed for 2 to 3 days

Parenteral Direct Thrombin Inhibitors

- lepirudin,argatroban, and bivalirudin

Vitamin K Antagonists

- warfarin produces their anticoagulant effects by inhibiting the production of vitamin K-dependent coagulation factors
- Stopped 5 days before surgery or invasive procedures
- INR should be less than 1.5
- Restarted 12 to 24 hours after surgery, and patients should receive prophylactic doses of heparin or LMWH after surgery until the INR is at least over 1.8

Direct-Acting Oral Anticoagulants

- Factor Xa

- Thrombin (dabigatran)

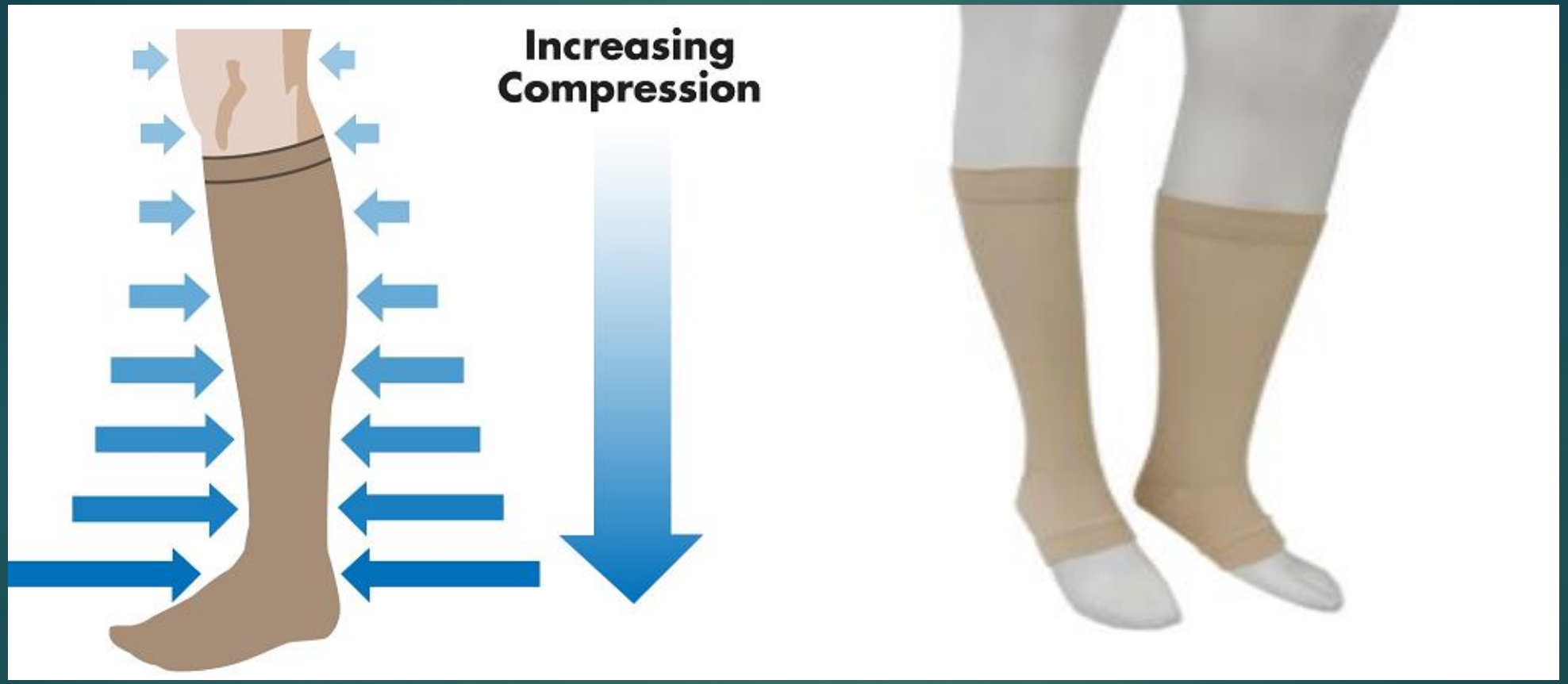
Adjunctive Measures for DVT

- Elevation of the legs above the heart reduces the acute edema and reduces pain
- Bed rest is no longer recommended for patients with VTE
- Applied gradient elastic compression and began early ambulation for the acute treatment of lower extremity DVT compared to bed rest with elevation
- There was no increase in the incidence of PE with early ambulation

