2023 MID-ATLANTIC CONFERENCE

11th ANNUAL CURRENT CONCEPTS IN

VASCULAR THERAPIES

2023

Hilton Virginia Beach Oceanfront
Virginia Beach, Virginia

APRIL 20-22

2023 MID-ATLANTIC CONFERENCE

11th ANNUAL CURRENT CONCEPTS IN

VASCULAR THERAPIES

2023

I was diagnosed with a DVT

What NOW?

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No Disclosures

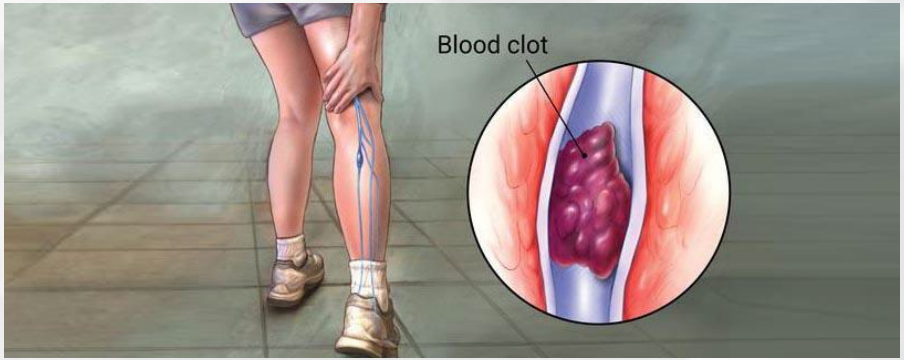
Goals of Presentation

- Introduction to DVT
- Diagnosis of DVT
- Management of DVT

Goals of Presentation

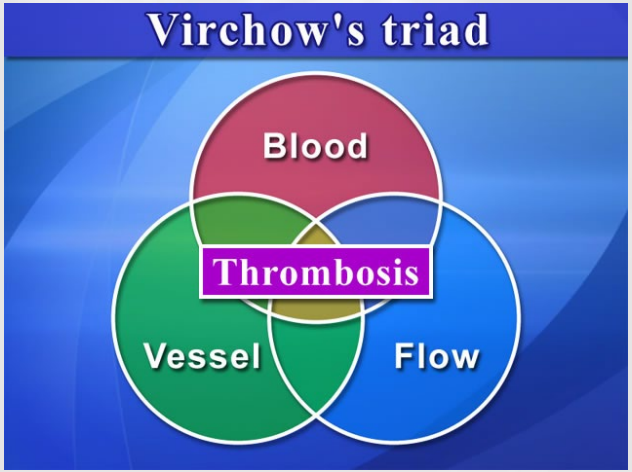
- **Introduction to DVT**
- Diagnosis of DVT
- Management of DVT

DEEP VENOUS THROMBOSIS (DVT)



- There are over 200,000 new cases of DVT each year in the U.S.
- The incidence of PE in patients with DVT ranges from 5 – 20% and can be fatal
- After an episode of DVT, 20 – 50% of patients develop Post Thrombotic Syndrome within the first 2 years

DVT Pathophysiology



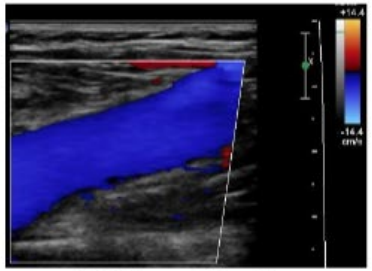
Virchow triad:

Hypercoagulability
Stasis
Intimal injury

DVT Pathophysiology

Balance

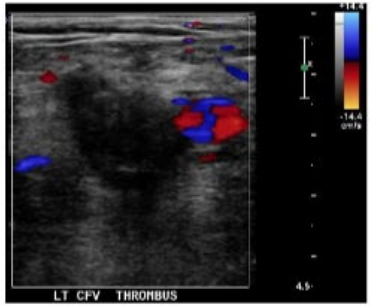
Coagulation,
Fibrinolysis



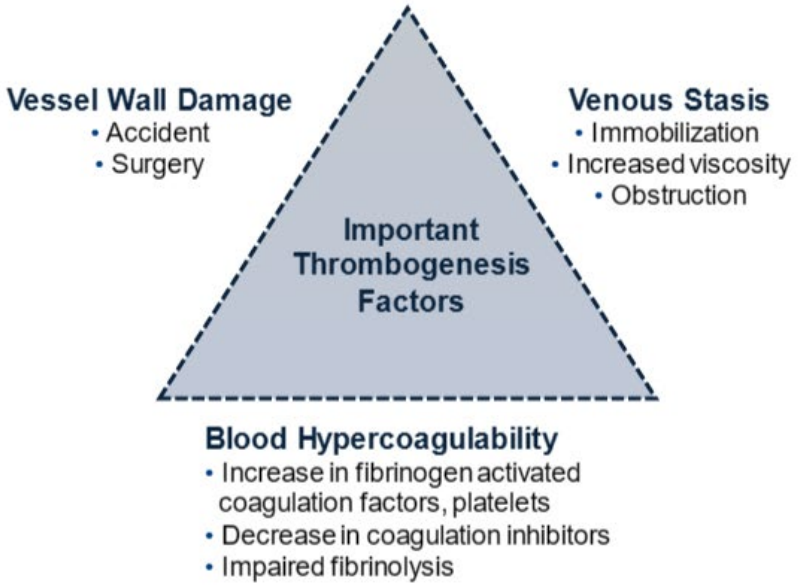
RT CFV normal blood flow

When balance is tipped to coagulation…

Thrombosis



RT CFV thrombosis



Venous thrombosis

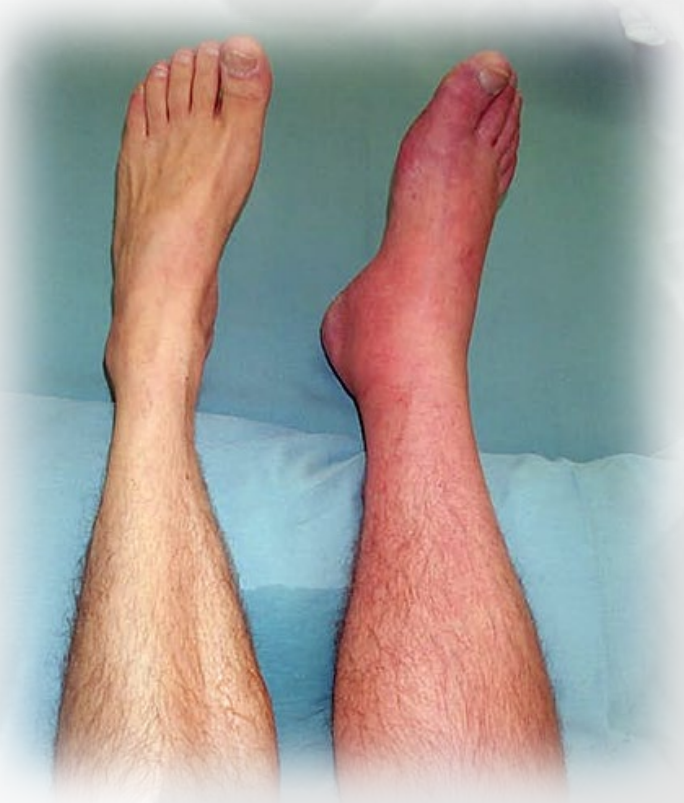
Common Etiologies:

- Injury / trauma
- Surgery
- Cancer
- Prolonged inactivity
- Bed rest post-op or post-partum
- Extended plane or car travel (longer than 4 hrs)
- Contraceptives/estrogen therapy
- Severe infection
- Undiagnosed anticoagulation disorder

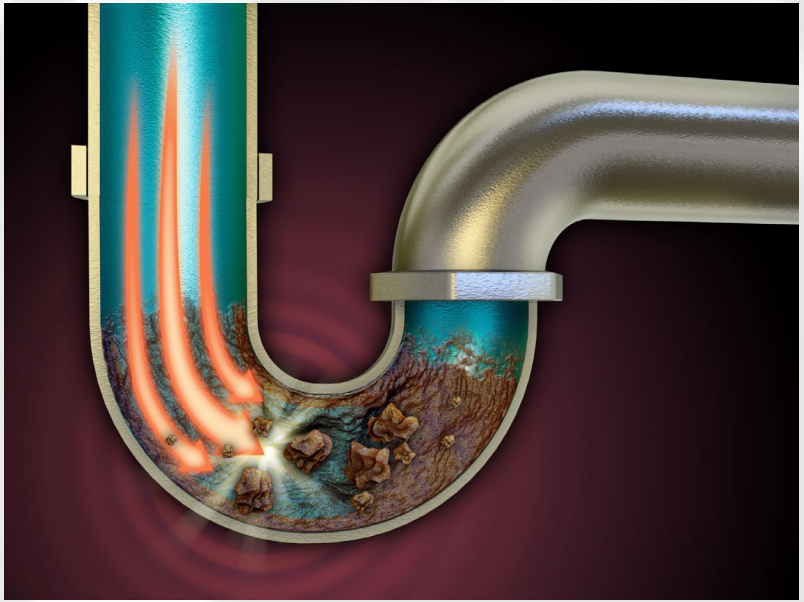
Venous thrombosis

Symptoms:

- Sudden swelling in affected limb
- Limb pain/tenderness
- Pain on dorsiflexion of the foot
- Dilated superficial collateral veins
- Cyanosis or pallor
- Warm skin over area of thrombosis
- Lack of distal pulses



When to consider surgical options

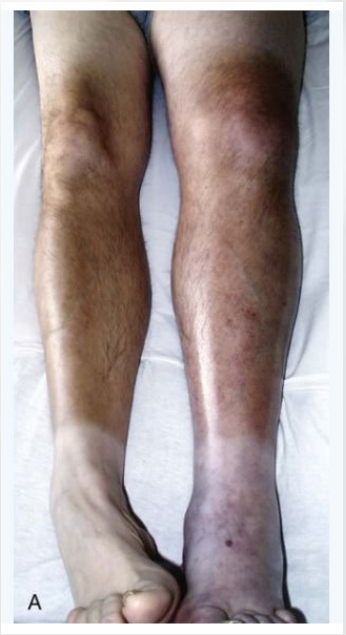


Extreme presentation

- **Phlegmasia alba dolens**
- **Phlegmasia cerulea dolens**

(One precedes the other in 50-60% of cases.)

  - **Phlegmasia alba** thrombosis involves major deep venous channels but spares the collateral veins
    - Venous drainage is significantly decreased but still present.
  - **Phlegmasia cerulea** thrombosis extends to collateral veins resulting in:
    - Severe venous congestion, massive fluid sequestration and edema
    - Compromise of arterial circulation due to shock, increase venous outflow resistance and collapse arterioles due to increased interstitial pressure.



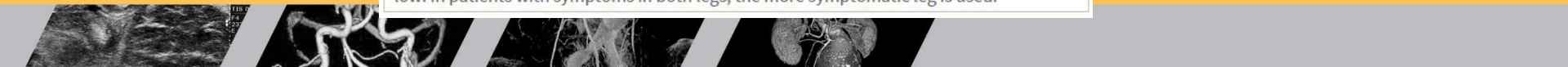
Goals of Presentation

- Introduction to DVT
- **Diagnosis of DVT**
- Management of DVT

DVT Probability Score/Wells Score

Clinical Characteristic	Score
Active cancer (patient receiving treatment for cancer within the previous 6 months or currently receiving palliative treatment)	1
Paralysis, paresis, or recent plaster immobilization of the lower extremities	1
Recently bedridden for 3 or more days or major surgery within the previous 12 weeks requiring general or regional anesthesia	1
Localized tenderness along the distribution of the deep venous system	1
Entire leg swollen	1
Calf swelling at least 3 cm larger than on the asymptomatic side (measured 10 cm below the tibial tuberosity)	1
Pitting edema confined to the symptomatic leg	1
Collateral superficial veins (nonvaricose)	1
Previously documented deep venous thrombosis	1
Alternative diagnosis at least as likely as deep venous thrombosis	−2

Note: A score of 2 or higher indicates that the probability of deep venous thrombosis is high; a score of less than 2 indicates that the probability of deep venous thrombosis is low. In patients with symptoms in both legs, the more symptomatic leg is used.

