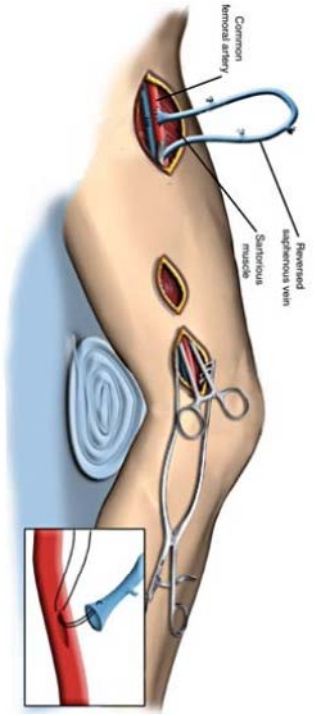


[B]	[처 방 내 역]	용량	단위	횟수	일수	용
Artery Bypass(인조혈관이용)[대퇴-슬와동맥						

처방코드	00164
처 방 명	ass(인조혈관이용)[대퇴-
의 보 수 가	555,477
일 반 수 가	1,281,870

[B]	[처 방 내 역]	용량	단위	횟수	일수	용
Lower Extremity Arteriography [흉부외과]						
혈관내 스텐트 삽입술(기타혈관)[흉부외과용						

처방코드	RA149CS
처 방 명	er Extremity Arteri aphy [흉부외
의 보 수 가	354,069
일 반 수 가	819,810

처방코드	M660 CS
처 방 명	내 스텐트 삽입술 기타혈관)[흉부외과
의 보 수 가	967,577
일 반 수 가	2,232,870

C-arm vs Cath room vs Hybrid-room

Hybrid-room

Cath-room

Operation-room

Field of Vascular Care !!

Lower Extremity Disease

- Iliac artery disease
- SFA ds – long occlusion, femoropopliteal disease
- Below the Knee

Renal, Carotid, Subclavian Artery Stenosis

Venous disease – SVC, DVT, Vein occlusion

Aorta Disease – Aortic dissection, aneurysm, AAA

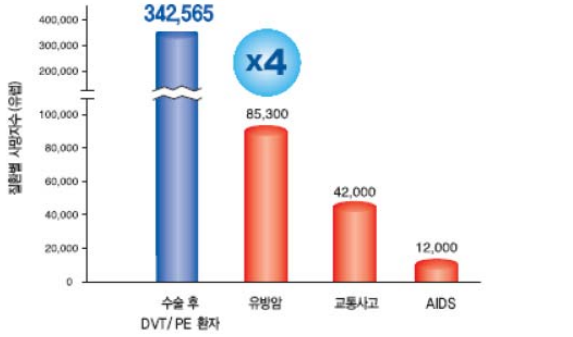
Adult congenital and structural heart disease (TAVI, ASD closure, percutaneous MVP)

Summary

Basic

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



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  - in the absence of treatment
    - 1/4 - 1/3 by Kearon
- **However, Need anticoagulation & Compression stocking!!!**

Basic

Acquired Risk Factors - Surgery

	Calf DVT	Proximal DVT	Fatal PE
High risk	**40-80%**	**10-30%**	**>1%**
• Surgical patients with history of venous thromboembolism			
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• Minor surgery in patients >40 years without any other risk factors			

Lecture

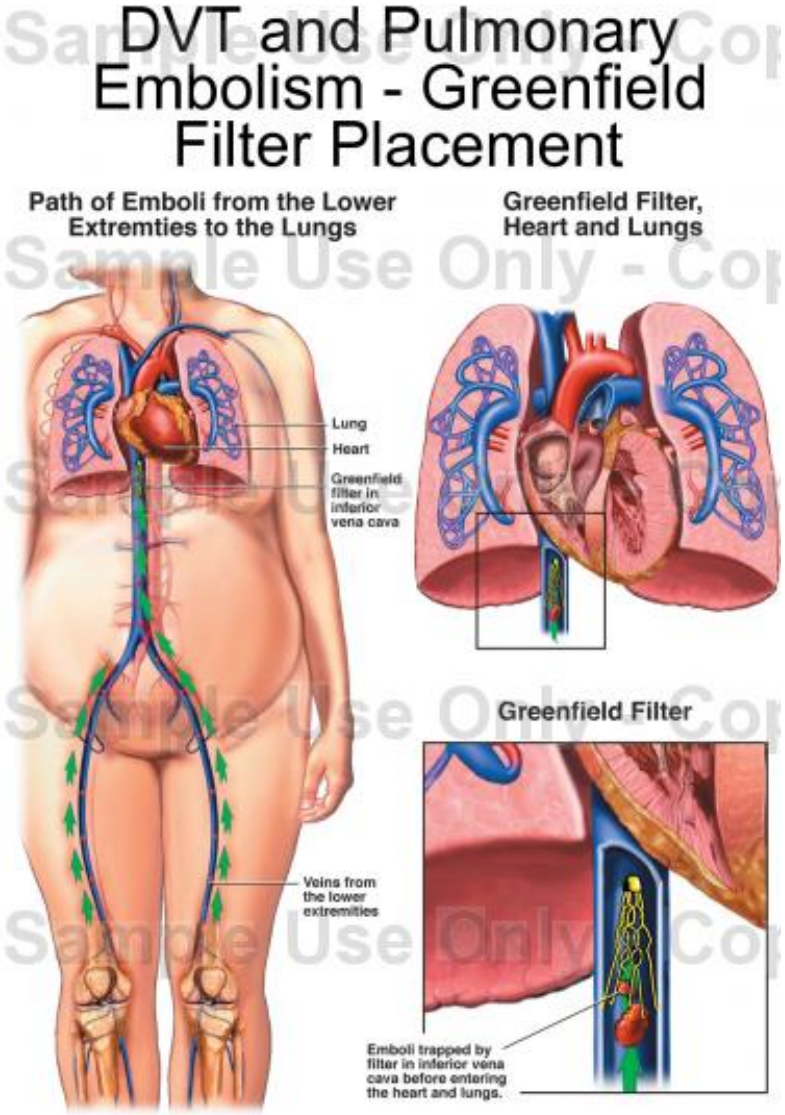
Deep Vein Thrombosis & Pulmonary Embolism

: overview & treatment

Department of Thoracic and Cardiovascular Surgery
Mediplex Sejong Hostpial
Joon Hyuk Kong

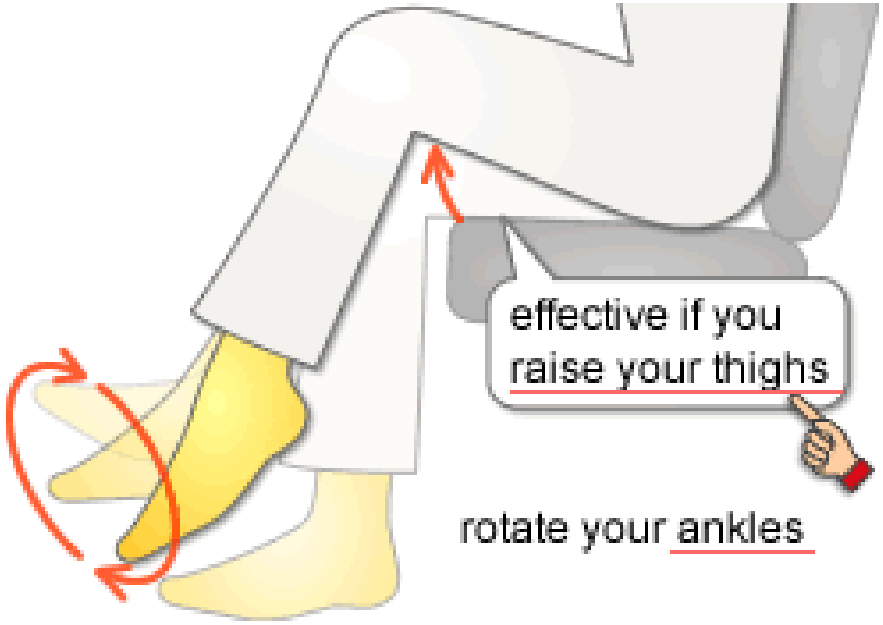
Basic

심부정맥 혈전증의 위험성



Basic

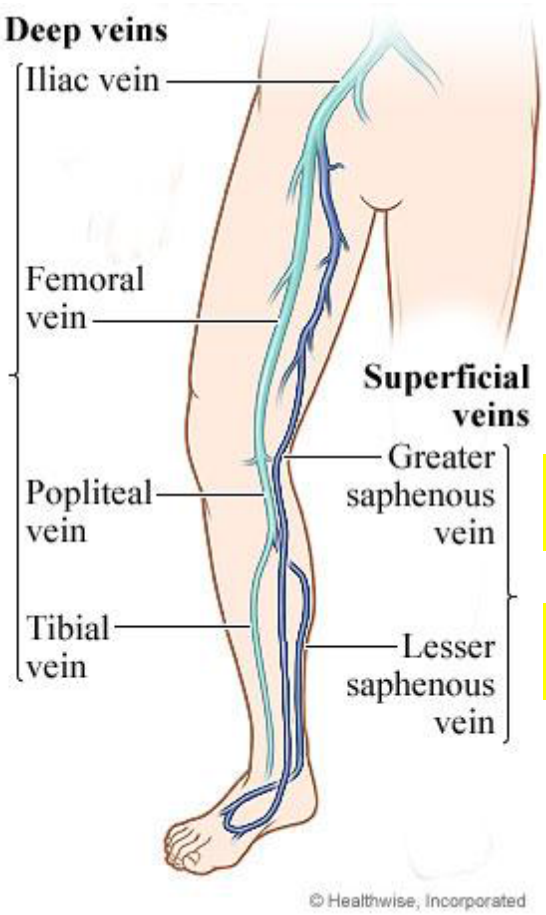
Economy class syndrome



Anatomy

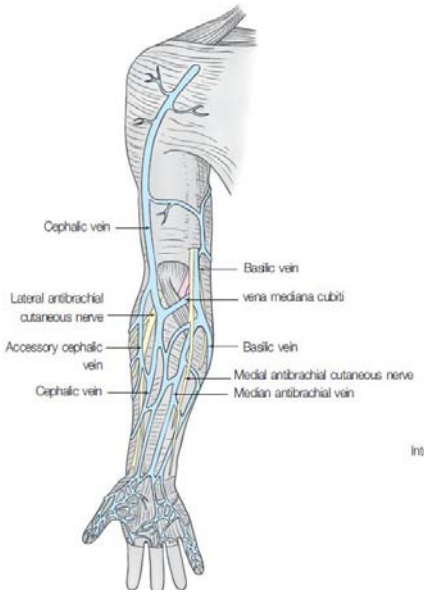
Basic

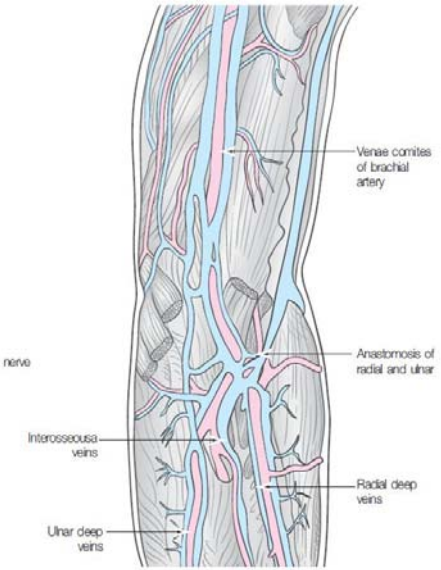
Venous System

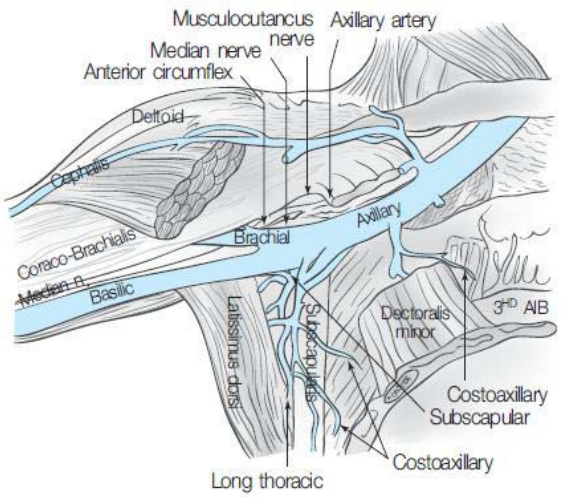


great

small





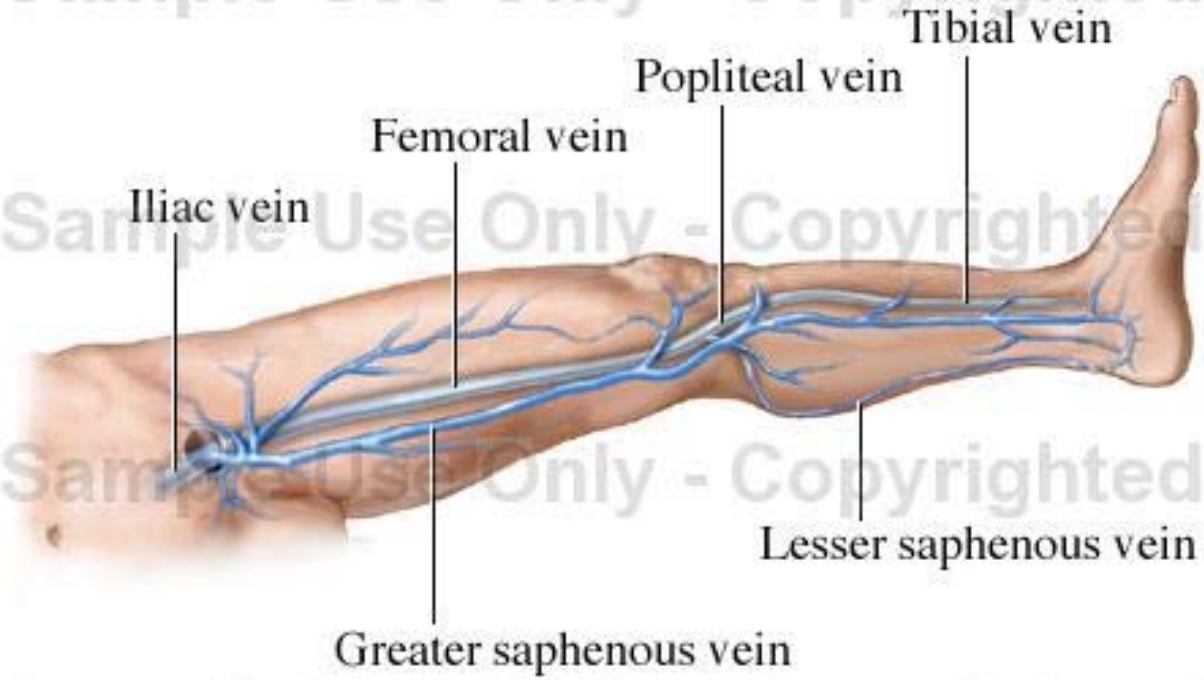


Pathophysiology

Summary

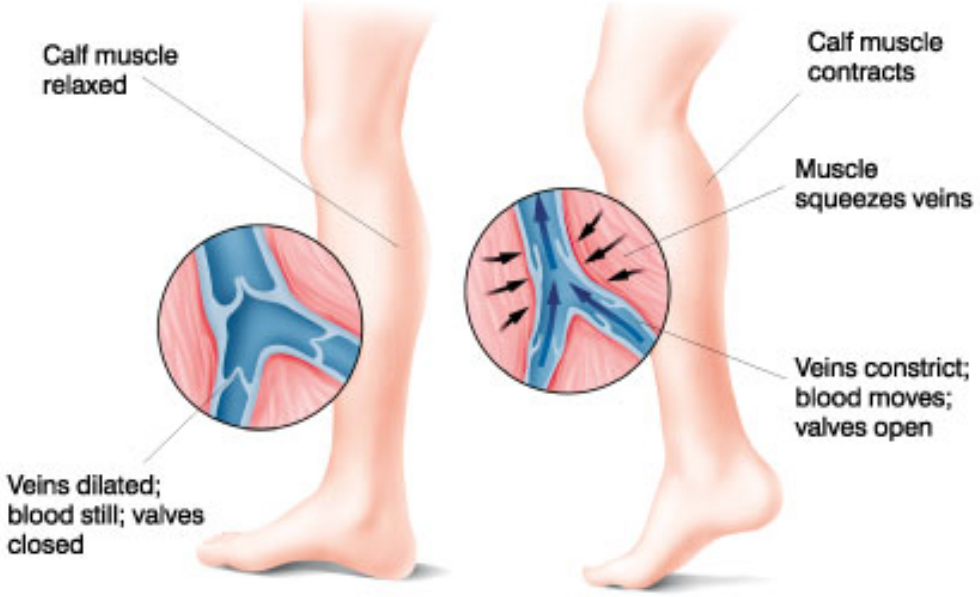
Basic

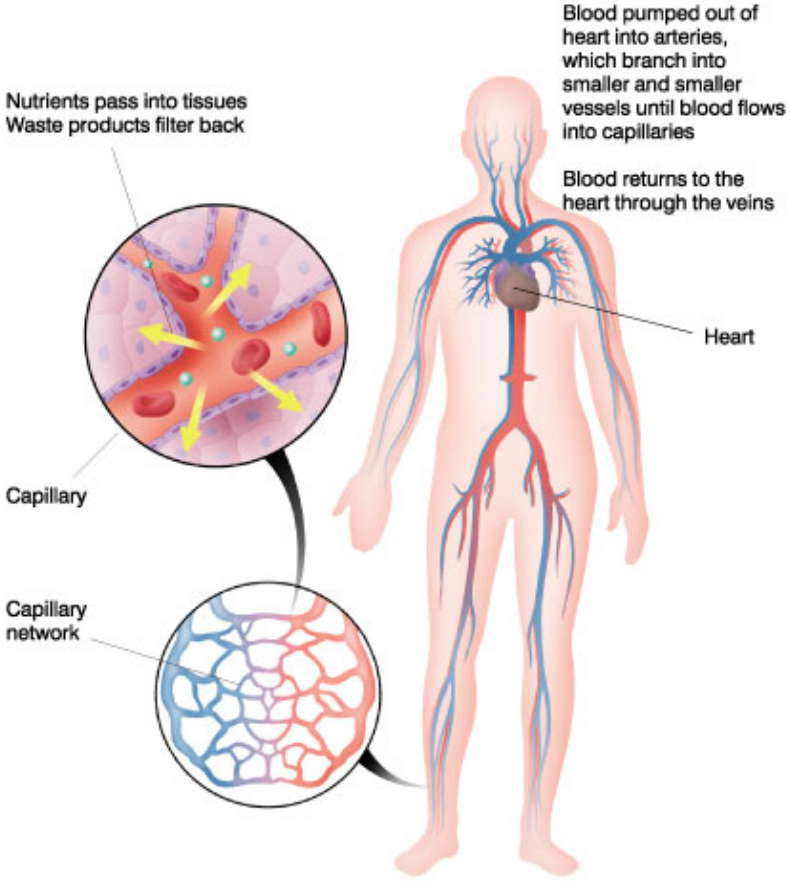
하지정맥의 구조



Basic

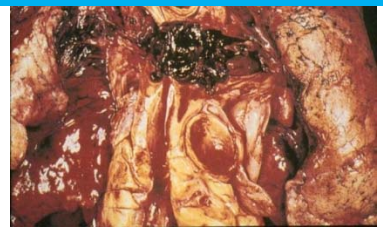
하지정맥의 순환





Venous Thrombo
Disorder

참고하세요.



- **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

Superficial Thromb

참고하세요.

- Cause ; Spontaneous, Trauma, Varicose vein, Buerger′s disease, Malignancy, Hypercoagulability
- Not related with bacterial infection, except caused by recent iv catheterization
- Symptoms ; localized pain, erythema, warmth, tenderness, swelling, palpable cord
- **Asymptomatic Synchronous DVT(+)** in **35%** => Check venous duplex study!
- Indication for treatment
  - Isolated superficial thrombophlebitis with encroachment on the S-F junction
  - Purulent infection
  - >5cm involvement: 45 days LMWH

Basic

Venous Thromboembolic Disorder

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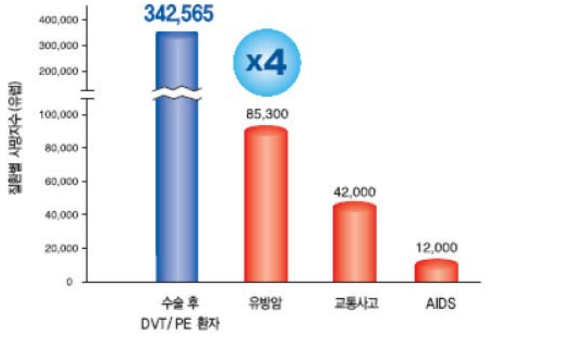

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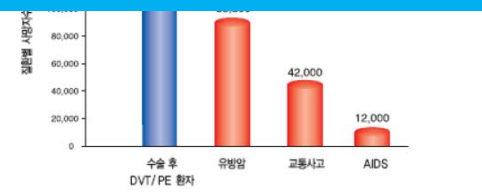

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- Incidence of acute DVT
  - Autopsy cases ; 35-52%
  - Community-based, venography, symptomatic ; 1.6 /1000 residents, yearly
  - Postoperative DVT; GS(19%), NS(24%), hip fracture(48%), hip arthroplasty(51%), knee arthroplasty(61%)
  - Trauma; autopsied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

Epidemiology and history

참고하세요.

