



Universität
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Universitätseinheit

Venenerkrankungen -IM Angiologie-

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Venenerkrankungen

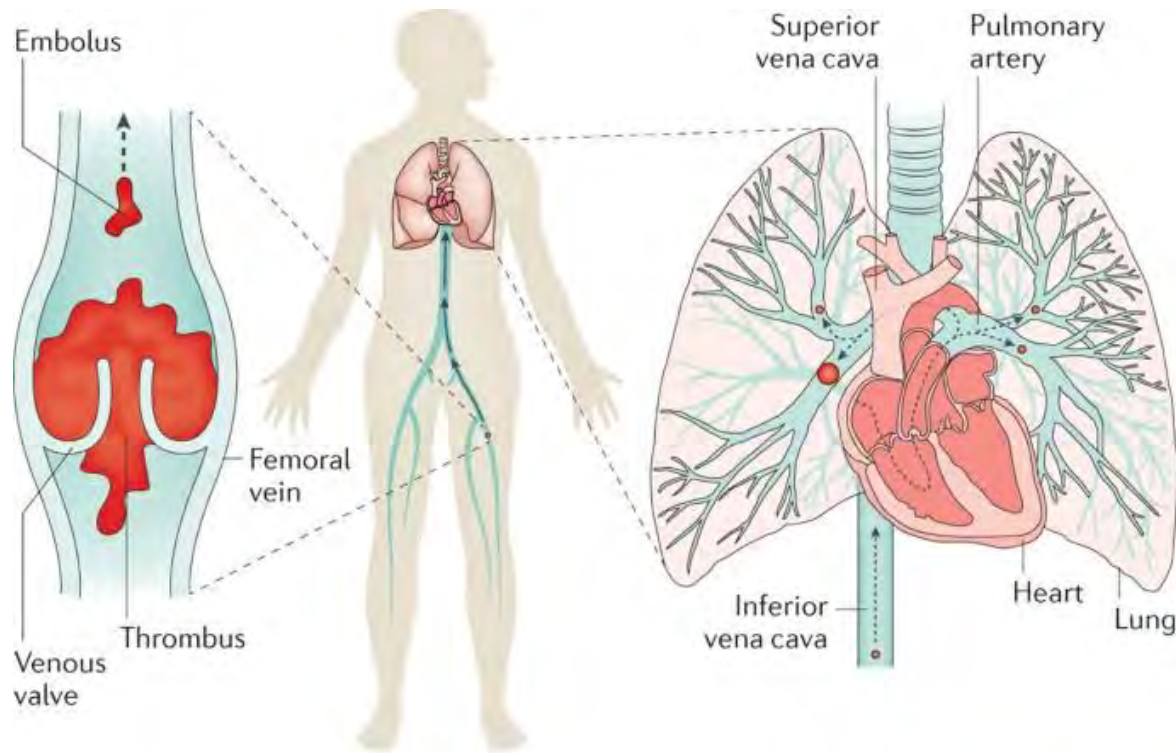
1. Acute venous thromboembolism (VTE)

- deep vein thrombosis (DVT)
- pulmonary embolism (PE)

2. Chronic venous insufficiency (CVI) and post-thrombotic syndrome (PTS)

Venous Thromboembolism (VTE)

Deep vein thrombosis (DVT) and pulmonary embolism (PE)



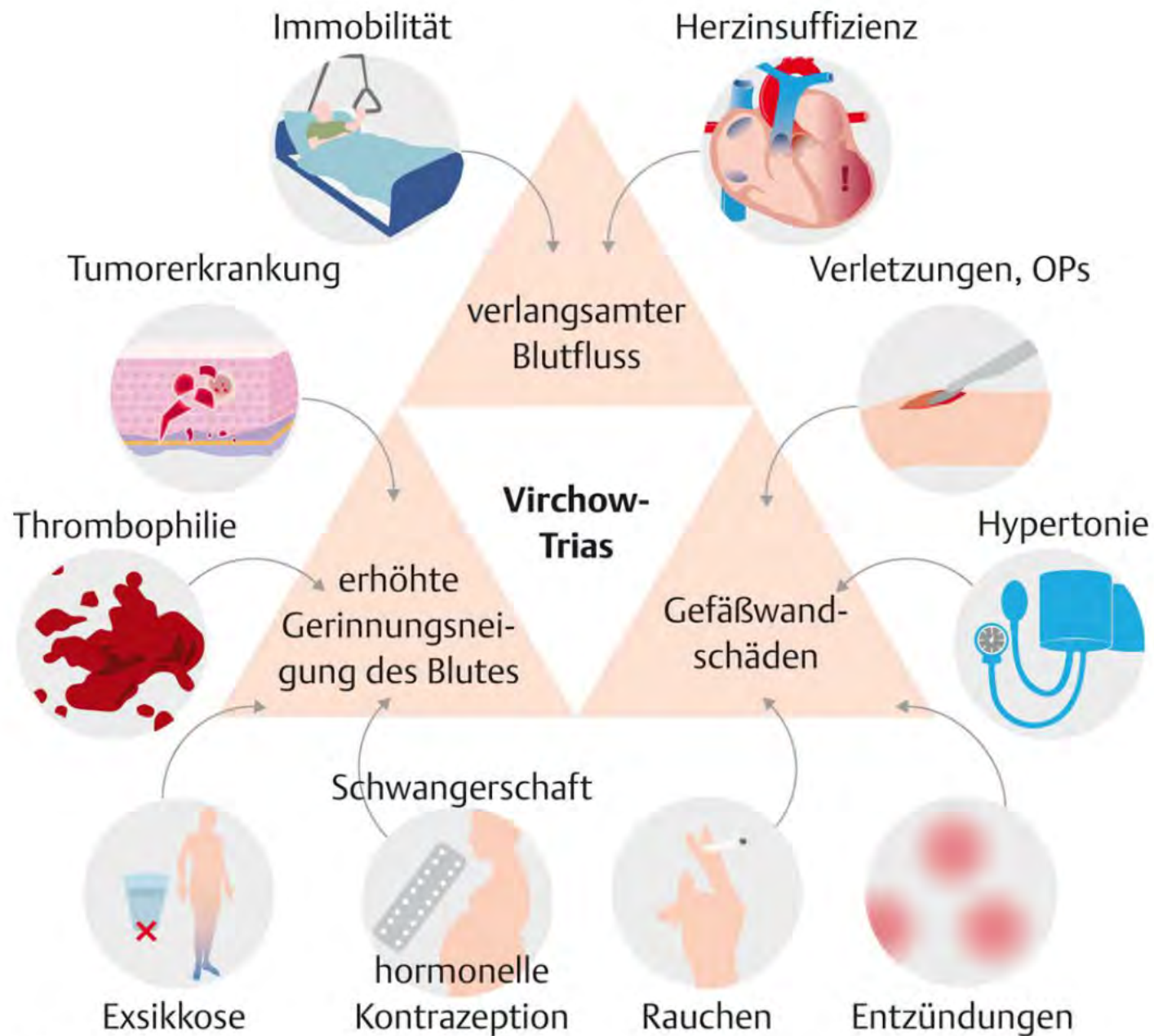
Nature Reviews | Disease Primers

**Symptomatic PE (+/- DVT)
30% of VTE**

No identifiable risk factors	40%
Cancer	20%
Hospital-associated	40%

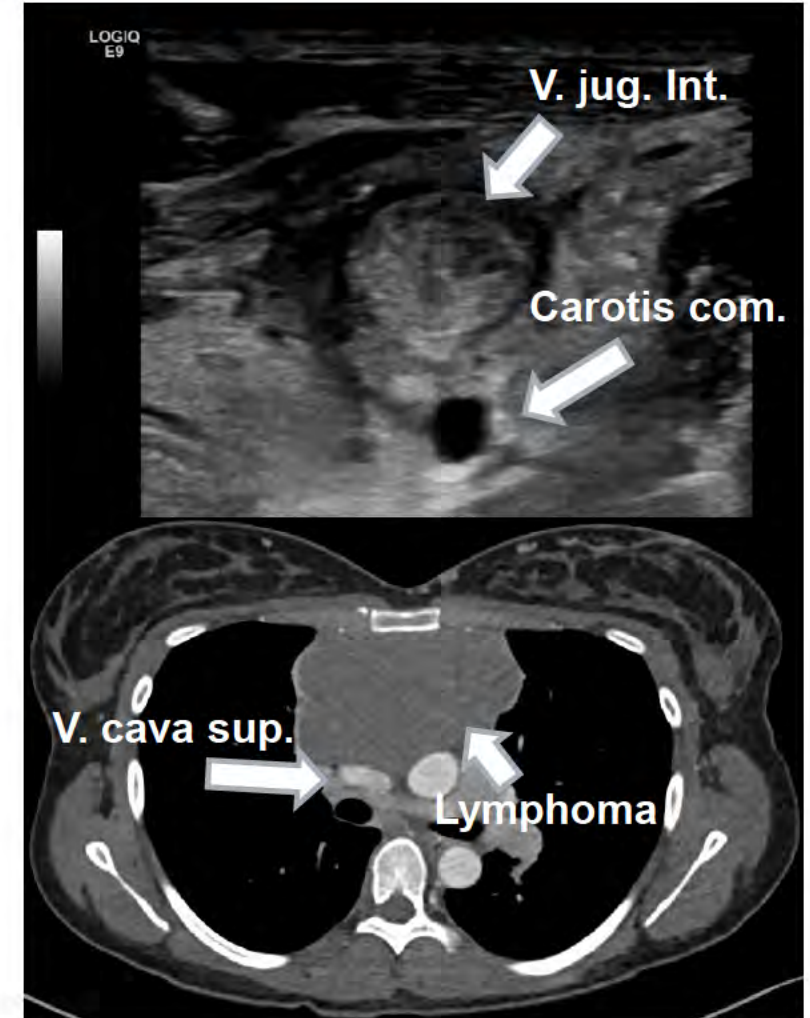
VTE risk linearly increases with age

Third most frequent cardiovascular disease
Incidence rate 2/1.000 pop-year (increasing trend)



