

Q



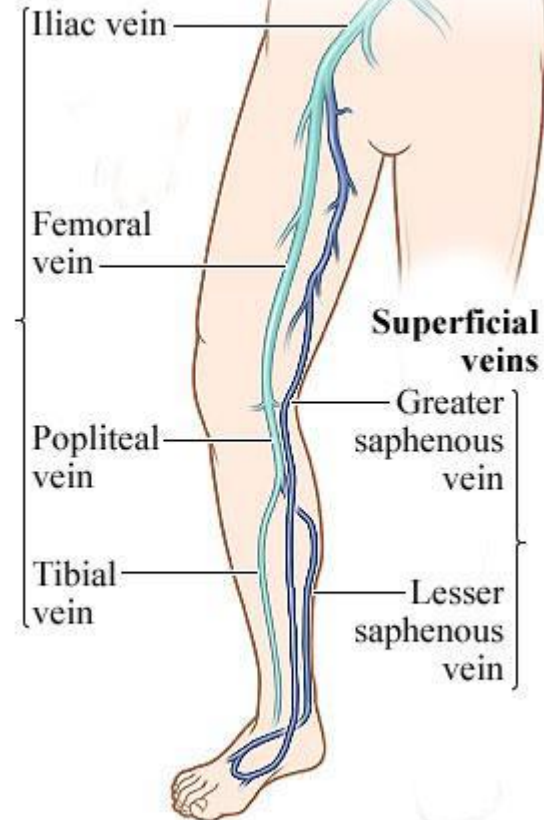
Deep Vein Thrombosis & Pulmonary Embolism : overview & treatment

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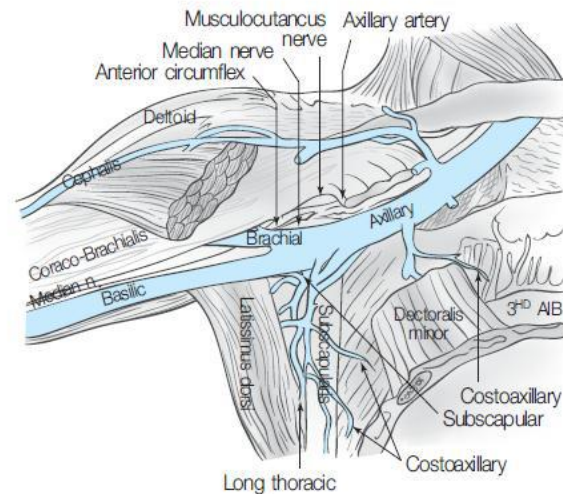
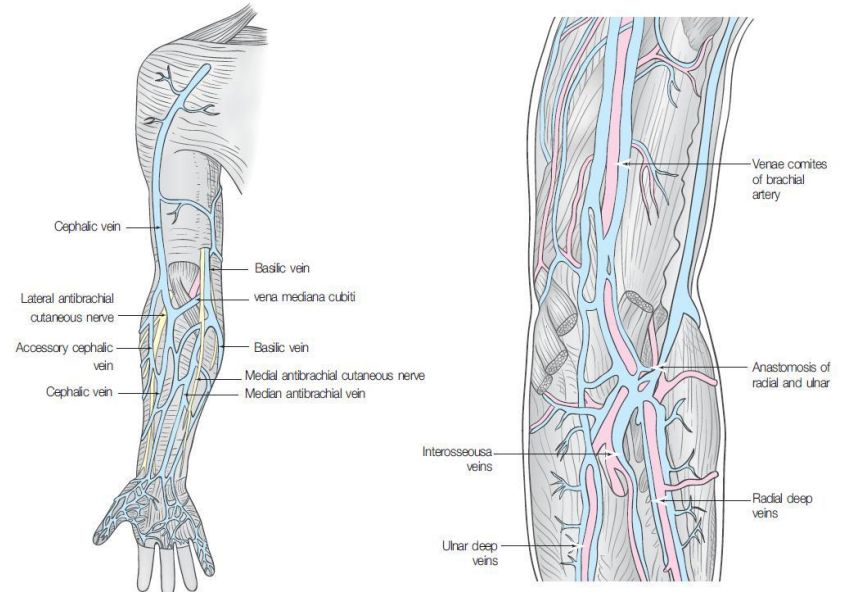
Anatomy

Venous System

Deep veins



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Pathophysiology

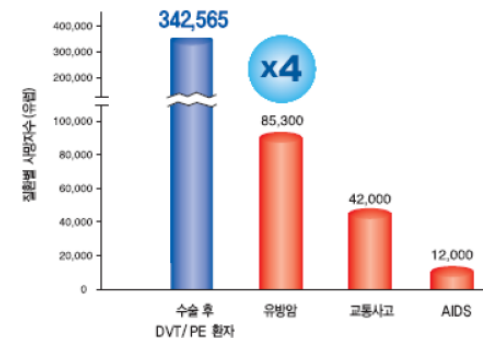
Venous Thromboembolic Disorder

- **Deep Vein thrombosis / Pulmonary embolism**
 - Traveler's thrombosis (Economy class syndrome)
 - Chronic venous insufficiency
- **Other forms of venous thrombosis**
 - Superficial thrombophlebitis
 - Axillary-Subclavian thrombosis
 - Mesenteric venous thrombosis



Venous Thromboembolic Disorder

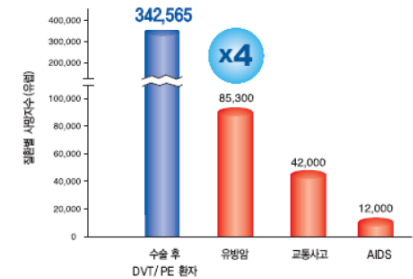
- Deep Vein thrombosis / Pulmonary embolism
 - Possible cause of mortality
 - First year mortality of acute DVT ; 19-21%
 - PE death; 15% hospital death, 150,000-200,000 death/year in USA
 - Significant morbidity due to progression to chronic venous insufficiency



▶유럽에서는 매년 유병률, 교통사고, AIDS환자 보다 더 많은 환자가 DVT나 PE[†]로 사망하고 있습니다.

Venous Thromboembolic Disorder

- Incidence of acute DVT
 - Autopsy cases ; 35-52%
 - Community-based, venography, symptomatic ; 1.6 /1000 residents, yearly
 - Postoperative DVT; GS(19%), NS(24%), hip fracture(48%), hip arthroplasty(51%), knee arthroplasty(61%)
 - Trauma; autopsied casualties(62%), venography(58%) -- duplex(4-20%)



▶유럽에서는 매년 유방암, 교통사고, AIDS환자 보다 더 많은 환자가 DVT나 PE[†]로 사망하고 있습니다.

Epidemiology and Natural history

- The incidence of **recurrent, fatal, and non fatal VTE** has been estimated to exceed 900,000 cases annually in the united state alone.
- In the United States of America, 200,000 new cases of **pulmonary embolism(PE)** occur each year, and 50,000 of these result in death.
- **VTE** kills four to five more people annually than dose breast cancer or acquired Immunodeficiency syndrome.
- **PE** is the third most common fatal vascular disorder following coronary artery disease (CAD) and cerebrovascular accident (CVA).
- The in-hospital mortality rate is 12%, and it is thus the number one preventable death in hospitalized patients.

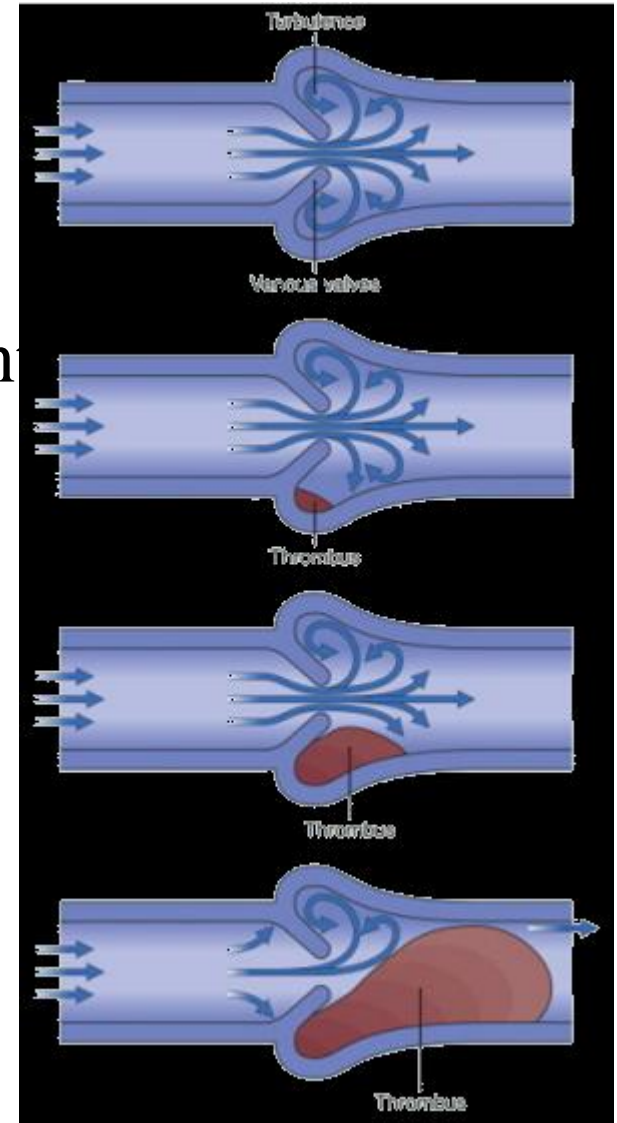
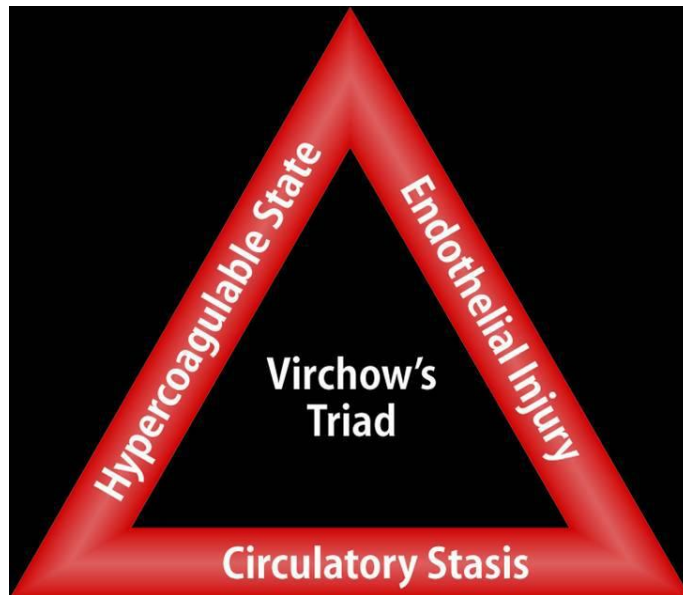
(*Rutherford's Vascular Surgery 7th edition, section 7 venous disease, chapter 48, p 736, chapter 50 , p 770, Saunders 2010)

Isolated calf vein thrombosis

- Differences in
 - Rates of PE / post-thrombotic complications
- **Recanalize more rapidly**
- Lower reflux in involved calf vein segments
- Lower long term complication
 - PE : 10%, 33% by V/Q scan
 - PTS: 23% at 1yr (vs 54% in proximal DVT)
- Proximal propagation : 15% to 23%
 - in the absence of treatment
 - 1/4 - 1/3 by Kearon
- **However, Need anticoagulation !!!**

Pathophysiology

- Virchow's triad
 - Endothelial abnormality
 - Stasis of blood flow (predominant)
 - Hypercoagulability of blood