- 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

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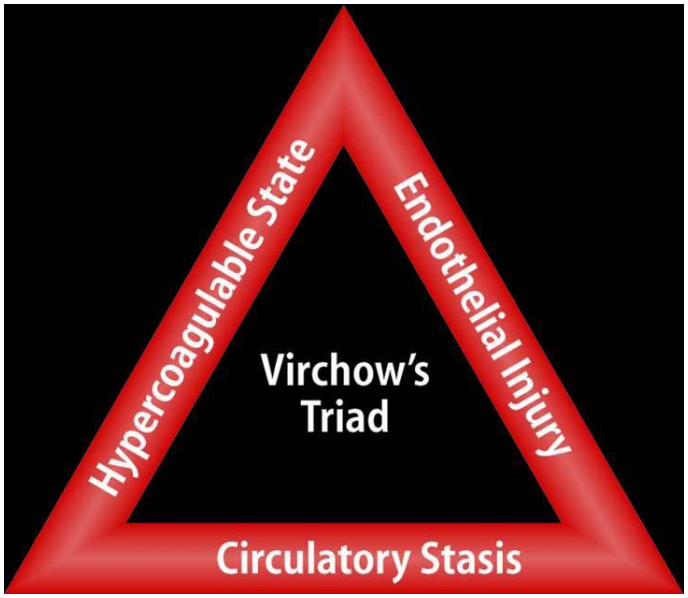
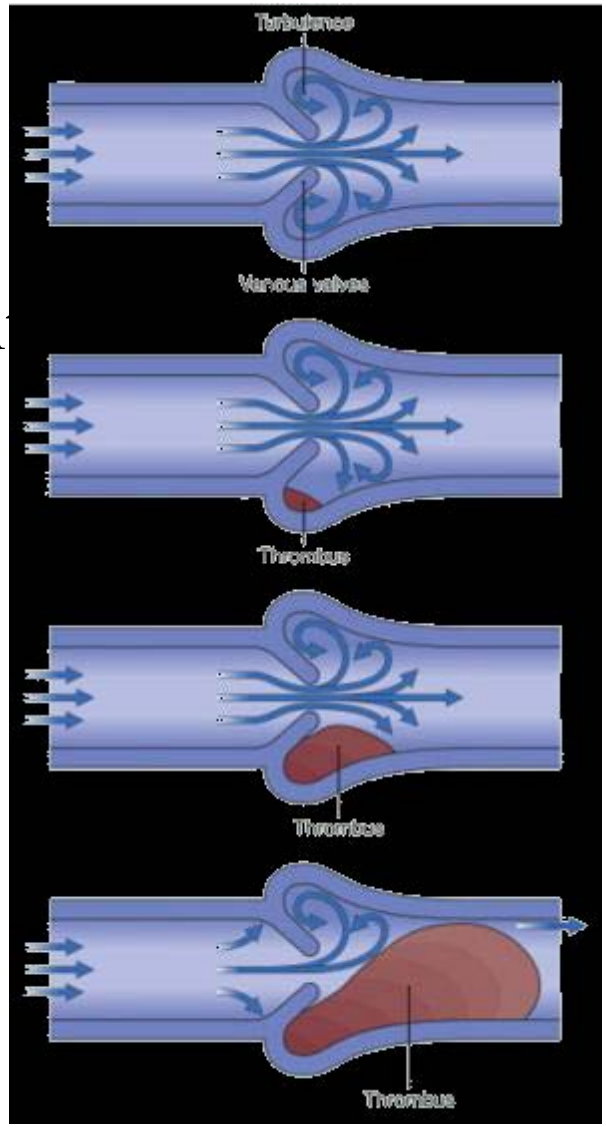
  - in the absence of treatment
    - 1/4 - 1/3 by Kearon
- **However, Need anticoagulation & Compression stocking!!!**

Basic

Pathophysiology

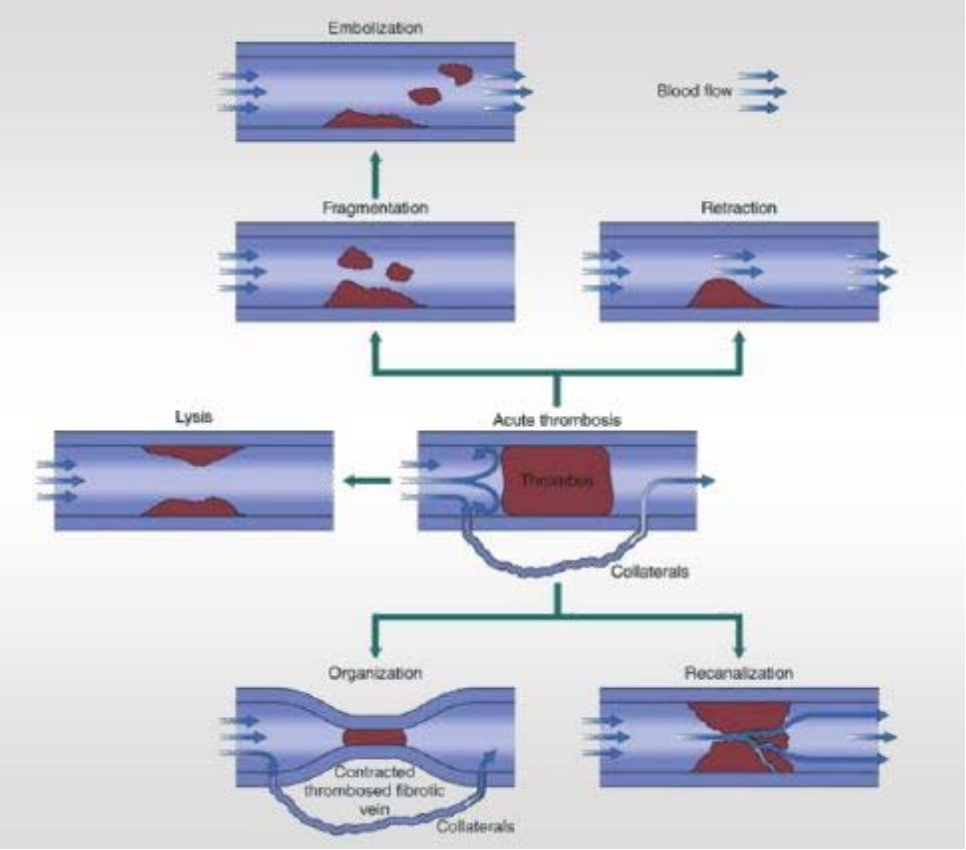
- **Virchow's triad**
  - Endothelial abnormality
  - Stasis of blood flow (predominan
  - Hypercoagulability of blood





Pathophysiolo
consequenc

참고하세요.



Basic

Clinical spectrum of acute DVT

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

Basic

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

Basic

Clincal 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 stagnnat vein imparts a cyanotic hue to the limb

Basic

Phlegmasia alba dolens (=white leg)

Basic

Phlegmasia cerulea dolens(=blue leg)

Risk Factors

Risk factor hypercoagulable

참고하세요.

Inherited	Acquired
Common	Age
Factor V Leiden	Surgery and trauma
Prothrombin gene mutation (G20110A)	Immobilization
Homozygous C677T mutation in methylene	Malignant disease
Tetrahydrofolate reductase gene	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	

Basic

Acquired Risk Factors - Surgery

	Calf DVT	Proximal DVT	Fatal PE
High risk	**40-80%**	**10-30%**	**>1%**
• Surgical patients with history of venous thromboembolism			
• Major pelvic or abdominal surgery for malignancy			
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Acquired Risk F

참고하세요.

- **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 rom activation of the cogulation 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

37

Inherited Throm

참고하세요.

- 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
Hyperhomocysteinaemia**	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**

38

Inherited Throm

참고하세요.

- Regulation of coagulation pathway

40

Inherited Throm

참고하세요.

- Mechanism of thrombosis

- Investigation for suspected inherited thrombophilia
  - age less than 45 years
  - recurrent episodes of VTE
  - Family history of VTE
  - thrombosis at unusual venous sites such as dural sinuses
  - recurrent miscarriages

41

참고하세요.

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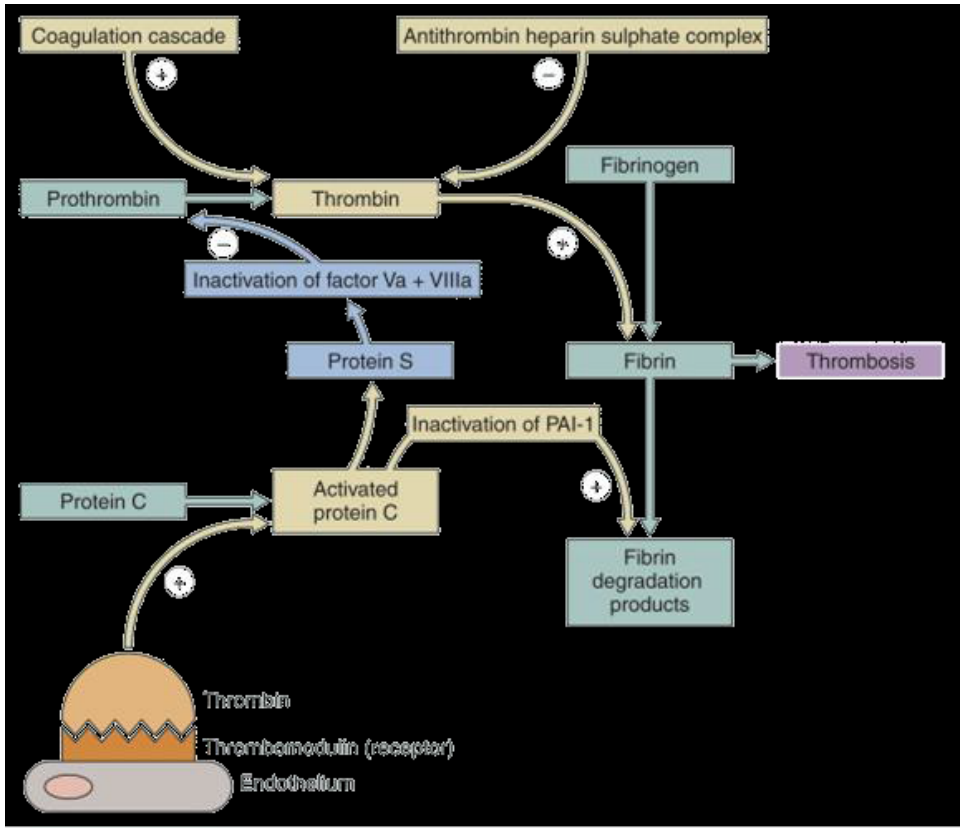
Inherited Thrombophilia

- Regulation of coagulation pathway



Inherited Throm

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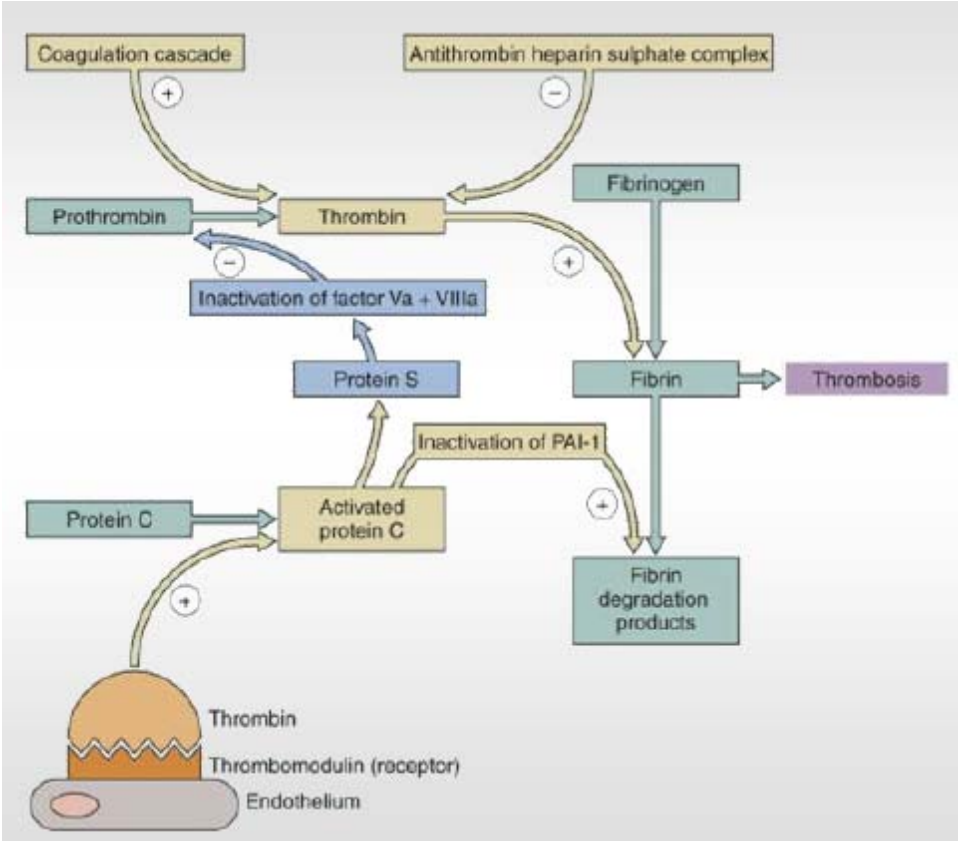

Inherited Thrombophilia

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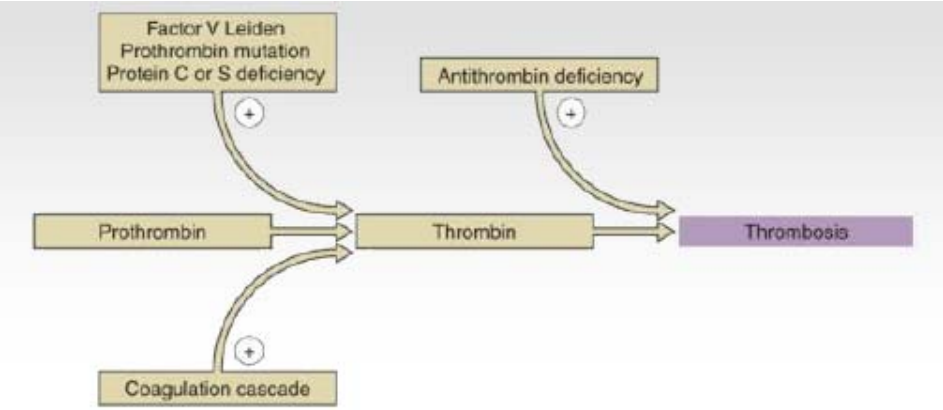

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  - age less than 45 years
  - recurrent episodes of VTE
  - Family history of VTE
  - thrombosis at unusual venous sites such as dural sinuses
  - recurrent miscarriages

Clinical Features

Basic

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 –

참고하세요.

- **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 sndrome
- 10-30% risk for **PE** (**similar to leg DVT**)

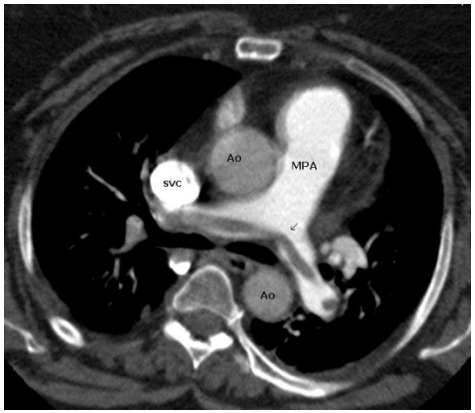
Basic

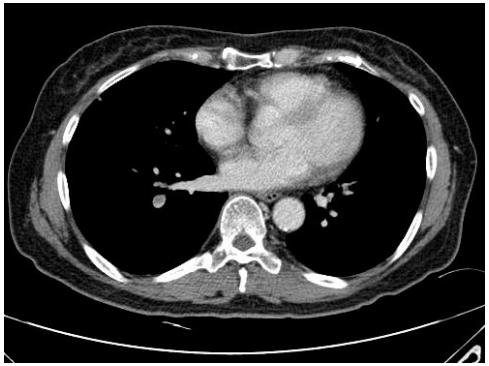
Clinical Features – PE

- Classification of PE

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

- **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

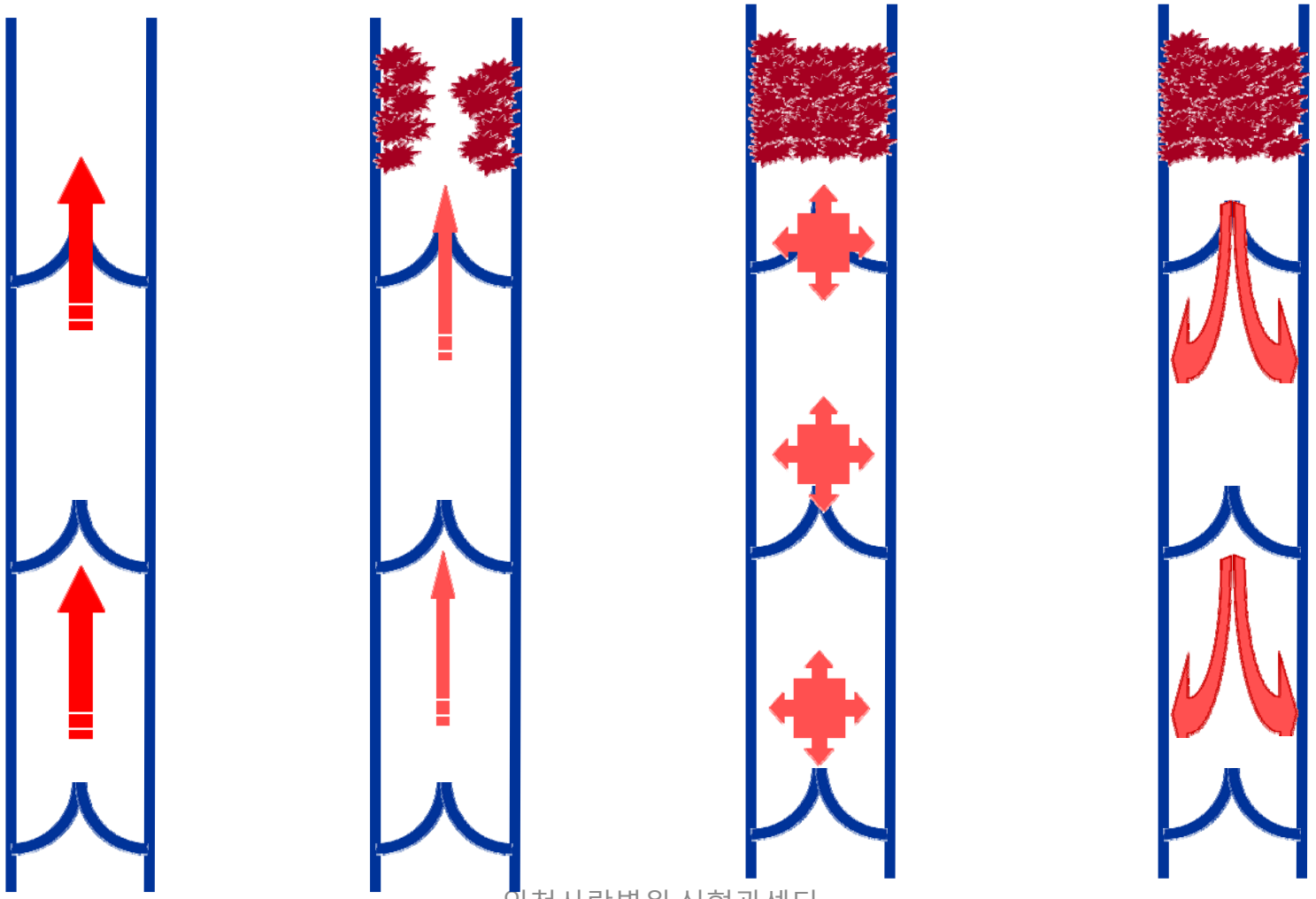




Complication

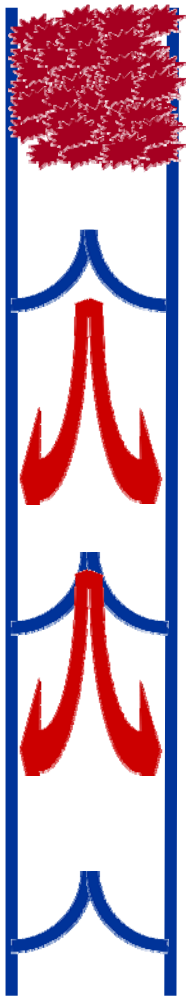
Basic

합병증 발생기전-01

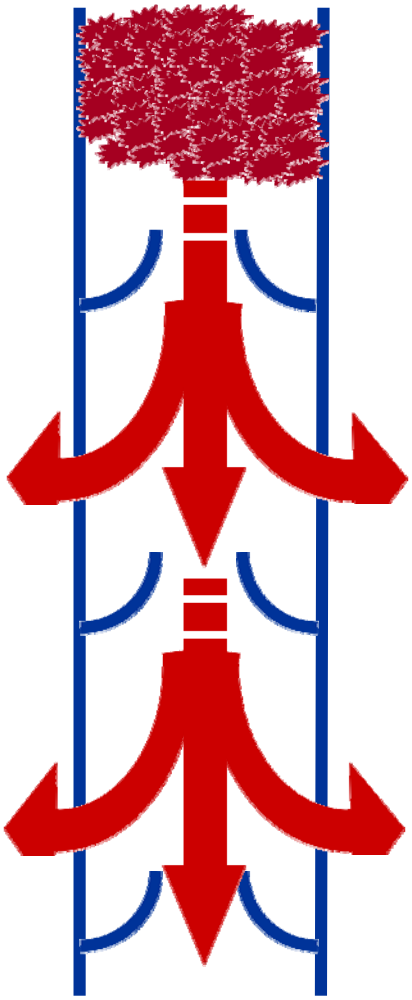


Basic

합병증 발생기전-02



- **Venous valvular incompetence**



- **Post-thrombotic syndrome (PTS) symptoms**
  - Chronic leg heaviness, leg aching
  - Venous claudication,
  - Leg edema, varicosities,
  - hyperpigmentation, nonhealing ulcers
- **PTS more frequently**
  - extensive multilevel DVT
  - recurrent DVT
  - oral anticoagulant regimen was inadequate

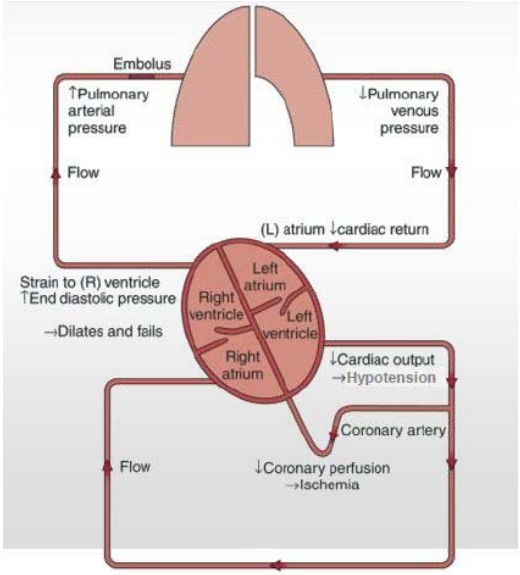
Basic

PTS

Basic

Complications (I)

- **Pulmonary Embolism**
  - **most devastating** complication
    - obstruction of blood flow distal to the clot
    - rapid increase in pulmonary arterial and right heart pressure



Basic

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

Basic

Post-Thrombotic Syndrome (PTS)

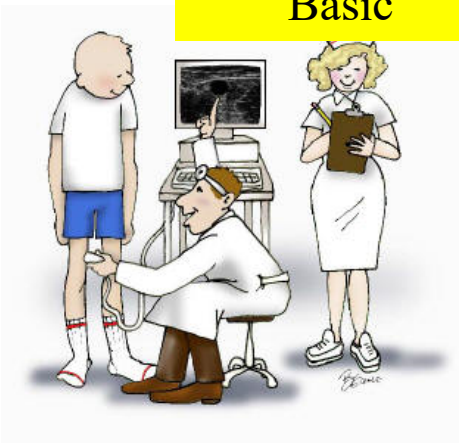
- Painfula heavy leg
- Cramps
- Paresthesia
- Prutitus
- Formation of varicosities
- Edema
- Hyperpigmentation of the skin