W, 29

- pregnant SSW 10
- flu (one week)
- acute thrombosis V. jug., V. brachiocephalica, V. subclavia
- compression due to lymphoma

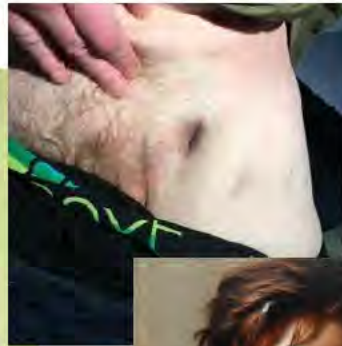


M (31) with **thorax pain, dyspnoea, syncopal episodes, and left leg pain**

Personal history / comorbidities:

- on methadone (prior drug abuse)
- depression

Transported to the ER with 4L O2

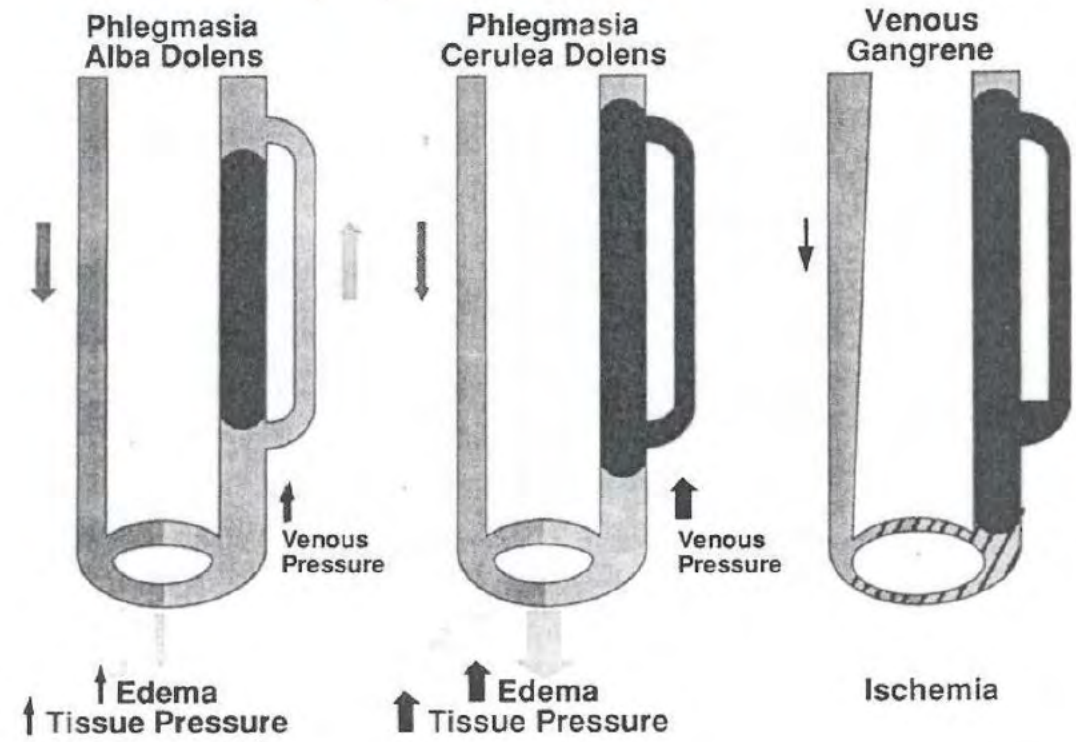


Signs and symptoms of deep vein thrombosis (usually unilateral)

- Swelling
- Pain
- Redness
- New collateral veins
- A feeling of warmth
- Cramping/soreness
- (Signs/symptoms of PE)

→ **Very aspecific**

Phlegmasia caerulea dolens



Signs and symptoms of pulmonary embolism



Schwindel



Atemnot



Husten



Herz-Rhythmus-
Störungen



Brustschmerzen



Schweiß-
ausbruch

- Tachypnea ($>20/\text{min}$) or need for O₂
- Syncope
- DVT ($>50\%$)
- **Hemodynamic decompensation / shock / CPR**
- Even more aspecific signs/symptoms than DVT!

Blood pressure 100/60 mmHg

Heart frequency 140 beats/min

SaO₂ 92% with 6L/min

Lactates 1.5 mmol/L

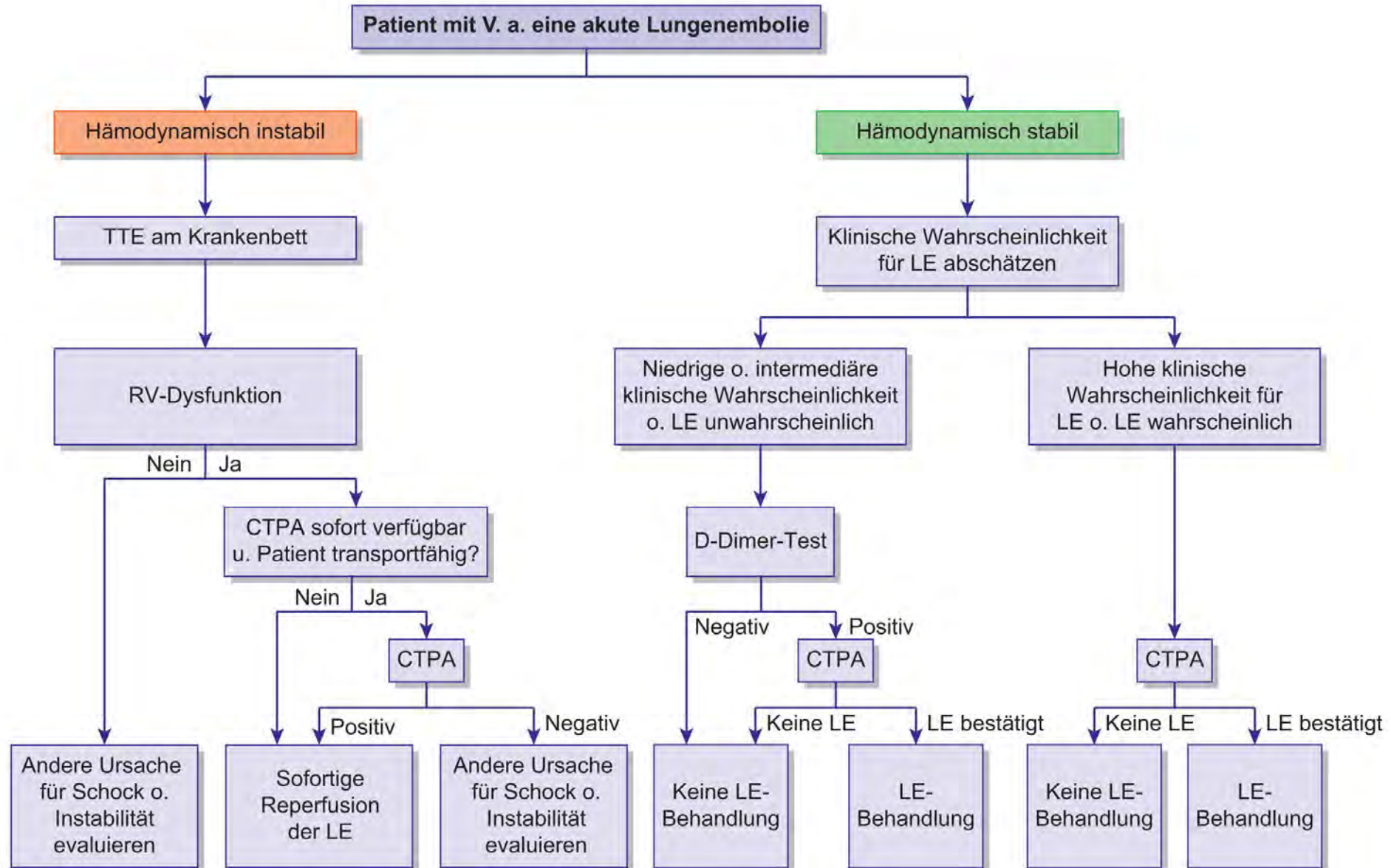


Entzündung				
CRP (C-reakt.Prot.)	< 5	mg/l	98 *	85 *
Herz und Muskel				
CK, total	< 190	U/l	79	142
Myoglobin	28 - 72	µg/l	27 *	
Troponin T, High Sensitive	< 14	ng/l	92 *	134 *
NT-proBNP (Roche)	< 85.8	ng/l	1599 *	
Schilddrüse				

What to do?