Clinical spectrum of acute DVT

1. Asymptomatic calf vein thrombosis
2. Symptomatic calf vein thrombosis
3. Femoropopliteal DVT
4. Phlegmasia Alba Dolens
5. Phlegmasia Cerulea Dolens
6. Venous gangrene

Clinical Course

- Acute (<2wks)
 - Flow void, low echogenic thrombus, venous distension, loss of compression
- Subacute (2-4wks)
 - Increased echogenecity, decreased venous size, resumption of flow
- Chronic (>4wks)
 - Echogenic thrombus, wall irregularity, valve abnormality, collateral veins

Clinical Course

- Acute DVT
 - Symptomless, warmness, redness, pain, swelling
- Phlegmasia alba dolens (=milk leg, white leg)
 - Increased tissue pressure exceeds the capillary perfusion pressure, causing pallor
- Phlegmasia cerulea dolens(=blue leg)
 - Deoxyhemoglobin in stagnat vein imparts a cyanotic hue to the limb

Phlegmasia alba dolens (=white leg)



Phlegmasia cerulea dolens (=blue leg)



Risk Factors

Risk factors- hypercoagulable status

Q

Inherited	Acquired
Common	Age
Factor V Leiden	Surgery and trauma
Prothrombin gene mutation (G20110A)	Immobilization
Homozygous C677T mutation in methylene Tetrahydrofolate reductase gene	Malignant disease
	Previous venous thromboembolism
	Pregnancy and puerperium
	Oral contraceptive
	Hormone replacement therapy
	Antiphospholipid antibodies
Rare	Unknown (probably multifactorial)
Antithrombin deficiency	Elevated levels of factor VIII, IX, and XI and fibrinogen
Protein S deficiency	
Protein C deficiency	
Dysfibrinogenemia	
Homozygous homocystinuria	

Acquired Risk Factors - Surgery



	Calf DVT	Proximal DVT	Fatal PE
High risk	40-80%	10-30%	>1%
<ul style="list-style-type: none"> • Surgical patients with history of venous thromboembolism • Major pelvic or abdominal surgery for malignancy • Major trauma • Major lower limb orthopedic surgery 			
Moderate risk	10-40%	1-10%	0.1-1%
<ul style="list-style-type: none"> • Geberak surgery in patients >40 years • Patients on oral contraception • Neurosurgical patients 			
Low risk	<10%	<1%	<0.1%
<ul style="list-style-type: none"> • Uncomplicated surgery in patients <40 years without any other risk factors • Minor surgery in patients >40 years without any other risk factors 			

Acquired Risk Factors

- **Old age**
 - a major risk factor of VTE
- **Prior venous thromboembolism**
 - independent risk factor for future VTE / adequate prophylaxis
- **Immobilization**
 - 60% of the paralyzed limb / 7% contralateral normal control leg
 - air travel
- **Malignancy**
 - resulting from activation of the coagulation cascade?
- **Superficial thrombophlebitis**
 - an independent risk factor for VTE
- **Antiphospholipid antibody syndrome**
 - anticardiolipin antibody / lupus anticoagulant antibody
 - 2% of population / 30-50% of patients with SLE
 - 50% frequency of DVT/ half having PE

Inherited Thrombophilia

- Epidemiology

Thrombophilia	General population (%)	Patients with VTE (%)
Factor V Leiden*	5	20
Prothrombin G20210A	3	7
Elevated factor VIII**	6-8	10-15
Protein C deficiency	0.2-0.5	3
Protein S deficiency	0.2-0.5	3
Antithrombin deficiency	0.02	1
Hyperhomocysteinemia**	5	10

*Rare in the Asian and African populations

**Likely to be multifactorial

- Diagnosis of inherited thrombophilia
 - Should be considered in any patient with VTE

Clinical Features

Clinical Features – L/E DVT

- Mostly asymptomatic
- Pain, Edema
 - due to vein obstruction, inflammation of perivascular tissue, lymphatic obstruction
- Distention of superficial veins
- Cutaneous erythema
- Homan's sign
 - pain in calf with forced dorsiflexion of foot

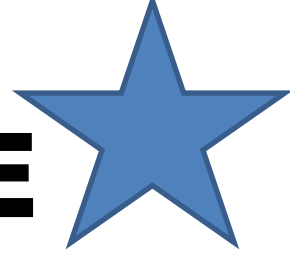


Clinical Features – U/E DVT

- **Less common (2-5% of population)**
- **Indwelling mechanical devices**
 - pacer lead, central venous catheters
 - 30-40% of cases
- **Conditions of venous compression**
 - lymphadenopathy, tumors
- **Paget-Schroetter syndrome**
- **10-30% risk for PE (similar to leg DVT)**

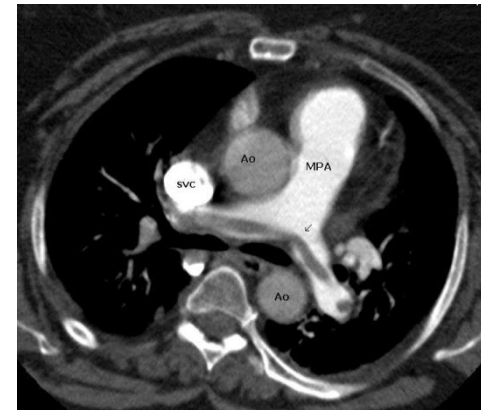


Clinical Features – PE



- Classification of PE

Pulmonary embolism	History	Pathophysiology	Therapy
Acute massive	Acute	Circulatory collapse	Thrombolysis, thrombectomy
Acute submassive	Acute	Stable, echocardiographic signs of RV overload	Thrombolysis?, heparin
Acute nonmassive	Acute	Stable	Heparin
CTEPH (Chronic thromboembolic pulmonary Hypertension)	Chronic	RV overload	Medical or elective thromboendarterectomy



- **Acute massive:** >50% PA occlusion
 - sudden death in 10%, within 1 hr,
 - severe acute dyspnea, syncope
- **Acute submassive**
- **Acute nonmassive:** <50% PA occlusion
 - asymptomatic or tachypnea, dyspnea, pleuritic pain



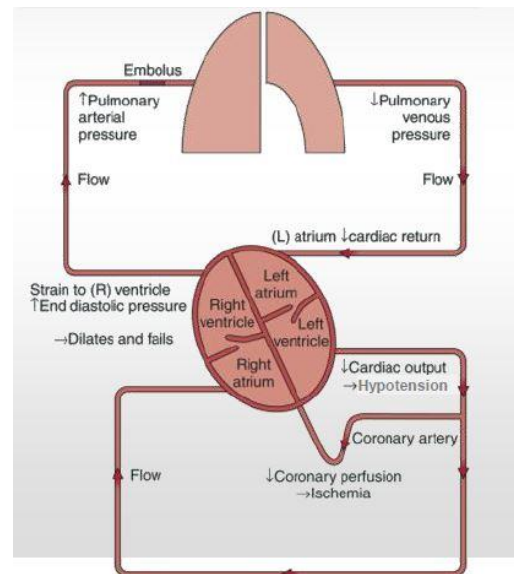
Complication

Complications (I)

- **Pulmonary Embolism**

- most devastating complication

- obstruction of blood flow distal to the clot
- rapid increase in pulmonary arterial and right heart pressure



Complications (II)

- **Pulmonary Embolism**

- Inadequate tx. of proximal venous thrombosis
 - 20% to 50% risk of significant recurrent VTE
 - 90% of thromboemboli arising from L/Ex veins
- Sx PE: 7% to 17% of proximal U/Ex thrombi
- Lung scan: + in 25- 51% of Asx patients
- Autopsy : [DVT + PE] = [1.8 X DVT alone]
- **PE** contributes to **approx. 15% of hospital deaths**
- 1-week survival rate after a PE : 71%
- 25% of PE manifest as sudden death
- Mortality in adequate Dx. and Tx.: 8% to 9%

Complications (III)

- **Post-thrombotic Syndrome**

- less dramatic than PE
- greater degree of chronic socioeconomic morbidity
- 29% to 79% of patients
 - pain, edema, hyperpigmentation, or ulceration
- Severe manifestations
- ambulatory venous hypertension
 - valvular reflux / persistent venous obstruction / anatomic distribution of these abnormalities
- X6 risk of post-thrombotic syndrome with recurrent DVT

Post-Thrombotic Syndrome (PTS)

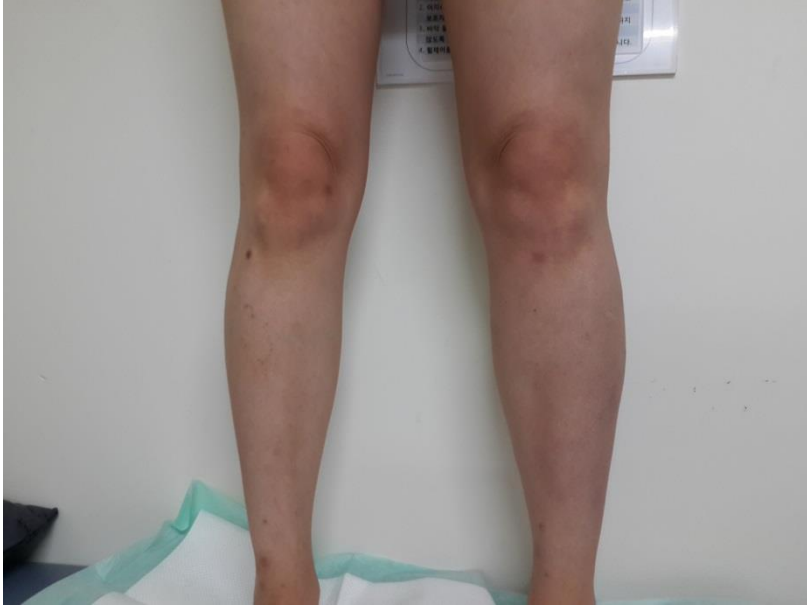
- Painful heavy leg
- Cramps
- Paresthesia
- Pruritus
- Formation of varicosities
- Edema
- Hyperpigmentation of the skin

=> **Reduced quality of life (QoL)**

PTS



Malpractice



Diagnosis

Diagnosis of DVT

- **D-dimer** ; cross-linked degradation product of fibrin.
 - Sensitivity 44-72%, specificity 44-70%
 - High negative predictive value; 97-99%
- **Duplex USG** ; test of choice (Accuracy >95%)
- **CT venography** ; pelvic vein evaluation, PE study
- Impedance phlethysmography
- Ascending venography
- MR Venography
- Lung ventilation & perfusion scan