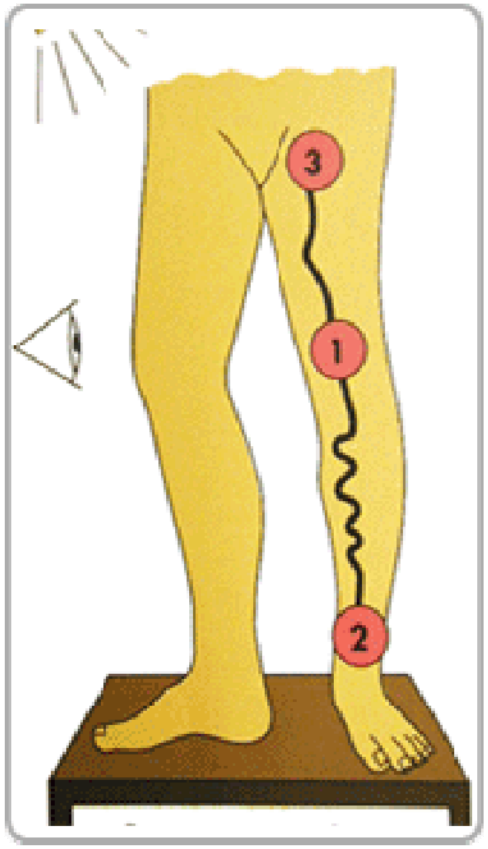
=> **Reduced quality of life (QoL)**

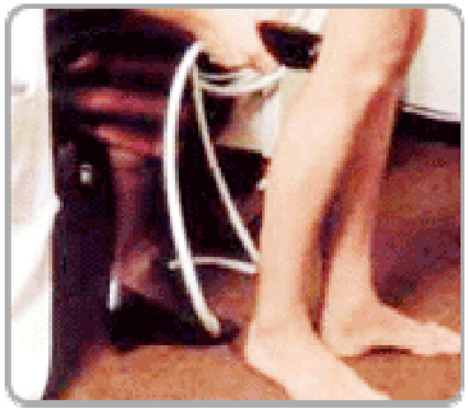
Diagnosis

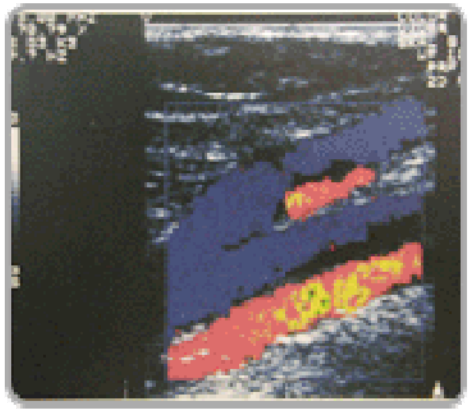
Basic

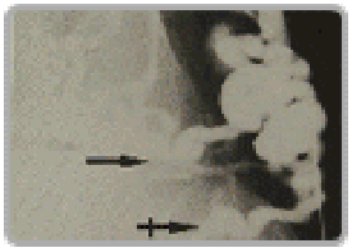
초음파검사





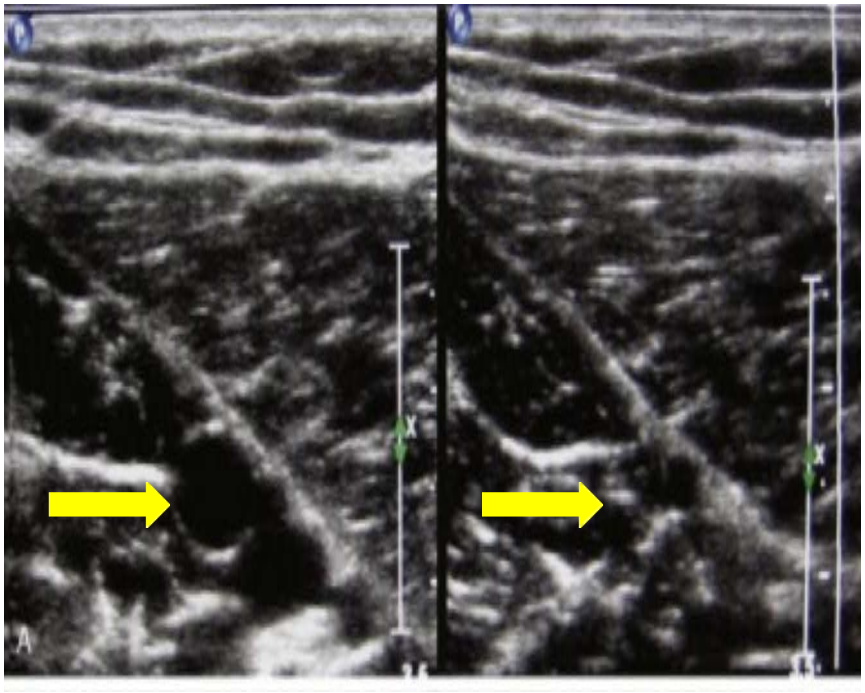


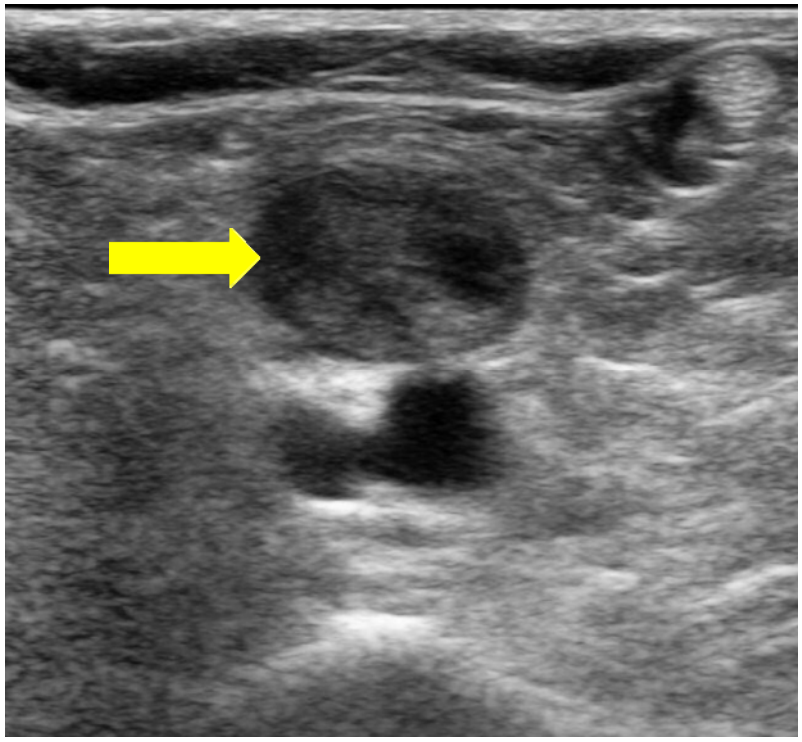




Basic

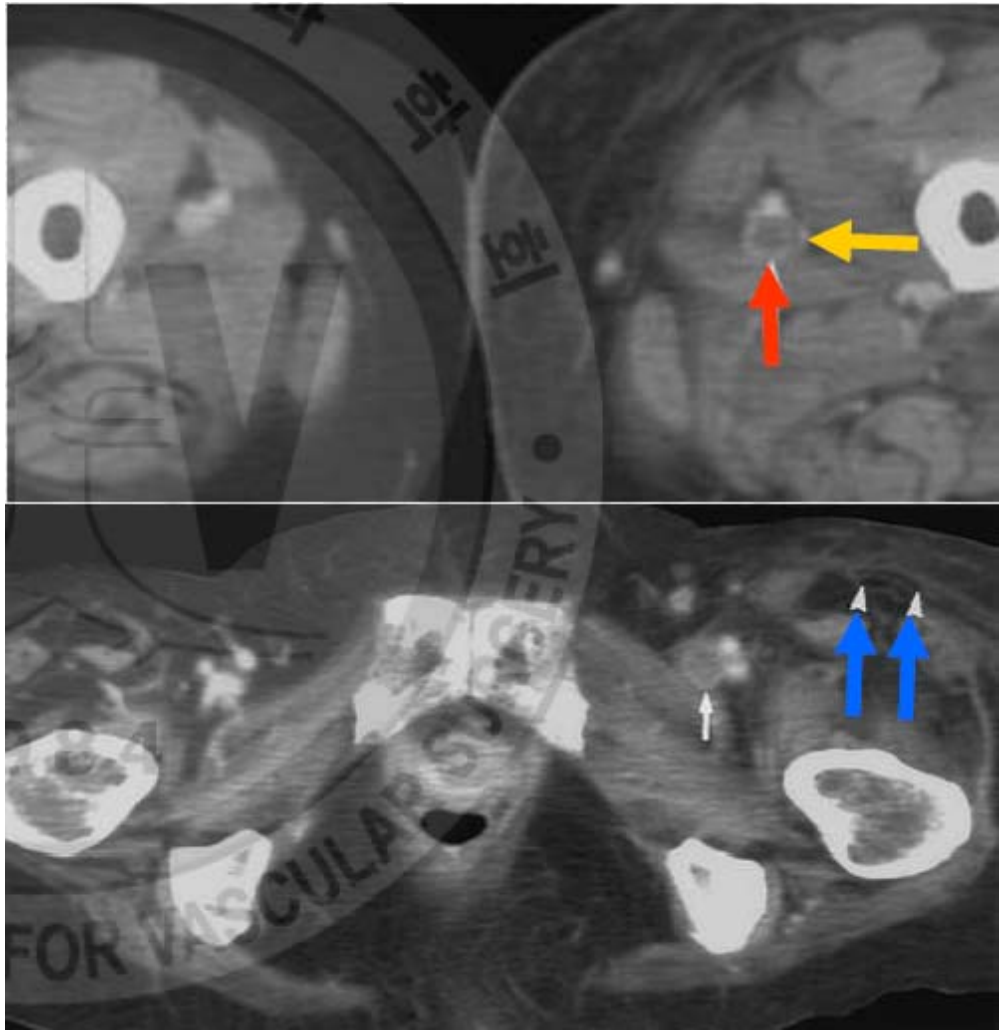
초음파검사





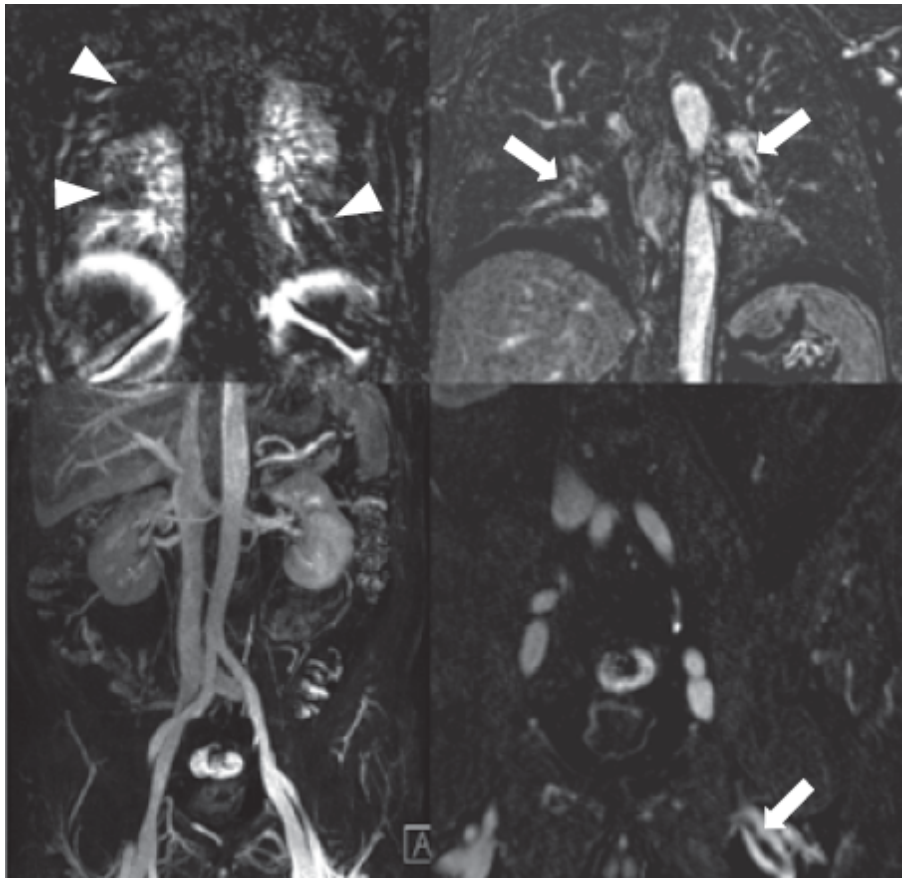
Basic

CT



Basic

MRI



Basic

혈관촬영

Basic

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

- Impedence phlethysmography
- Ascending venography
- MR Venography
- Lung ventilation & perfusion scan

Basic

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

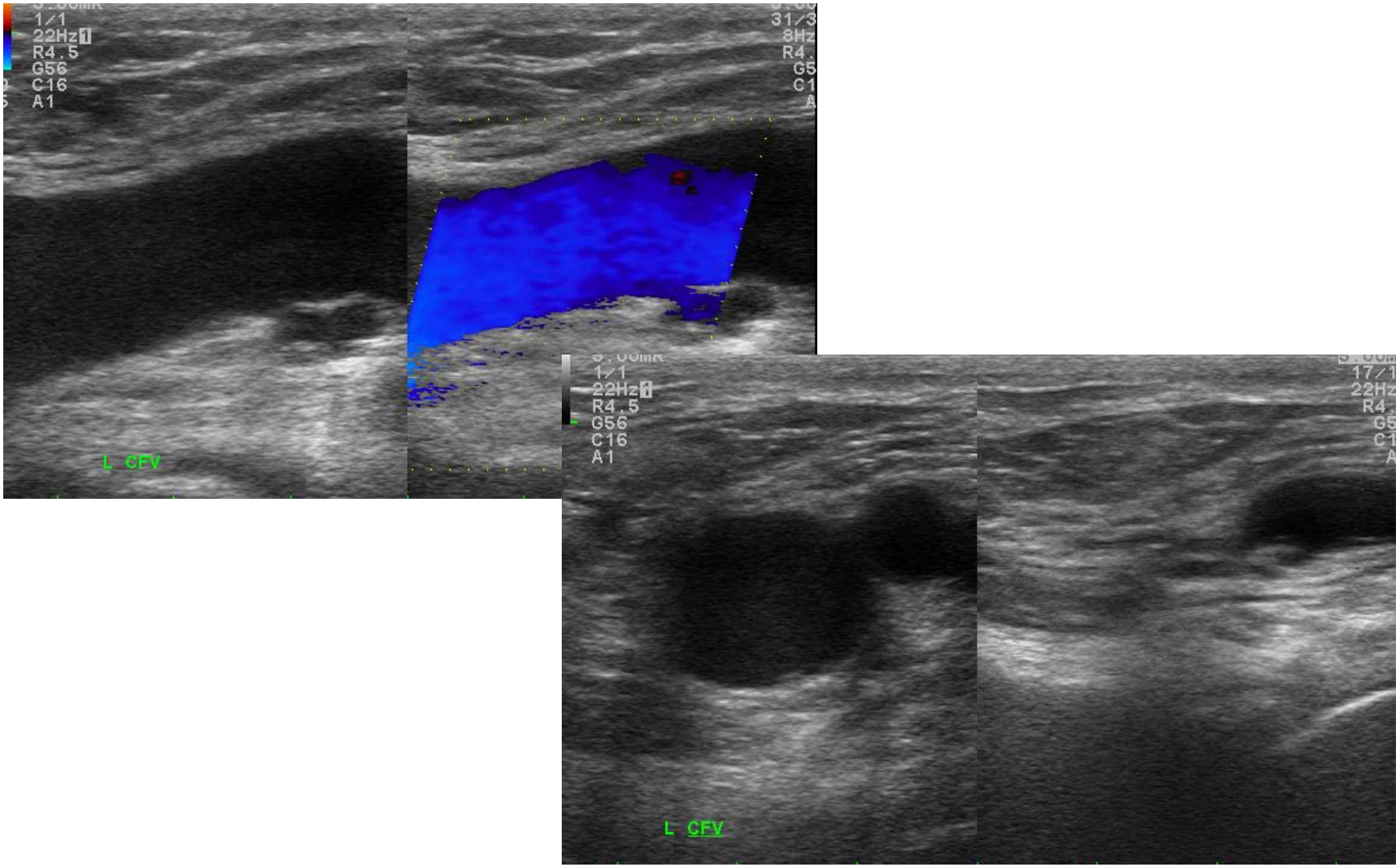
Duplex criteria for DVT

- Negative for DVT
  - Complete approximation of the vein wall during compression
  - Complete color filling of the lumen without any defect

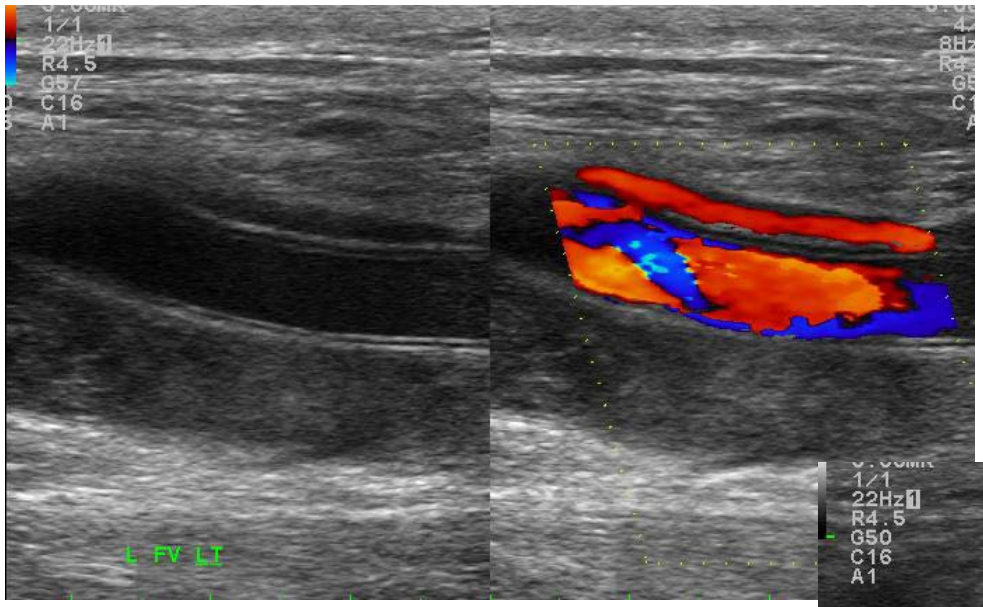
- **Positive** for DVT
  - Partially compressible or noncompressible vein
  - **Echogenic material** within the vein
  - **Filling defect** on color imaging
  - Absence of doppler signal

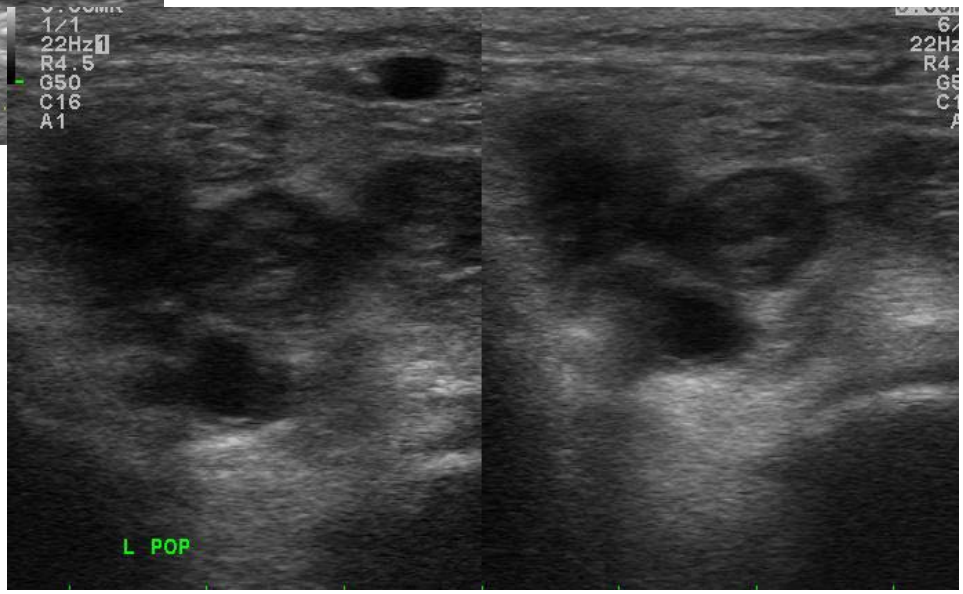
Mansour & Labropoulos: Vascular DIagnosis(2005)

Duplex USG ; normal finding



Duplex USG ; abnormal finding





Conditions tha
mimic acute

참고하세요.

Muscle strain or blunt trauma
Ruptured muscle with subfascial hematoma
Spontaneous hemorrhage or hematoma
Ruptured synovial cysts (Baker's cysts)
Arthritis, synovitis, or pyositis
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

64

Diagnostic strategie

참고하세요.

- 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 general anesthesia	1
Localized tenderness along distribution of deep venous system	1
Entire leg swollen	1
Calf swelling > 3cm compared to asymptomatic leg (measured 1cm below tibial tuberosity)	1
Pitting edema confined to symptomatic leg	1
Collateral superficial veins (non-varicose)	1
Previously documented DVT	1
Alternative diagnosis as least as likely as DVT	-2

Risk Assessment	Score
Low risk	≤ 0
Moderate risk	1-2
High risk	≥ 3

65

Diagnostic strate
DVT

참고하세요.

Annal Int Med 2003

66

Conditions that mimic acute

참고하세요.

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Spontaneous hemorrhage or hematoma
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Arterial insufficiency
Pregnancy or oral contraceptive use
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Chronic venous insufficiency or venous reflux syndromes
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Dependency or leg immobilization (casts)
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참고하세요.

Diagnostic strategie

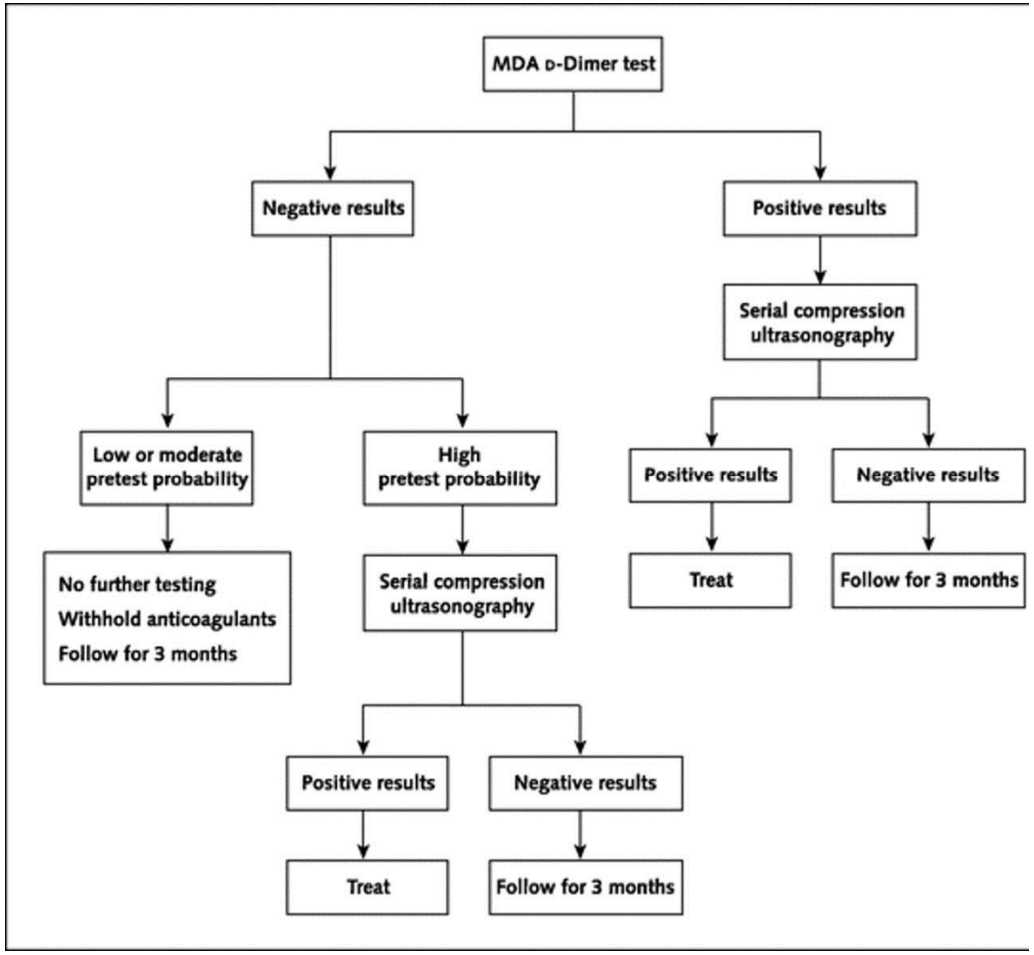
- Assessment of risk of venous thrombosis; Modified Wells Criteria

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 ≥ 3cm 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

Diagnostic strate
DVT

참고하세요.



Annal Int Med 2003

Summary of Pathophysiology

- Deep vein thrombosis (DVT) and pulmonary embolism (PE) are a single clinicopathological entity
  - > venous thromboembolic disease, VTE
- The incidence: **1 (DVT)** and **0.5 (PE)** cases per **1000 population per year** in the **Western world**
- In a hospital setting, 15% of medical and 30-50% of surgical patients develop VTE if no prophylaxis is initiated
- Clinical feature: nonspecific and inaccurate
- Serious complications; ***30-40% mortality*** in **untreated PE**, ***~50% PTS*** **in DVT**
- Clinical risk assessment and plasma D-dimer testing with duplex study and pulmonary CT angiography

Treatment

Basic

치료방법

- 약물치료
- 혈관내 시술
- 수술적 방법

Concerns in a pati
DVT

참고하세요.