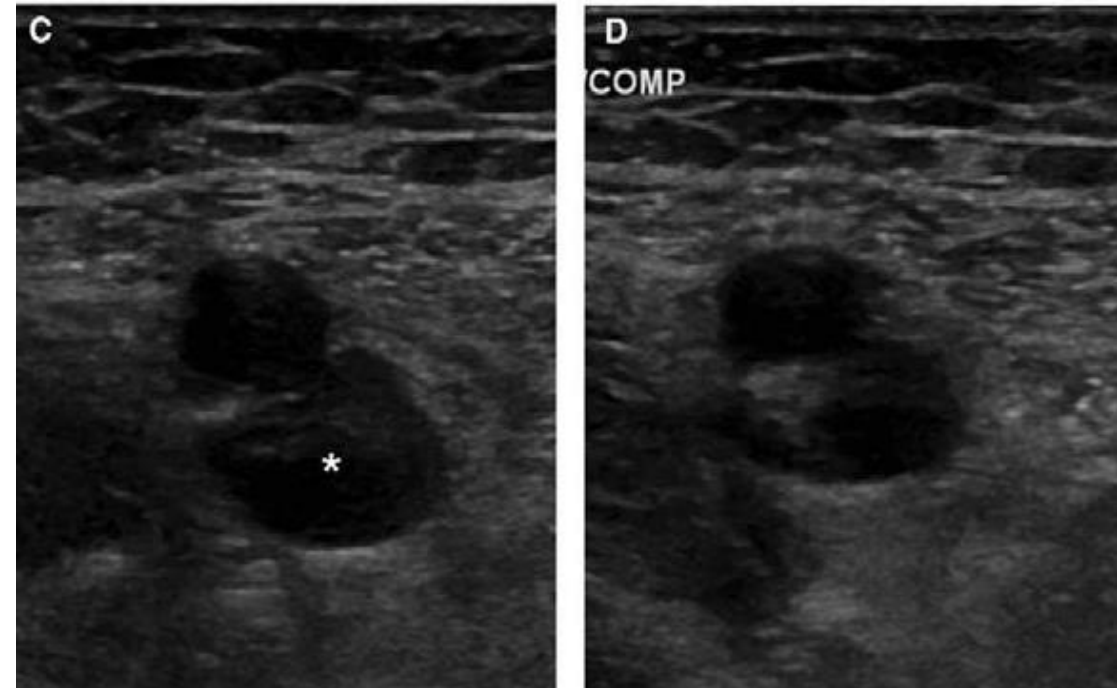
- Give heparin/LMWH
- D-dimer
- Coronary angiography
- CT-angiography
- Lower-extremity sonography
- Pulmonary embolism response team
- Echocardiography

Diagnosis of acute PE

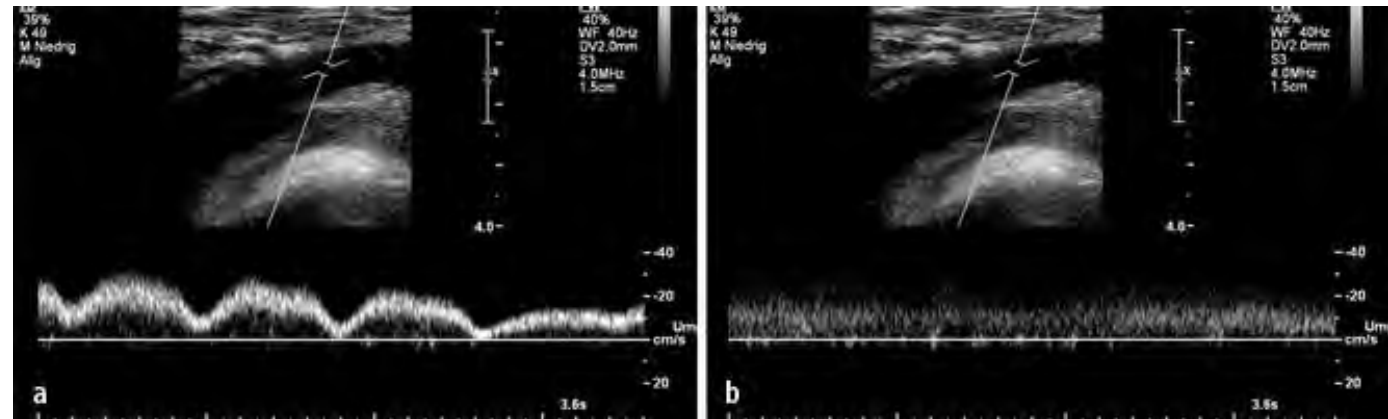


Ven. Duplexsonographie

1) Kompression

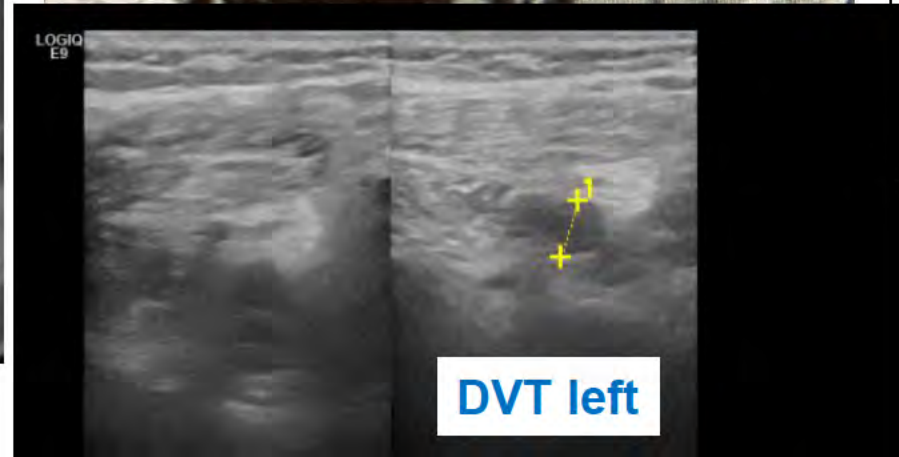
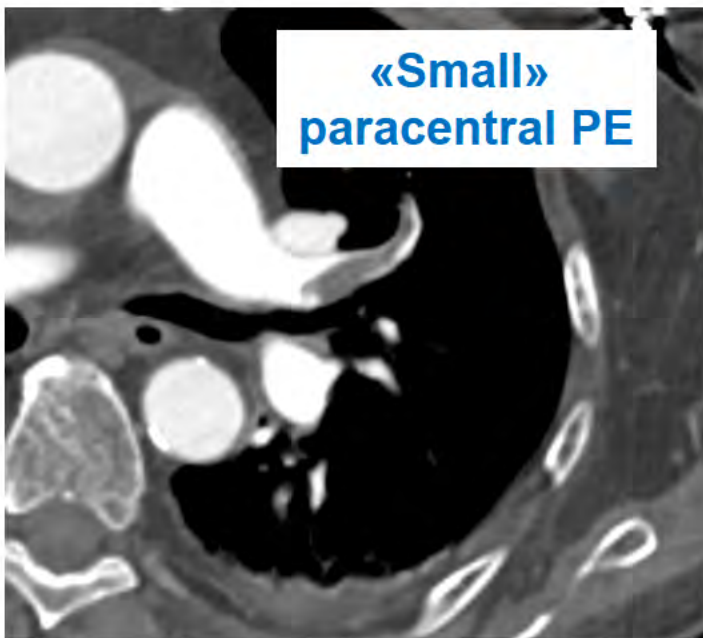
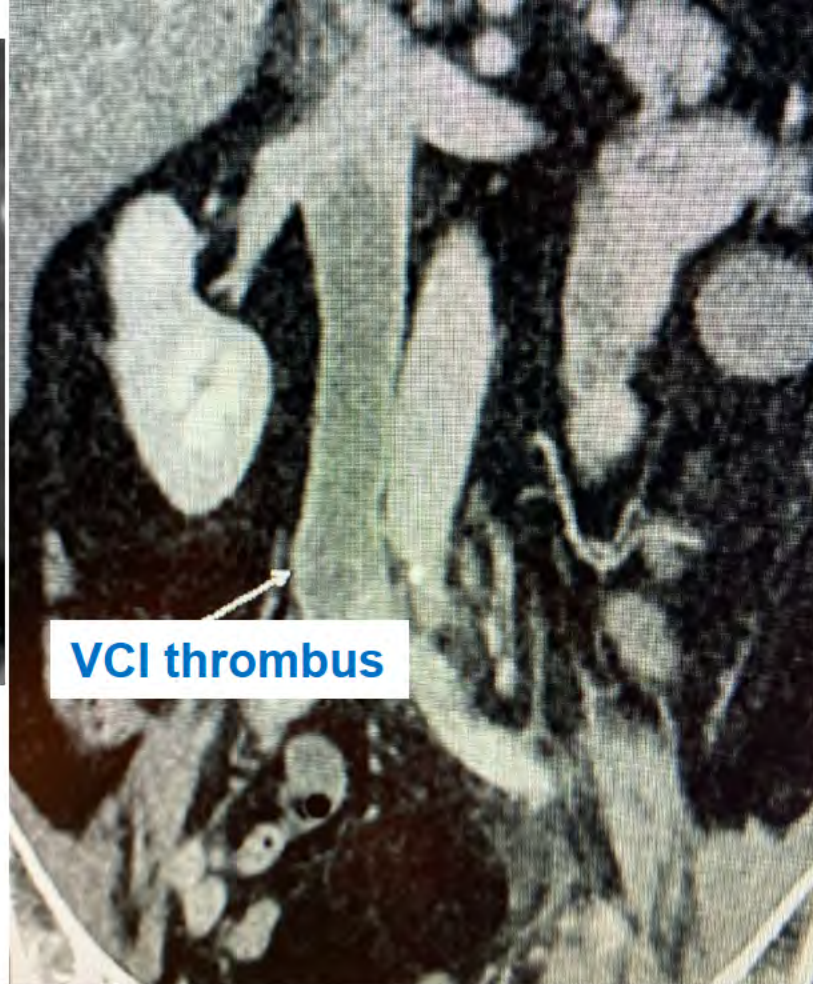


2) Flusssignal



Normal

Pathologic



What to do?

- Heparin/LMWH
- DOACs
- Systemic lysis
- Endovascular thrombectomy
- Cava filter
- Surgical thrombus removal



Acute VTE

Early
discharge

Choice of the anticoagulant agent

ICU
Monitoring or
Reperfusion

Duration of anticoagulant
treatment

Comprehensive evaluation
(e.g occult cancer,
thrombophilia)

Post-PE impairment
Postthrombotic syndrome
CTEPH

First 24 hours

First week

First 3-6 months

LOW RISK

INTERMEDIATE RISK

HIGH RISK

HOME TREATMENT



CLOSE MONITORING / I.C.U.