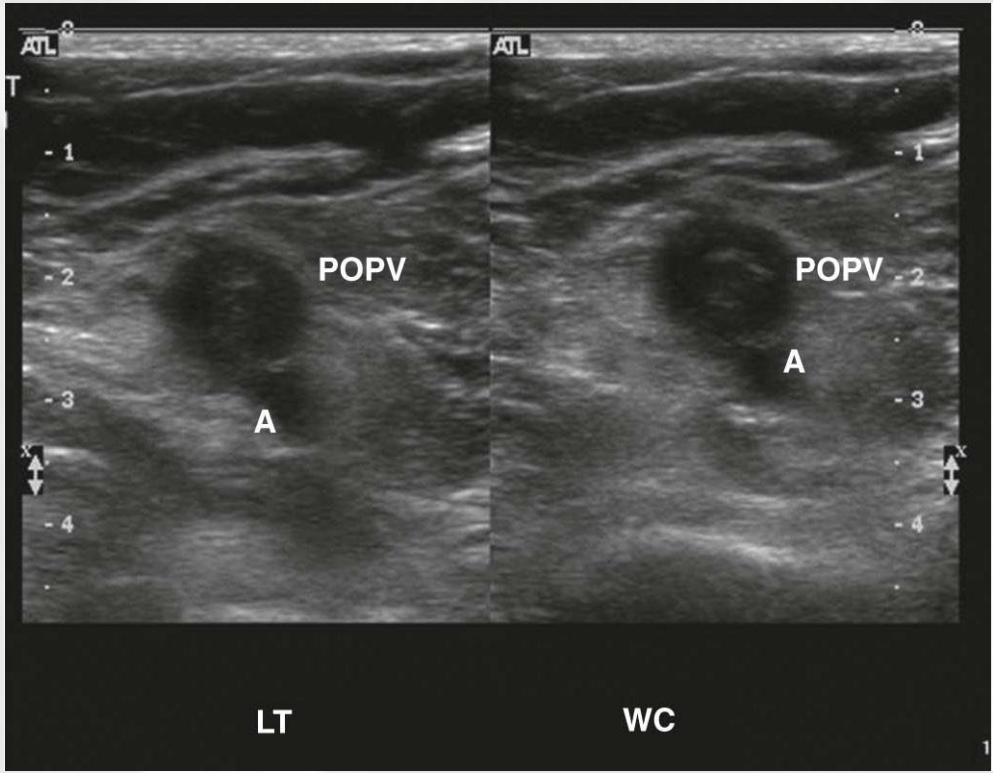


Diagnosis

- Patient risk factors/medical history.
- Physical exam
  - Specific limb symptoms (edema, pallor)
- Clinical predictive scores
- D-dimer: used to exclude PE in patients with low clinical suspicion (99% NPV)
- Duplex ultrasound – dominant diagnostic test.

Diagnostic Duplex Criteria DVT

- Major:
  - Venous incompressibility
  - Thrombus visualization (less echogenic)
  - Absent or diminished spontaneous venous flow
  - Absence of respiratory variation
  - Absent or incomplete color filling of lumen
  - Increased venous diameter, Immobile venous valves



Diagnosis cont.

- Venography – “the gold standard” for diagnosis of DVT
- Computer Tomographic Venography –has not been studied in calf DVT and has some false positives
- Magnetic Resonance Venography – may be considered with anatomic limitations in imaging inferior vena cava and iliac vessels

Goals of Presentation

- Introduction to DVT
- Diagnosis of DVT
- **Management of DVT**

DVT: Treatment Options

- Observation/Compression
- High-dose Heparin Therapy
- Surgical Treatment
- Thrombolytic Therapy
- Mechanical Thrombectomy
- Pharmacomechanical thrombectomy

DVT: Treatment Options

Duration of Clinical Symptoms:

- Acute <14 days
- Sub-acute >14 days
- Chronic Changes – Months to Years
- Acute on chronic

Expected technical success is highest in patients with acute DVT (<14 days)

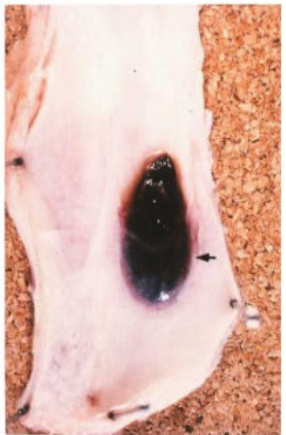
>70% of clot removed at **time of treatment** is resistant to lytics (non-fibrin).[1]

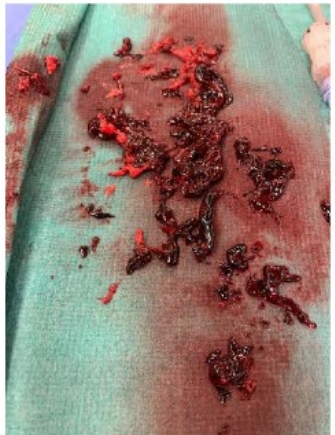
Clot formation

DAY 3	DAY 7	DAY 15	DAY 21
Fibrin-Rich Matrix[2]	~20% Collagen[2]	>50% Collagen[2]	~80% Collagen[2]

Acute | **Subacute** | **Chronic**

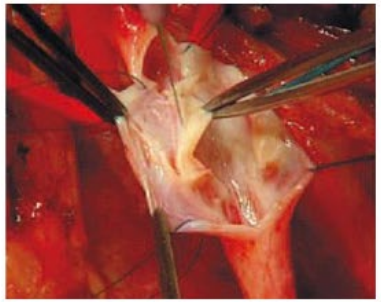
Acute thrombus in a CFV valve





PTS damage in a CFV valve

Thrombus conversion to collagen "Chronic DVT": Chronic Fibrosis



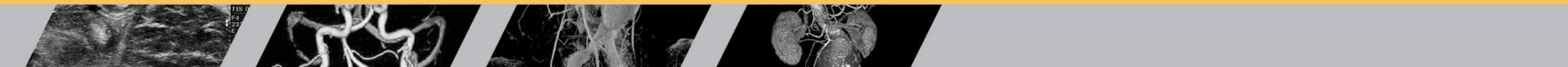
Post-thrombotic luminal changes

DVT: Treatment Options

Anticoagulation is Standard of Care
(heparin, warfarin, LMWH)