- A more recent study,using surveillance lung scanning, showed that bed rest did not reduce PE
- Some studies indicate that immobility increases the risk for development of PE
- Most guidelines recommend initiating anticoagulation prior to allowing patients to ambulate

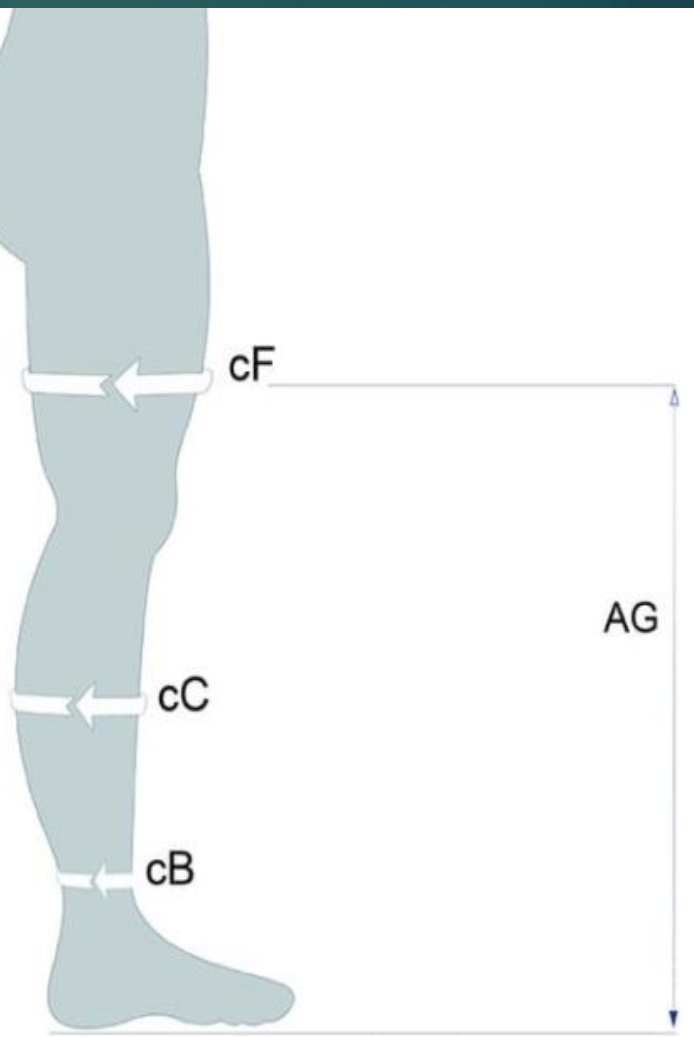
Elastic Compression Stockings

- Graduated elastic compression stockings (GCSs) reduce the cross-sectional area of the veins and increase the velocity of venous blood flow
- 30 to 40 mm Hg at the ankle