HOSPITALIZATION



LOW RISK

HOME TREATMENT



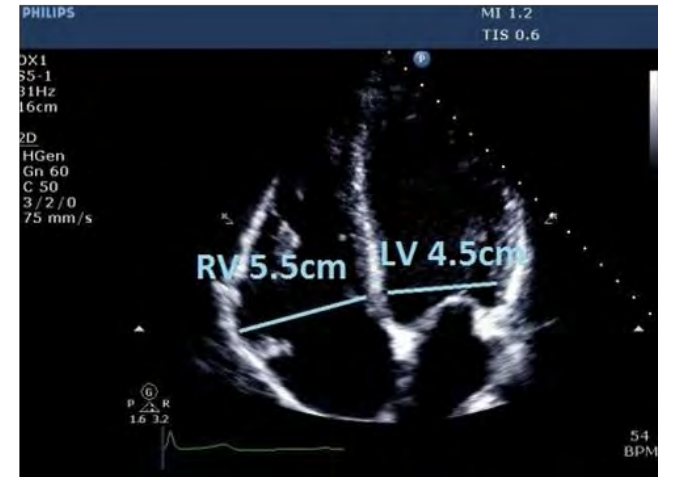
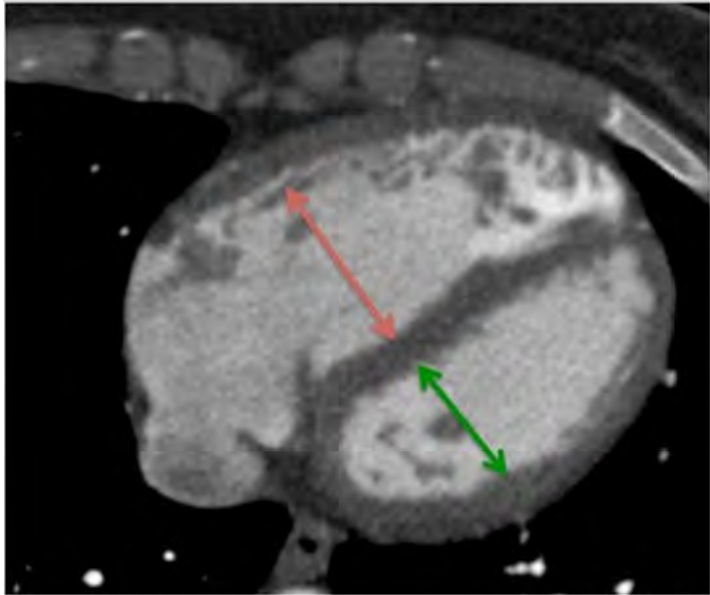
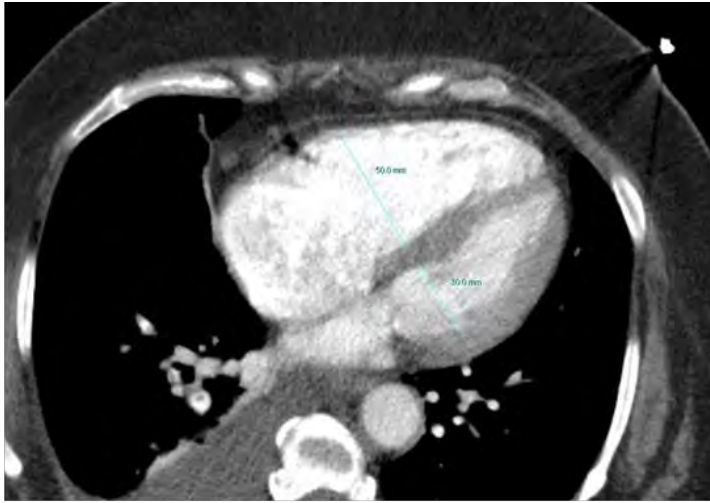
OK for almost all patients with isolated deep vein thrombosis (without PE)

If PE is present:

- low clinical risk (scores) plus
- no right ventricular dysfunction (CT or echo)

Early discharge after PE: absent Hestia criteria or sPESI = 0

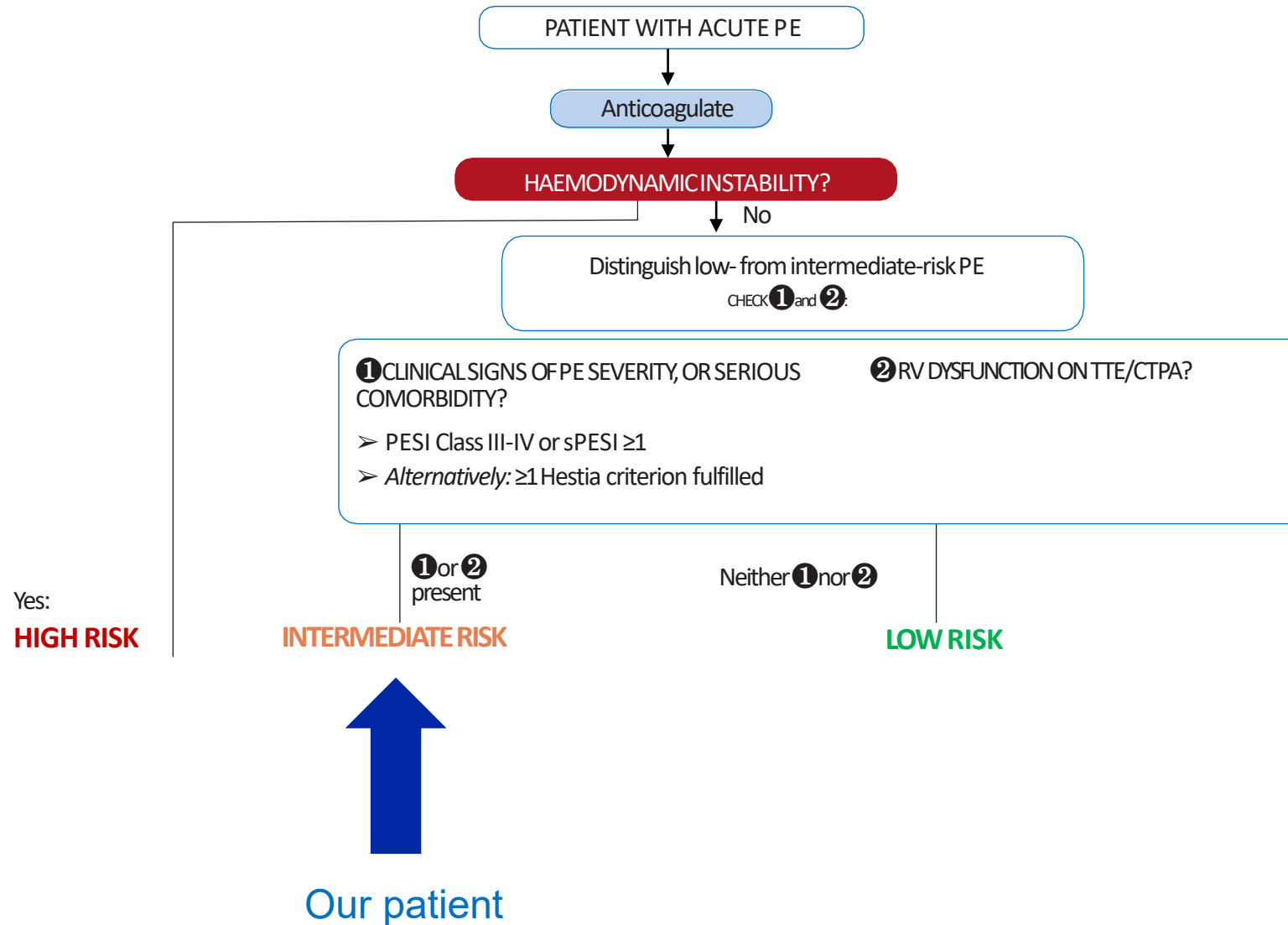
	Simplified PESI	Hestia criteria
Age	Age > 80 years	-
PE-related	Heart rate > 110 bpm	Haemodynamically unstable (clinical judgement, heart rate, systolic BP), thrombolysis needed
	Systolic BP < 100 mmHg	
	SaO ₂ < 90 %	SaO ₂ < 90 %
Comorbidities	Cardiopulmonary diseases	-
	Cancer	
	Implicit?	Severe medical conditions (requiring hospitalization), high bleeding risk, prior HIT
		Organ dysfunction
		Pregnancy
Pregnancy		
Feasibility		Lack of social, familiar, or medical support
RV dysfunction	Implicit?	Implicit? → severe medical conditions



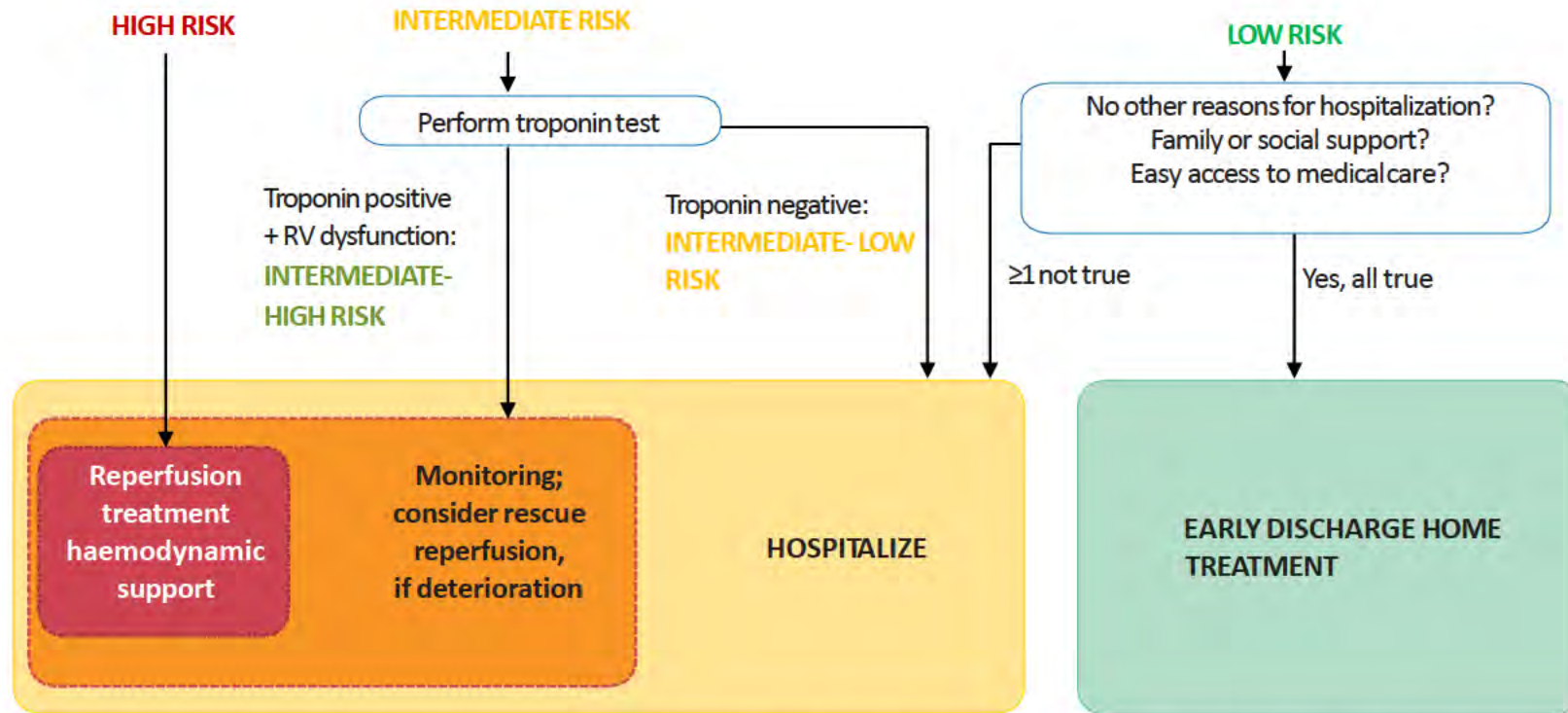
Wie definiert man die hämodynamische Instabilität?