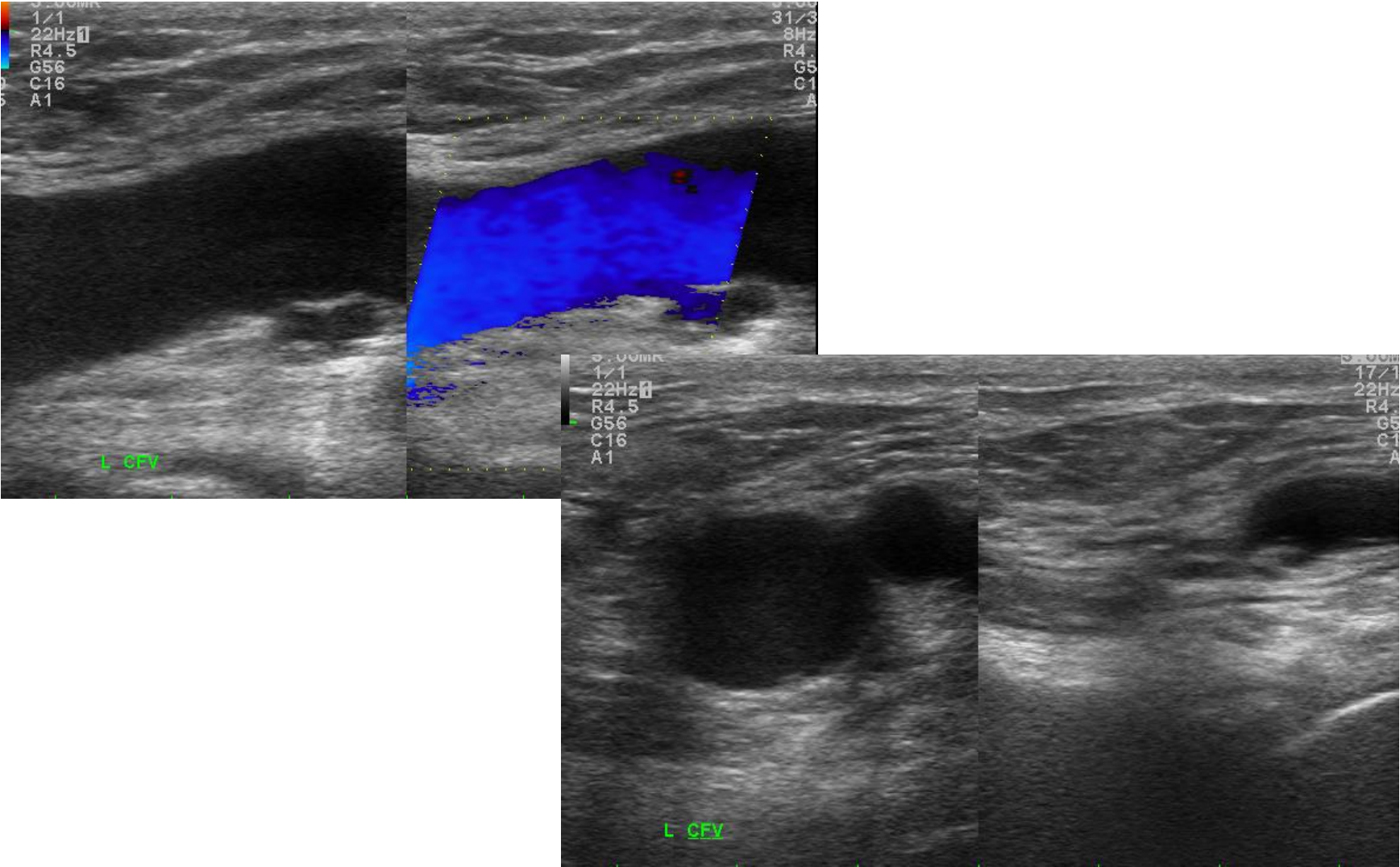
DVT ; Diagnosis

- **Before anticoagulation, Check coagulation profiles !**
 - CBC ; Hb, Hct, platelet
 - BT / PT / aPTT
 - AT-III, protein C, protein S
 - Coagulation factors VIII, IX, XI
 - Fibrinogen, FDP, D-dimer, homocysteine
 - Lupus anticoagulant, anticardiolipin Ab, antiphospholipid Ab
- **Family study in hereditary or familiar tendency**
 - Factor V Leiden, Prothrombin gene mutation ; rare in KOREA

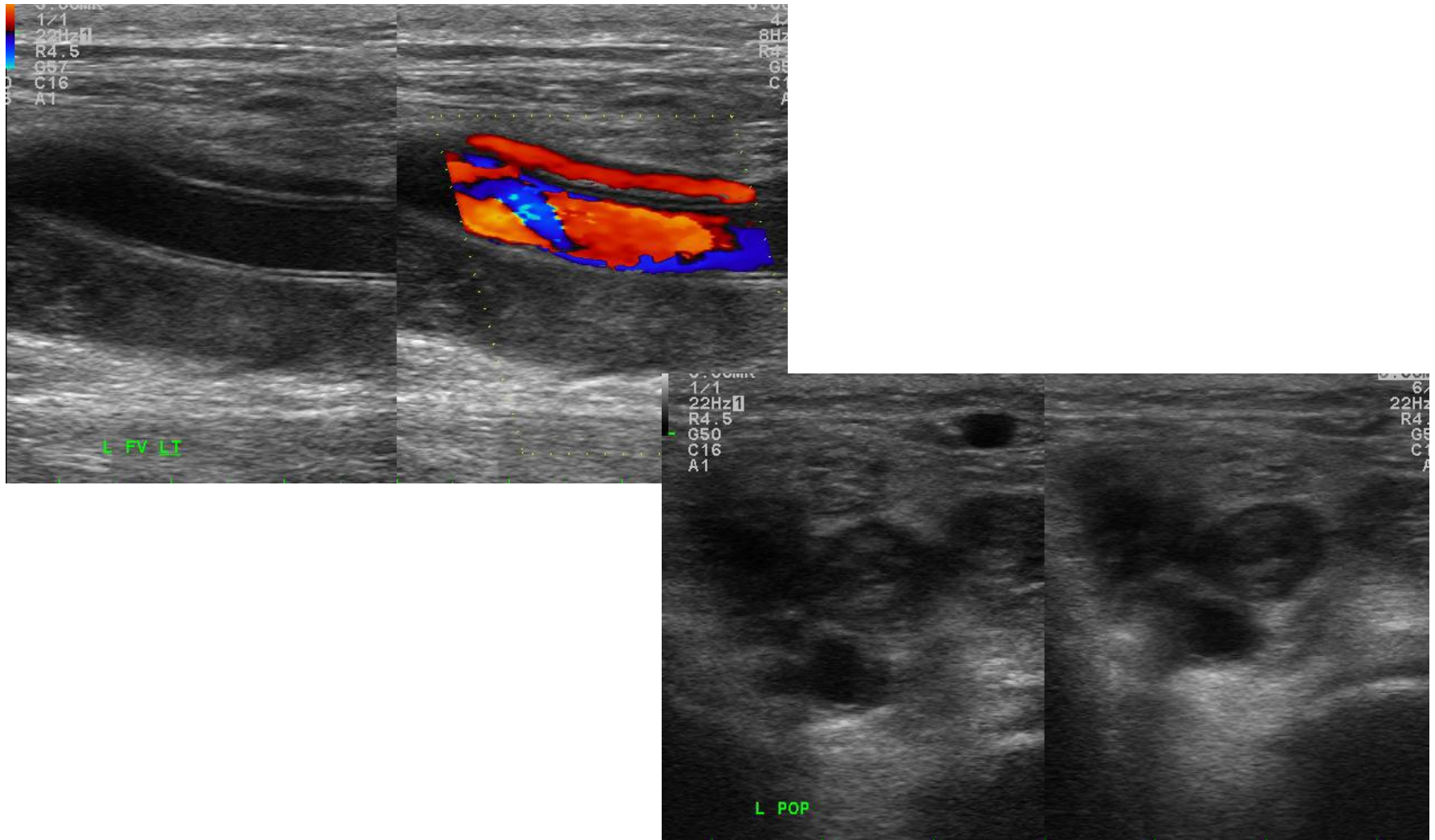
Duplex criteria for DVT

- Negative for DVT
 - Complete approximation of the vein wall during compression
 - Complete color filling of the lumen without any defect
- **Positive** for DVT
 - Partially compressible or noncompressible vein
 - **Echogenic material** within the vein
 - **Filling defect** on color imaging
 - Absence of doppler signal

Duplex USG ; normal finding



Duplex USG ; abnormal finding



Conditions that may mimic acute DVT



Muscle strain or blunt trauma
Ruptured muscle with subfascial hematoma
Spontaneous hemorrhage or hematoma
Ruptured synovial cysts (Baker's cysts)
Arthritis, synovitis, or myositis
Cellulitis, lymphangitis, or inflammatory lymphedema
Superficial thrombophlebitis
Arterial insufficiency
Pregnancy or oral contraceptive use
Lymphedema
Lipedema
Chronic venous insufficiency or venous reflux syndromes
Extrinsic venous compression: lymphadenopathy, tumors, lymphomas,
hematomas, abscesses, right iliac artery
Systemic edema: congestive heart failure, metabolic, nephrotic syndrome,
post-arterial reconstruction
Dependency or leg immobilization (casts)
Arteriovenous fistula

Diagnostic strategies for DVT



- Assessment of risk of venous thrombosis; [Modified Wells Criteria](#)

Criteria	Score
Active cancer (receiving treatment within previous 6 months or receiving palliative treatment)	1
Paralysis, paresis, or recent immobilization of lower extremity	1
Recently bedridden for ≥ 3 days, or major surgery within 12 weeks requiring any type anesthesia	1
Localized tenderness along distribution of deep venous system	1
Entire leg swollen	1
Calf swelling ≥ 3 cm increased compared to asymptomatic leg (measured 10cm below tibial tuberosity)	1
Pitting edema confined to symptomatic leg	1
Collateral superficial veins (nonvaricose)	1
Previously documented DVT	1
Alternative diagnosis at least as likely as DVT	-2
Risk Assessment	Score
Low risk	≤ 0
Intermediate risk	1-2
Likely	> 2

Treatment

Concerns in a patients with Q DVT



- Pulmonary embolism
- Symptoms
- Extension of thrombosis
- Recurrence
- Post-thrombotic syndrome

=> Aim of DVT treatment

Goals of DVT Therapy

- **Diminish the severity and duration of lower extremity symptoms**
- **Prevent Pulmonary embolism**
- **Minimize the risk of recurrent venous thrombosis**
- **Prevent the postthrombotic syndrome (PTS)**

Overview of Treatment



1. Systemic Anticoagulation

2. Systemic Thrombolysis

3. Surgical Thrombectomy

4. IVC filter

5. Catheter Directed Thrombolysis (CDT)

6. Percutaneous Mechanical Thrombectomy (PMT?)

7. PharmacoMechanical Thrombolysis (PMT)

8. Adjuvant Venous Angioplasty and Stenting

DVT: Treatment options

- Anticoagulants
- Thrombolytic therapy
- Pharmacomechanical thrombectomy
- Surgical thrombectomy
- Vena cava filter
- Conservative treatment

DVT: Treatment options



Goal	Caval filter	Anti-Coagulation	Thrombolytic Therapy	Venous Thrombectomy
reduce PE	+	+	+	+
prevent thrombus extension		+	+	+/-
reduce DVT recurrence		+	+	+/-
restore venous patency			+	+
restore venous valve			+	+
reduce chronic venous insufficiency		+/-	+	+