Increasing
Compression

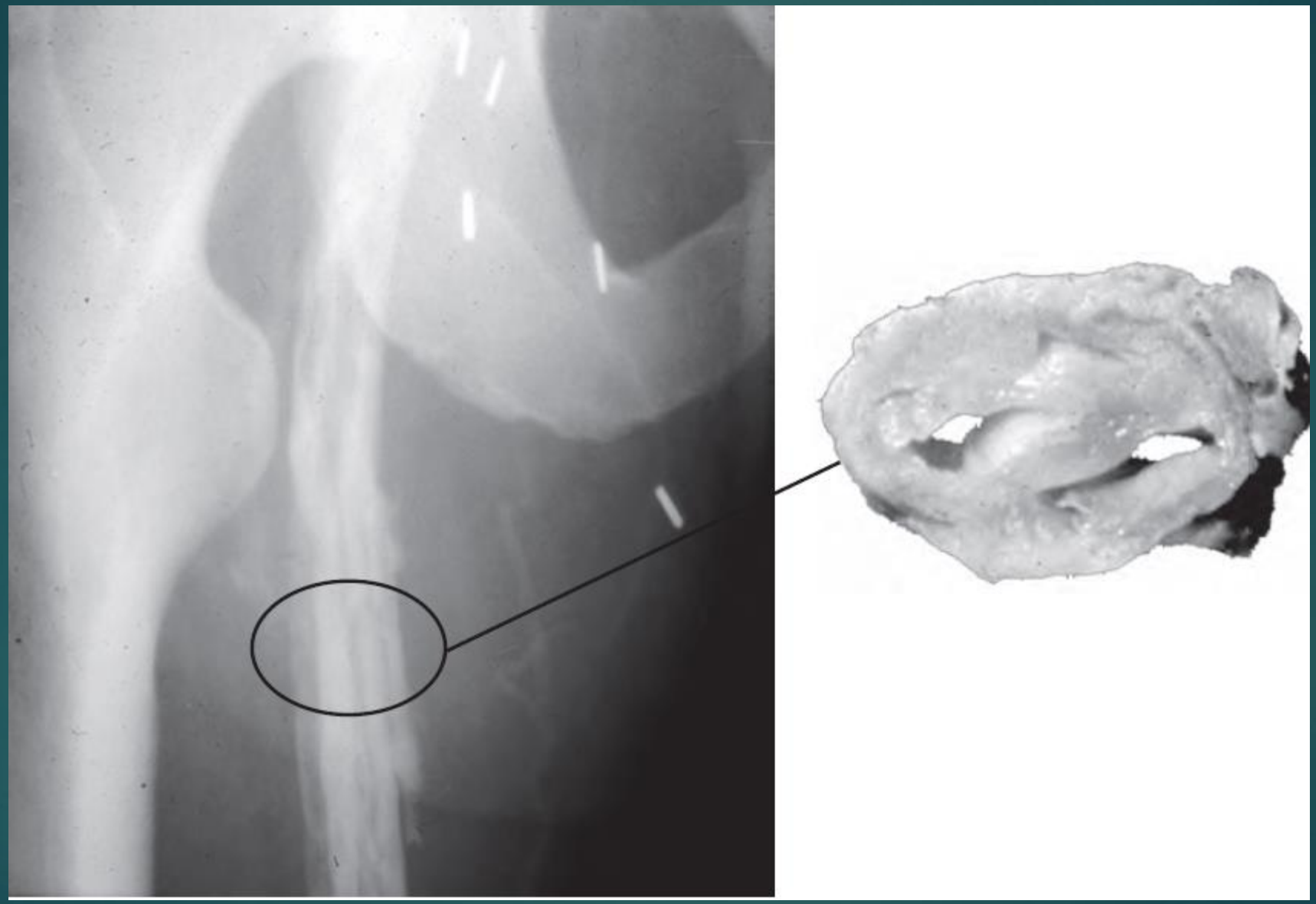
- Peripheral artery disease with lack of palpable foot pulses
- Ankle-brachial index less than 0.8
- Patients with severe leg edema secondary to congestive heart failure
- Patients with dermatitis

محدوده سایز بندی	سایزها (cm)					
	S (II)	M (III)	L (IV)	XL (V)	XXL (VI)	XXXL(VII)
cB	20 - 22	22 - 24	24 - 26	26 - 28	28 - 30	30 - 32
cC	30 - 37	33 - 40	35 - 43	37 - 45	39 - 47	41 - 49
CF	40 - 52	43 - 56	46 - 60	50 - 65	53 - 68	56 - 71



Management of iliofemoral DVT (IFDVT)