- Persistierende arterielle Hypotonie mit systolischem Blutdruck < 90 mmHg,
oder
- Abfall des systolischen Blutdrucks um > 40 mmHg über mehr als 15 Min.,
oder
- CPR

Risk-adjusted management strategy for acute PE (1)



Risk-adjusted management strategy for acute PE (2)



©ESC

CTPA = computed tomography pulmonary angiography; PESI = Pulmonary Embolism Severity Index; RV = right ventricular; TTE = transthoracic echocardiography.

Anticoagulation in acute PE

LOW RISK

INTERMEDIATE RISK

HIGH RISK

INITIAL ANTICOAGULATION WITH ORAL AGENTS (DOACs)



PARENTERAL ANTICOAGULATION



PRIMARY REPERFUSION NOT RECOMMENDED

PRIMARY REPERFUSION

Principles of initial management of acute DVT

- Fixed-dose **direct oral anticoagulants** in most patients (≥ 3 months)
- **LMWH/UFH** in patients with gastric cancer or (reduced dose) if thrombocytopenia < 50000 G/L or if surgery planned
- **Leg compression** (stockings class II)
- **VKA** only if antiphospholipid syndrome known / highly suspected or if other reasons for VKA

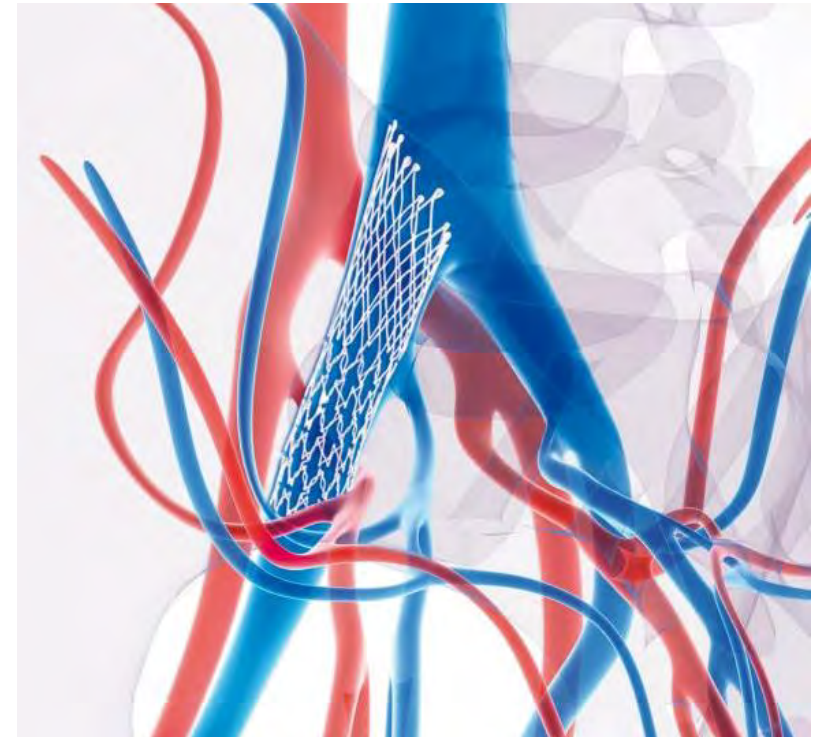
Genetic thrombophilia test (almost) never needed

Guidances and guidelines for iliofemoral DVT

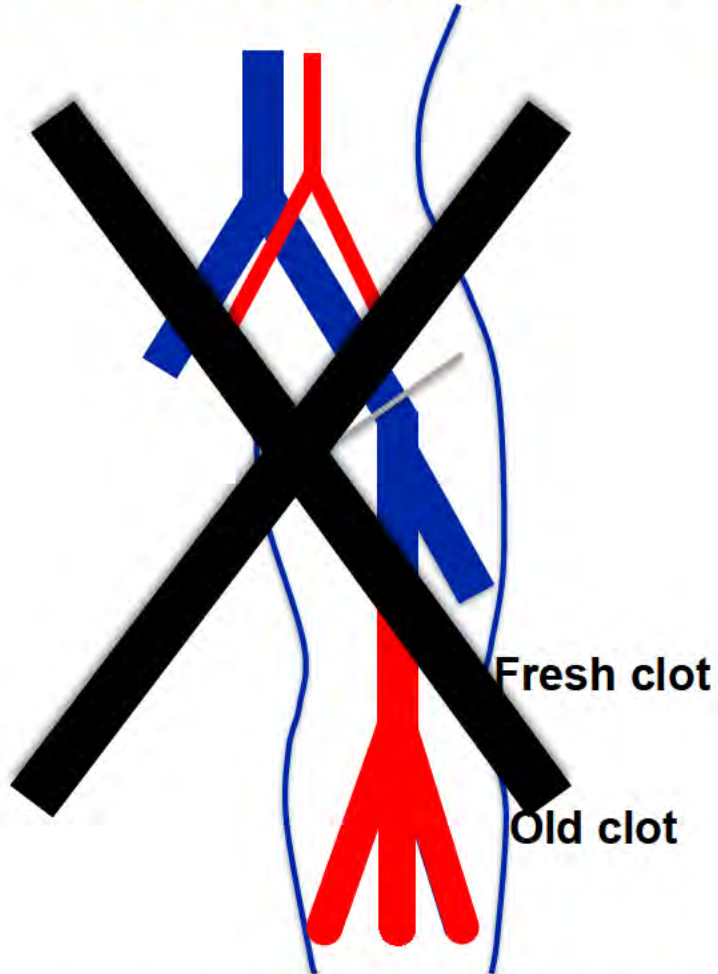
- Thrombus removal for patients with phlegmasia and in selected patients with iliofemoral deep vein thrombosis
- Systemic thrombolysis *not* recommended
- Self expanding metallic stents at the time of clot removal in the case of compression

InterEPID guideline

ESVS guidelines

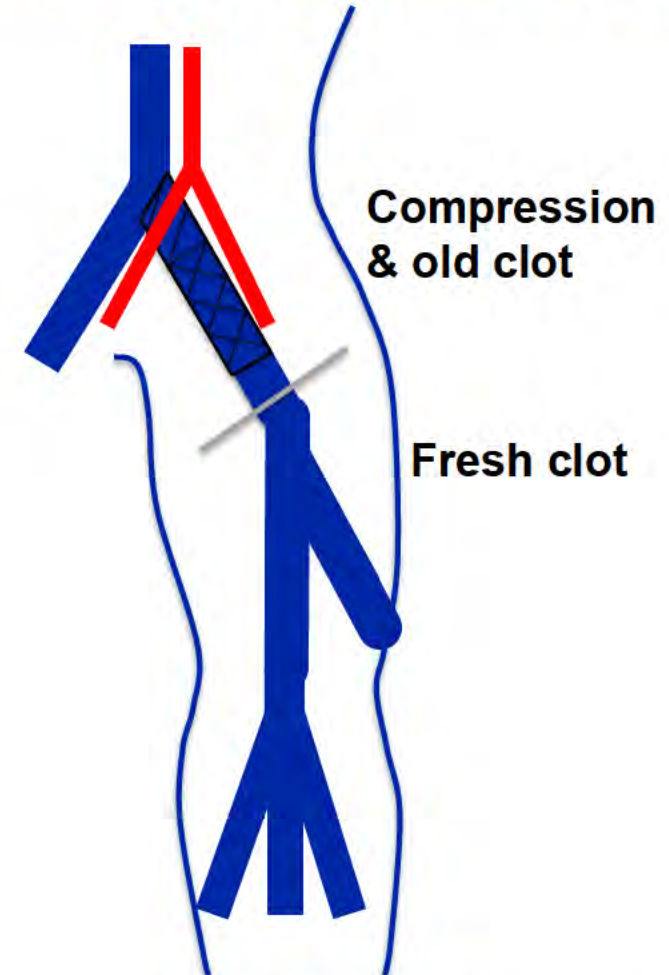


Ascending femoropopliteal DVT



Inflow unlikely to be improved by catheter therapies

Descending iliofemoral DVT



Inflow improved by catheter therapies & stent

Our patient



PE

«intermediate-low» risk
slightly elevated troponin
no right ventricular dilatation

No reperfusion needed
Anticoagulation alone

DVT

Ascending DVT
Common iliac vein (May-Thurner point) not thrombosed
Symptomatic but no phlegmasia