Treatment

- **Conservative Treatment**

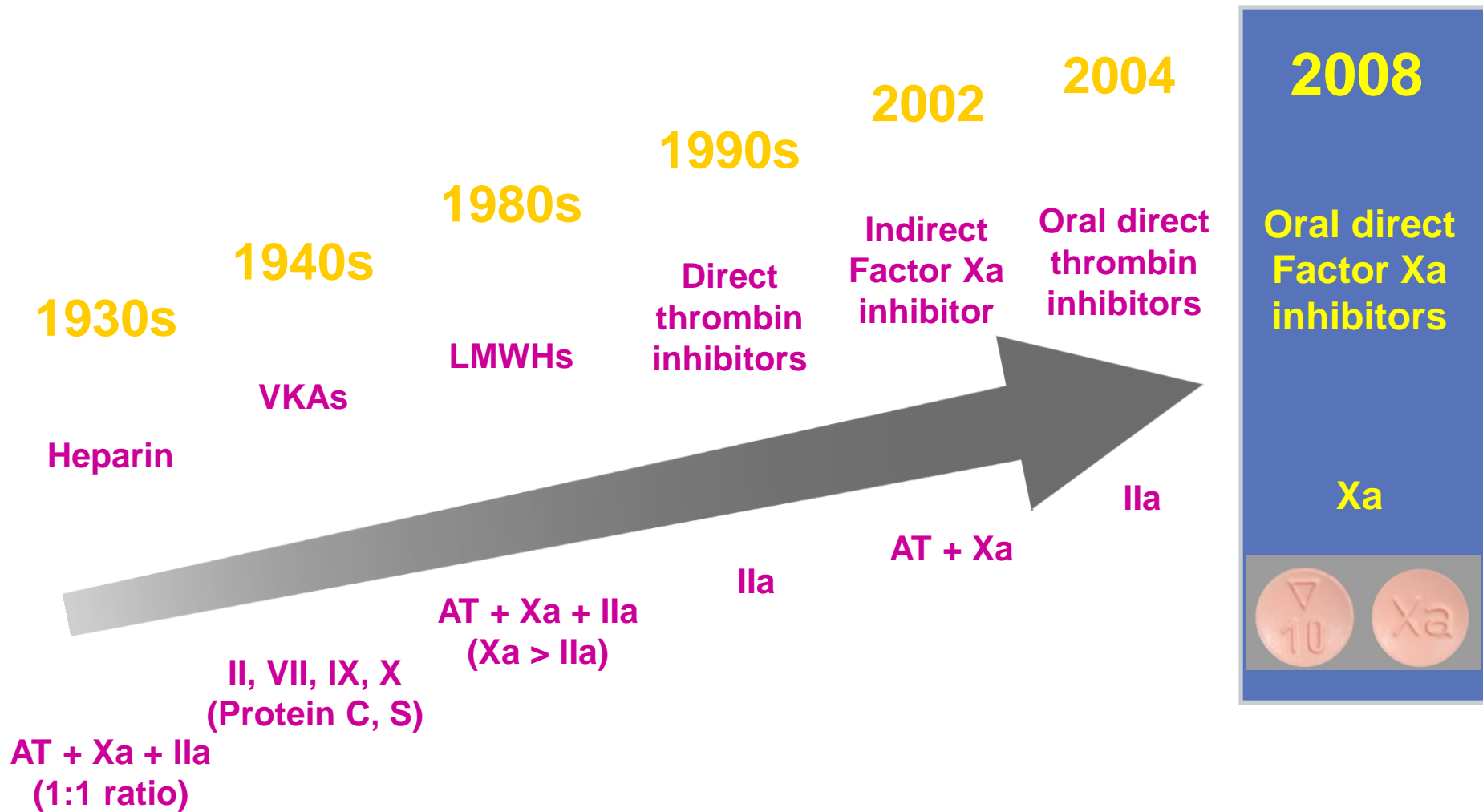
Conservative Treatment Q

- **Bed rest and leg elevation**
 - 1289 prospective cohort study
 - Bed rest **does not prevent PE**
 - LMWH + early ambulation + compression bandage or ES, faster improvement of pain and swelling w/o increasing risk of PE, decreased PTS
 - Partsch H, JVS 2002
- **Graduated compression stocking**
 - Graduated compression stocking for 24 months post-5 yr cumulative data of incidence of **PTS 26% vs. 49%**
 - Prandoni P et al, Ann Int Med 2004
- Below-the-knee stocking is equivalent to the thigh one

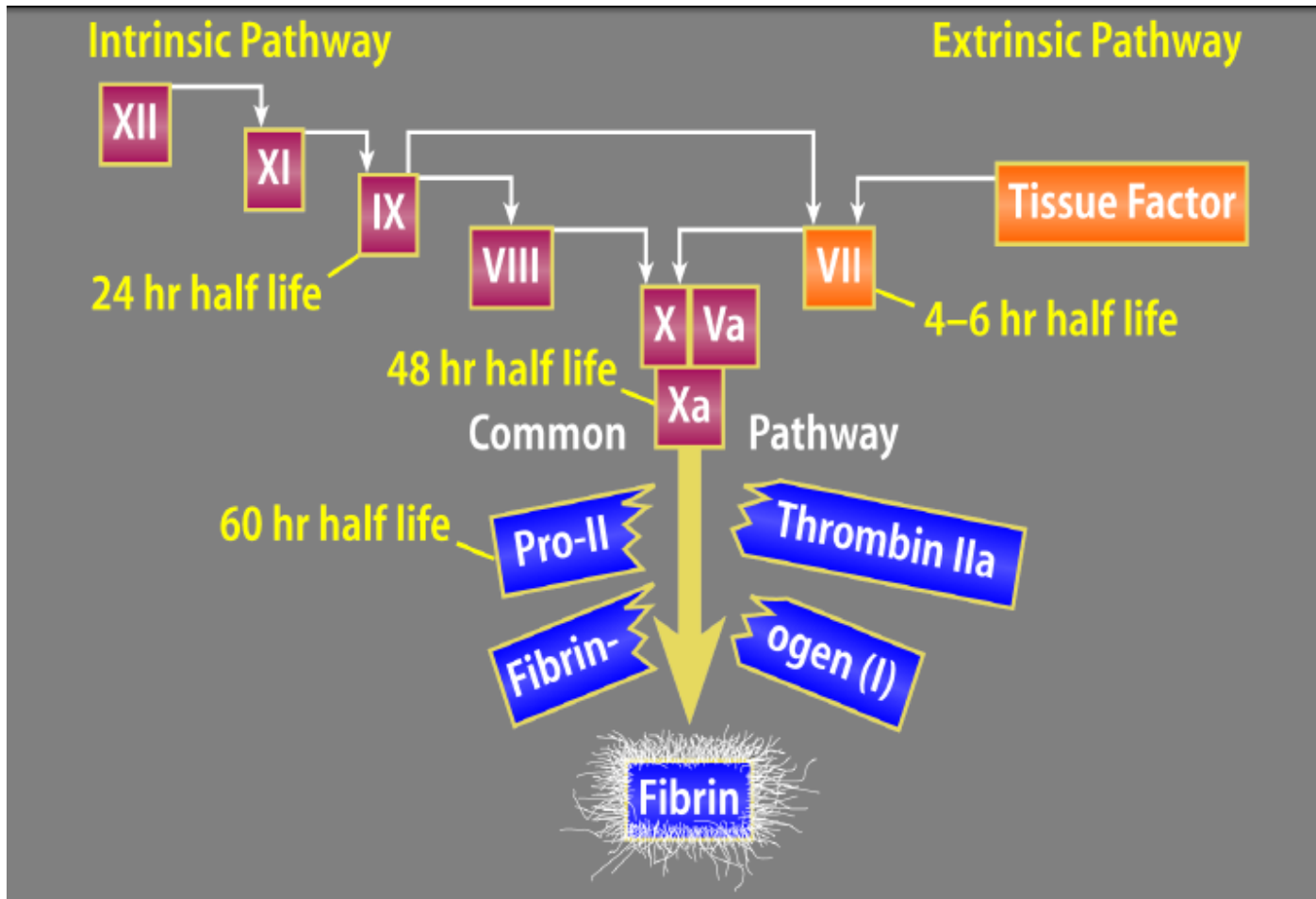
Treatment

- **Anticoagulation**

The evolution of anticoagulant drugs



Clotting Cascade



Heparin (UFH)

- **Heterogenous mixture** of polysaccharide fragments w/ molecular weight 12,000~15,000
- **Bind to the antithrombin**, results **conformational change of AT**, thereby enhance AT's inhibitory effect on thrombin and other coagulation factors esp., Xa
- **Drawbacks of unfractionated heparin (UFH)**
 - Need to administer heparin by continuous IV infusion
 - Unpredictable activity, requiring laboratory monitoring
 - Heparin induced thrombocytopenia (HIT)

Low Molecular Weight Heparin (LMWH)

- Obtained by various fractionation or depolymerisation of polymeric heparin
- Molecular weight < 8000
- Various activity to the **AT and Xa**
- Constant release \rightarrow predictable effect, do not need monitoring

Low Molecular Weight Heparin (LMWH)



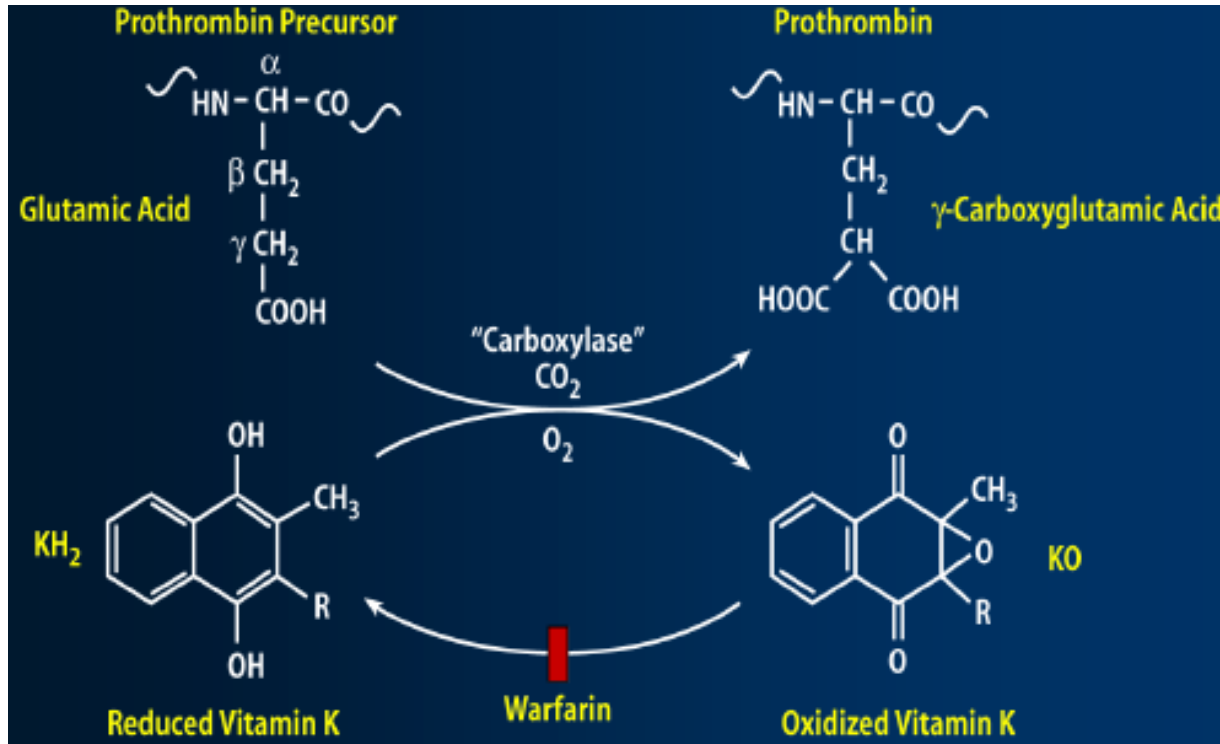
Agent	Trade Name	Mean MW	Anti-Xa:Anti-Iia Ratio
UFH	-	12,000~15,000	1
Ardeparin	Normiflo	6,000	1.9
Dalteparin	Fragmin	6,000	2.7
Enoxaparin	Clexane	4,200	3.8
Nadroparin	Fraxiparin	4,500	3.6
Reviparin	Clivarine	4,000	3.5
Tinzaparin	Innohep	4,500	1.9

Advantages of LMWH



Pharmacokinetic Characteristic	Clinical advantage
Reduced protein binding	Good bioavailability
	Predictable dose response
	Resistance not encountered
Predictable dose response	Fixed or wt-based dosing possible
	Monitoring not required
Longer plasma half-life	Once- or twice-daily dose possible
Smaller molecule	Improved subcutaneous absorption
Less effect on platelets and endothelium	Reduced incidence of HIT and, possibly, bleeding