Advantages:
- Reduces occurrence of a PE
- Can decrease symptoms
- Easy to administer

Disadvantages:
- Bleeding complications from long-term use of anticoagulants
- Does not decrease thrombus burden
- Has not been shown to reduce incidence of valve damage



Anticoagulation for DVT

- Only one controlled trial performed
- 1960 Barritt and Jordan
- Anticoagulation vs no anticoagulation for acute PE
- Heparin 1.5 days/ nicoumalone 14 days

14 Day Follow-up

- Treated
  - 16 patients
  - No recurrent PEs
  - No fatal PEs
  - One death (bleeding)
- Untreated
  - 19 patients
  - 10 recurrent PEs
  - 5 fatal PEs
  - 5 deaths

Historical anticoagulation options (pre-2010)

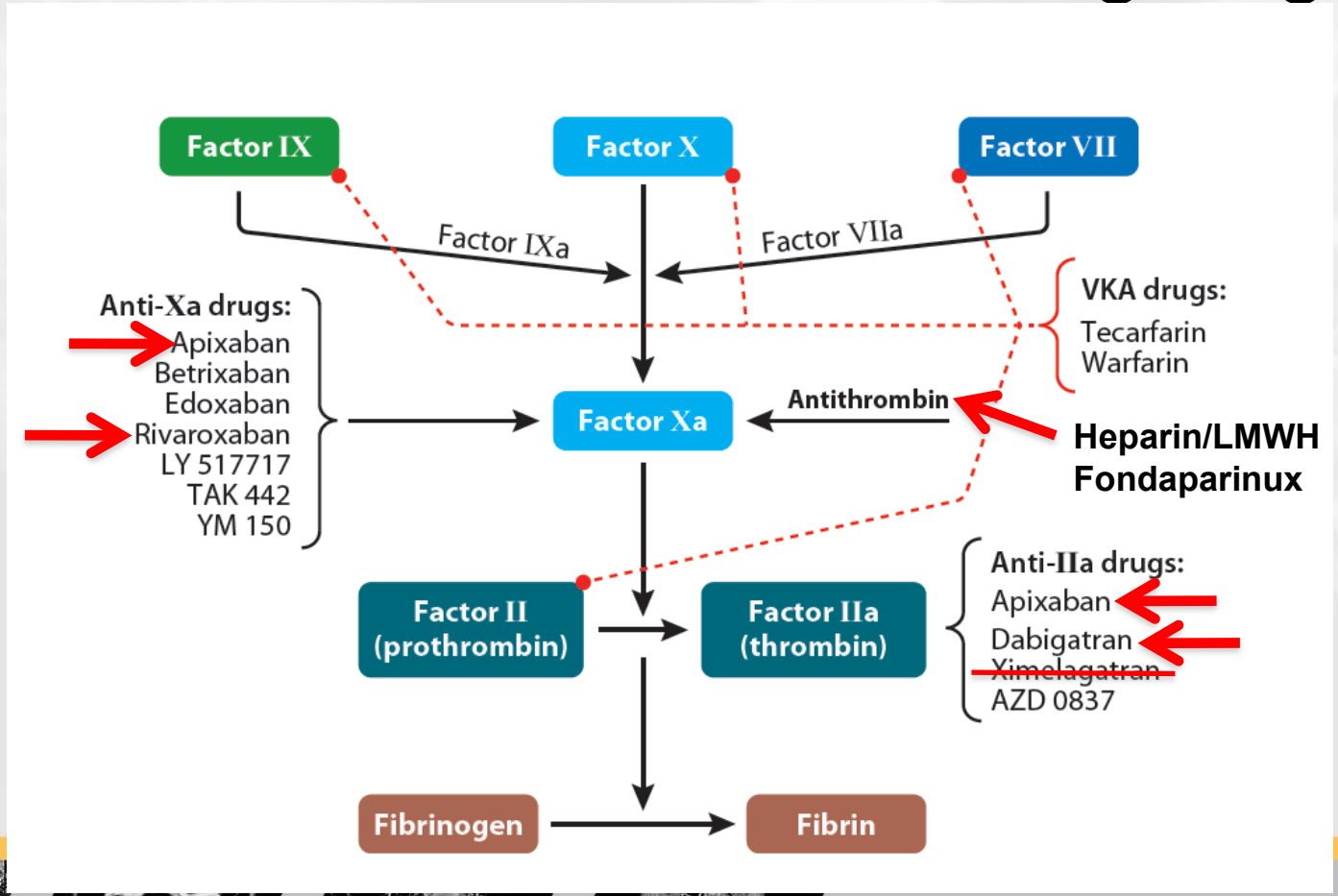
<u>Oral</u>

- Warfarin

<u>Intravenous/subcutaneous</u>

- Heparin
- Fondaparinux
- Argatroban
- Lepirudin

Direct Factor Targeting



reed , Ann Rev Pharm Tox (2012); 52:79-99

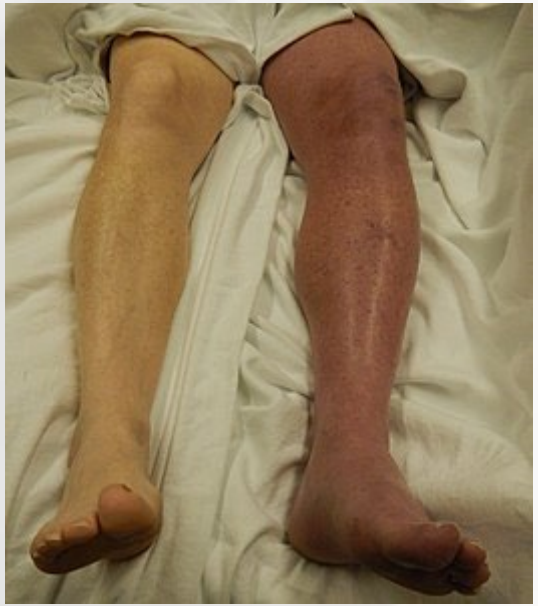
Factor Xa inhibitors: Rivaroxaban

- AKA XARELTO
- High bioavailability (80%)
- Rapid onset 2-4 h
- Half life 5-9h
- 66% renal excretion
- Also hepatic and fecal elimination
- Substrate for P-glycoprotein transporters
  - Contraindicated for patients taking HIV protease inhibitors and azole drugs
- May be taken with food