No reperfusion strictly needed
Anticoagulation alone

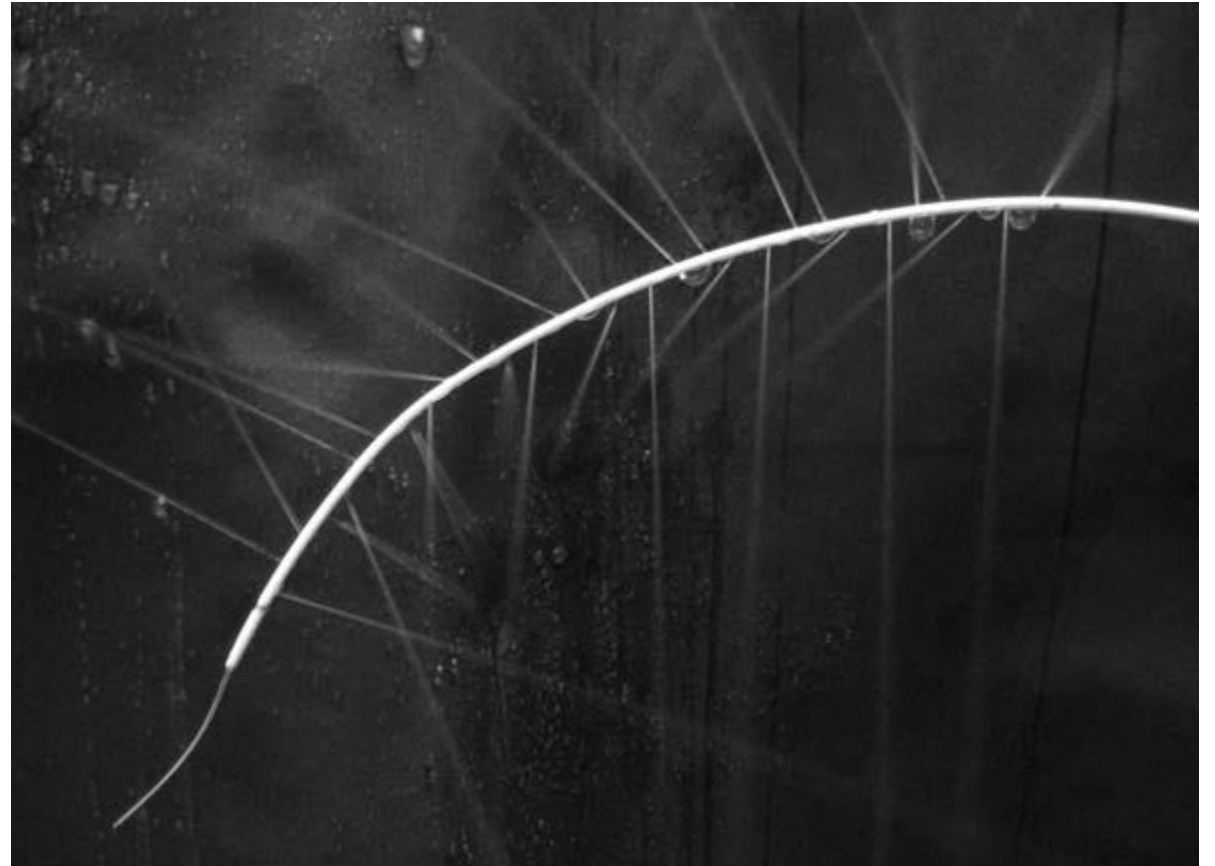
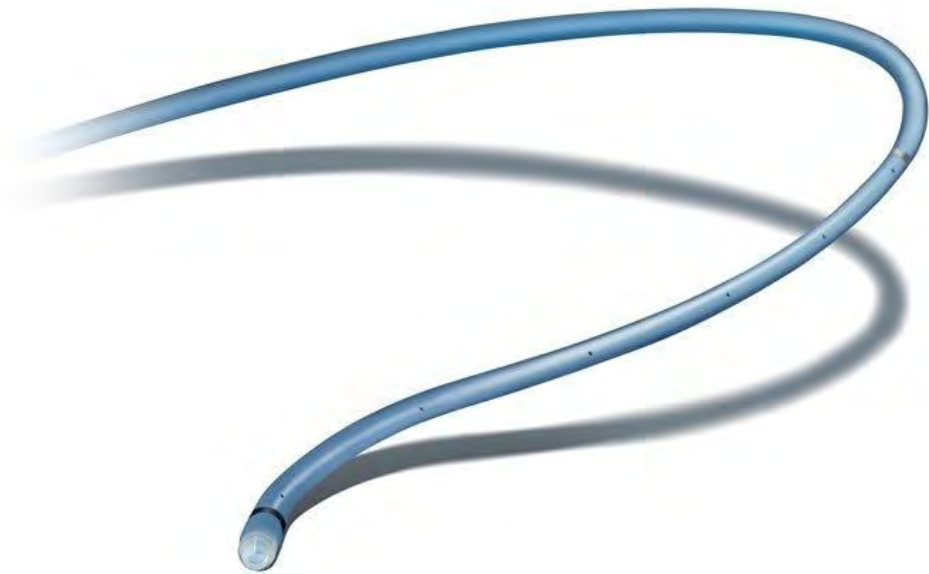
Cava thrombosis

High risk of embolization
Cava filter risky (dilated VCI and need for suprarenal placement)

Anticoagulation plus either endovascular thrombectomy or local lysis

Standard catheter-directed thrombolysis

- 5F catheters *without* ultrasounds
- Multiside hole infusion catheter



**Isolated distal
DVT** (without
cancer)

**Reversible major
transient risk
factors** for VTE

No identifiable risk
factors

Active cancer or
cancer treatment

**Recurrent VTE or
persisting risk factor**
(i.e. autoimmune
disease, transplantation,
CTEPH, VTE familiar
history + thrombophilia)

3-month AC

3-month AC

Long-term AC

**Long-term AC
(until cancer
cured)**

Long-term AC

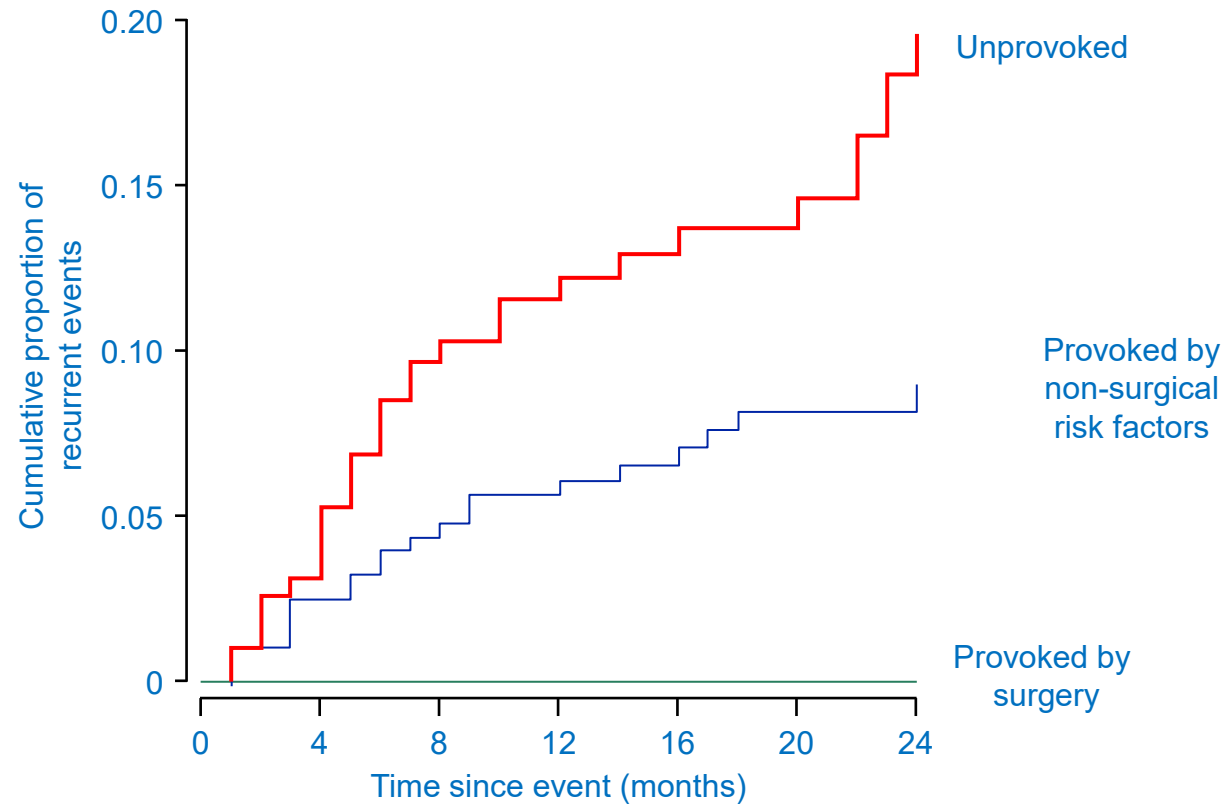
**After 6 months,
reduced-dose AC**

**After 6 months,
reduced-dose AC**

Risk scores/D-
dimer → **stop** AC in
some patients

Impact of Clinical Risk Factors on VTE Recurrence

Cumulative proportions of recurrent thrombosis after cessation of anticoagulant therapy*
(N=558)



- Anticoagulation effectively resolves VTE, but stopping treatment increases the cumulative risk of VTE recurrence
- The cumulative incidence of recurrent VTE is approximately 10% in the first year if anticoagulation is stopped

*Patients with malignant disease and antiphospholipid syndrome were excluded from the study
Baglin T *et al*, *Lancet* 2003;362:523–526

CHRONIC PE = CTEPH (1-4%)

ACUTE PE

N Engl J Med 2004;350:2236-2238



CENTRAL ILLUSTRATION: Sequence of Events

The Right Ventricle and Its Load in Pulmonary Hypertension

Pulmonary vessel narrowing leads to increased vascular load on right ventricle (RV)



RV adapts by increasing muscle contractility and wall thickness ("coupling")