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

=> Aim of DVT treatment

Basic

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)

Basic

Overview of Treatment

1. **Systemic Anticoagulation**
2. **Systemic Thrombolysis**
3. Surgical Thrombectomy
4. **IVC filter**
5. **Catheter Directed Thrombolysis (CDT)**
6. **Percuataneous Mechanical Thrombectomy (PMT?)**
7. **PharmacoMechanical Thrombolysis (PMT)**
8. **Adjuvant Venous Angioplasty and Stenting**

DVT: Treatment

참고하세요.

- Anticoagulants
- Thrombolytic therapy

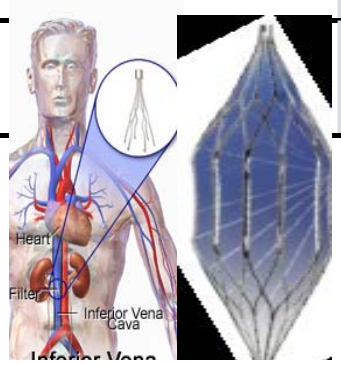
- Pharmacomechanical thrombectomy
- Surgical thrombectomy

- Vena cava filter
- Conservative treatment

Basic

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

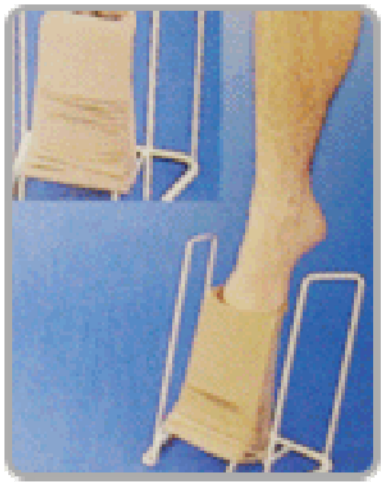
- Conservative Treatment

Basic

심부정맥 혈전증의 예방

Basic

심부정맥 혈전증의 예방



Conservative Tr

참고하세요.

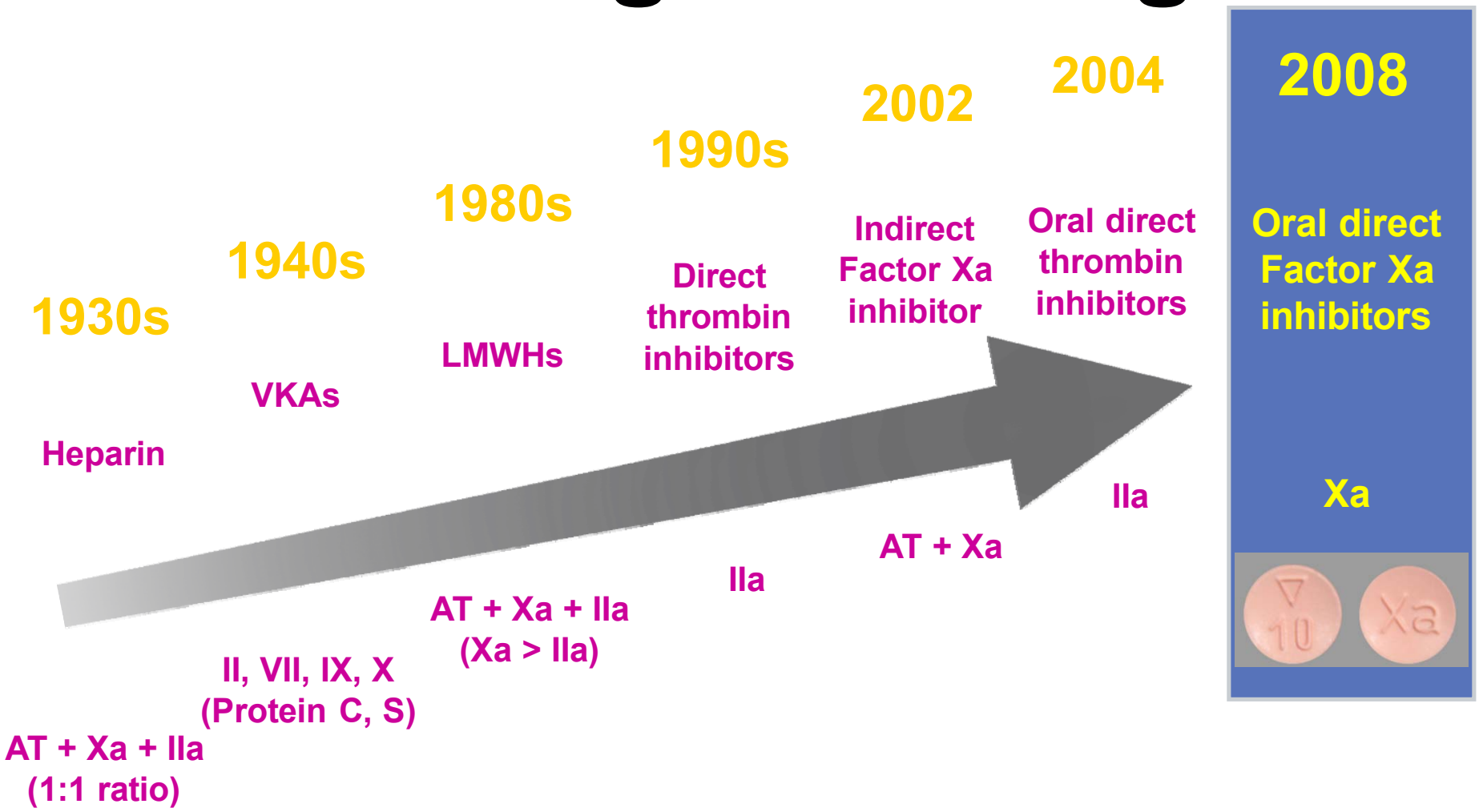
- **Bed rest** and **leg elevation**
  - 1289 prospective cohort study
  - Bed rest does not prevent PE
  - LMWH + early ambulation + compression bandage or ES, faster improvement of pain and swelling w/o increasing risk of PE, decreased PTS
    - Partsch H, JVS 2002
- Graduated **compression stocking**
  - 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

Basic

The evolution of anticoagulant drugs



Outpatient Anticoa… Therapy: Relati…

참고하세요.

- PE with hemodynamic or respiratory instability
- Extensive iliofemoral thrombus
- Known potential for non-compliance
- Ac…
- Se…
- Re…
- Th…
- He…

82

Anticoagula…

참고하세요.

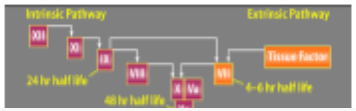
- UFH (Unfractionated heparin)
- LMWH (low molecular weight heparin)
- Fondaparinux

Clotting Case

참고하세요.

Clotting Case

참고하세요.



85

Heparin (UF…

참고하세요.

- **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

Low Molecular W… Heparin (LMW…

참고하세요.

- Obtained by various fractionation or depolymerisation of polymeric heparin
- Molecular weight < 8000

Low Molecular W… Heparin (LMW…

참고하세요.

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	4,500	3.8
Nadro…			
Revip…			
Tinzap…			

88

Advantages of …

참고하세요.

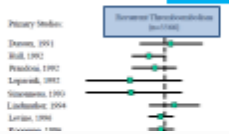
Pharmacokinetic Characteristic	Clinical advantage
Reduced protein binding	Good bioavailability
	Predictable dose response
	Resistance not encountered
Predictable dose response	Fixed or wt-based dosing possible
	Monitoring not required

Heparin vs. L…

참고하세요.

Meta-Analysis LM… Heparin for Treatme…

참고하세요.



91

Fondaparin…

참고하세요.

- Synthetic pentasaccharide
- Factor Xa inhibitor
- For injection
- Fondaparinux vs enoxaparin in hip/knee

UFH vs LMWH vs For…

참고하세요.

	UFH	LMWH	Fondaparinux
Mechanism	Enhances AT effects on Xa & thrombin	Enhances AT effects more selectively on Xa than on thrombin	Enhances anti-Xa activity of AT
Half-life	1-2 hr	4.5-7hr	17-21 hr
Dosing	Continuous drip	BID or once daily	Once daily
Reversal agents	Protamin sulfate 1mg neutralizes	Protamin sulfate neutralizes 60% of	Not reversible by

LMWH *vs.* UF He…

참고하세요.

Recurrences rate	Enoxaparin	UF Heparin	RR (>0.75)
Vein thrombosis event	4.5 %	5.7 %	0.81
DVT	3.1 %	4.4 %	0.79
PE	0.95 %	1.8 %	0.63

94

LMWH *vs.* UF He…

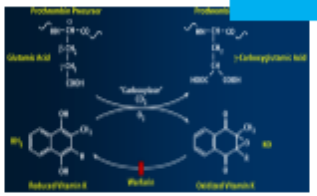
참고하세요.

Complication (%)		Enoxaparin	UF Heparin	RR (> 0.75)
Major bleeding	10days	2.2 %	2.0 %	NS
	30days	2.9 %	4.3 %	0.74 (28%)
Death		3.3 %	5.8 %	NS
Mortality				0.69 (31%)

95

Warfarin : Mechanism

참고하세요.



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

96

Outpatient Anticoa
Therapy: Relati

참고하세요.

- PE with hemodynamic or respiratory instability
- Extensive iliofemoral thrombus
- Known potential for non-compliance
- Active bleeding
- Severe hypertension (HTN)
- Renal clearance <30 mL/min or SCr >2.5 mg/dL
- Thrombocytopenia <100,000
- History of heparin-induced thrombocytopenia

Michigan Quality Improvement Consortium (MQIC) guidelines 2011

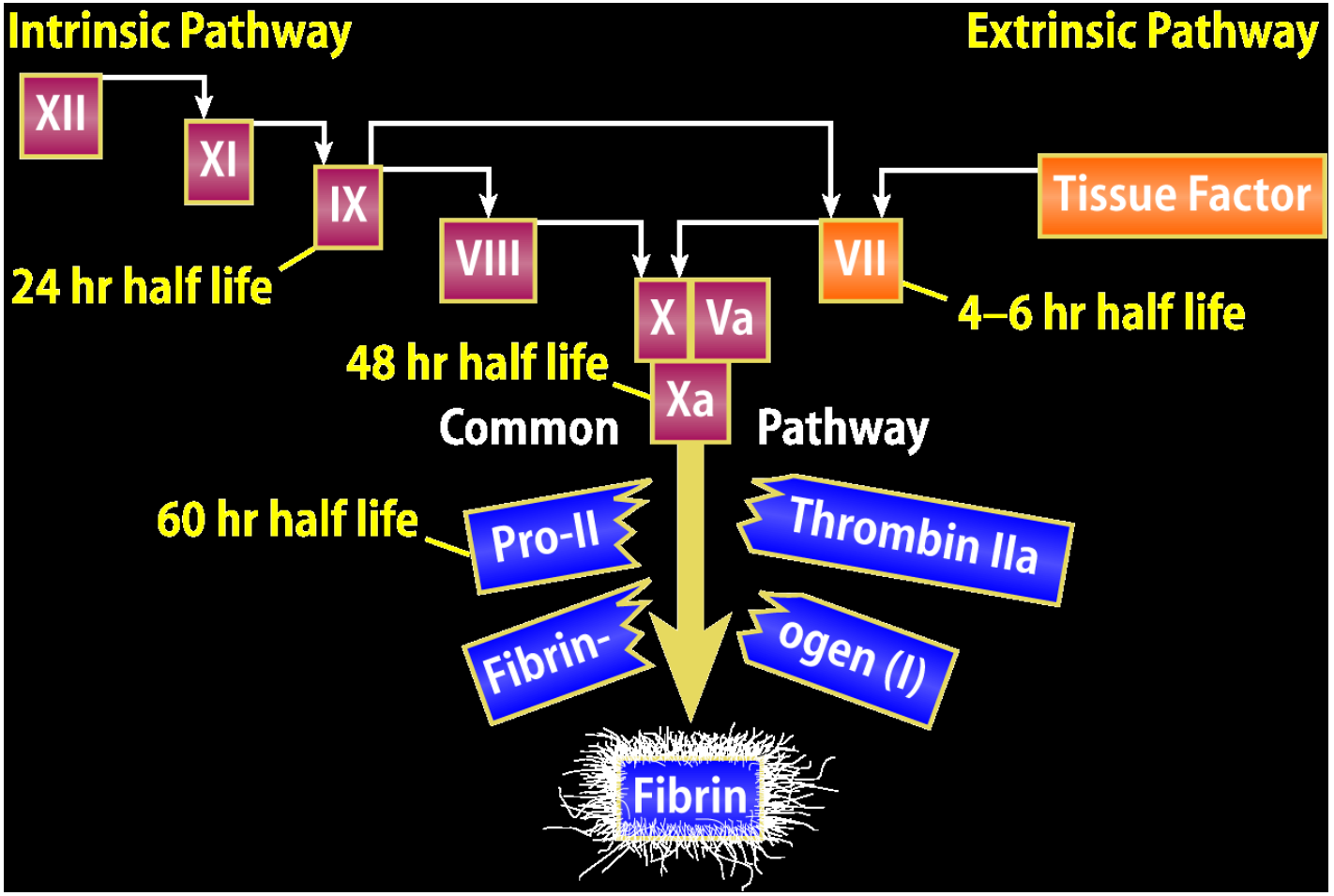
Anticoagula

참고하세요.

- UFH (Unfractionated heparin)
- LMWH (low molecular weight heparin)
- Fondaparinux
- Vitamin K antagonist
- Direct thrombin inhibitor
- Factor Xa inhibitor

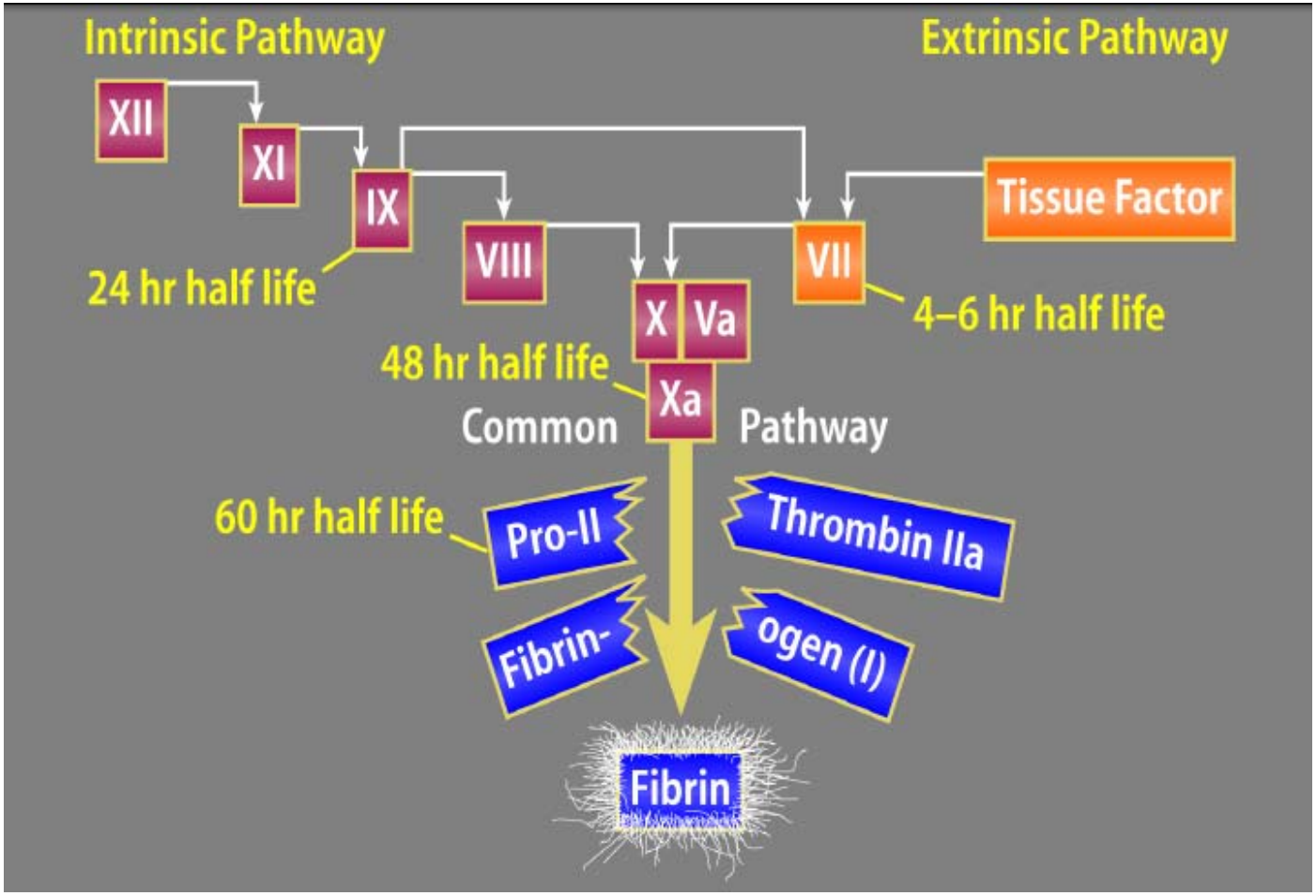
Clotting Case

참고하세요.



Clotting Case

참고하세요.



Heparin (UF

참고하세요.

- **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 W
Heparin (LMW

참고하세요.

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

Low Molecular W
Heparin (LMW

참고하세요.

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

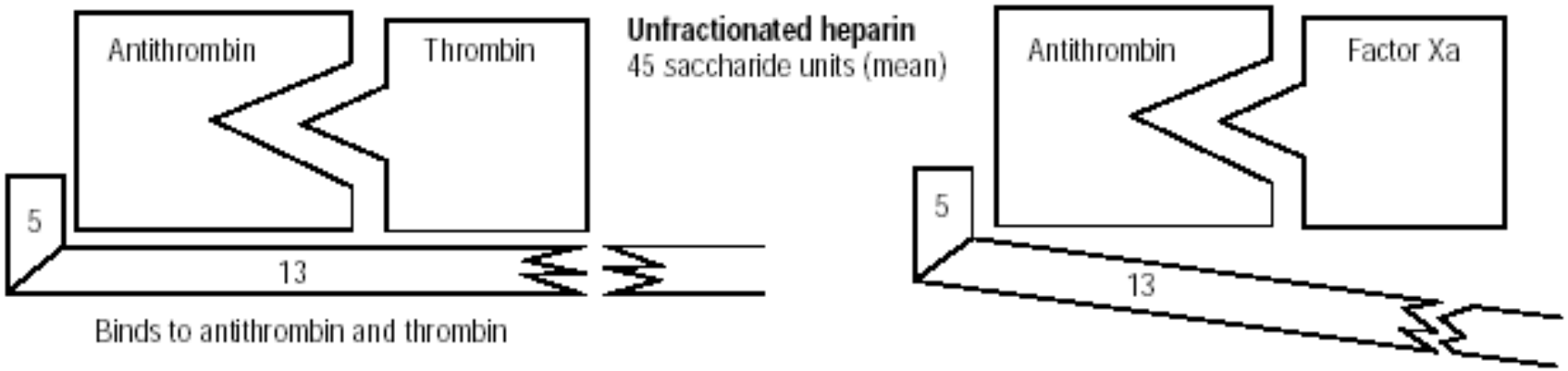
Advantages of

참고하세요.

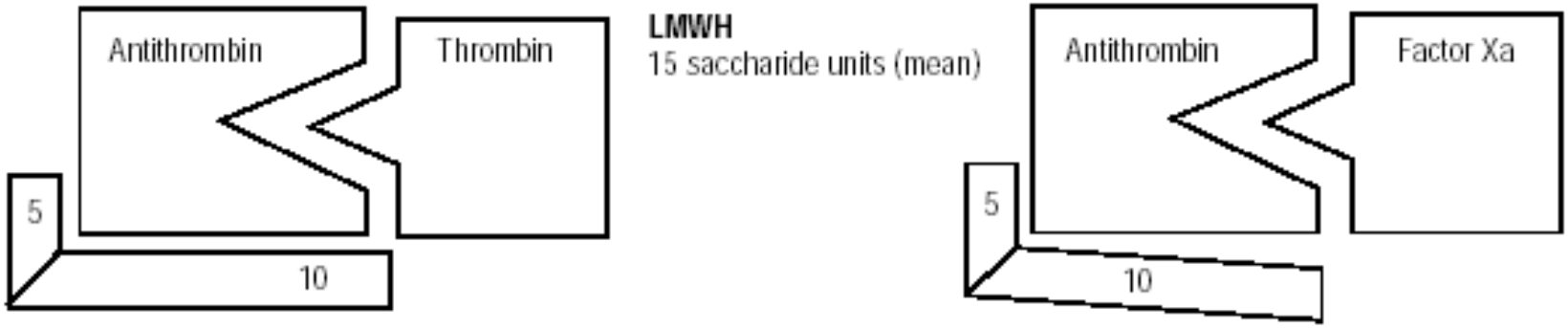
Pharmacokinetic Characteristic	Clinical advantage
Reduced protein binding	Good bioavailability
	Predictable dose response
	Resistance not encountered
Predictable dose response	Fixed or wt-based dosing possible
	Monitoring not required
Longer plasma half-life	Once- or twice-daily dose possible
Smaller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

Heparin vs. L

참고하세요.



Binds to antithrombin and thrombin

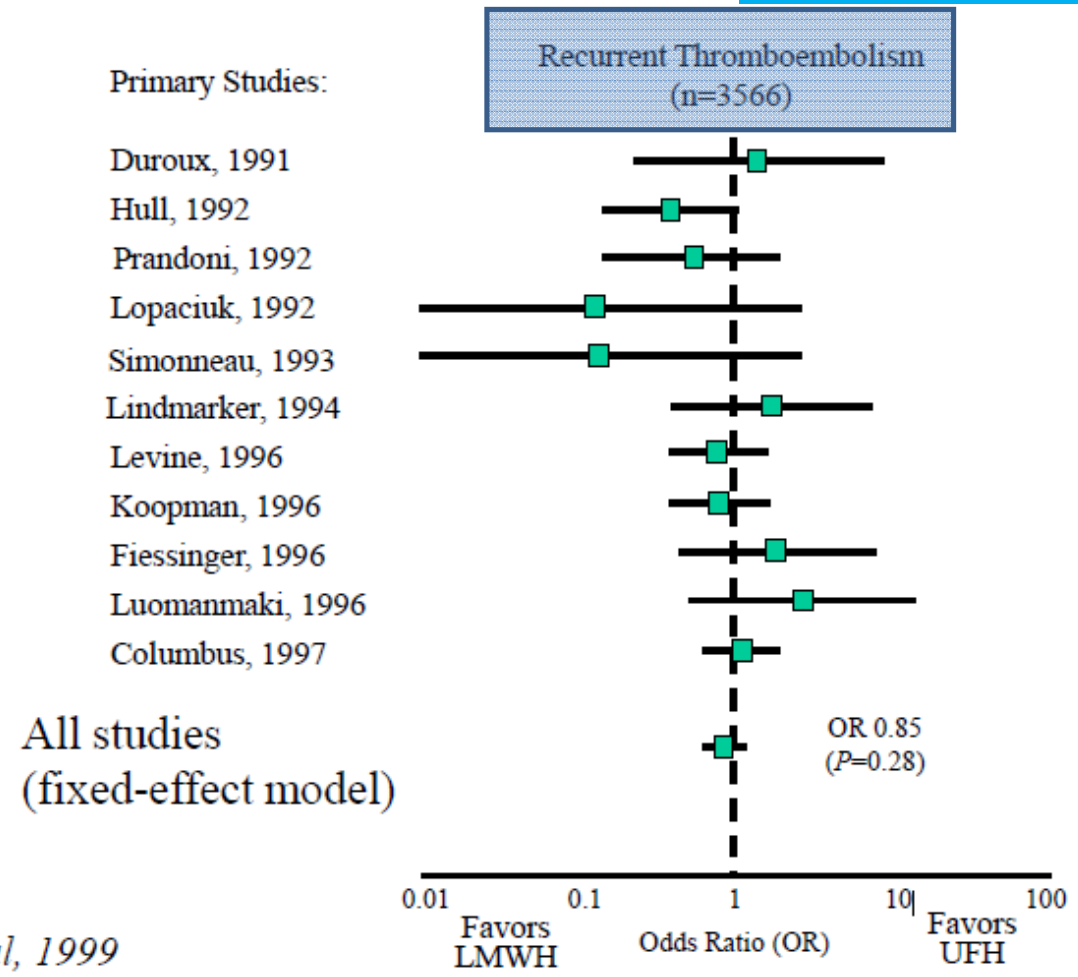


Binds to antithrombin but poorly to thrombin

Binds to antithrombin

Meta-Analysis LM
Heparin for Treatme

참고하세요.