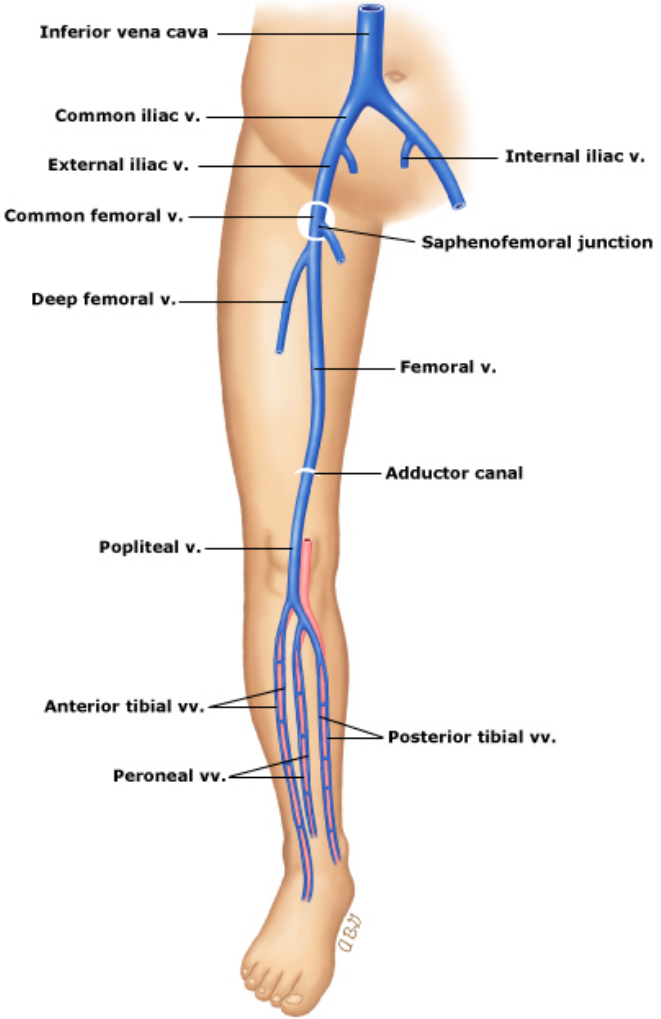
Factor Xa inhibitors: Apixaban

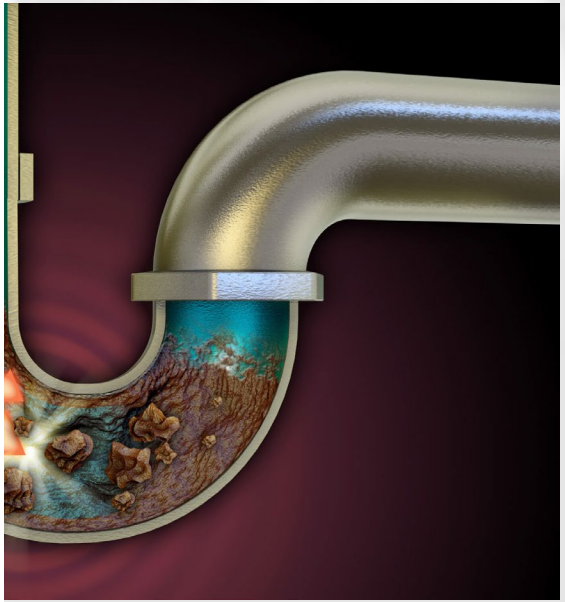
- AKA ELIQUIS
- Peak plasma concentration: 3h
- Half life: 8-11h (once daily) and 12-15h (twice daily)
- Main metabolism involves **CYP3A4**
- Apixaban presence can be determined by
  - Drug specific Factor Xa assays
  - Mild prolongation of PT and aPTT

When to admit to hospital



When to c al options





Surgical Treatment Options

Endovascular Option

- Mechanical Thrombectomy for the removal of venous thrombus

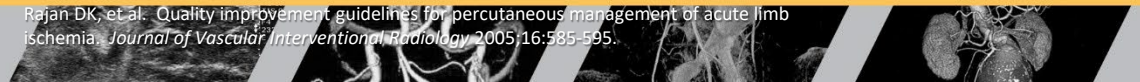
Mechanical Thrombectomy Advantages

- On-label
- Quick reperfusion
- Removal of thrombus vs. dissolving
- Can be used with other treatment strategies

Potential risks:

- Renal insufficiency/failure due to hemolysis
- Embolization including PE

SOURCE:
Rajan DK, et al. Quality improvement guidelines for percutaneous management of acute limb ischemia. *Journal of Vascular Interventional Radiology.* 2005;16:585-595.



Thrombolysis for DVT

Indications

- Iliofemoral location
- Symptoms <14 days
- Good functional status
- >1 year life expectancy
- Low risk of bleeding

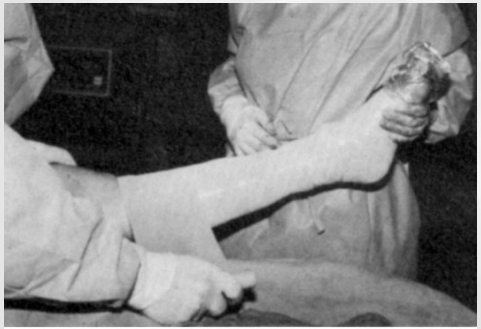
- **Goals of treatment**
  - Prevent post-thrombotic syndrome
  - Prevent recurrence
  - Prevent death from PE