To maintain cardiac output, RV dilates and heart rate increases
Increase in wall stress and oxygen consumption per gram follow
Leftward septal bowing results

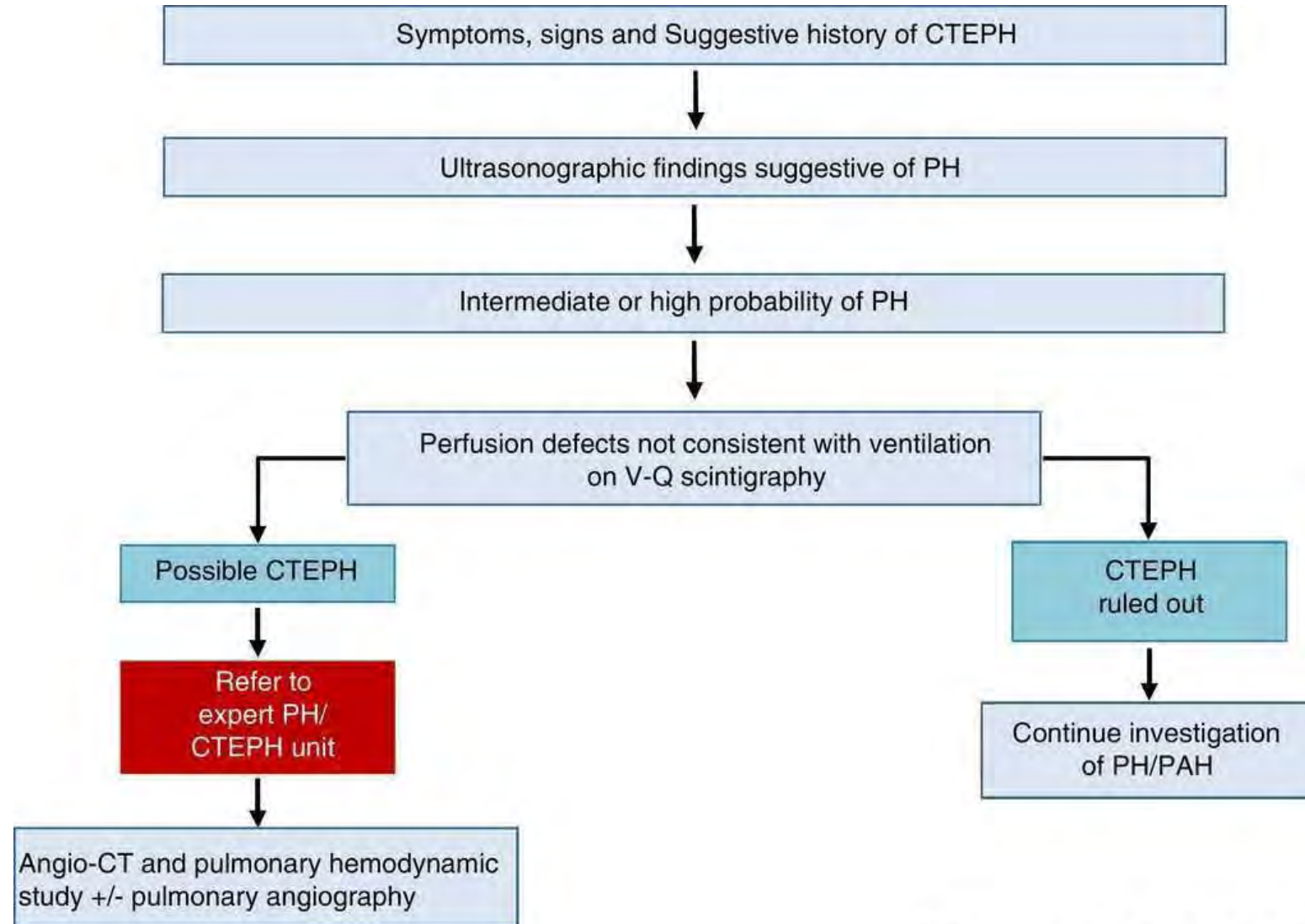


Final stage:
Uncoupling occurs with high metabolic demand and reduced output



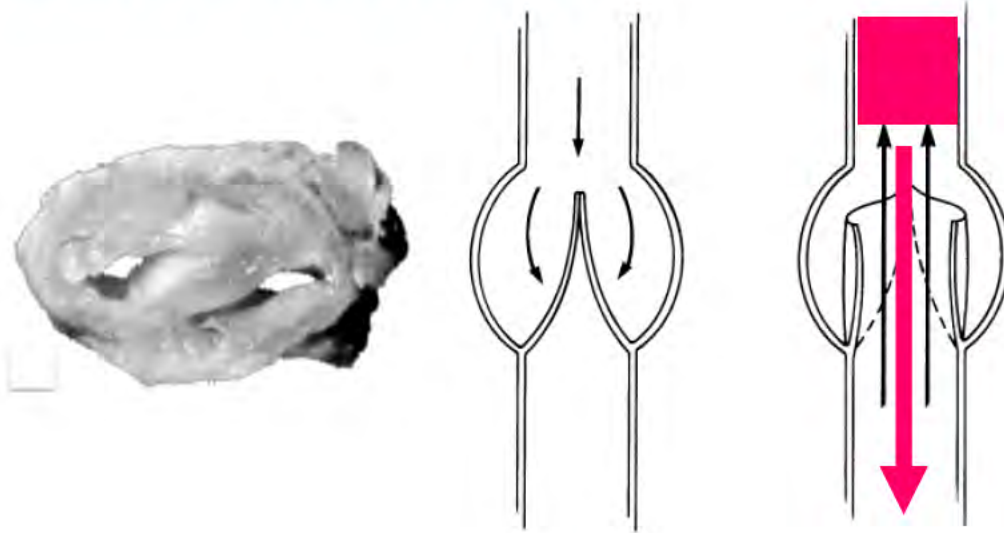
Vonk Noordegraaf, A. et al. J Am Coll Cardiol. 2017;69(2):236-43.

Follow-up: CTEPH screening at 3-6 months



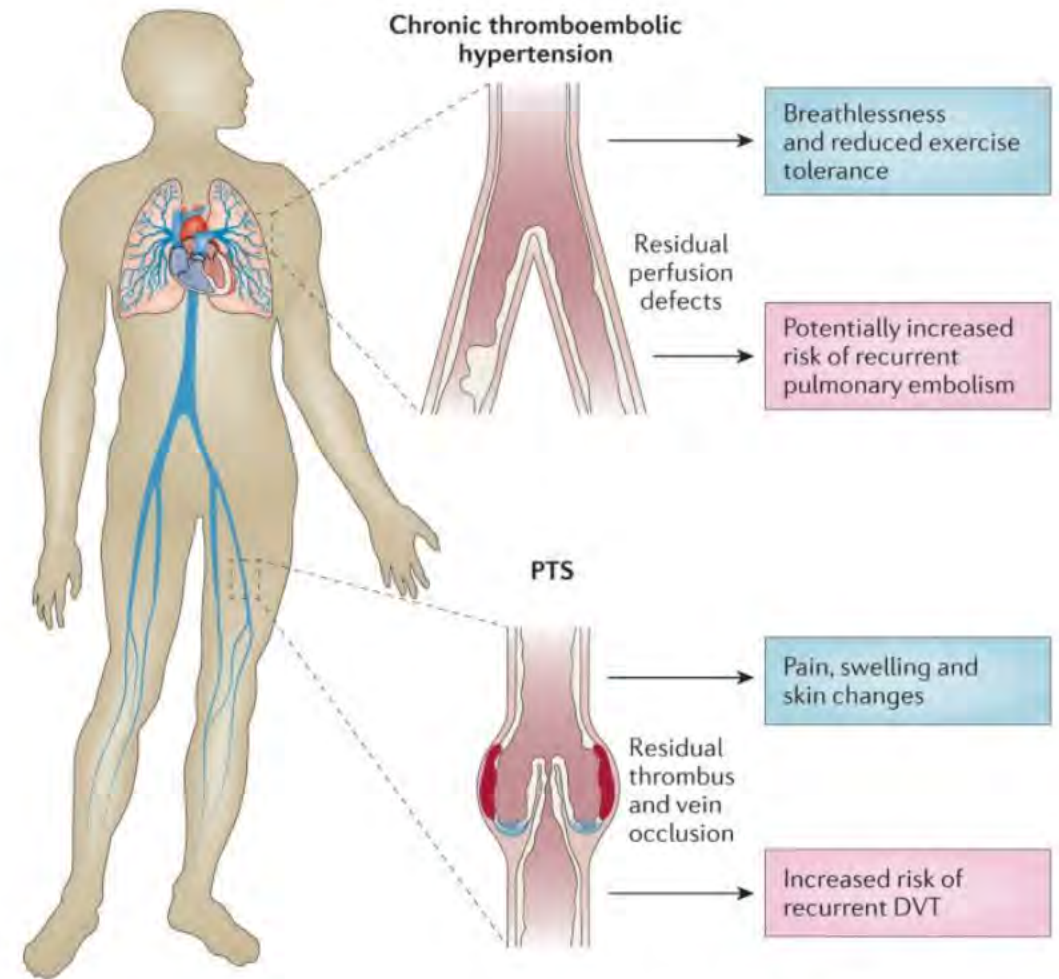
Definition des Postthrombotischen Syndroms (PTS)

Sekundäre chronisch venöse Insuffizienz (CVI) bedingt durch einen Zustand nach tiefer Beinvenenthrombose



Hauptmechanismen: Reflux, Obstruktion

Beim PTS: oft Reflux und Obstruktion in Kombination



Klassifikation des Postthrombotischen Syndroms: Villalta Score

Symptoms	Signs
Pain	Pretibial oedema
Heaviness	Induration of the skin,
Cramps	Hyperpigmentation
Pruritus	New venous ectasia
Paraesthesia	Redness
	Pain during calf compression
	Leg ulceration

For each item a score of 0 (= no or minimal) to 3 (severe) is assigned.
A total score 5–14 is a mild-to-moderate PTS, a score of ≥ 15 or a leg ulcer is always severe PTS.