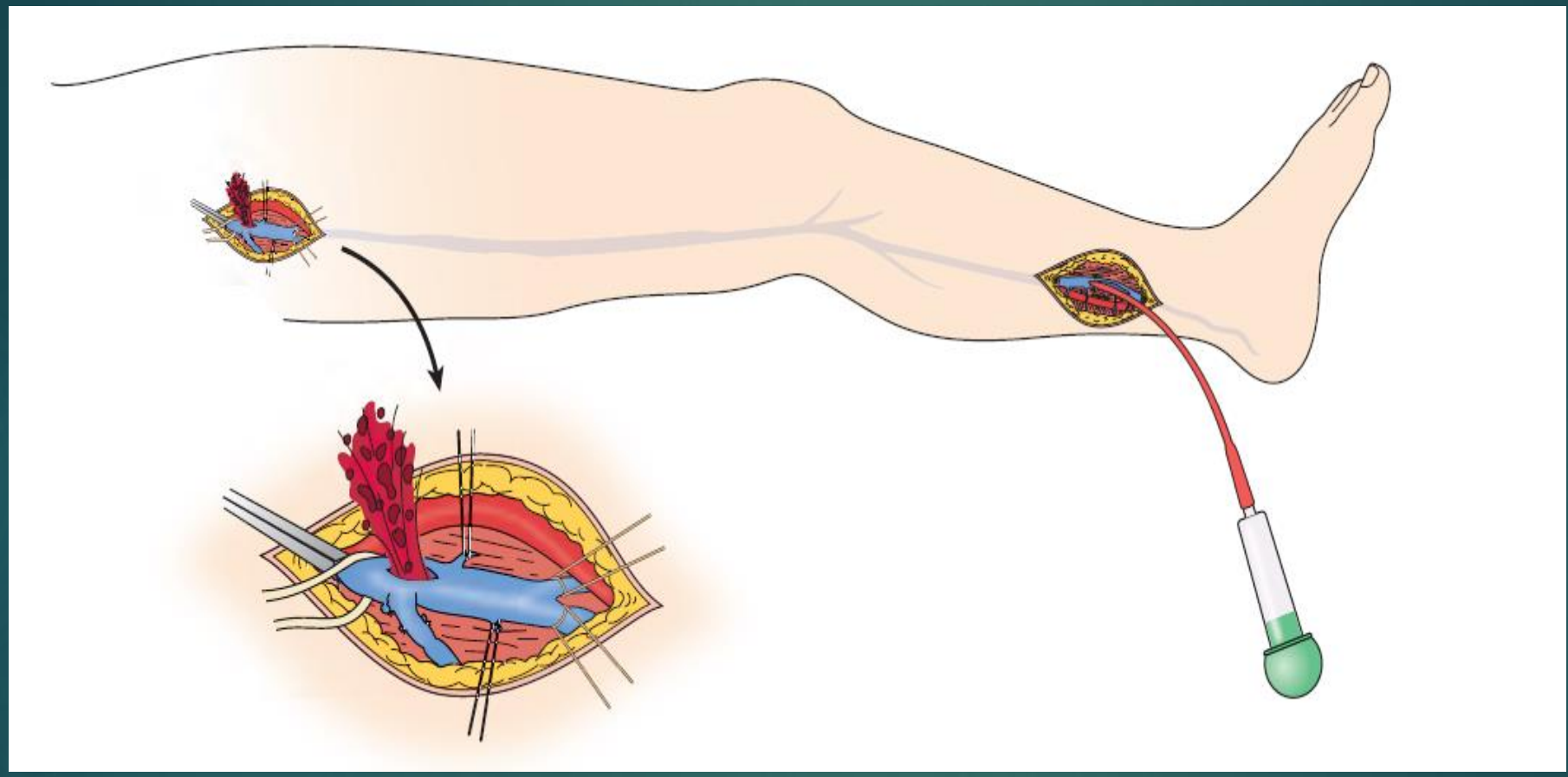
- Guidelines suggest interventional strategies for thrombus removal that include surgical and catheter-based techniques to reduce the incidence of postthrombotic syndrome (PTS), especially in patients with extensive venous thrombosis