Gould et al, 1999

Fondaparin

참고하세요.

- Synthetic pentasaccharide
- Factor Xa inhibitor
- For injection
- Fondaparinux vs enoxaparin in hip/knee surgery
  - More effective at preventing VTE
  - No difference in major bleeding
- no report of HIT

참고하세요.

UFH vs LMWH vs Fon

	UFH	LMWH	Fondaparinux
Mechanism	Enhances AT effects on Xa & thrombin	Enhances AT effects more selectively on Xa than on thrombin	Enhances anti-Xa activity of AT
Half-life	1-2 hr	4.5-7hr	17-21 hr
Dosing	Continuous drip	BID or once daily	Once daily
Reversal agents	Protamin sulfate 1mg neutralizes 100u of heparin	Protamin sulfate neutralizes 60% of activity	Not reversible by protamin
Monitoring	aPTT, heparin assays	none	none
Clearance	Hepatic & RES, No renal adjustments	Renal Adjust for CrCl<30mL/min	Renal contraindicated in CrCL<30mL/min
Cause HIT	yes	yes	no

LMWH *vs.* UF Hep

참고하세요.

Recurrences rate	Enoxaparin	UF Heparin	RR (>0.75)
Vein thrombosis event	4.5 %	5.7 %	0.81
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Mortality				0.69 (31%)

참고하세요.

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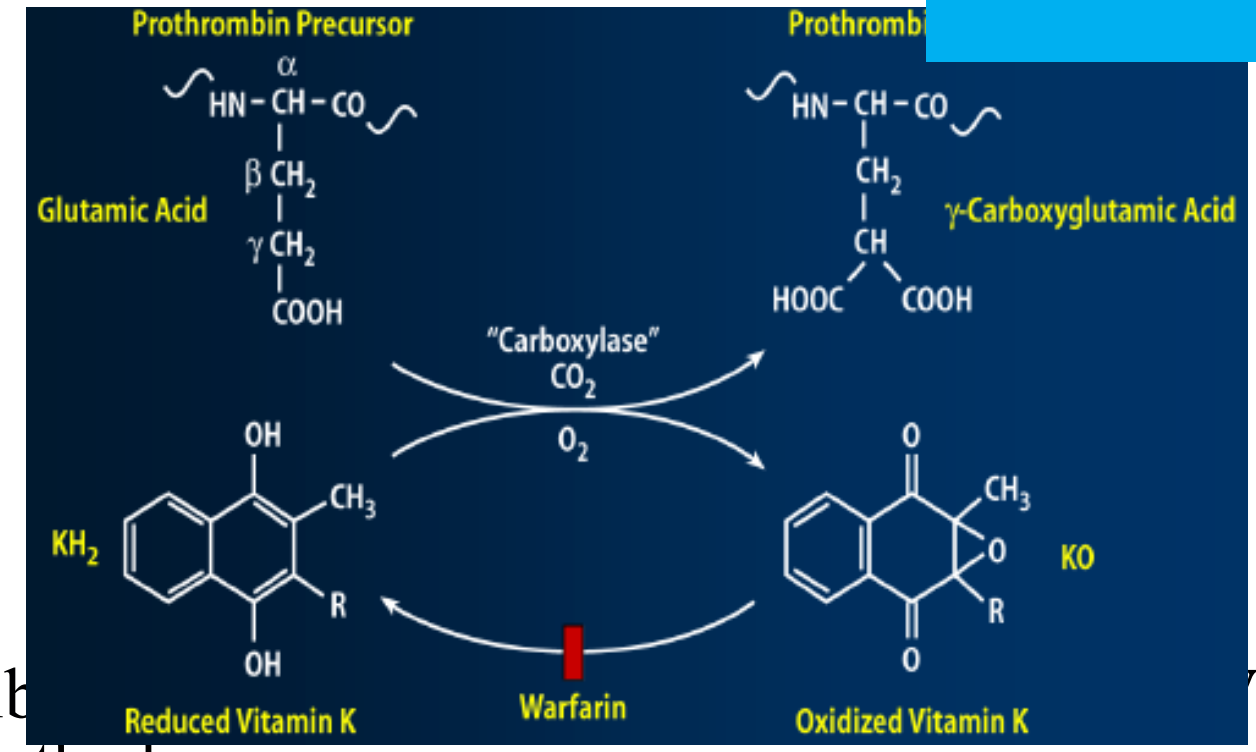
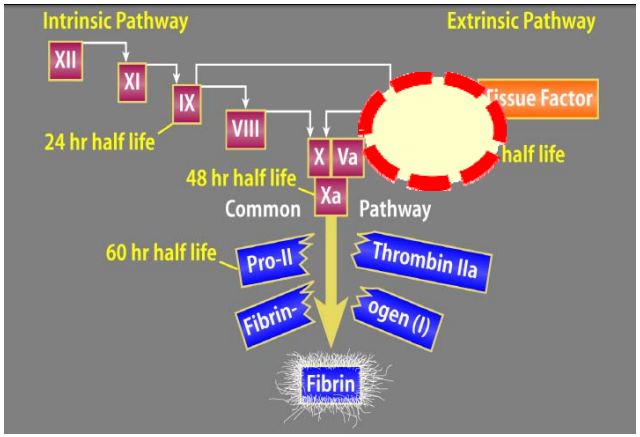


- Inhib…VII, IX, X in the liver
- Also inhibits natural anticoagulant protein C/S

VKA should be giv
heparin at the be

참고하세요.

- 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



Basic

New Oral Anticoagulants (NOACs)

- Factor Xa inhibitors
  - Rivaroxaban
  - Apixaban
  - Edoxaban

- Direct thrombin inhibitors
  - Dabigatran

Basic

New ERA of NOAC in VTE treatment

Rivaroxaban (Xarelto®)

EINSTEIN-PE 2012 NEJM
EINSTEIN-DVT 2010 NEJM

Dabigartran (Pradaxa®)

RE-COVER 2009 NEJM
RE-COVER II 2014 Circulation

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 th
Contraindicat

참고하세요.

- 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

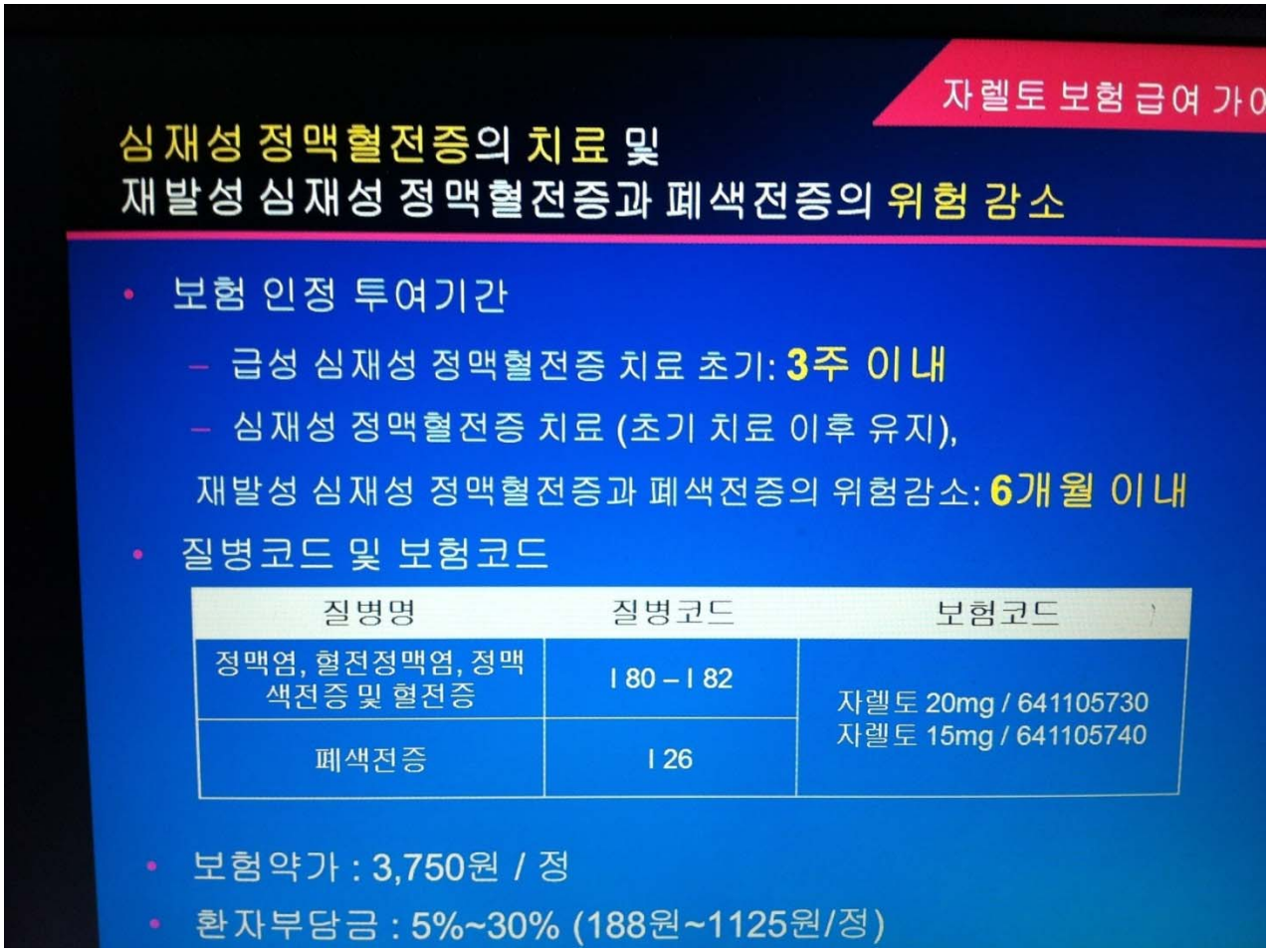
Optimal Duration of Ant
Therapy for Symptomat
Thrombosis

참고하세요.

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

Basic

보험인증기준

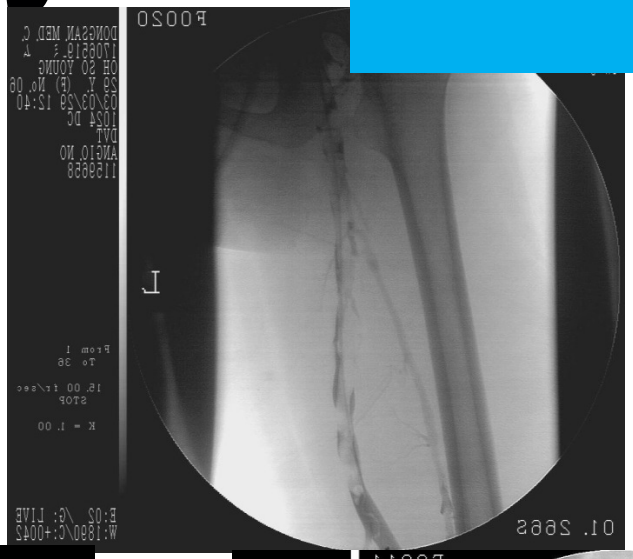


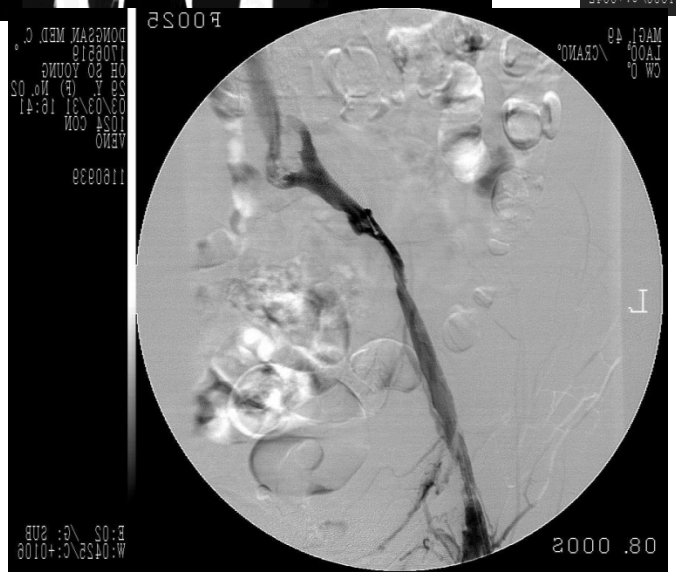
Treatment

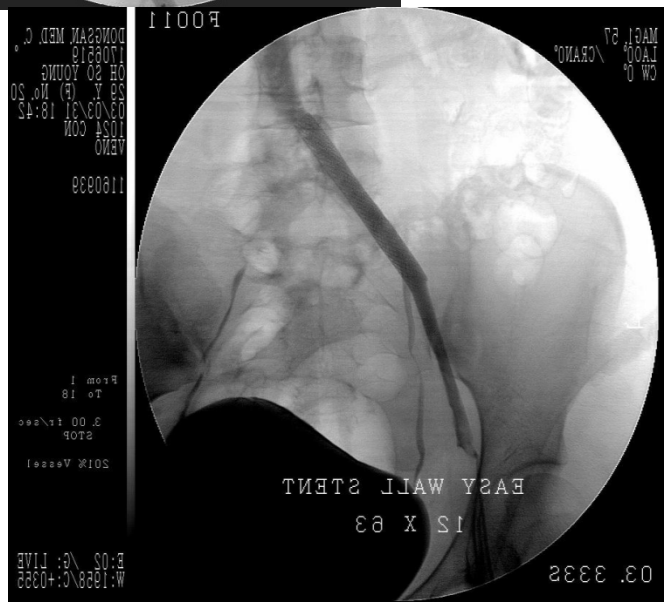
- **Catheter Directed Thrombolysis (CDT)**

Thrombolytic t

참고하세요.





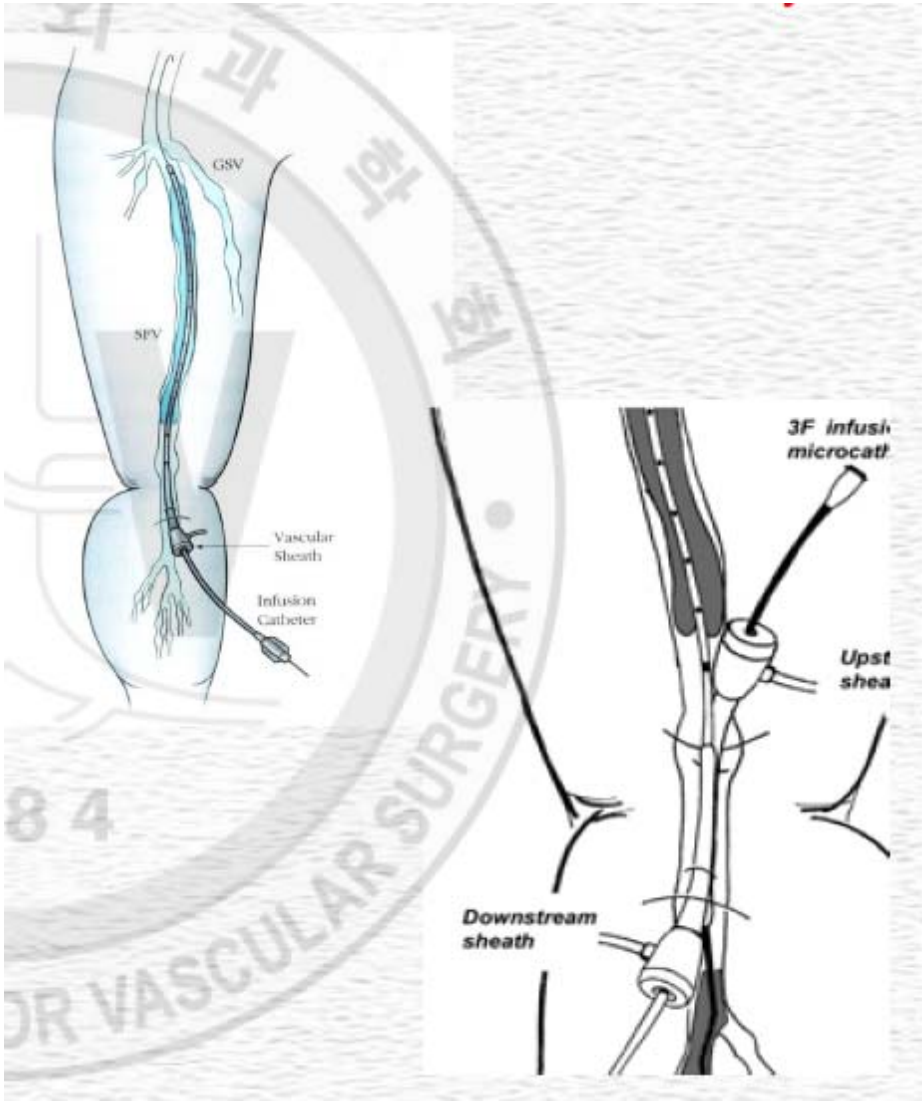


Basic

Catheter directed thrombolytic therapy (CDT)

- **Access**
  - Ipsilateral Popliteal vein
  - Contralateral Femoral vein
  - Internal Jugular vein

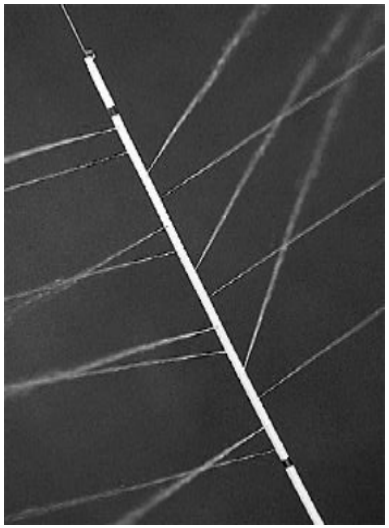
- **6-F sheath : <u>Heparin</u>**
- **5F multi-sideportcatheter : <u>UK</u>**
  - Heparin 500 unit/hr
  - Urokinase30~100 x 103IU/hr



Basic

Catheter directed thrombolytic therapy (CDT)

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



National Multicente
Radiology 199

참고하세요.

- 287 patients
  - Acute 188, 45 chronic, 54 acute on chronic

- Results
  - Complete lysis 31%, significant(50-99%) 52%, incomplete(<50%) 17%
  - 7.8 million U of UK during 53.4 hrs
  - Higher complete lysis rate in patients with symptoms of less than 10days
  - Major non-fatal bleeding complication 11%
  - Pulmonary embolism in 6 patients, 1 death
  - Overall mortality 0.4%
  - Improved 1 yr patency in treated w/ stent(74%) than w/o stent(53%)

Limitations of

참고하세요.

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

Treatment

- **PharmacoMechanical Thrombolysis (PMT)**

Basic

Pharmacomechanical thrombectomy(PMT)

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

Basic

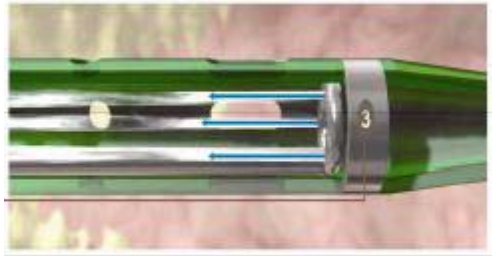
PMT Devices

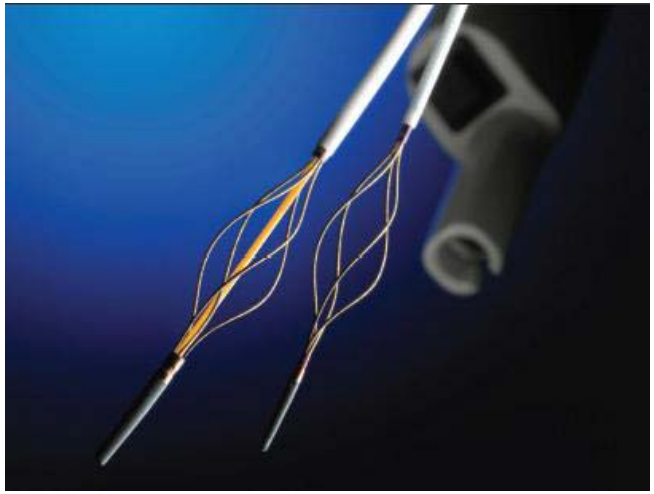
- Aspiration thrombectomy device
- Rotational device
  - Arrow PTD
- Rheolytic thrombectomy
  - **angiojet**, oasis, hydrolyser
- Isolated PMT
  - **trellis**
- Ultrasound accelerated thrombolysis
  - Ekos