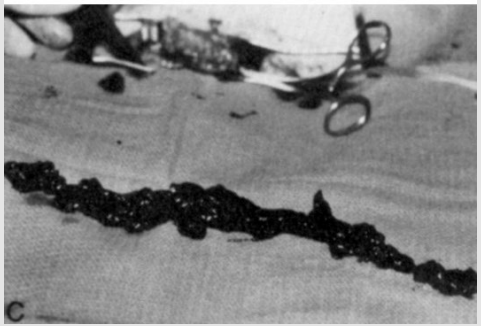
Thrombolysis

- Non-operative
- Identification of underlying stenoses
- May allow for more directed operation
- Clears clot in smaller, non-accessible branch vessels
- Avoid intimal injury associated with balloons or thrombectomy catheters
- Preserves endothelial function and valve competence
- Distal valve incompetence develops with anticoagulation alone
- Clot resolution within 90 days usually preserves valve function

- **Disadvantages:**
  - **Potential for bleeding complications**
  - **Embolization risks**
  - **Higher doses and longer infusions increase risk of potential complications**

Iliofemoral Venous Thrombectomy





- Removal of distal thrombus mechanically with Esmark compression or massage
- AVF between GSV branch and SFA
- Consider fasciotomy in phlegmasia cases

Iliofemoral Venous Thrombectomy

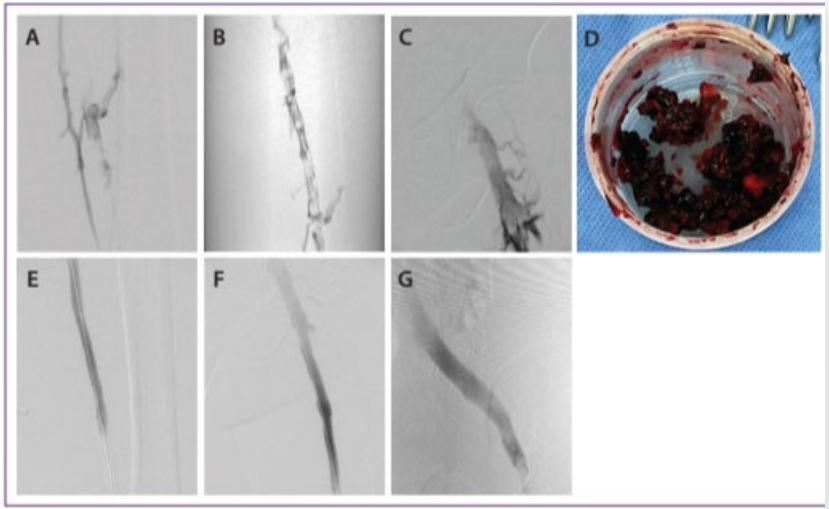
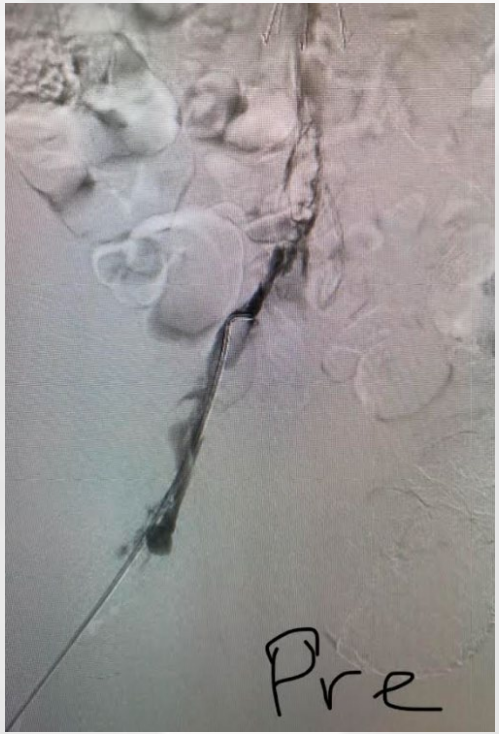
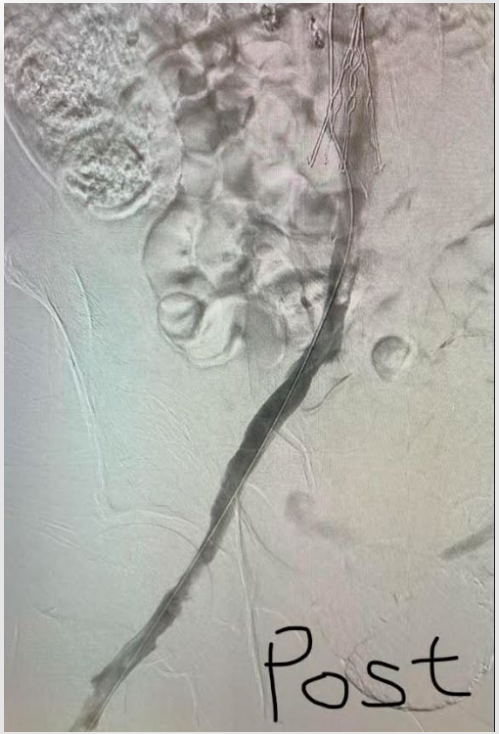
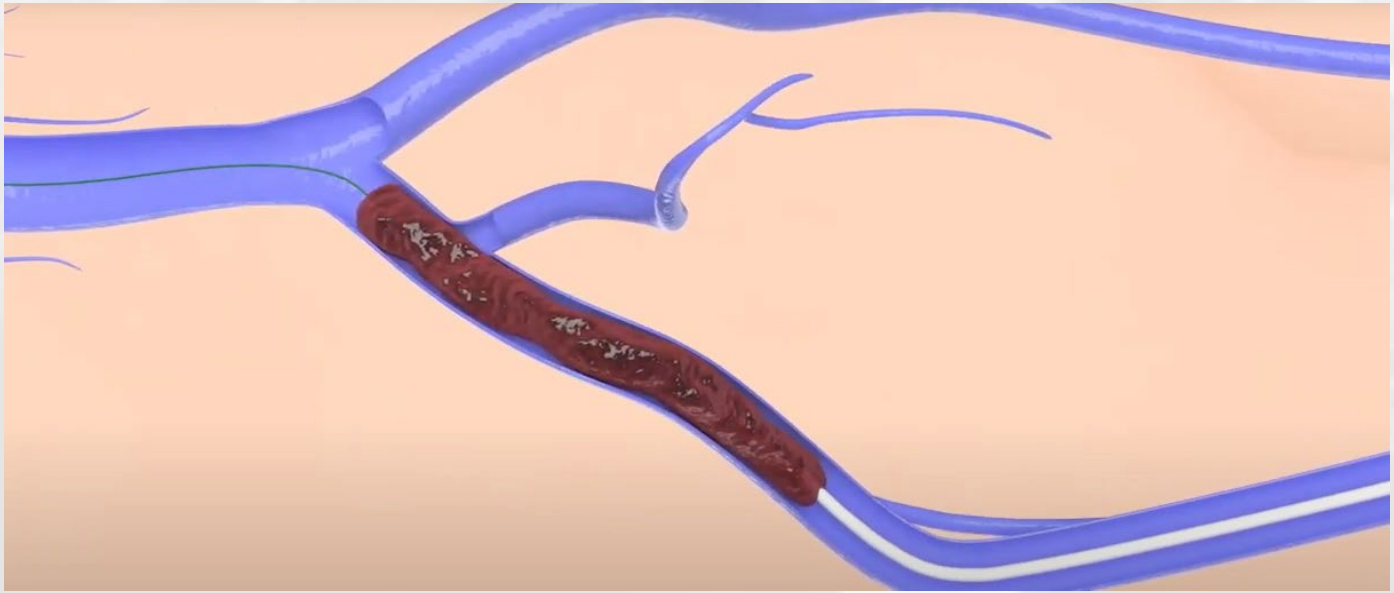