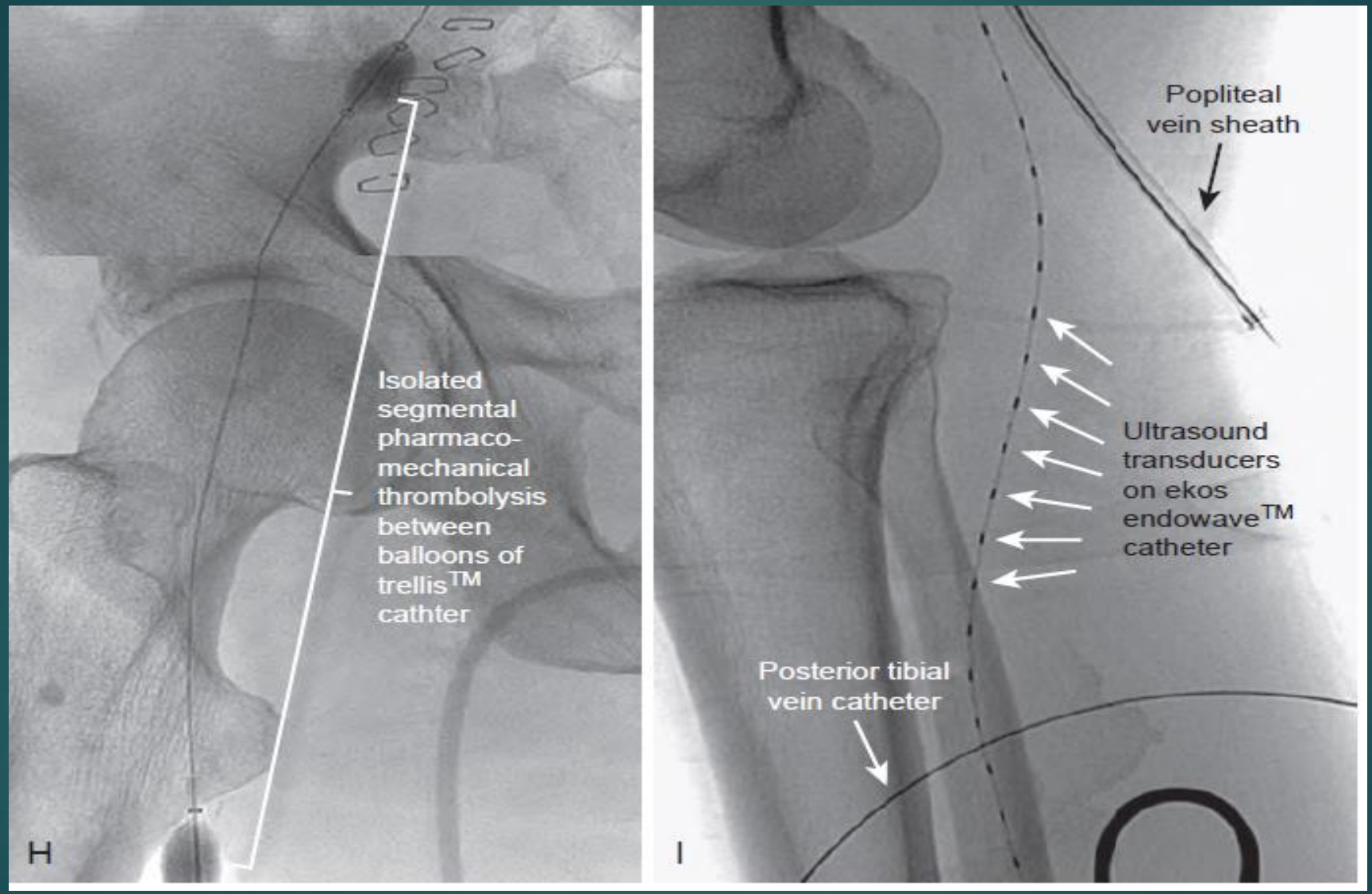


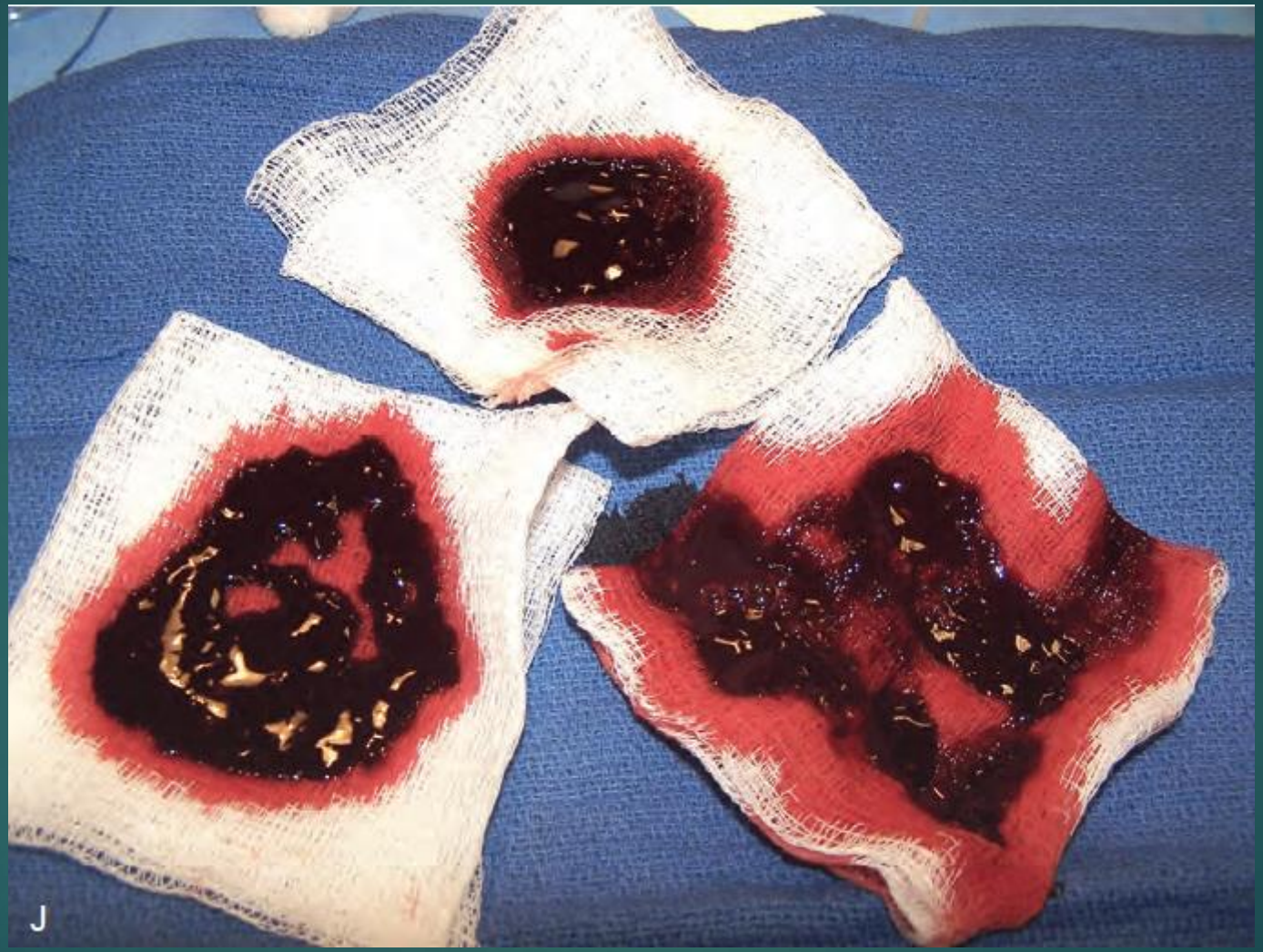
When a strategy of thrombus removal is successful:

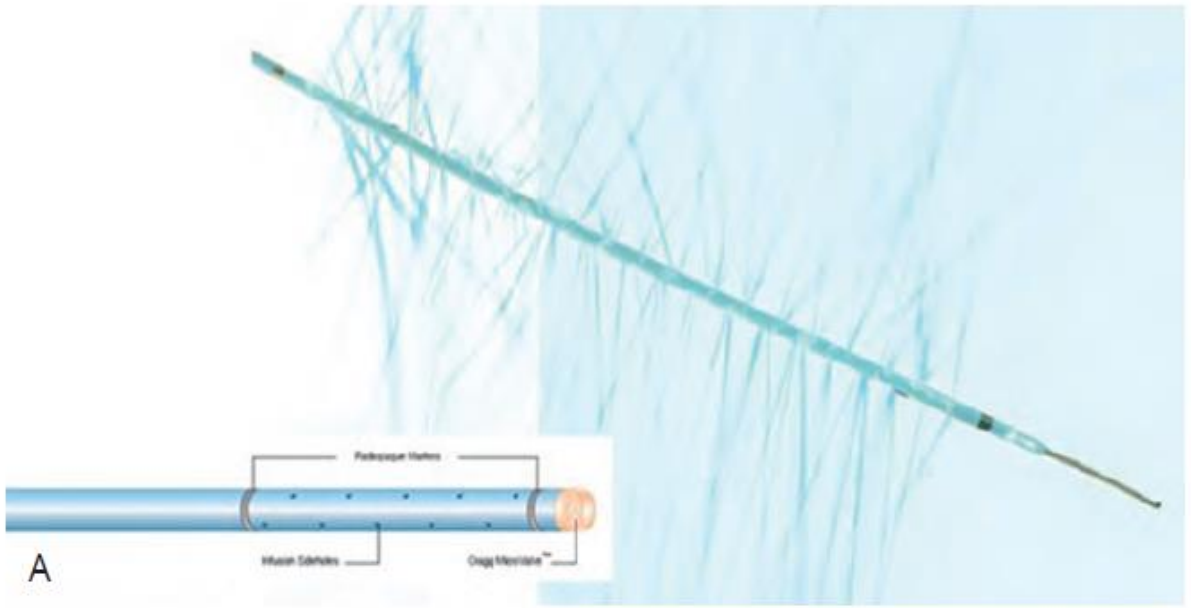
1. Venous patency is restored
2. Valve function is maintained
3. QoL is improved
4. The risk of recurrence is reduced

- *Intrathrombus Catheter-Directed Thrombolysis*
- *Pharmacomechanical Thrombolysis*
  1. Ultrasound-Accelerated Thrombolysis
  2. Isolated Segmental Pharmacomechanical Thrombolysis
  3. Endovascular Aspiration Thrombectomy
- *Operative Venous Thrombectomy*




Isolated segmental pharmaco-mechanical thrombolysis between balloons of trellis™ cathter
H
Popliteal vein sheath
Ultrasound transducers on ekos endowave™ catheter
Posterior tibial vein catheter
I