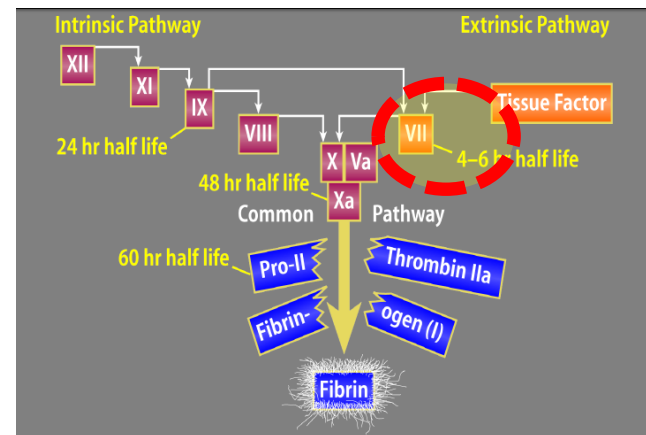
Warfarin : Mechanism of Action



- Inhibit carboxylation of coagulation factor II, VII, IX, X in the liver
- Also inhibits natural anticoagulant protein C/S

VKA should be given with heparin at the beginning

- Slow action of VKA
- Relatively hypercoagulable state due to short half life of natural anticoagulants (protein C/S)
- Very short half life of factor VII → initial INR may not reflect effect of VKA



New Oral Anticoagulants (**NOACs**)

- Factor Xa inhibitors
 - Rivaroxaban
 - Apixaban
 - Edoxaban
- Direct thrombin inhibitors
 - Dabigatran

New ERA of NOAC in VTE treatment

Rivaroxaban
(Xarelto®)



EINSTEIN-PE 2012 NEJM
EINSTEIN-DVT 2010 NEJM



Dabigatran
(Pradaxa®)

RE-COVER 2009 NEJM
RE-COVER II 2014 Circulation

WFR

Apixaban
(Eliquis®)



AMPLIFY 2013 NEJM



Edoxaban
(Lixiana®)

Hokusai-VTE 2013 NEJM

Pharmacokinetics of NOACs

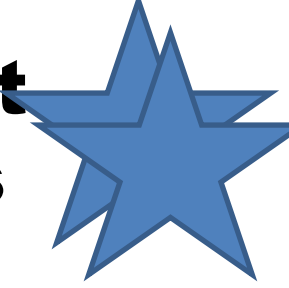
	Dabigatran	Rivaroxaban	Apixaban
Administration	bid	QD	bid
Bioavailability	6.50%	80%	66%
Tmax	1.25-3 h	2-4 h	1-3 h
Half life	12.14 h	5-13 h	8-15 h
Renal excretion	80%	66%	25%
Plasma protein binding	35%	>90%	87%
Dialysability	Yes	Not expected	Unlikely

Anticoagulant therapy:

Contraindication

- Active bleeding
- Recent CNS surgery : 2 mo
- Recent major surgery : 2 wk
- Recent hemorrhagic stroke 2 mo
- Severe uncontrolled hypertension
- Severe renal and/or hepatic dysfunction

Optimal Duration of Anticoagulant Therapy for Symptomatic Venous Thrombosis



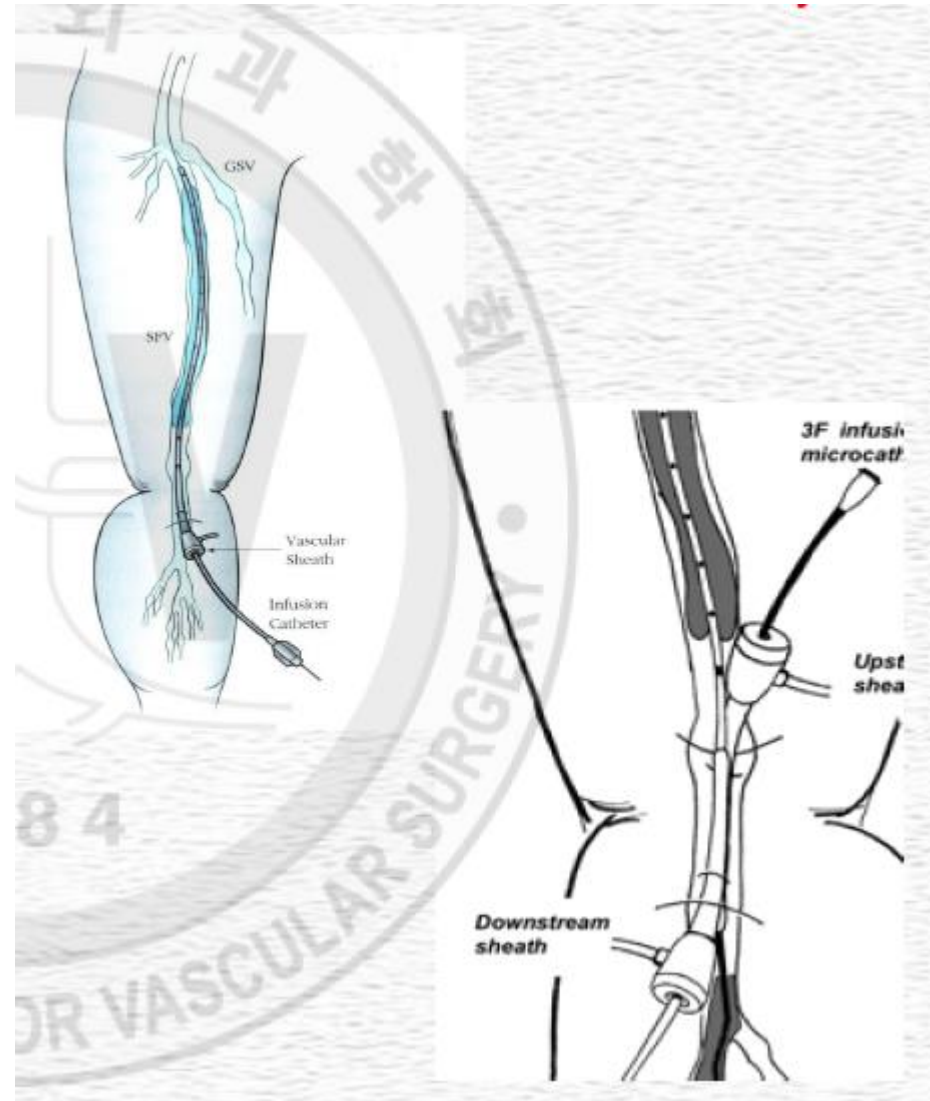
Indication	Duration
DVT with provocative events	3 months
DVT without provocative cause	6 months to > 1 year
DVT with malignancy	until resolution of malignancy
Hypercoagulable state	life long
Recurrent DVT	life long

Treatment

- **Catheter Directed
Thrombolysis (CDT)**

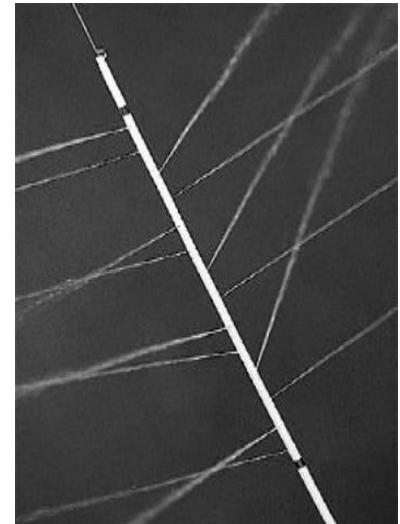
Catheter directed thrombolytic therapy (CDT)

- **Access**
 - Ipsilateral Popliteal vein
 - Contralateral Femoral vein
 - Internal Jugular vein
- **6-F sheath : Heparin**
- **5F multi-sideportcatheter : UK**
 - Heparin 500 unit/hr
 - Urokinase 30~100 x 10³IU/hr



Catheter directed thrombolytic therapy (CDT)

- Delivery of thrombolytics into the thrombus
- Popliteal approach
- Urokinase >> streptokinase, rtPA – more bleeding
- Pulsed spray catheter



Limitations of CDT

- Time to lysis
- Need to hospitalization and intensive monitoring
- Risk of hemorrhage
- Cost

Treatment

- **PharmacoMechanical
Thrombolysis (PMT)**

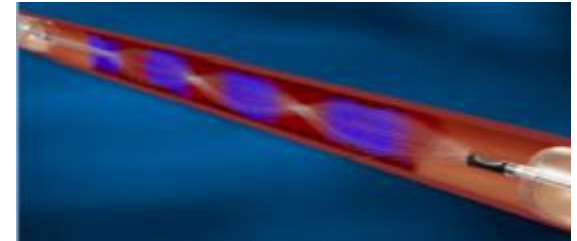
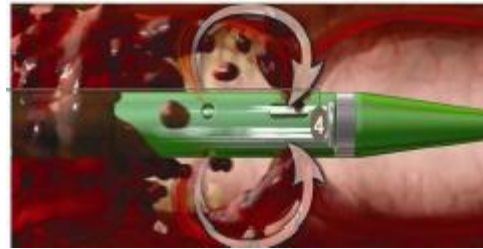
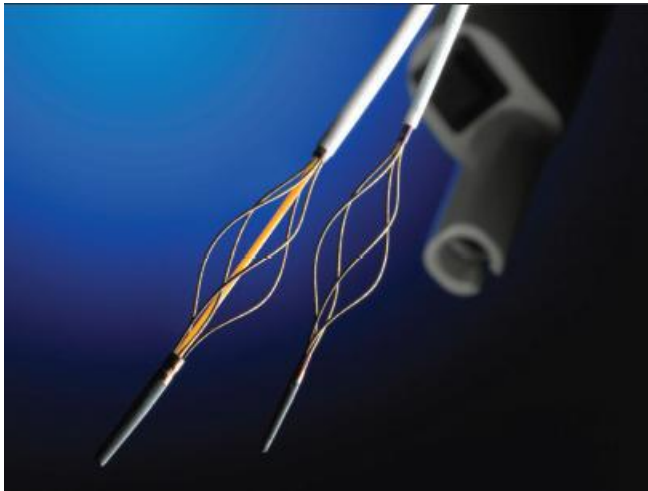
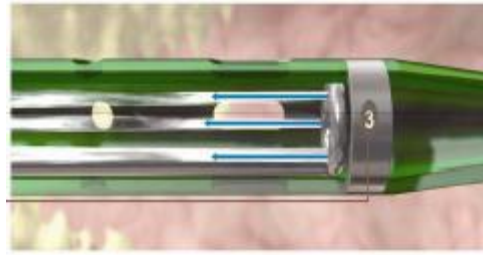
Pharmacomechanical thrombectomy(PMT)

- Reduce dosage of thrombolytic Tx
- Reduce treatment time
- Increase safety
 - narrows contraindications
 - decrease complications
- Reduced cost

PMT Devices

- Aspiration thrombectomy device
- Rotational device
 - Arrow PTD
- Rheolytic thrombectomy
 - angiojet, oasis, hydrolyser
- Isolated PMT
 - trellis
- Ultrasound accelerated thrombolysis
 - Ekos

PMT Devices

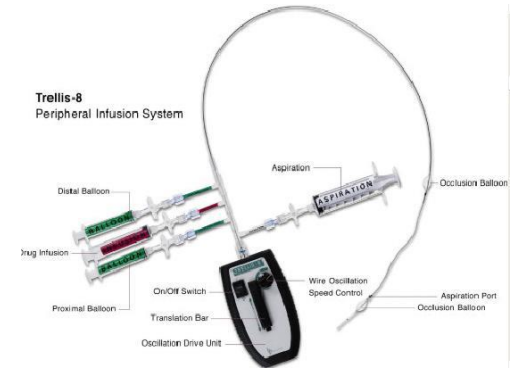


EKOS
2nd Generation

5.2 ft slide-hole drug delivery catheter

Control Unit

Device



CDT vs. PMT

	complete thrombus remove	partial thrombus remove	angioplasty & stenting
CDT	70 %	30 %	78 %
PMT	75 %	25 %	82 %