Basic

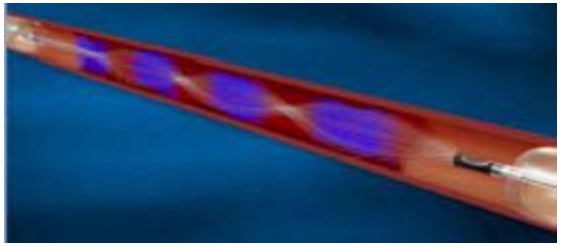
PMT Devices

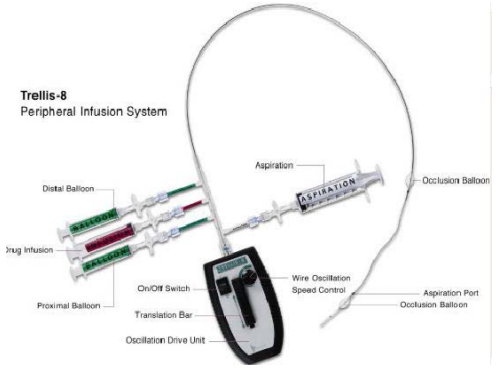
angioje





trellis





Basic

PMT

Trellis

Angiojet

Basic

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

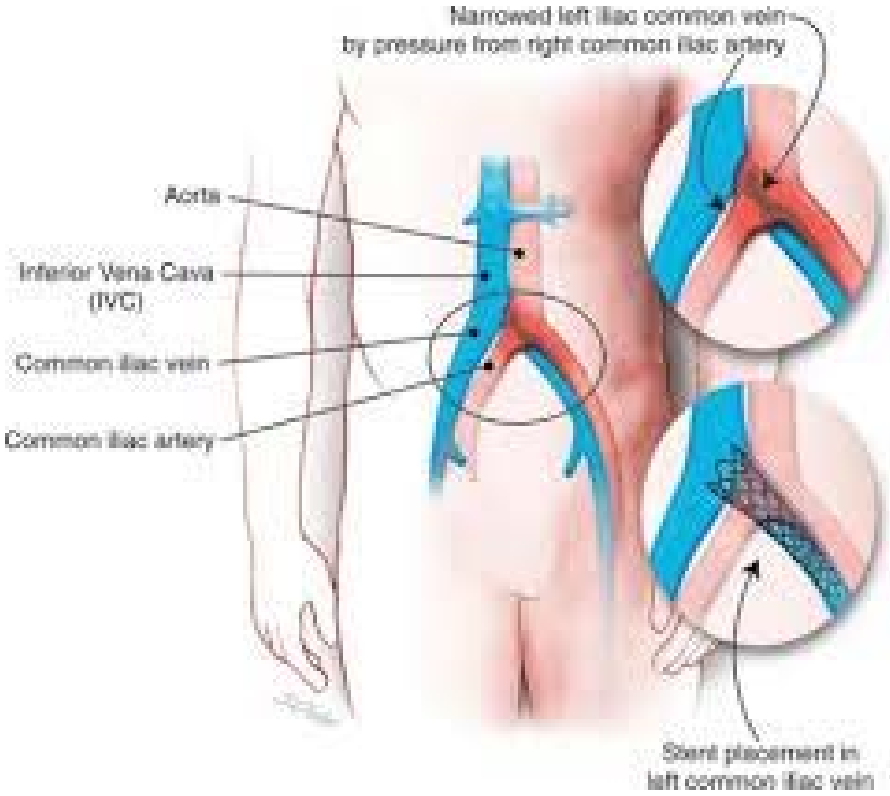
Treatment

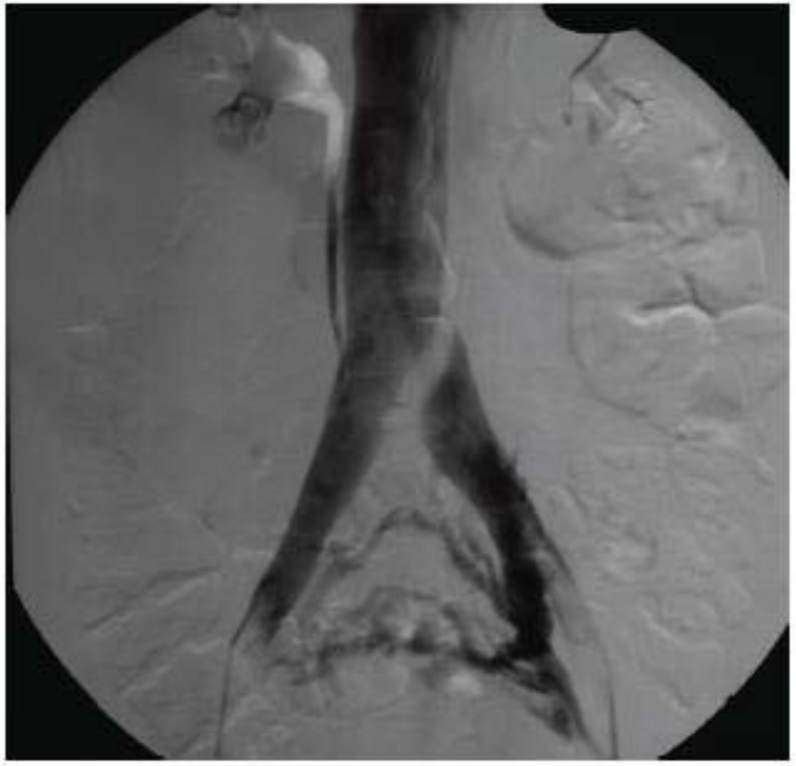
- **Adjuvant Venous Angioplasty and Stenting**

Basic

May-Thurner Syndrome

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

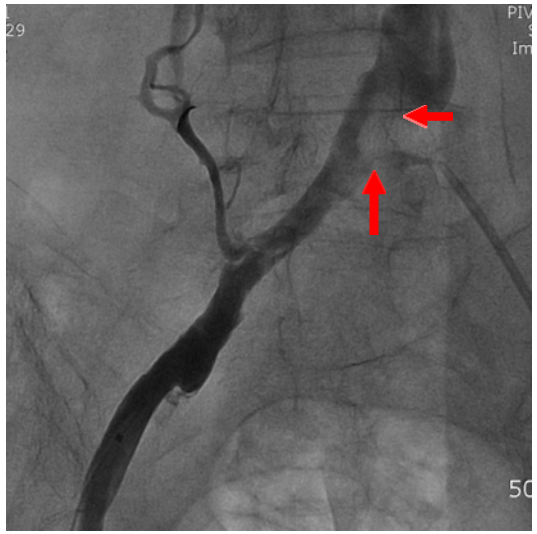


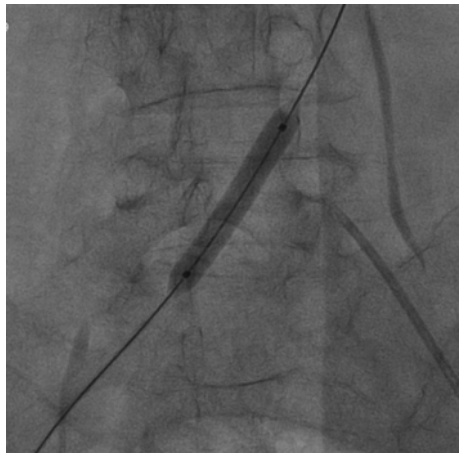


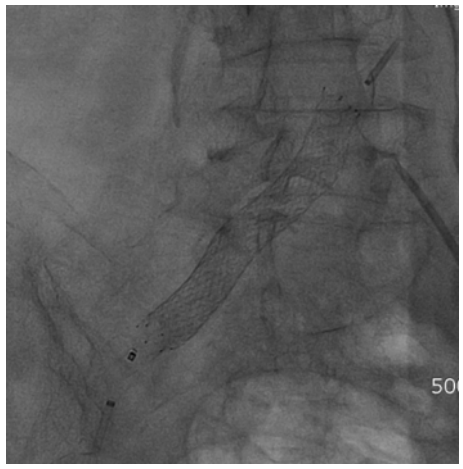
Basic

Adjuvant Venoplasty & Stenting

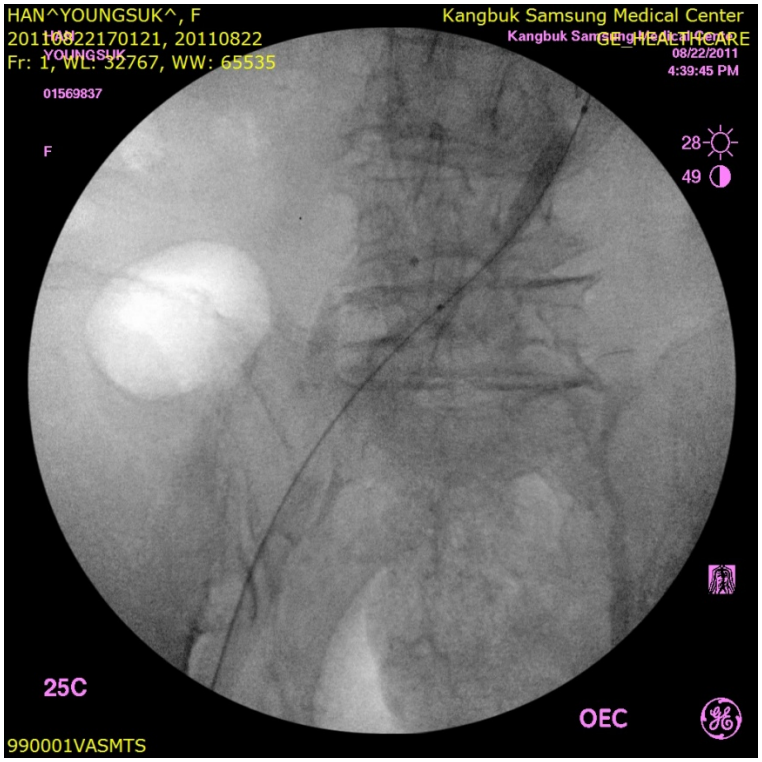
- **Technique**
  - Popliteal vein approach
  - Venoplasty balloon (8~10 mm)
  - Self-expanding stents (10~16 mm)
  - After the procedure, oral warfarin for 6 months



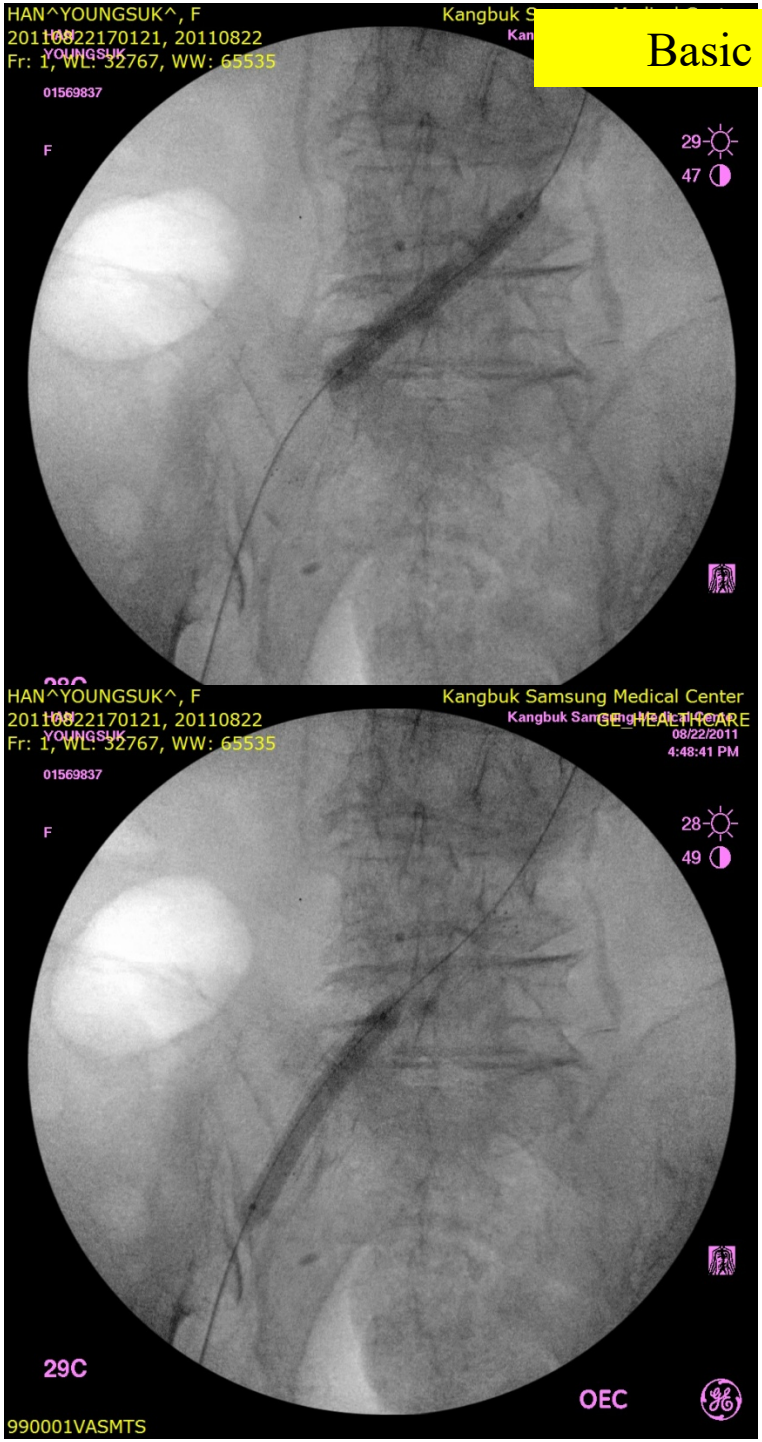




Balloon angioplasty & Stent insertion



Basic



Balloon angioplasty insertion

참고하세요.

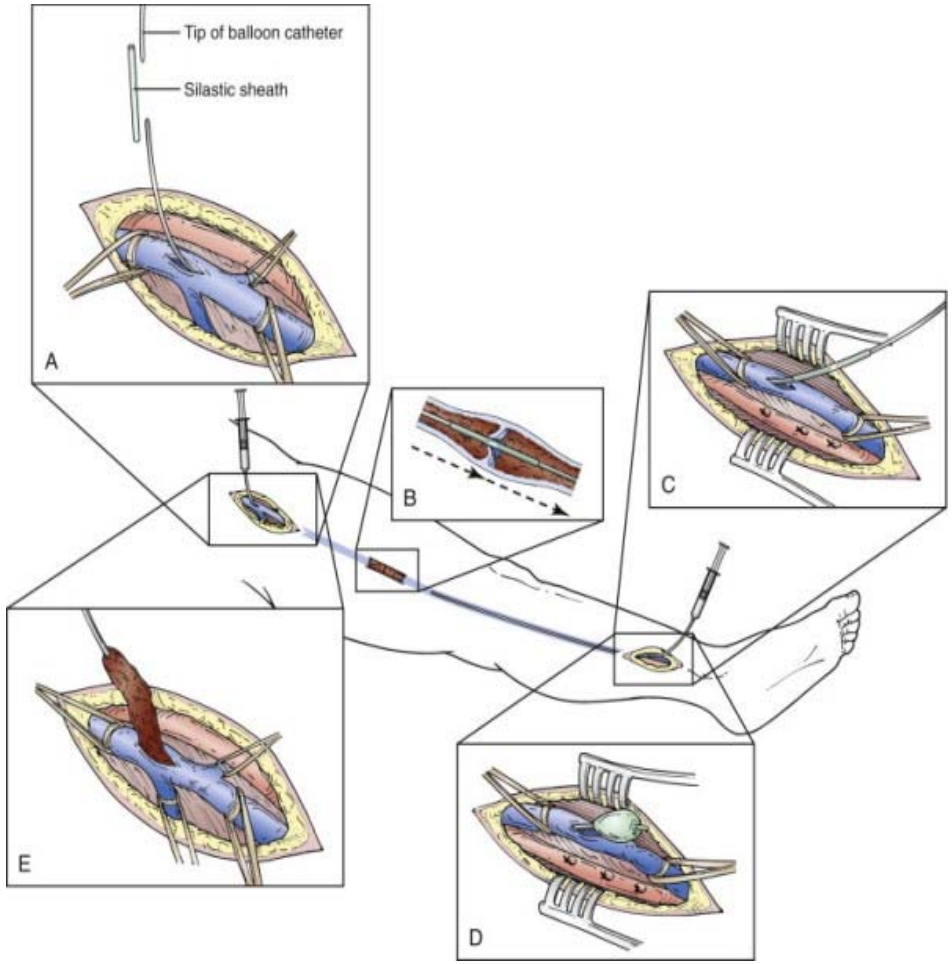
Author (year)	N	Success rate	Primary patency				Sx resolution	Compl ication
			6 mts	1 yr	2 yrs	4 yrs		
O'Sullivan GJ (2000)	39	87%		**92% (A) 94% (C)**			85%	17%
Hurst DR (2001)	18		89%	**79%**				
Kwak HS (2005)	22	96%		**95%**	95%			9%
Husmann MJ (2007)	11	100%		**90%**	82%		90%	
Oguzkurt L (2008)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

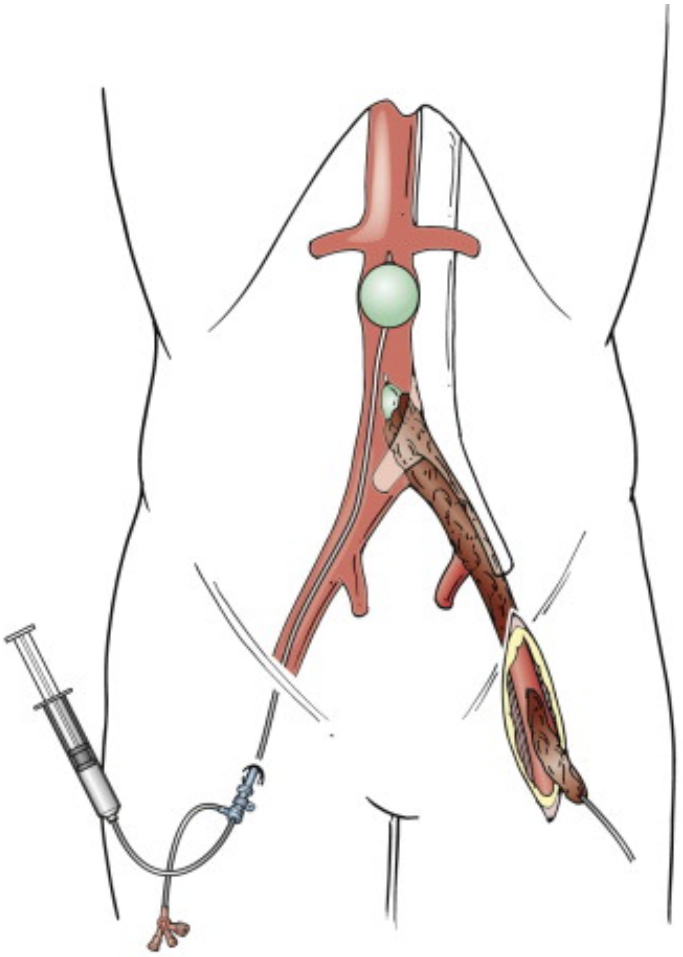
Treatment

- Surgical Thrombecotmy

Basic

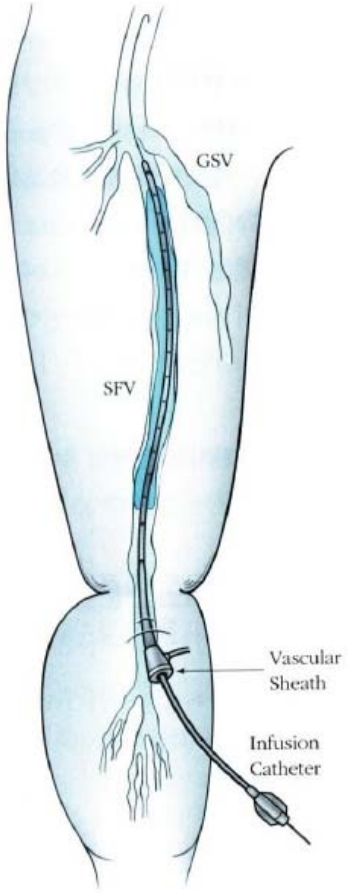
Operative thrombectomy

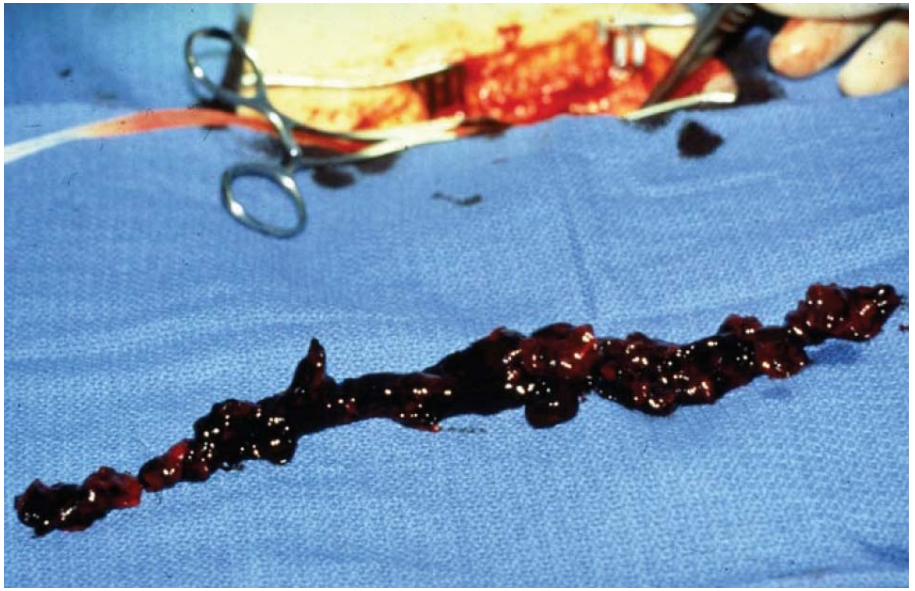




Basic

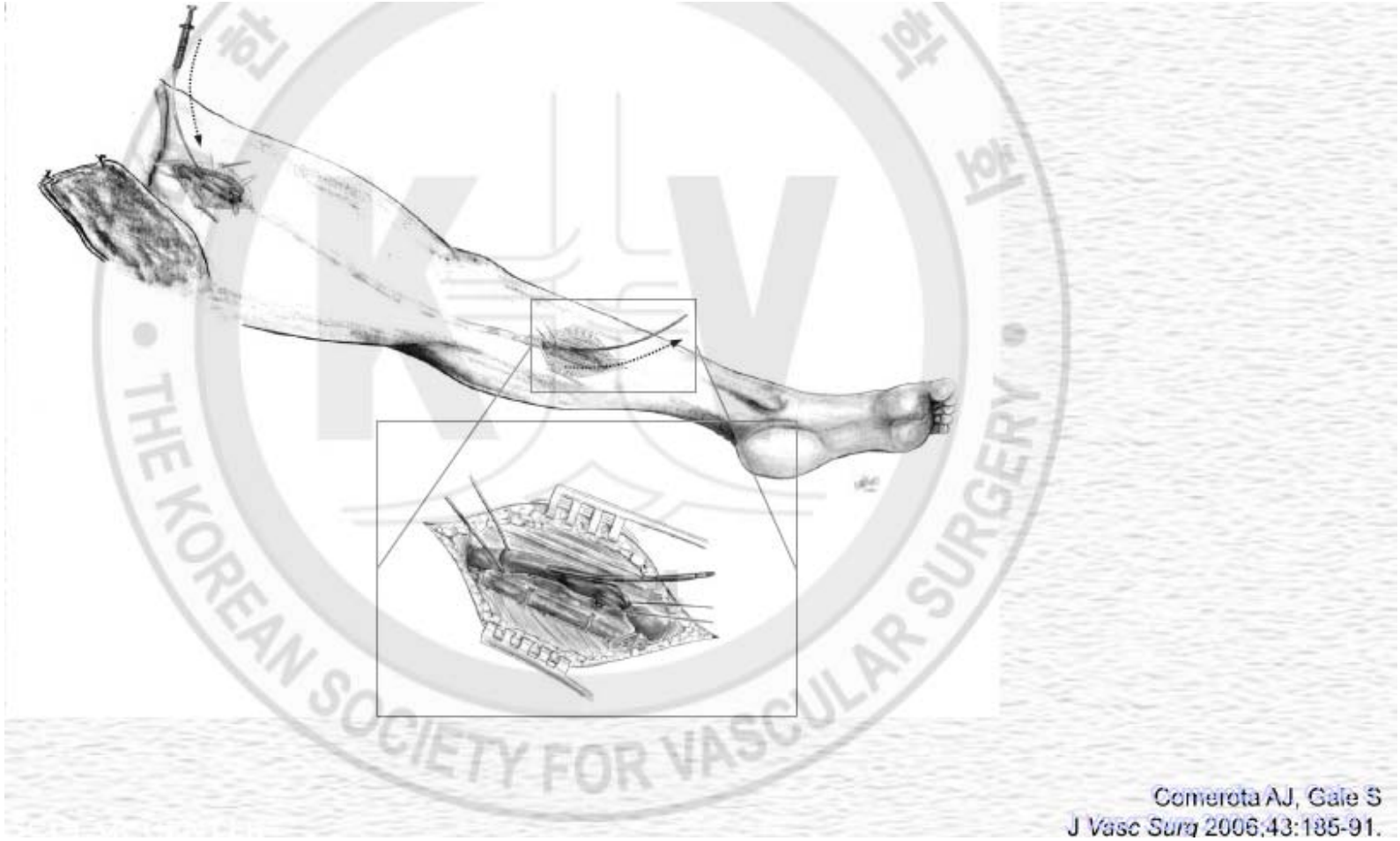
기계적 혈전제거술





Basic

Venous Thrombectomy
- infrainguinal Ballon Cathter Passage -



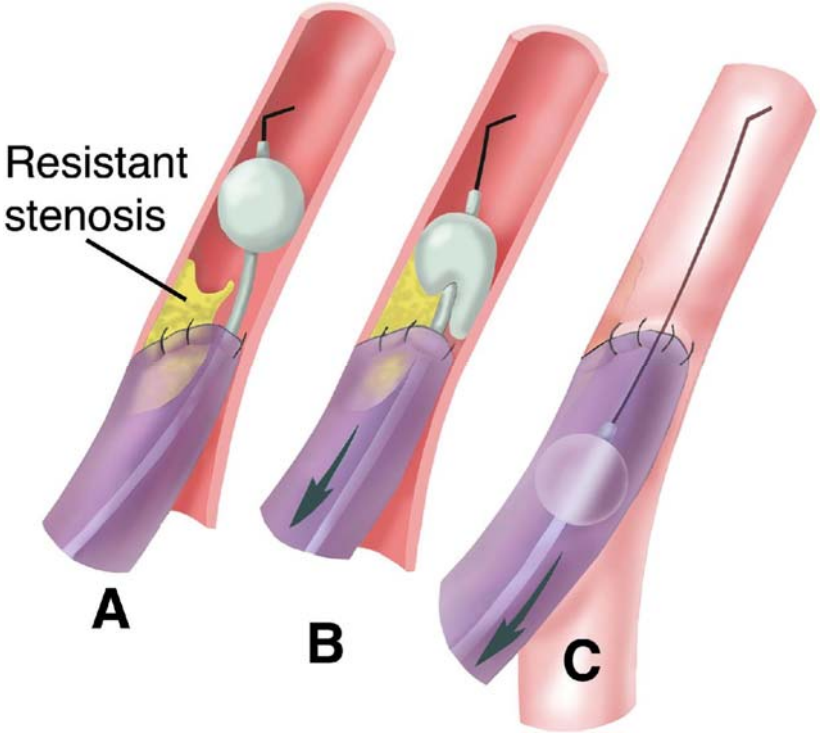
- 소병준, 원광대

Basic

Over-wire-Fogarty

Old type

Over-the-wire



Venous Thromb

참고하세요.