Figure 1. Preprocedure venograms demonstrate thrombus in the left popliteal, femoral, common femoral, external iliac, and common iliac segments (A, B). No contrast flowed into the IVC (C). Extracted thrombus (D). Repeat venogram demonstrates patent popliteal, femoral, common femoral, and iliac vein segments (E, F). Completion venogram confirms good flow into the IVC and resolved stenosis (G).

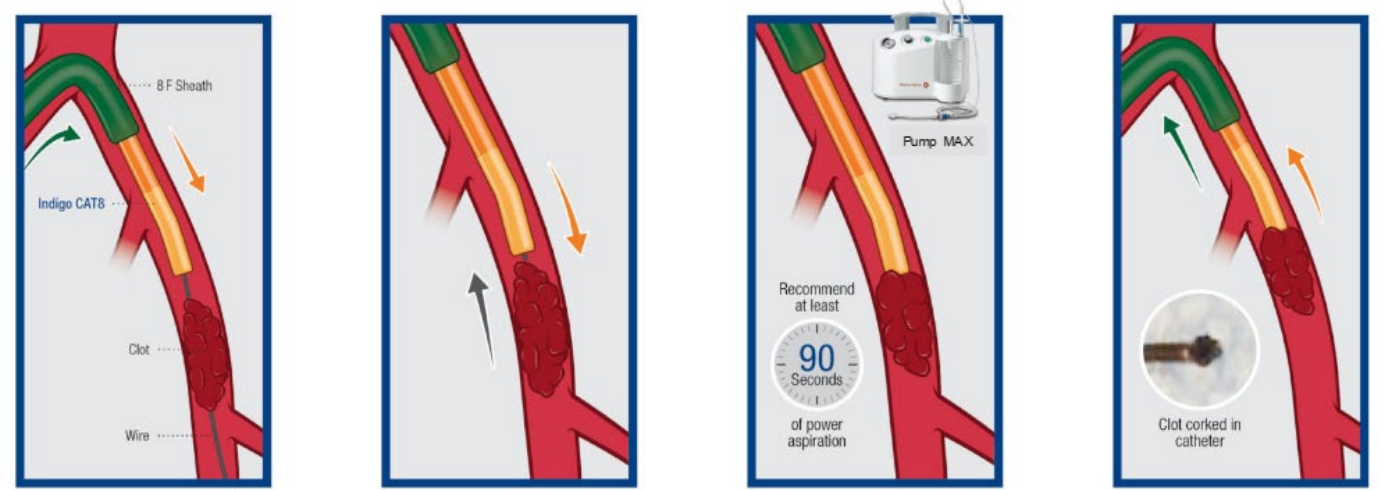




Iliofemoral Venous Thrombectomy



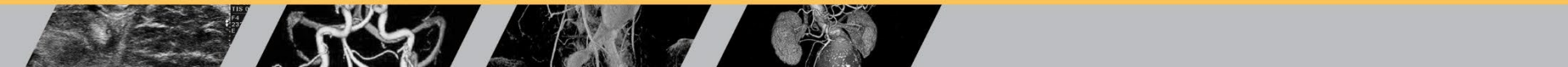
Iliofemoral Venous Thrombectomy



ATTRACT Trial

- Addition of catheter-based intervention to anticoagulation failed to reduce occurrence of post-thrombotic syndrome compared to anticoagulation alone
- Above-knee DVT – evaluated both ileo-femoral and fem-pop DVT
- **Not sufficiently powered to eval ileo-femoral DVT group**
- Catheter-based therapy group had significantly higher major bleeding within 10 days

- The CaVenT trial had shown reduction (ARR 28%) in PTs with catheter-based interventions but no improvement in quality of life



National Venous Registry

- Registry comparing patients treated with thrombolysis to cohort of anticoagulation alone
- Quality of life evaluated at 16 and 22 months
- Significant improvement in lysis group vs anticoagulation

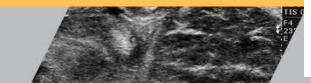
Dur VT)

- Reve
  - til cancer resolved
- Unp
  -
  -
- Secc
  -

Duration of Anticoagulation for DVT or PE*

Event	Duration	Strength of Recommendation
First Time event of Reversible cause (surgery/trauma)	At least 3 mos	A
First episode of idiopathic VTE	At least 6 mos	A
Recurrent idiopathic VTE or continuing risk factor (e.g., thrombophilia, cancer)	At least 12 mos	B
Symptomatic isolated calf-vein thrombosis	6 to 12 weeks	A