Lin PH et al. Am J Surg 2006

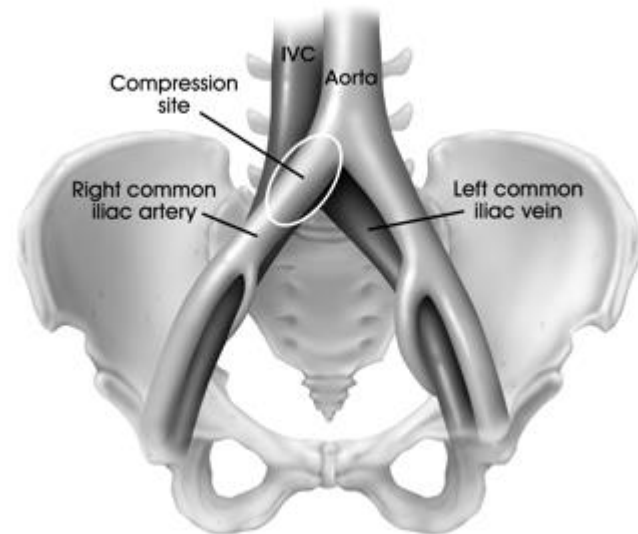
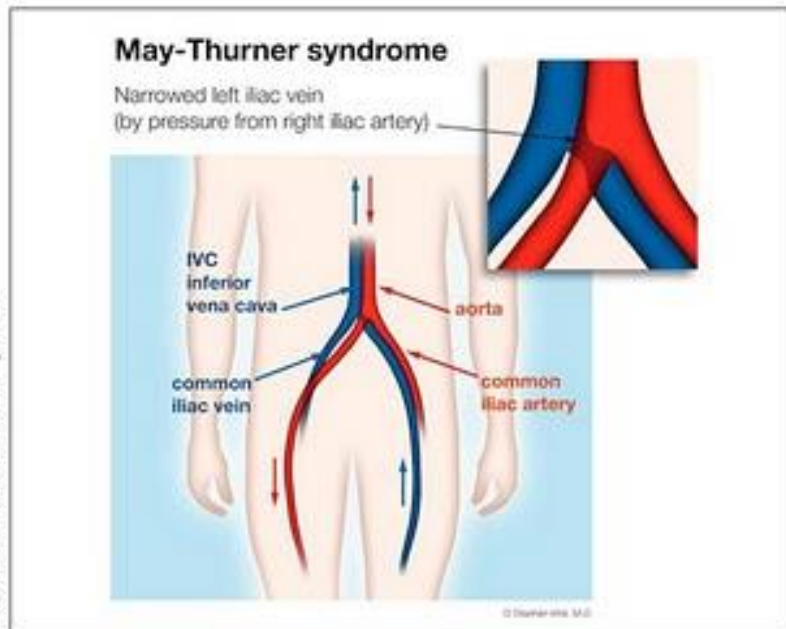
- ❖ Compared to CDT, it provided similar treatment success, with reduced ICU, total hospital length of stay, and hospital costs

Treatment

- **Adjuvant Venous Angioplasty and Stenting**

May-Thurner Syndrome

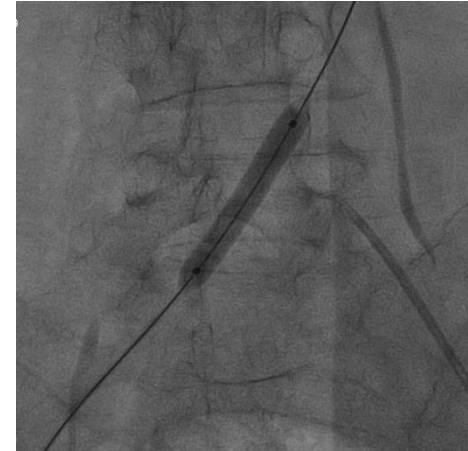
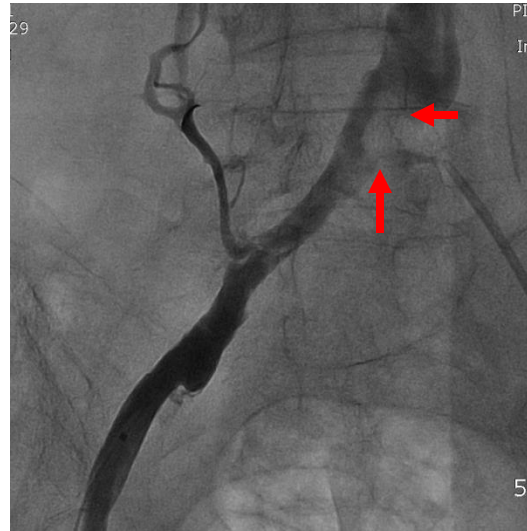
- **Iliac vein compression syndrome**
 - Compression of the left common iliac vein by the overlying right common iliac artery



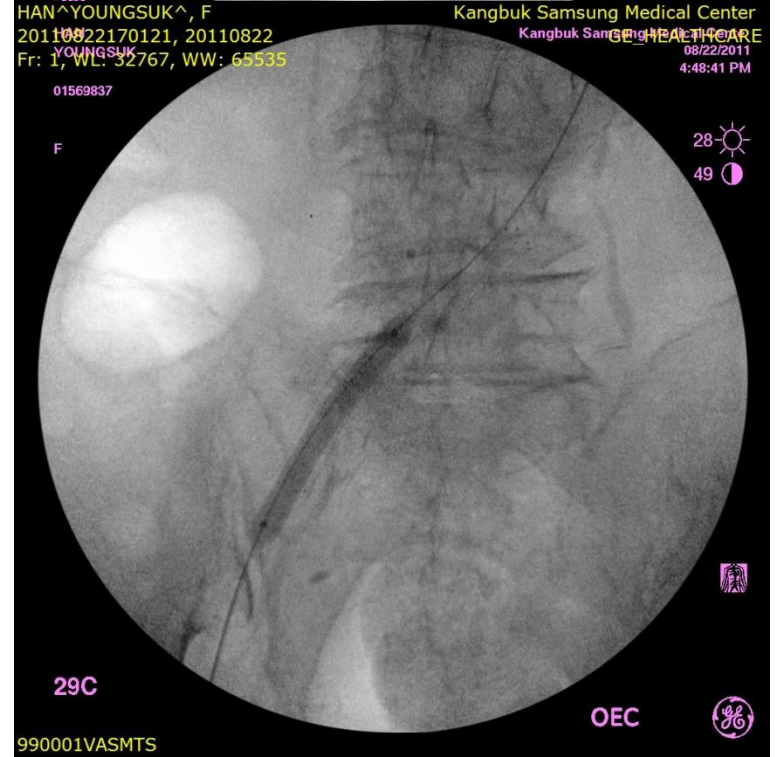
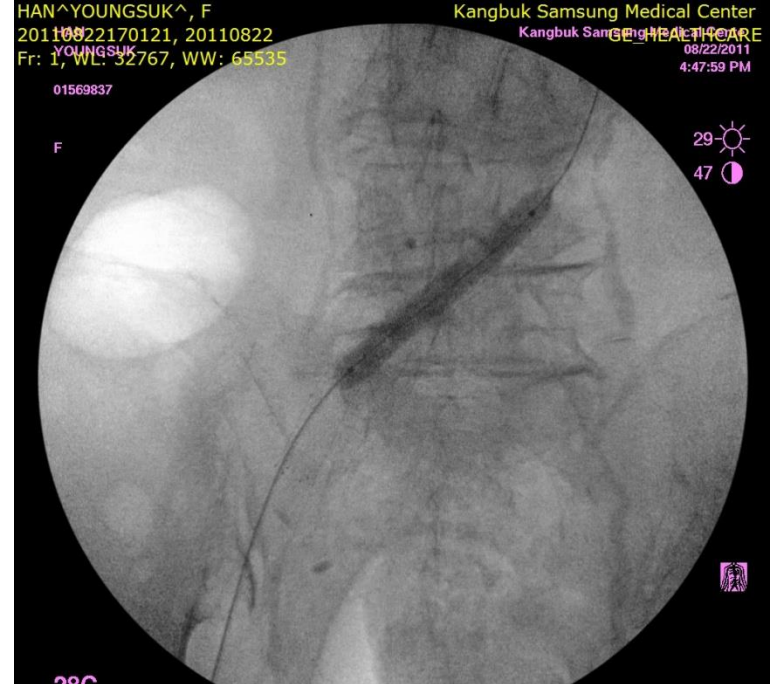
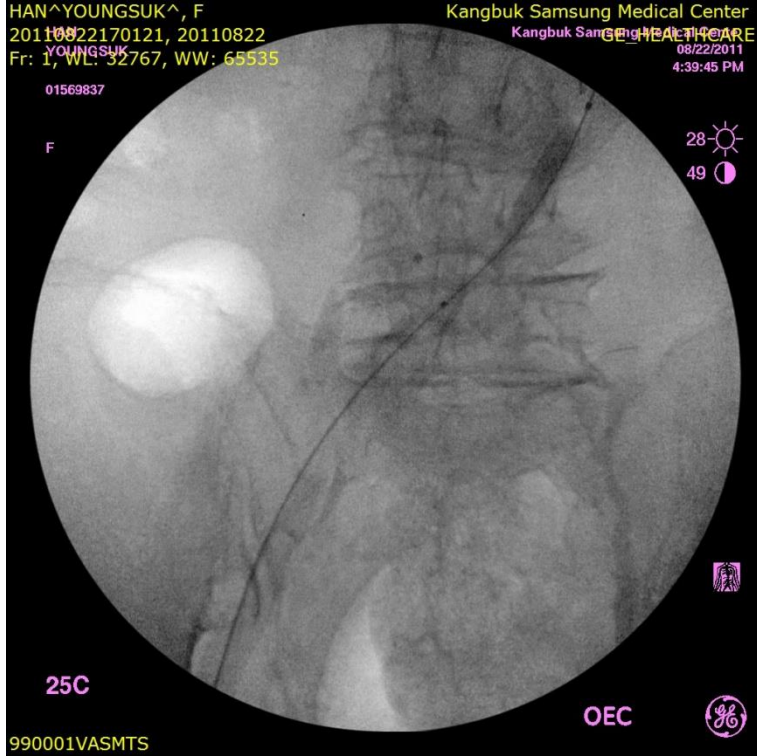
Adjuvant Venoplasty & Stenting

- **Technique**

- Popliteal vein approach
- Venoplasty balloon (8~10 mm)
- Self-expanding stents (10~16 mm)
- After the procedure, oral warfarin for 6 months