- 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 Thromb

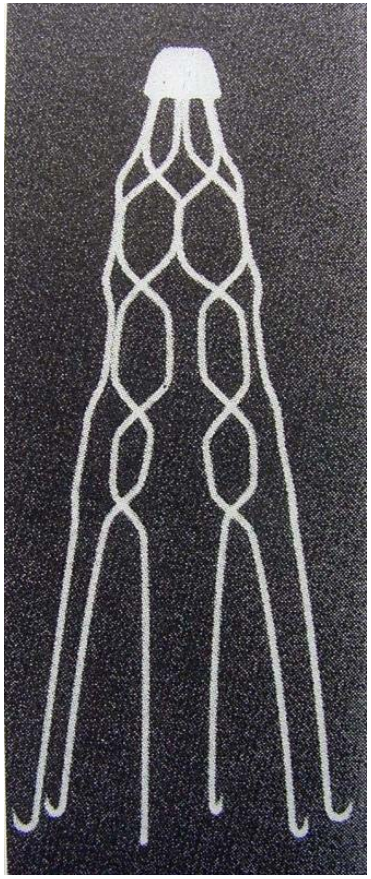
참고하세요.

- 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

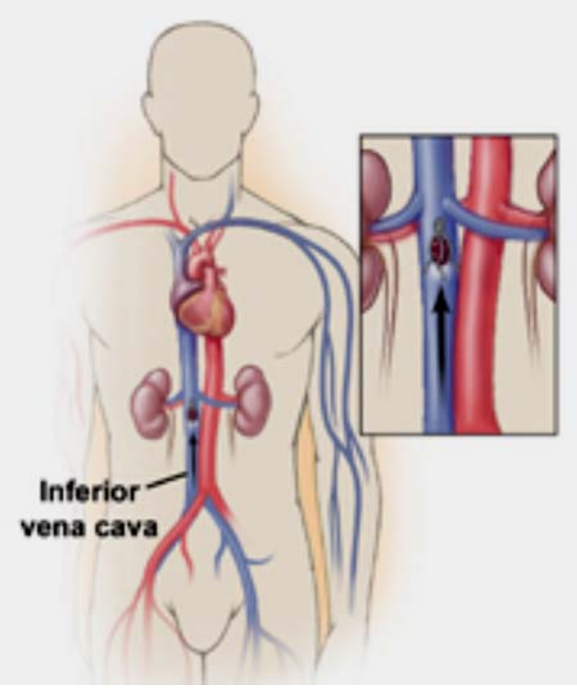
Inferior Vena Cava Filter

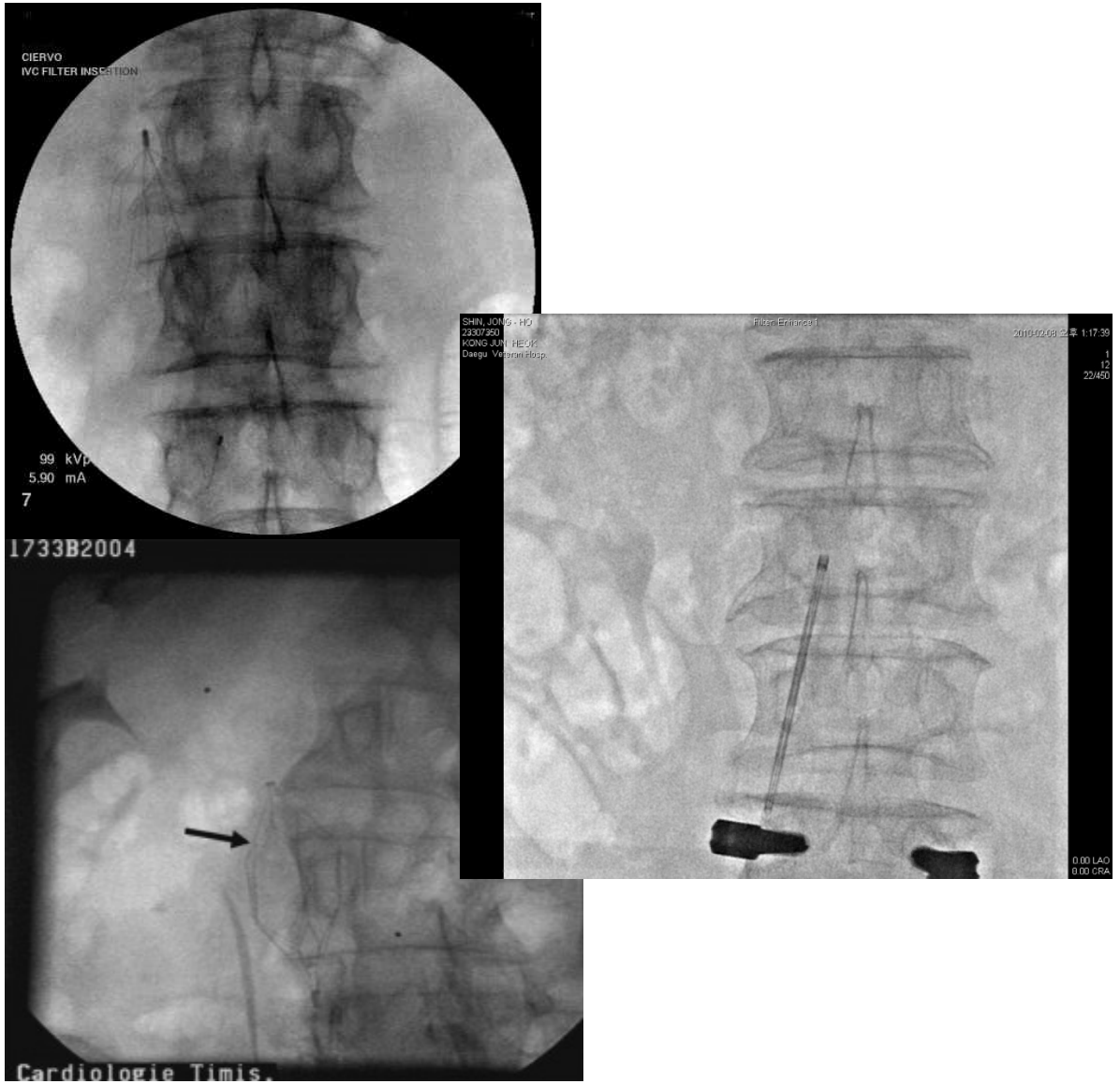


Basic

Technique of IVC Filter

- **Approach**
  - Rt or Lt **femoral**,
  - Rt **internal jugular** approach



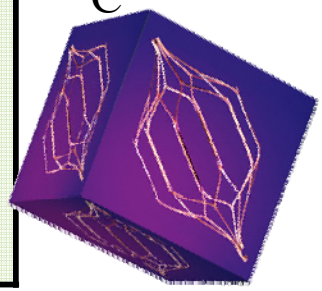


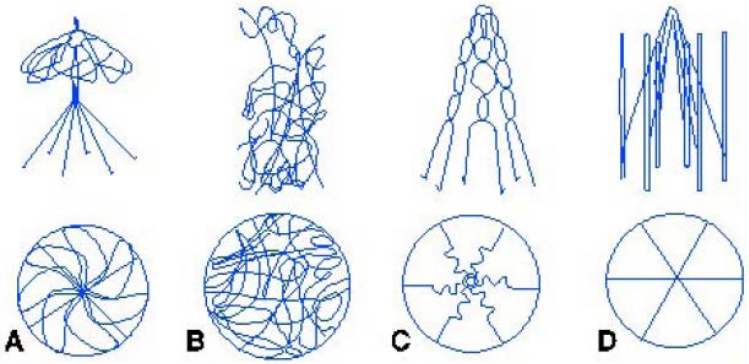
Basic

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

C





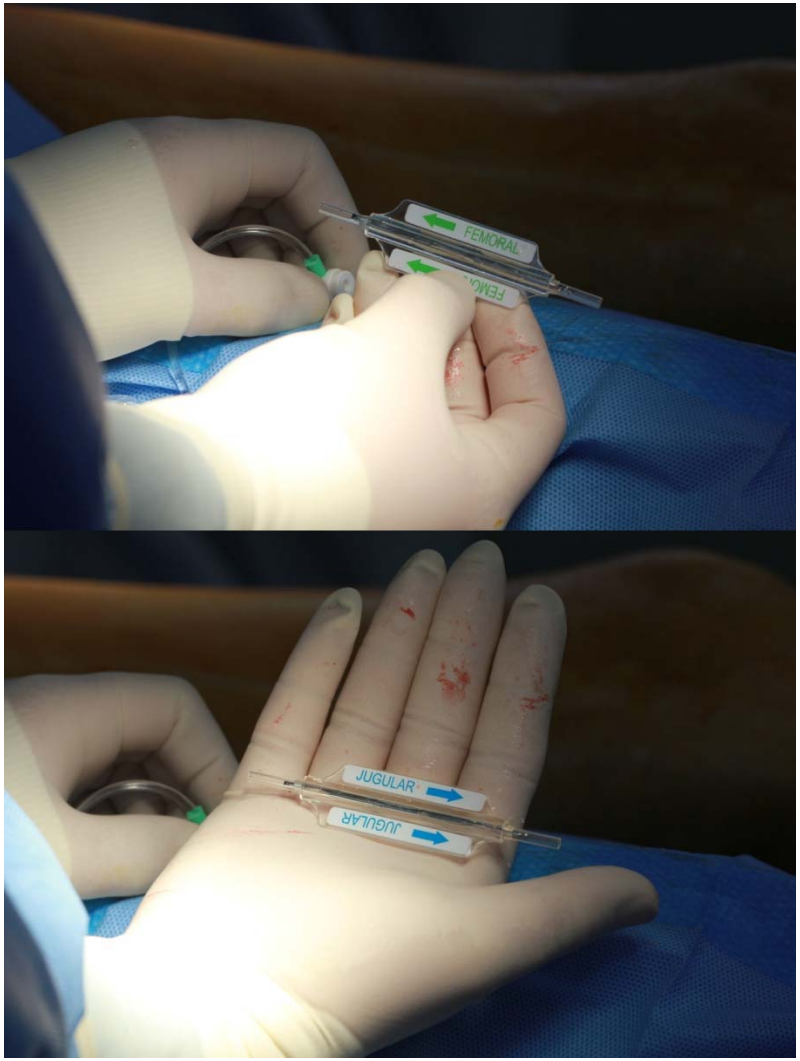
A

B

Basic

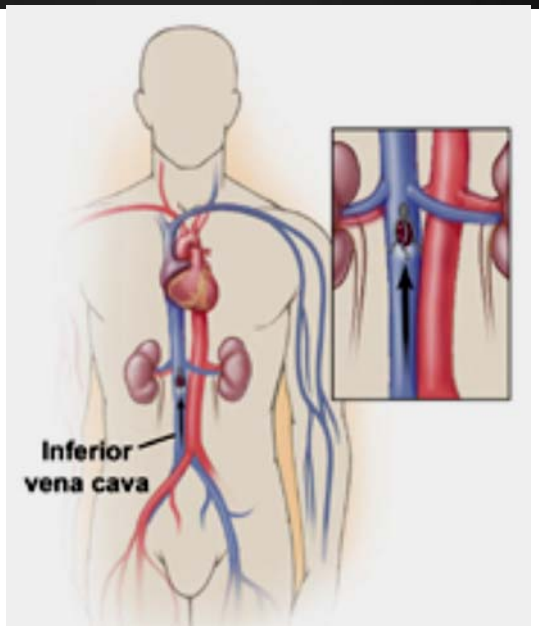
I. IVC filter

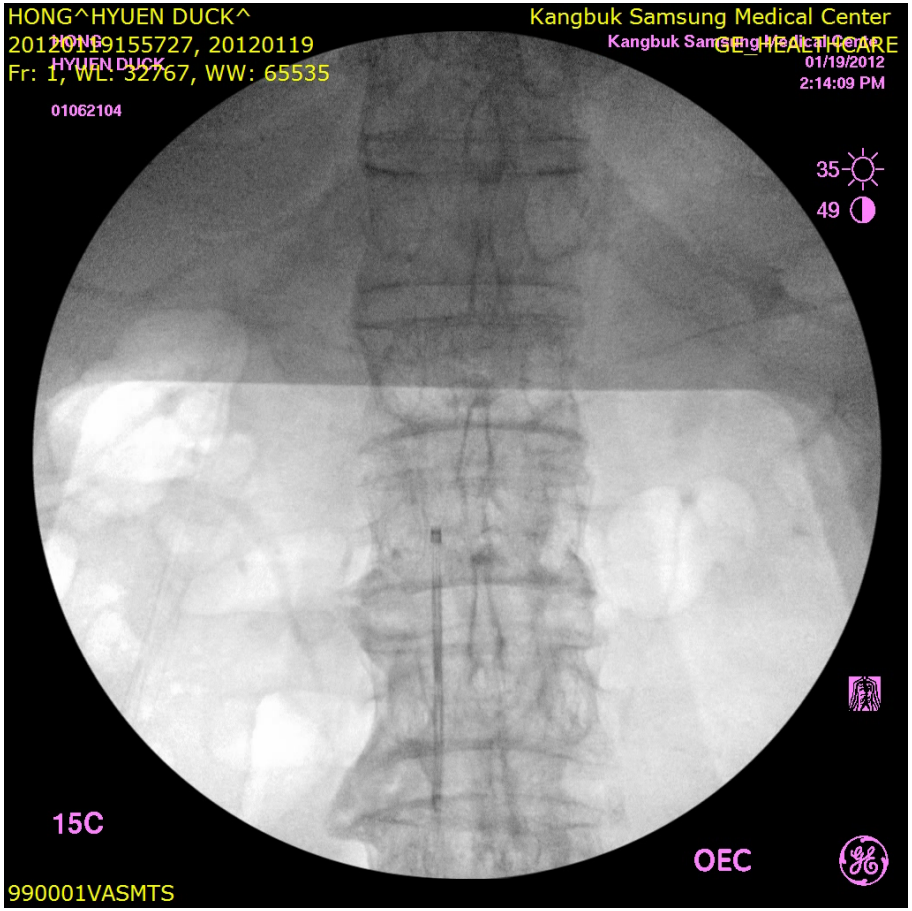
Medial view



Basic

I. IVC filter





Basic

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 Ca

참고하세요.

- **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 Ca

참고하세요.

- **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

Basic

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.

Basic

Summary (cont'd)

- **CDT** for lower extremity DVT
  - are ***not esblished***,
  - **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)**

Basic

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**

Basic

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**

Basic

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**

Acute DV

참고하세요.

Studies
- Thrombolysis registry 1999
- Cavent study 2012, 2016
- PEAR...
- Attra...
- VIDI...

Guidelines
- SIR 2006
- SIR 2009

143

CaVenT trial (

참고하세요.

- Additional CDT resulted in a persistent and increased clinical benefit during follow-up for up to 5 years, supporting the use of additional CDT in patients with extensive proximal DVT

ATTRACT trial

참고하세요.

The NEW ENGLAND JOURNAL of MEDICINE

ORIGINAL ARTICLE

Pharmacomechanical Catheter-Directed Thrombolysis for Deep-Vein Thrombosis

S. Vedantham, S.Z. Goldhaber, J.A. Julian, S.R. Kahn, M.R. Jaff, D.J. Cohen,

145

ATTRACT T

참고하세요.

- recombinant tissue plasminogen activator (rt-PA) (Activase, Genentech, South San Francisco, CA)
- Good flow to poplitcal vein
  - Isolated thrombolysis using Trellis
  - Power Pulse Thrombolysis using the AngioJet
- Pootr inflow to poplitcal vein
  - Infusion-First Thrombolysis using a multisidehole catheter
- PTS, defined as a score of ≥5 on the Villalta PTS Scale

ATTRACT trial

참고하세요.

- Leg pain and swelling significantly improved in PCDT vs no-PCDT out to 30 days (p=0.019 and p=0.05)
  - In IFDVT mod-severe PTS
    18.4% vs 28.2% in PCDT vs no-PCDT

ATTRACT t

참고하세요.

- PTS : 46.7% for PCDT vs 48.2% for no-PTCD (p=0.56)
- Recurrent VTE : 12.5% for PCDT vs 8.5% for no-PCDT (p=0.09)
- Major and any bleeding rates statistically higher in PCDT arm (1.7% vs 0.3% ; p=0.49 and 4.5% vs 1.7%; p=0.034)

148

ATTRACT t

참고하세요.

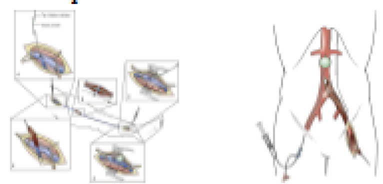
PCDT (pharmacomechanical catheter directed thrombolysis)

- Helpful for acute symptoms
- More benefit in IFDVT
- Did not result in a lower risk of the PTS
- Higher risk of major bleeding

Hybrid is non-inferi

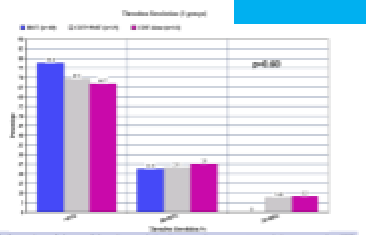
참고하세요.

- novel single-incision approach that combines operative and endovascular techniques to maximize thrombus resolution.



Hybrid is non-inferi

참고하세요.



HOT thrombectomy established complete (≥ 95%) thrombus resolution more frequently than PT did (78% vs 67%; P = .11)

151

Hybrid Operative Thrombe... (youtube: joonhyuk

참고하세요.

152

DVT: Treatment options

Basic

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		+-	+	+

153

Acute DV

참고하세요.

Studies

- Thrombolysis registry 1999
- **Cavent study 2012, 2016**
- PEARL registry 2015
- **Attract study 2013, 2017**
- VIDIO trial 2016

Guidelines

- SIR 2006
- SIR 2009
- SVS 2012
- AHA 2011
- ACCP 2012 9th
- **ACCP 2016 9th update**
- **ESC 2017**

CaVenT trial (

참고하세요.

- **Additional CDT resulted in a persistent and increased clinical benefit during follow-up for up to 5 years, supporting the use of additional CDT in patients with extensive proximal DVT**

- **However, allocation to this therapy did not lead to better quality of life**

ATTRACT trial

참고하세요.

The NEW ENGLAND JOURNAL of MEDICINE

ORIGINAL ARTICLE

Pharmacomechanical Catheter-Directed Thrombolysis for Deep-Vein Thrombosis

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N Engl J Med 2017;377:2240-52.

ATTRACT T

참고하세요.

- recombinant tissue plasminogen activator (rt-PA) (Activase, Genentech, South San Francisco, CA)
- Good flow to popliteal vein
  - Isolated thrombolysis using Trellis
  - PowerPulse Thrombolysis using the AngioJet
- Pootr inflow to popliteal vein
  - Infusion-First Thrombolysis using a multisidehole catheter
- PTS, defined as a score of ≥5 on the Villalta PTS Scale

Assessment	Baseline	Initial Tx	10 d	30 d	6 m	12 m	18 m	24 m
Leg pain (Likert)	X		X	X				
Leg circumference	X		X	X				
Venous QOL (VEINES)	X			X	X	X	X	X
General QOL (SF-36 version 2)	X			X	X	X	X	X
Duplex ultrasonography	X			X		X*		
Venogram (PCDT arm only)		X†						
Cost diary review			X	X	X	X	X	X
Villalta Scale to assess PTS	X		X	X	X	X	X	X
VCSS					X	X	X	X
CEAP classification					X	X	X	X

Abbreviations: *VEINES*, Venous insufficiency epidemiological and economic study; *SF-36*, short-form 36; *VCSS*, venous clinical severity score; *CEAP*, clinical-etiologic-pathophysiologic-anatomic classification.
* Performed in a subgroup of patients.
† Performed pre- and post-PCDT

ATTRACT trial

참고하세요.

- **Leg pain and swelling significantly improved** in PCDT vs no-PCDT out to **30 days** (p=0.019 and p=0.05)

  - In IFDVT mod-severe PTS
    18.4% vs 28.2% in PCDT vs no-PCDT
  - In FPDVT mod-severe PTS
    17.1% vs 18.1% in PCDT vs no-PCDT

ATTRACT t

참고하세요.

- **PTS** : 46.7% for PCDT vs 48.2% for no-PTCD (p=0.56)
- **Recurrent VTE** : 12.5% for PCDT vs 8.5% for no-PCDT (p=0.09)
- **Major** and ***any*** **bleeding** rates statistically higher in PCDT arm (**1.7% vs 0.3%** ; p=0.49 and ***4.5% vs 1.7%***; p=0.034)

ATTRACT t

참고하세요.

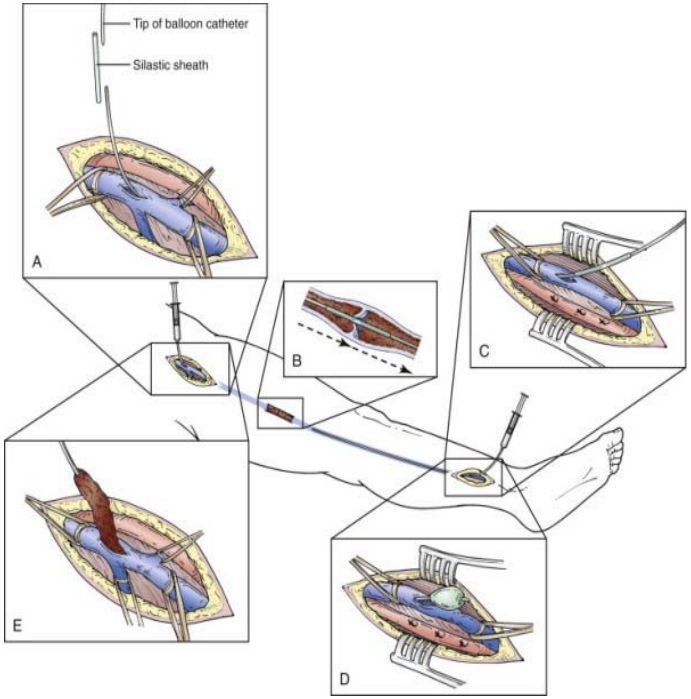
PCDT (pharmacomechanical catheter directed thrombolysis)

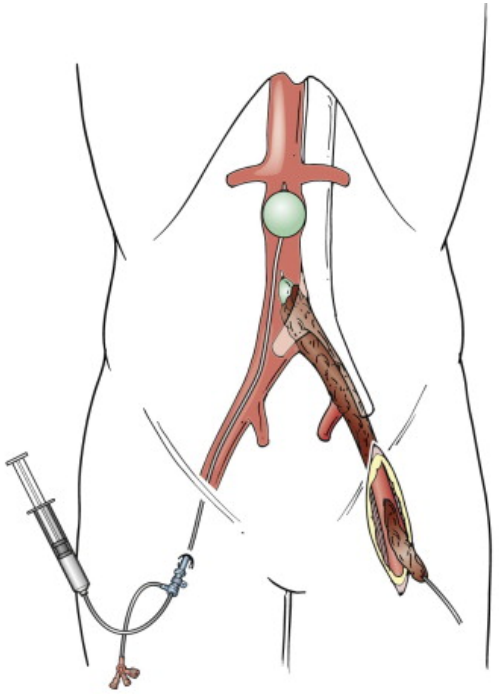
- Helpful for **acute symptoms**
- More benefit in **IFDVT**
- **Did not** result in a **lower risk of the PTS**
- Higher risk of **major bleeding**

참고하세요.