*From American College of Chest Physicians

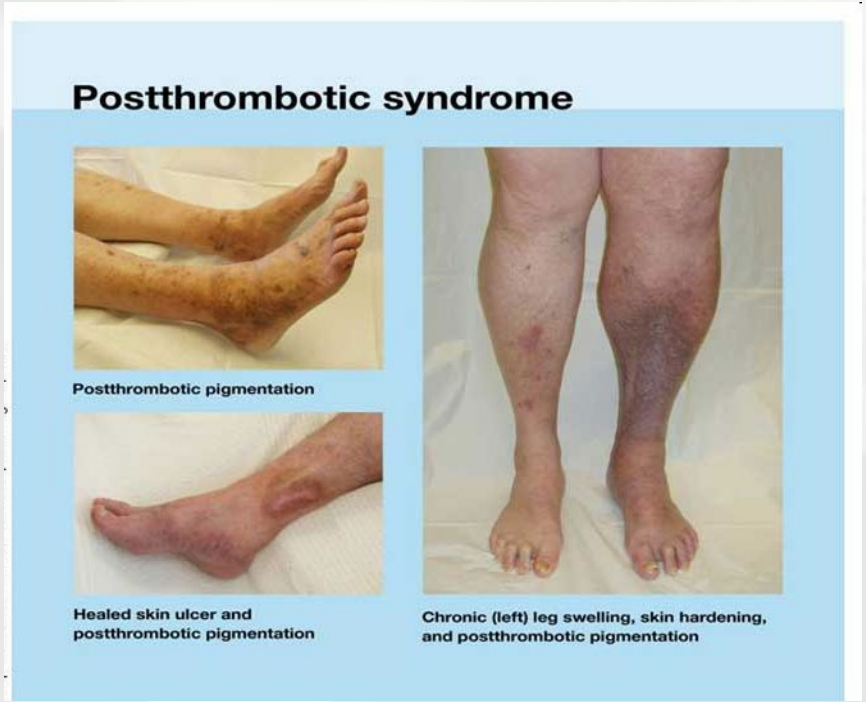


Sequelae of Iliofemoral DVT

- Anticoagulation therapy alone
  - 90% ambulatory venous hypertension
  - 40% venous claudication
  - Up to 15% ulcer development at 5 years

Sequelae of Iliofemoral DVT

- Post-thrombotic syndrome may result in:
  - Chronic pain
  - Swelling
  - Skin ulceration secondary to post-phlebitic syndrome
- Chronic condition in 30-75% of DVT patients within 2 years
  - 90% unable to work due to leg symptoms 10 years after iliofemoral DVT
- Irreversible damage to veins & valves
  - **Impact on quality of life**

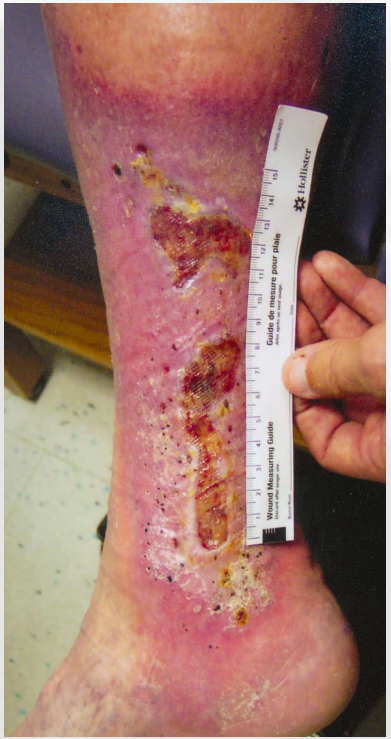


1. Geerts et al. Chest. 2004;126(suppl):338S-400S
2. Parikh et al. JVIR 2008 19; 521-528
3. Kahn SR, Ginsberg JS. "Relationship Between Deep Venous Thrombosis and the Post-thrombotic Syndrome". Arch Intern Med 2004; 164:17–26.

Sequelae of Iliofemoral DVT

Post-Thrombotic Syndrome

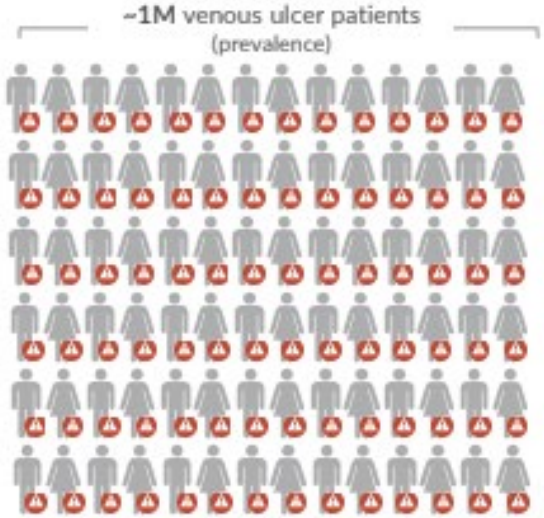
- PTS develops in 29% to 74% of patients following DVT
- Affects 5% of US population
- 400,000 to 500,000 individuals have venous stasis ulcers
- Annual direct cost of PTS in the US of $200 million
- 2 million workdays lost annually in the US

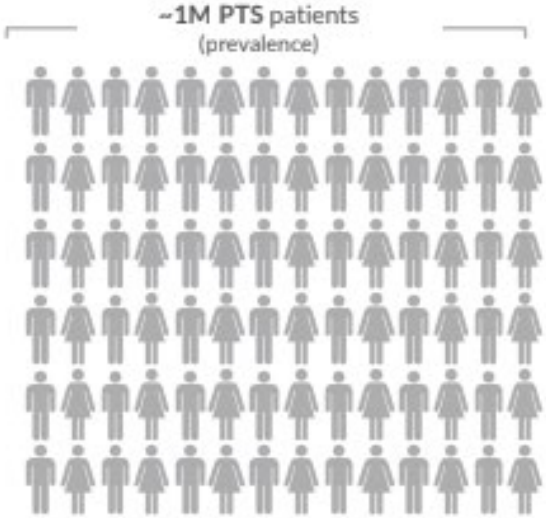


Heit, *J Vasc Surg* 2001
Phillips, *J Amer Acad D*

Conclusions

A lot of DVT Patients need our help…





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