Balloon angioplasty & Stent insertion



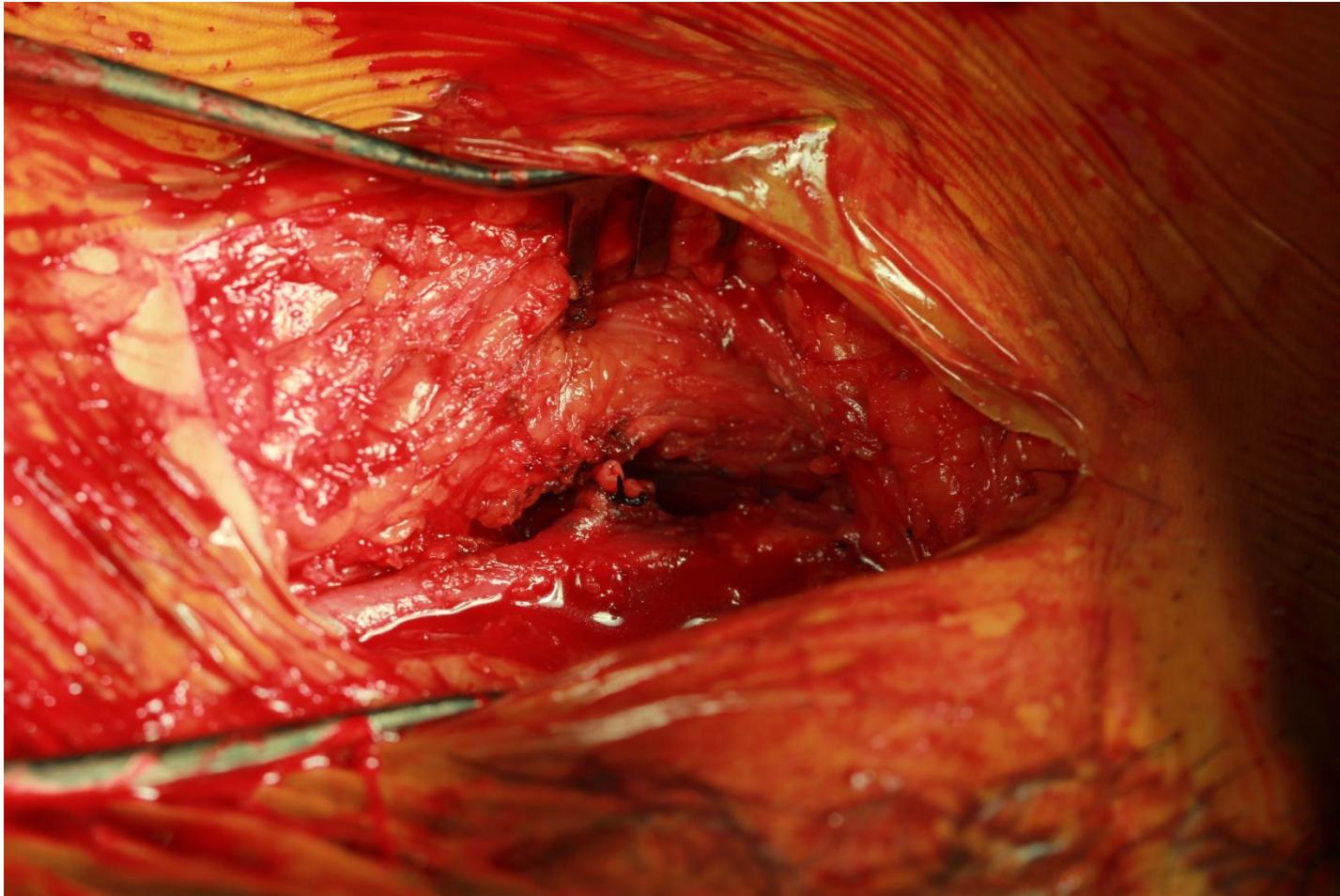
Balloon angioplasty & Stent insertion

Author (year)	N	Success rate	Primary patency				Sx resolution	Complication
			6 mts	1 yr	2 yrs	4 yrs		
O'Sullivan GJ (2000)	39	87%		92% (A) 94% (C)			85%	17%
Hurst DR (2001)	18		89%	79%				
Kwak HS (2005)	22	96%		95%	95%			9%
Husmann MJ (2007)	11	100%		90%	82%		90%	
Oguzkurt L (2008)	36	94%		85%		80%	85% (A) 25% (C)	3%

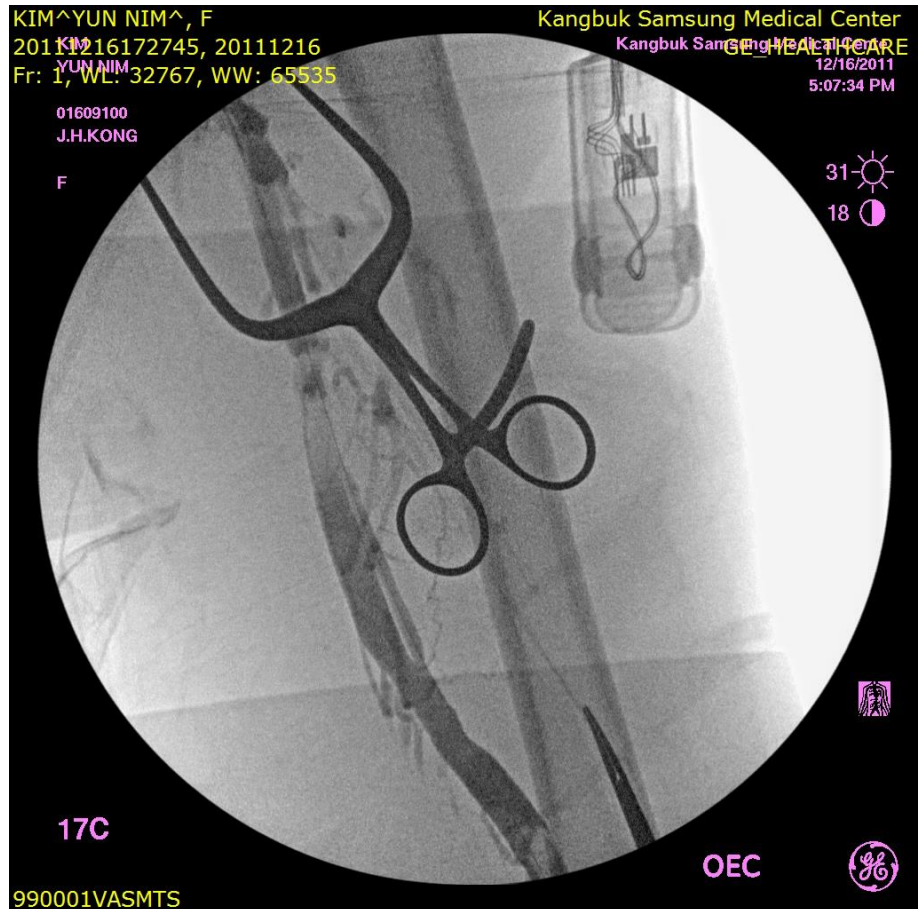
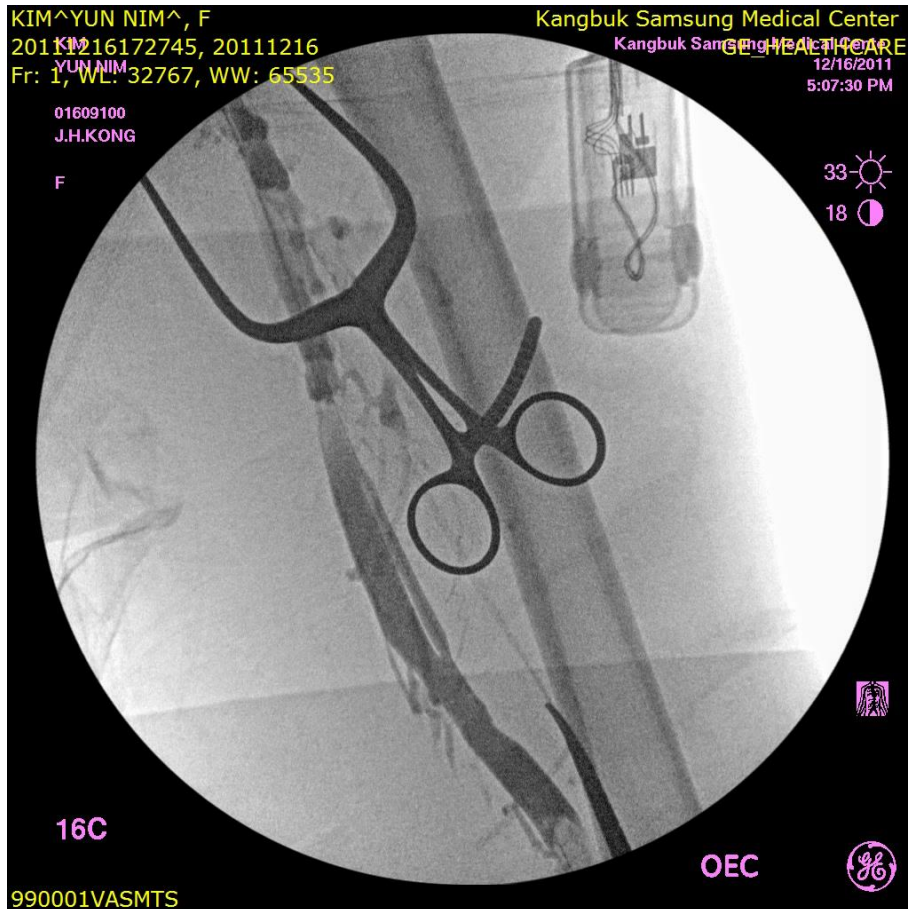
Treatment

- **Surgical Thrombectomy**

CFV Exposure



Hybrid Thrombectomy (Femoral Lt.)



Thrbombus



Venous Thrombectomy

- Revival of thrombectomy in the management of acute iliofemoral venous thrombosis.
 - 230 thrombectomy
 - No fatal PE
 - 1 operative mortality
 - Early & long-term patency 80% vs 30% of anticoagulated pts
 - Eklof B, Contemp Surg 1992

Venous Thrombectomy

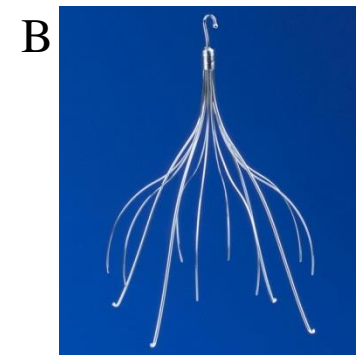
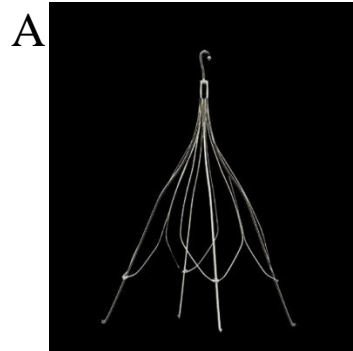
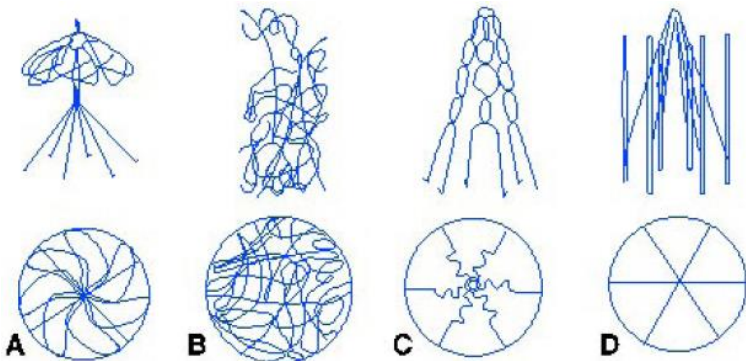
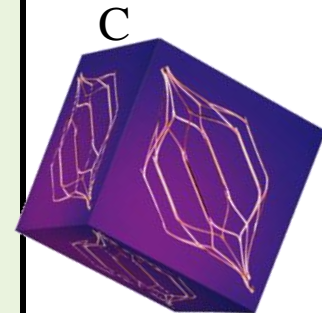
- AVF treatment guidelines for acute DVT
 - Accurate definition preoperatively of the extent of thrombosis, including routine contralateral iliocavography
 - Completion phlebography after thrombectomy to insure the adequacy of thrombectomy & examine residual venous lumen
 - Construction of a small arteriovenous fistula to increase velocity through a thrombogenic iliofemoral venous segment which assists in maintaining patency
 - Immediate & prolonged anticoagulation

Treatment

- IVC filter

Inferior Vena Cava Filters

Permanent filter	Optional retrievable filter
Simon Nitinol (A) Bird's Nest (B) Greenfield (C) VenaTech (D) TrapEase	Gunther Tulip (A) Cook Celect Filter (B) OptEase (C) Recovery Filter