Hybrid is non-inferi

- **novel single-incision approach that combines operative and endovascular techniques to maximize thrombus resolution.**





참고하세요.

Hybrid is non-inferi

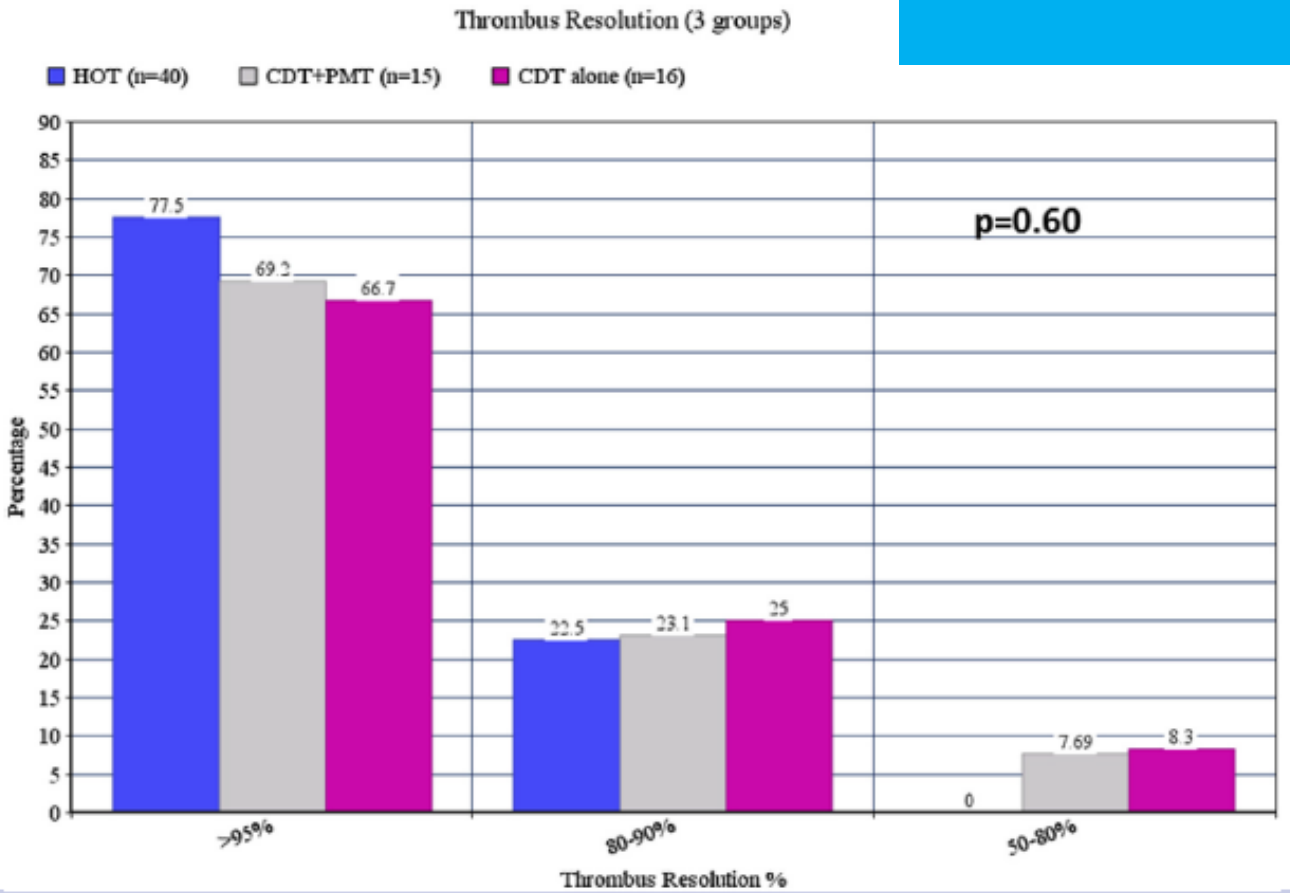


Fig 1. Comparison of degree of thrombus resolution between the groups at completion venography. *CDT,* Catheter-directed thrombolysis; *HOT,* hybrid operative thrombectomy; *PMT,* pharmacomechanical thrombectomy.

HOT thrombectomy established complete (≥ 95%) thrombus resolution more frequently than PT did (78% vs 67%; P = .11

Hybrid Operative Thrombe

(youtube: joonhyuk

참고하세요.

Basic

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		+/-	+	+

Calf Vein Thrombo

참고하세요.

Calf Vein Thrombo

참고하세요.

- 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

참고하세요.

Acute DV

참고하세요.

Studies

- Thrombolysis registry 1999
- **Cavent study 2012, 2016**
- PEARL registry 2015
- **Attract study 2013, 2017**
- VIDIO trial 2016

Guidelines

- SIR 2006
- SIR 2009
- SVS 2012
- AHA 2011
- ACCP 2012 9th
- **ACCP 2016 9th update**
- **ESC 2017**

158

ACCP 9th update 2

참고하세요.

The CAVENT Study has reported that CDT reduced PTS, did not alter quality of life, and appears to be cost-effective

A retrospective analysis of CDT (3869 patients) was associated with increases in transfusion(32%), intracranial bleeding (3%), PE(3.32%), and vena caval filter insertion(32%)

This new evidence has not led to a change in our recommendation for the use of CDT in patients with DVT since ACCP 2012

CHEST 2016; 149(2):315-352

159

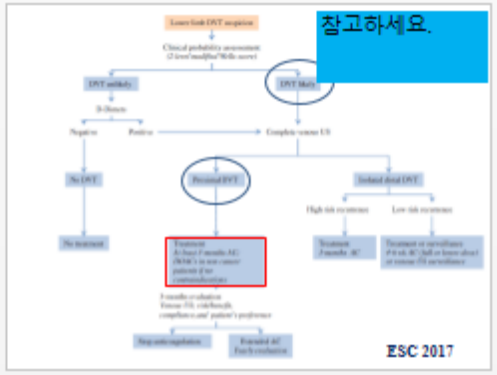
ACCP Guideline 2

참고하세요.

- **Catheter-Directed Thrombolysis for Acute DVT of the Leg**
  - In patients with **acute proximal DVT of the leg**, we suggest **anticoagulant therapy alone over CDT (Grade 2C)**
  - We propose that the patients who are most likely to **benefit from CDT** have
    - **Iliofemoral DVT**
    - **Symptoms for <14 days**
    - **Good functional status**
    - **Life expectancy of >1 year**
    - **Low risk of bleeding**

CHEST 2016; 149(2):315-352

160



161

Acute DV

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ACCP 9th update 2

참고하세요.

Outcomes	No. of Participants (Studies) Follow-up	Quality of the Evidence (GRADE)	Relative Effect (95% CI)	Anticipated Absolute Effects: Risk with Anticoagulation Alone	Anticipated Absolute Effects: Risk Difference with Catheter-Assisted Thrombus Removal (95% CI)
All-cause mortality	209 (1 study) 3 mo	⊕⊕⊖⊖ **Low**[a,b] because of imprecision	RR 0.43 (0.08-2.16)	46 per 1,000[c]	26 fewer per 1,000 (from 43 fewer to 54 more)
Recurrent VTE	189 (1 study) 3 mo	⊕⊕⊖⊖ **Low**[a,b] because of imprecision	RR 0.61 (0.3-1.25)[d]		Moderate-Risk Population[e]
				48 per 1,000	19 fewer per 1,000 (from 34 fewer to 12 more)
Major bleeding	224 (2 studies) 3 mo	⊕⊕⊖⊖ **Low**[a,b] because of imprecision	RR 7.69 (0.4-146.9)[d]		Moderate-Risk Population[e,f]
				29 per 1,000	194 more per 1,000 (from 17 fewer to 1000 more)
PTS	189 (1 study) 2 y	⊕⊕⊕⊖ **Moderate**[a] because of imprecision	RR 0.74 (0.55-1)[g]		Moderate-Risk Population[h]
				588 per 1,000	153 fewer per 1,000 (from 265 fewer to 0 more)[i]
Patency	189 (1 study) 6 mo	⊕⊕⊕⊖ **Moderate**[b] because of imprecision	RR 1.42 (1.09-1.85)	455 per 1,000[j]	191 more per 1,000 (from 41 more to 386 more)
QoL	189 (1 study) 24 mo	⊕⊕⊕⊖ **Moderate**[k] because of risk of bias			The mean quality of life in the intervention groups was 0.2 higher (2.8 lower to 3 higher)[l,m]

The CAVENT Study has reported that CDT reduced PTS, did not alter quality of life, and appears to be cost-effective

A retrospective analysis of CDT (3649 patients) was associated with increase in transfusion(2X), intracranial bleeding (3X), PE(1.5X), and vena caval filter insertion(2X)

This new evidence has not led to a change in our recommendation for the use of CDT in patients with DVT since ACCP 2012

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ACCP Guideline 2

참고하세요.

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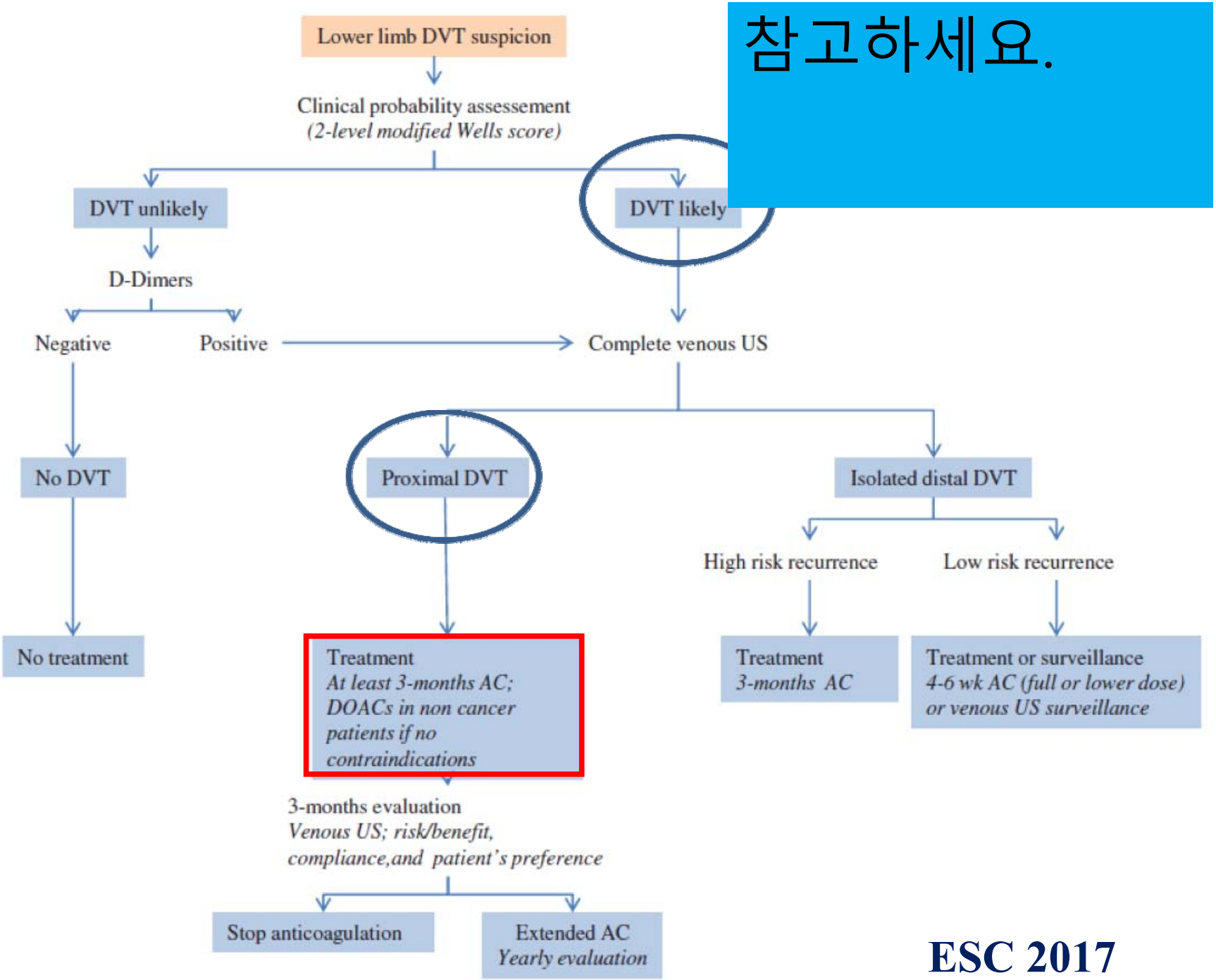
참고하세요.



ESC 2017

Pregnanc

참고하세요.

DVT in pregn

참고하세요.

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

Malignanc

참고하세요.

Anticoagulant thera
with maligna

참고하세요.

- 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 availble
- Extended anticoagulation

Anticoagulant thera
with brain tun

참고하세요.

- High risk of VTE : 7.5~25%
  - esp., age≥60 years, glioblastoma, large tumor size, subtotal resection, use of chemotherapy, neurosurgery ≤ 2 mo, leg paresis
- Risk of bleeding: 2~4% in pts w/ glioma,
  - esp., pituitary adenoma, metastatic tumor from melanoma, choriocarcinoma, thyroid ca., renal cell ca.
- Anticoagulant therapy LMWH>VKA

Prophylax

참고하세요.

Basic

DVT: Prophylaxis

	Calf DVT	Proximal DVT	Fatal PE
High risk	**40-80%**	**10-30%**	**>1%**
• 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%**
• Geberak surgery in patients >40 years			
• Patients on oral contraception			
• Neurosurgical patients			
Low risk	**<10%**	**<1%**	**<0.1%**
• Uncomplicated surgery in patients <40 years without any other risk factors			
• Minor surgery in patients >40 years without any other risk factors			

DVT: Prophyl

참고하세요.

- **Pharmacologic**
  - UFH
  - LMWH
  - Fondaparinux
  - Oral direct thrombin inhibitor
  - Factor Xa inhibitor
  - VKA
  - Aspirin

- **Mechanical**
  - Intermittent pneumatic compression

Summary

참고하세요.

Therapeutic Goals of Treatment

참고하세요.

- Relieve the patient's symptoms
- Prevent further thrombus propagation
- Prevent pulmonary embolism & CTEPH
- Prevent DVT recurrence
- Prevent postthrombotic syndrome

Acute Pulmonary Embolism

Clinical poi

참고하세요.

acute, major PE→20% die within 48hrs
→most remaining, resolve over days to weeks

minor: <30% occlusion
PaO2 65~80mmHg
PaCO2 35mmHg

major: 30~50% occlusion
at least 2 lobar pul a obstruction
PaO2 50~60mmHg
PaCO2 <30mmHg

massive: >50% occlusion→50% mortality
PaO2 <50mmHg
PaCO2 <30mmHg
* chronic massive embolism→severe PHTN
* acute embolism in normal RV function→PA pressure may be normal
└,30~40mmHg=severe PHTN

참고하세요.

Supportive & throm

O2, ventilator support

heparin: IV heparin 70U/kg bolus→18~20U/kg/hr
monitor aPTT 50~70sec every 6~8hr
PLT evey 2~3days for HIT

LMWH

Thrombolytics: UK 4400U/kg over 10min→4400U/kg for 12hr
heparin+thrombolytics=more effective & lower mortality rate
contraindication
-fresh surgical wound
-anemia
-recent stroke
-peptic ulcer
-bleeding tendency

Basic

Acute PTE Embolectomy

Indication

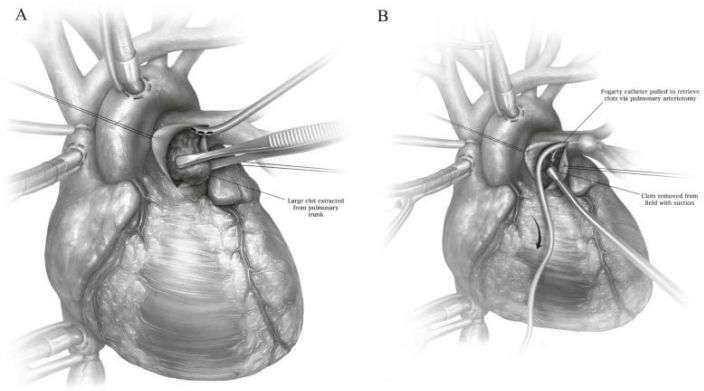
hemodynamic unstable
major PE c ↓ O2 gas exchange
contraindication to thrombolytics or heparin
large trapped clot in RA or RV

Postop treatment

no caval procedures
wafarin for 6mon

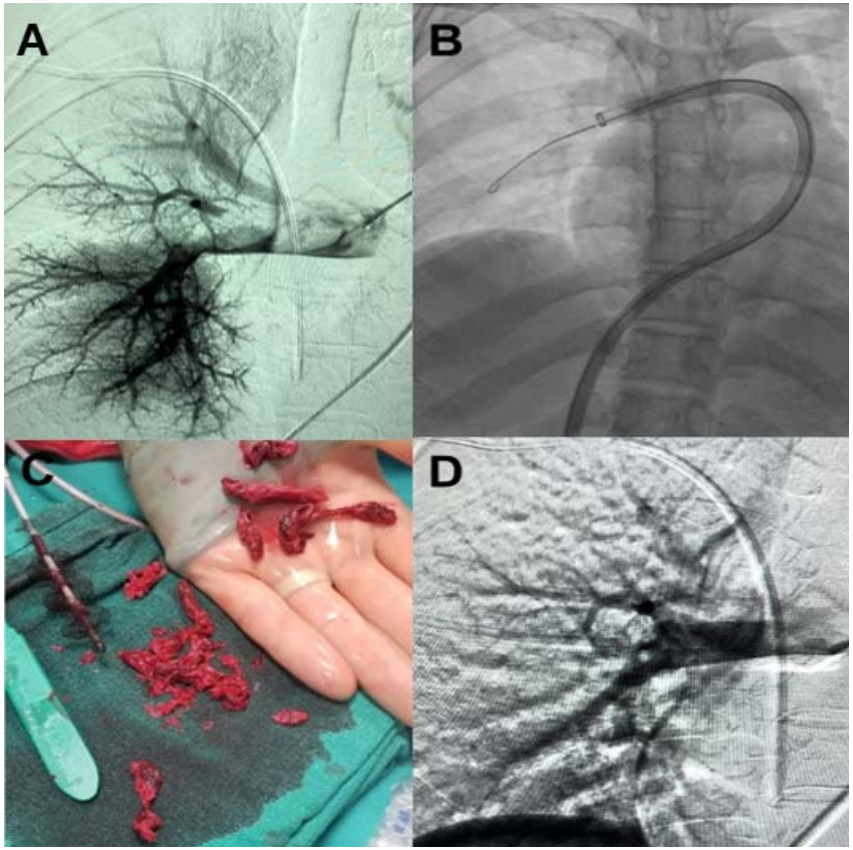
IVC filter indication

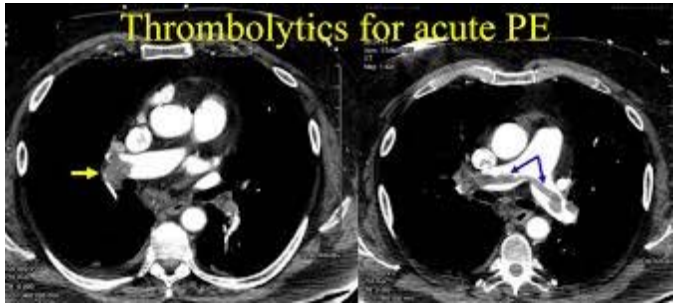
contraindication to thrombolytic
to recurrent PE on anticoagulati



Basic

Acute PTE





Chronic Pulmonary Embolism

Natural history

acute emboli, not lysed--1~2wk→attach to arterial wall
--with times→converted into connective & elastic tissues
--a few weeks→vessel narrowing, fibrosis

why acute emboli fail to resolve
-unclear
-lupus anticoagulant
-deficiency of protein C, S, AT-III

PHTN >40mmHg→30% will survive at 5 years
>50mmHg→10% will survive at 5 years

chronic process involve proximal PA from pul. trunk to sublobar PA

infarction is infrequently

Surgical indication

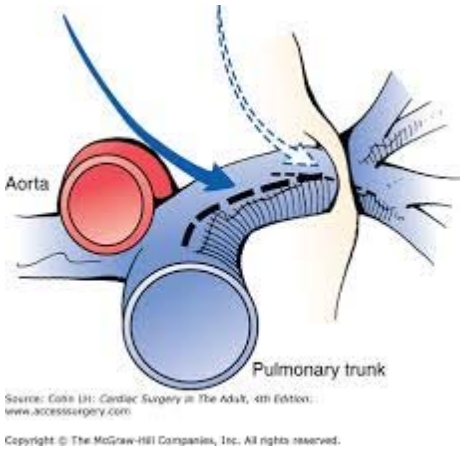
Purpose

• hemodynamic goal: ameliorate RV compromise d/t PHTN

• respiratory goal: improve lung function by removal of non-functioning space

• prophylactic goal: prevent progress RV dysfunction, retrograde extension of clot

prevent secondary vasculopaty



Indication

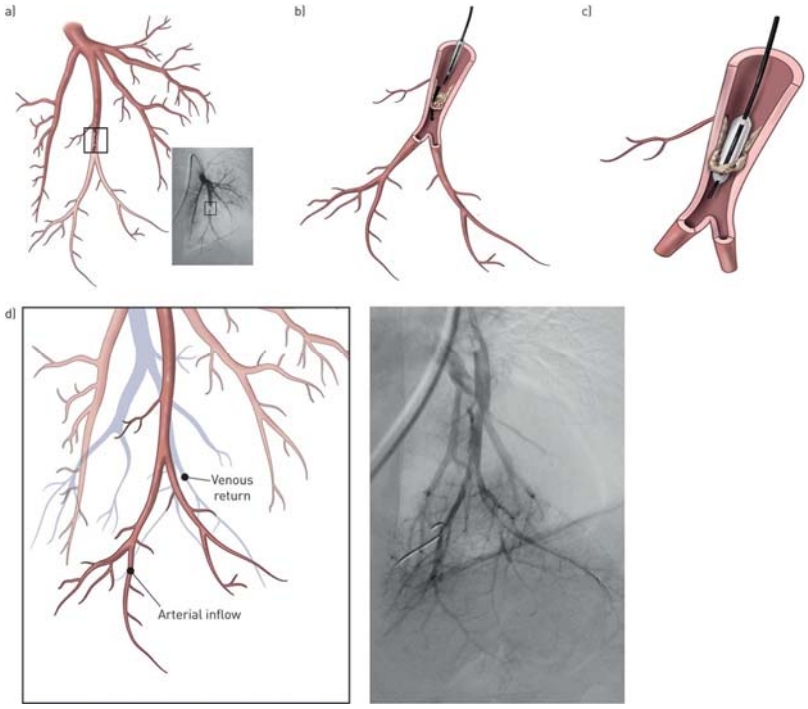
• symptomatic & hemodynamic or ventilatory impairment

• increased PVR

• lobar, segmental, PA occlusion

Basic

Chronic PTE Endo



Basic

Vascular Surgeon with Balance