J


A


B

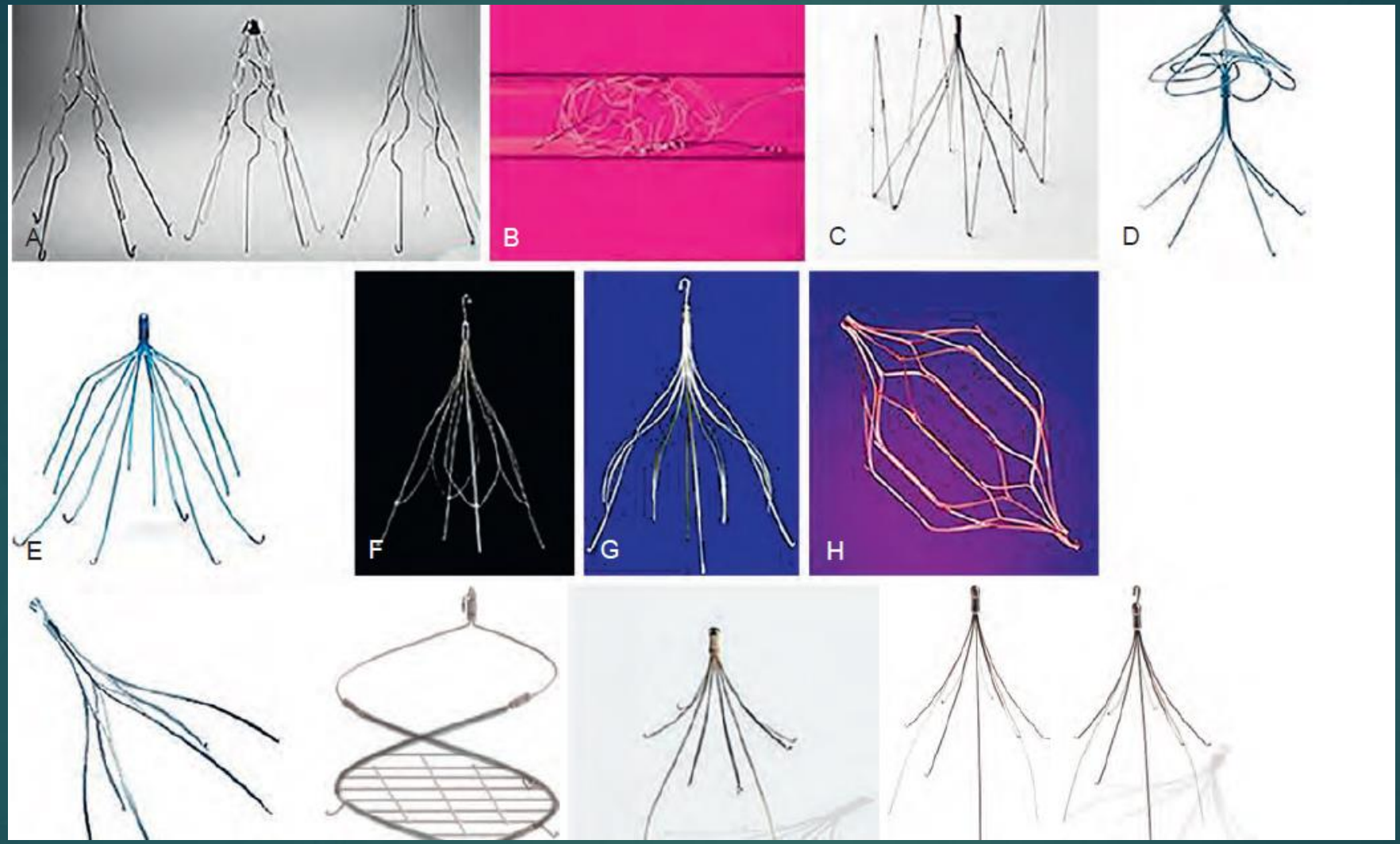
upper extremity DVT

- Pulmonary embolism is known to occur in 5% to 20% of patients with upper extremity DVT
- The distal tip of all central venous catheters be located at the junction of right atrium and the superior vena cava

- UEDVT to be treated with 3 to 6 months of anticoagulation and removal of the central catheter if the patient does not require it

Catheter-directed thrombolysis:

- Those with severe symptoms, thrombus involving most of the subclavian and axillary veins
- Symptoms present for less than 14 days
- Good functional status
- life expectancy greater than 1 year, and low risk for bleeding.


A
B
C
D
E
F
G
H

Evidence-Based Guidelines

- Documented VTE with contraindication to anticoagulation
- Documented VTE with complications of anticoagulation
- Recurrent PE despite therapeutic anticoagulation
- Documented VTE with inability to achieve therapeutic anticoagulation

Relative Expanded Indications

- Poor compliance with anticoagulation
- Free-floating iliocaval thrombus
- Renal cell carcinoma with renal vein extension
- Venous thrombolysis/thromboembolectomy
- Documented VTE and limited cardiopulmonary reserve
- Documented VTE with high risk for anticoagulation complications
- Recurrent PE complicated by pulmonary hypertension
- Documented VTE—cancer patient
- Documented VTE—burn patient
- Documented VTE—pregnancy
- VTE prophylaxis—high-risk surgical patients
- VTE prophylaxis—trauma patients
- VTE prophylaxis—high-risk medical condition

Contraindications

- Chronically occluded vena cava
- Vena cava anomalies
- Inability to access the vena cava
- Vena cava compression
- No location in the vena cava available for placement

PE, Pulmonary embolism; *VTE*, venous thromboembolism.

Prophylaxis in High-Risk Patients

- Critically ill
- Previous DVT
- Family history of DVT
- Morbid obesity
- Malignancy
- Known hypercoagulable state
- Prolonged immobility

Prophylaxis in Trauma

- Multiple traumatic injuries
- Spinal cord injury
- Closed head injury
- Complex pelvic fractures
- Multiple long-bone fractures

Increased Bleeding Risk

- Major operation
- Intracranial hemorrhage
- Solid intraabdominal organ injury
- Pelvic or retroperitoneal hematoma
- Ocular injury
- Medical problems (cirrhosis, end-stage renal disease, peptic ulcer disease, medication, coagulation disorder)

DVT, Deep venous thrombosis.