Permanent IVC filter Indication

- Contraindication to anticoagulation
- Patients who experience a complication to anticoagulation treatment
- Recurrent PE
- DVT pts who have cancer, burns
- DVT during Pregnant
- High-risk surgical and trauma patients with a contraindication for anticoagulation



Inferior Vena Cava Filter

- **Absolute** Indication
 - Contraindications to anticoagulation
 - Recurrent thromboembolism **despite adequate anticoagulation**
 - Complications of anticoagulations that have to be forced the therapy to be discontinued
 - Immediately after pulmonary embolectomy
 - Failure of another form of caval interruption, demonstrated by recurrent thromboembolism

Inferior Vena Cava Filter

- **Relative** indications
 - A large free-floating iliofemoral thrombus demonstrated on venography in a high-risk patient
 - Propagating ilio-femoral thrombus despite adequate anticoagulation
 - Chronic pulmonary embolism in a patient with pulmonary hypertension and cor pulmonale
 - Occlusion of more than 50% of pulmonary bed and would not be tolerate any additional thrombus
 - Recurrent septic embolism

Summary

DVT: Treatment options



Goal	Caval filter	Anti-Coagulation	Thrombolytic Therapy	Venous Thrombectomy
reduce PE	+	+	+	+
prevent thrombus extension		+	+	+/-
reduce DVT recurrence		+	+	+/-
restore venous patency			+	+
restore venous valve			+	+
reduce chronic venous insufficiency		+/-	+	+

Summary

- **IVC filters**

- are *not considered* indicated for thrombolysis,

- **strongly considered**

- in case of **loose (free-floating) thrombi** or **patients with poor cardiopulmonary reserve**, filter placement before thrombolysis or mechanical thrombectomy should be strongly considered.

* Optimal or **retrievable filters** should be considered for this purpose.

Summary (cont'd)

- **CDT** for lower extremity DVT
 - are *not established*,
 - **seriously considered**
 - patients with iliac and proximal femoral vein thrombosis, especially who are younger,
 - patients with thrombosis of short duration (less than 10 – 14 days)

Summary (cont'd)

- **Mechanical thrombectomy**
 - may turn out to shorten the treatment time
 - possibly decrease the risk of complications, but this remains to be proved
- **Endovascular stents**
 - are used almost only in the iliac veins

Highlights in Thrombolytic Management of DVT

- WHAT'S **IN**?
 - **Cather-directed thrombolysis**: good effect and low rate of bleeding complications
- WHATS'S **OUT**?
 - **Systemic thrombolysis**: because of a high rate of bleeding complications

Highlights in Thrombolytic Management of DVT

- WHAT'S **NEW**?
 - **Pharmacomechanical thrombolysis**:
 - is associated with reduced thrombolysis time
 - allows aggressive treatment of underlying pathology
- WHATS'S **CONTROVERSIAL**?
 - Aggressive thrombolysis combined with immediate treatment of underlying obstructions or other causes

Calf Vein Thrombosis (CVT)

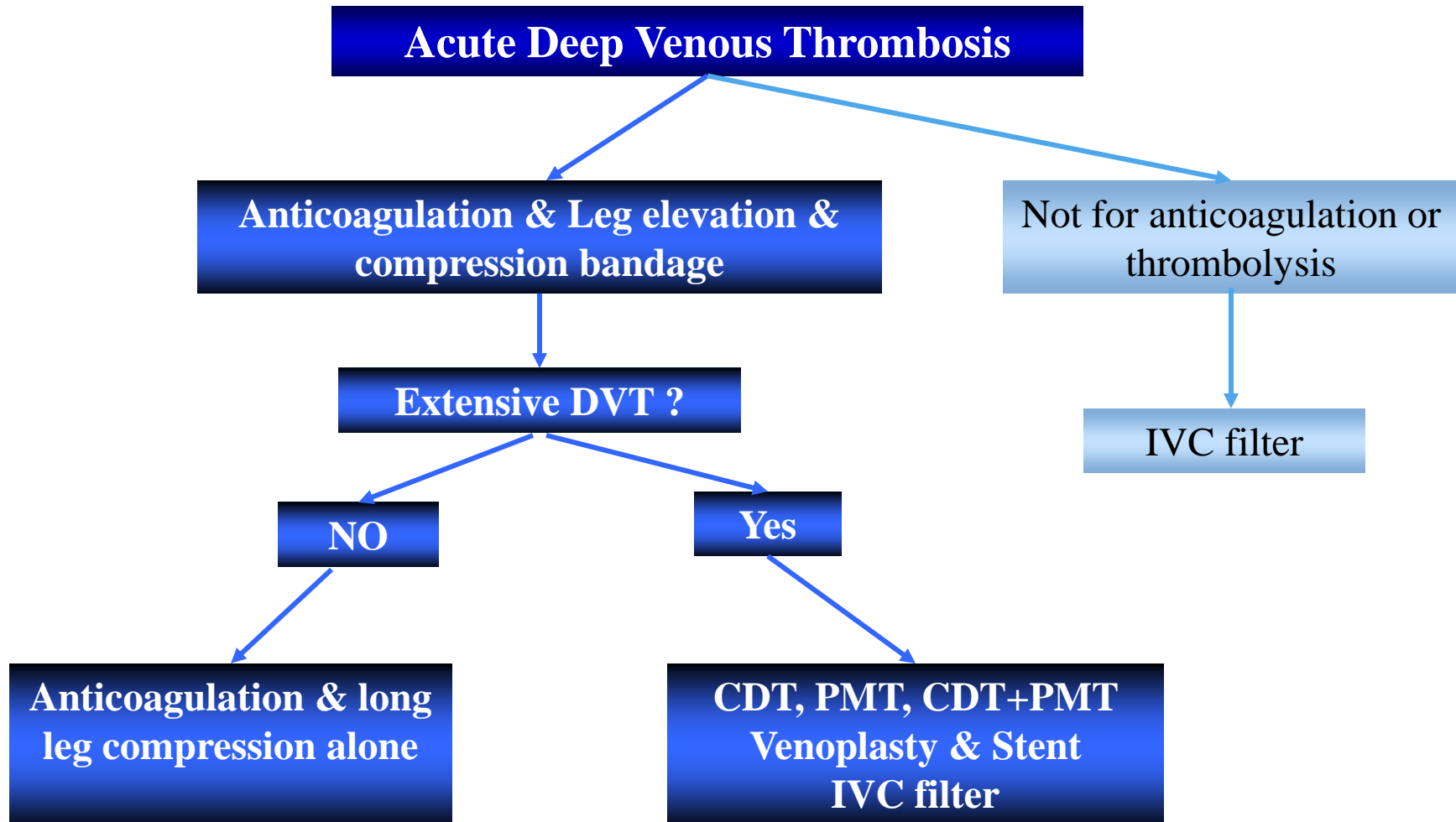
Calf Vein Thrombosis (CVT)

- CVT usually do not cause major sequelae & high risk of PE
- But CVT can embolize, propagation to large veins substantially increases the risk of PE & post-thrombotic syndrome
- Propagation rate : 6-30%
- If not treated, recurrent VTE occurred in 30% of pts.
- 29% recurrent VTE in pts treated w/ 5 days IV heparin vs. no recurrence in pts receiving 3 mo of anticoagulation

Lagerstedt CI, Lancet 1985

Guideline

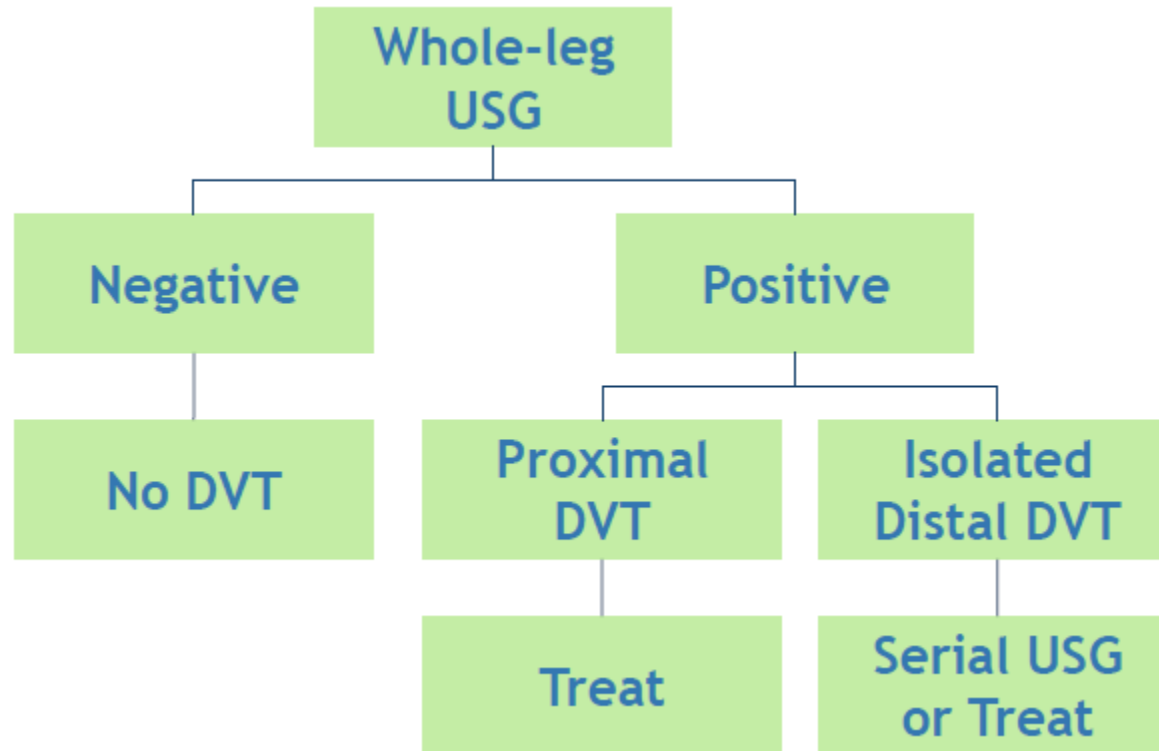
DVT treatment algorithm.



ACCP Antithrombotic Guidelines, 9th ed



Q



Pregnancy

DVT in pregnancy

- Increased risk of VTE in pregnancy
- Warfarin – teratogenic
- LMWH until delivery

Malignancy

Anticoagulant therapy in pts with malignancy

- Risk of VTE : 11%, 2nd leading cause of death in pt w/ overt malignancy
- Recurrence rate is higher in pts w/ malignancy than without malignancy
- Bleeding complication is higher in pts c malignancy than without malignancy

- Anticoagulant therapy LMWH > VKA
- NOAC – no data available
- Extended anticoagulation

Prophylaxis

DVT: Prophylaxis

	Calf DVT	Proximal DVT	Fatal PE
High risk	40-80%	10-30%	>1%
<ul style="list-style-type: none"> • Surgical patients with history of venous thromboembolism • Major pelvic or abdominal surgery for malignancy • Major trauma • Major lower limb orthopedic surgery 			
Moderate risk	10-40%	1-10%	0.1-1%
<ul style="list-style-type: none"> • Geberak surgery in patients >40 years • Patients on oral contraception • Neurosurgical patients 			
Low risk	<10%	<1%	<0.1%
<ul style="list-style-type: none"> • Uncomplicated surgery in patients <40 years without any other risk factors • Minor surgery in patients >40 years without any other risk factors 			

DVT: Prophylaxis

- **Pharmacologic**
 - UFH
 - LMWH
 - Fondaparinux
 - Oral direct thrombin inhibitor
 - Factor Xa inhibitor
 - VKA
 - Aspirin
- **Mechanical**
 - Intermittent pneumatic compression