PTS Häufigkeit nach TVT

- Cohort study mit 387 Patienten mit symptomatischer TVT
 - Follow up 2y, mit Villalta Scale nach 1/4/8/12/24M
 - Resultate:
 - Wdh ganzem Studienintervall → fast 50% mit PTS!
 - ca. 30% mild
 - ca. 10% moderate
 - 3% severe
 - PTS ist der Hauptdeterminant der Lebensqualität (QOL) 2 Jahre nach TVT
 - Therapie: Antikoagulation, Kompressionstherapie, Revaskularisation der (Becken)venen bei gutem In-flow



Chronic vein insufficiency (CVI) which includes post-thrombotic syndrome (PTS)



VEIN DISEASE STAGES

CEAP is a classification system used to identify the stages of vein disease.



Healthy
Leg

C1
Spider Veins

C2
Varicose Veins

C3
Swelling

C4
Skin Changes

C5
Healed Ulcer

C6
Venous Stasis
Ulcer

Typen von Ulzerationen

Abb. 1 ► *Ulcus cruris venosum* (postthrombotisch) seit über 40 Jahren



Abb. 2 ► *Ulcus cruris mixtum*: postthrombotisches Syndrom, periphere arterielle Verschlusskrankheit, sekundäres Lymphödem



Abb. 3 ► Prätibiales *Ulcus cruris arteriosum*, ABI 0,4



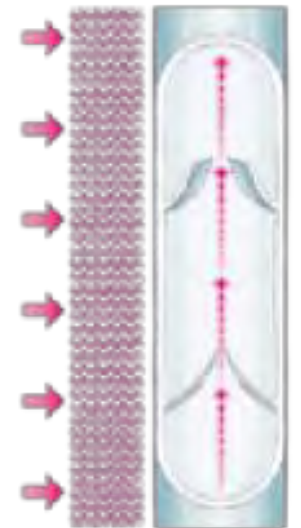
Ulcus venosum	57-80%
Ulcus cruris mixtum	4-30%
Ulcus arteriosum	3-20 %
Ulcus bei Vasculitis	2-13 %
Sonstige Ursachen	5-10 %

Herrmanns: Gefäßchirurgie 2010: 15: 273-87

Kompressionstherapie



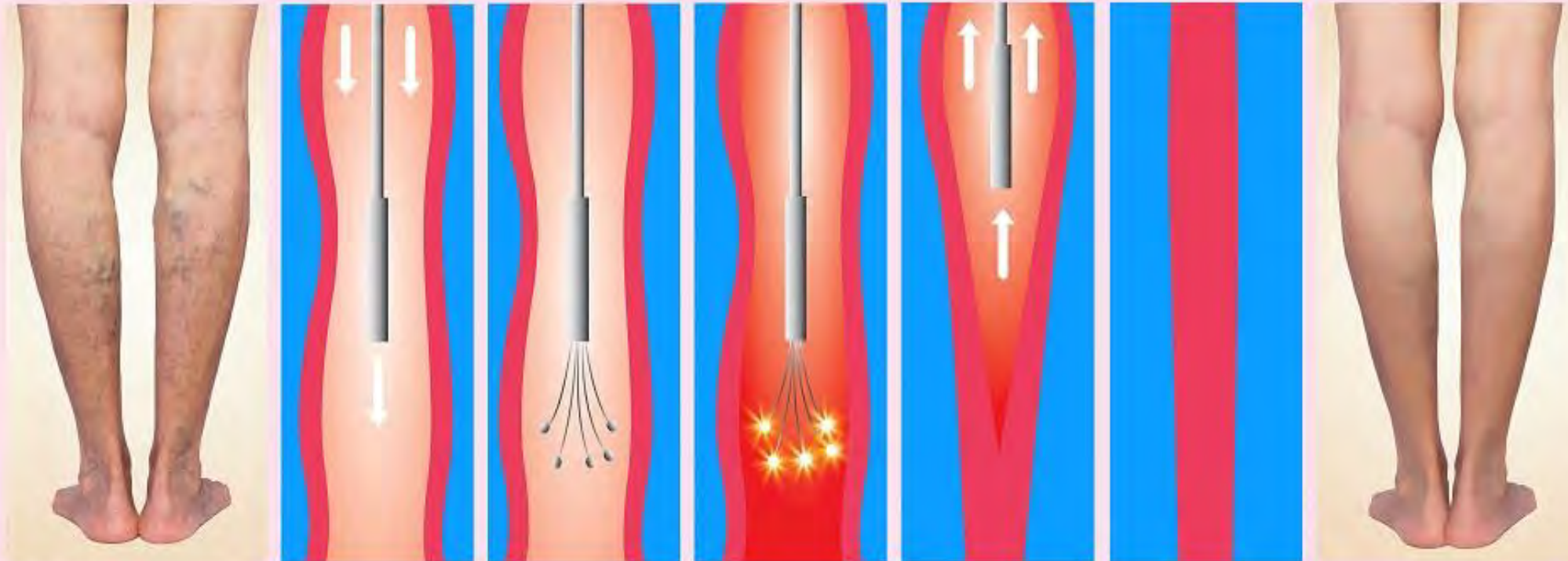
Krankhaft veränderte
Vene mit defekten
Venenklappen



Krankhaft veränderte
Vene mit medizinischem
Kompressionsstrumpf

Bei venösen Ulcerationen Kompression = primärer Therapie-Ansatz

VARICOSE VEINS TREATMENT WITH RADIOFREQUENCY ABLATION or OBLITERATION



BEFORE

Catheter inserted
into the vein

Electrodes are
placed in the vein

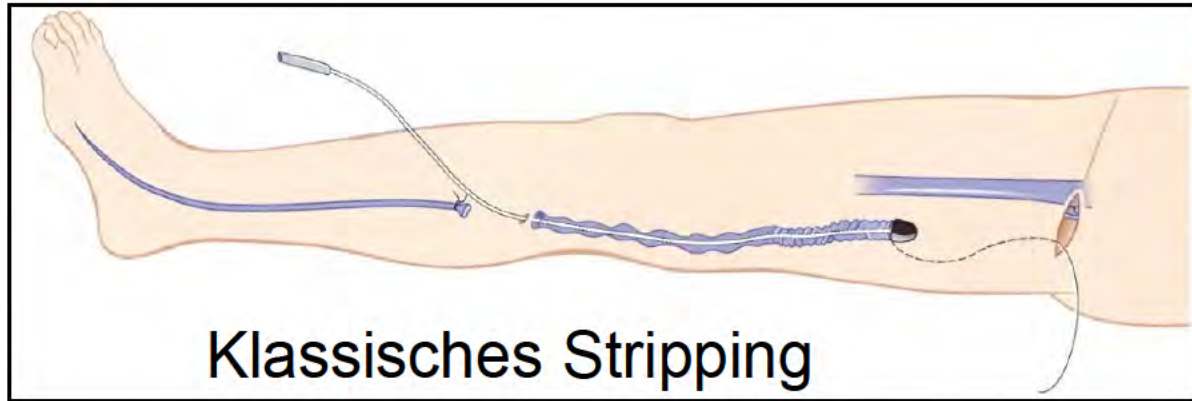
A radiofrequency
wave is sent

Catheter withdrawn,
closing vein

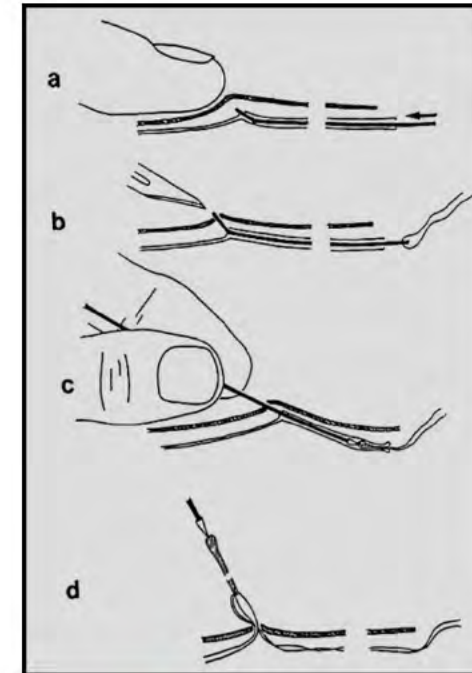
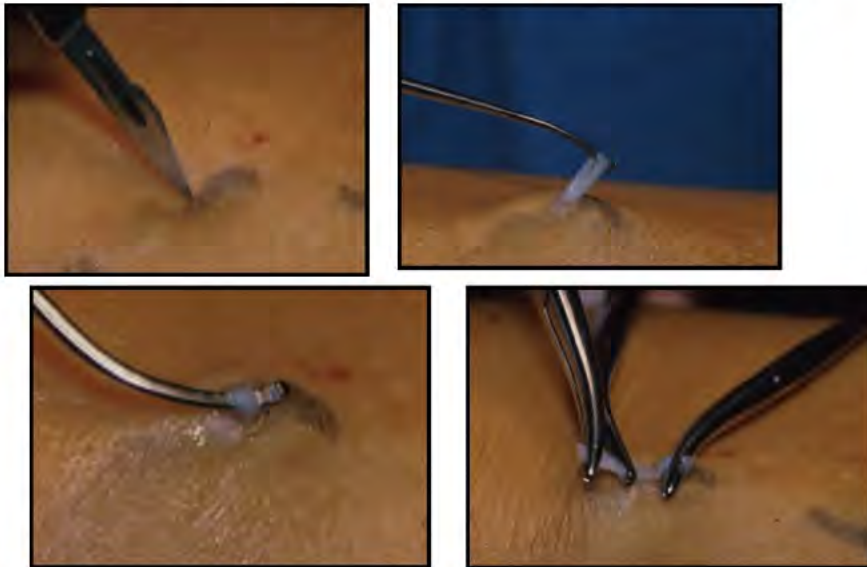
Closed vein
following
treatment

AFTER

Stripping Methoden

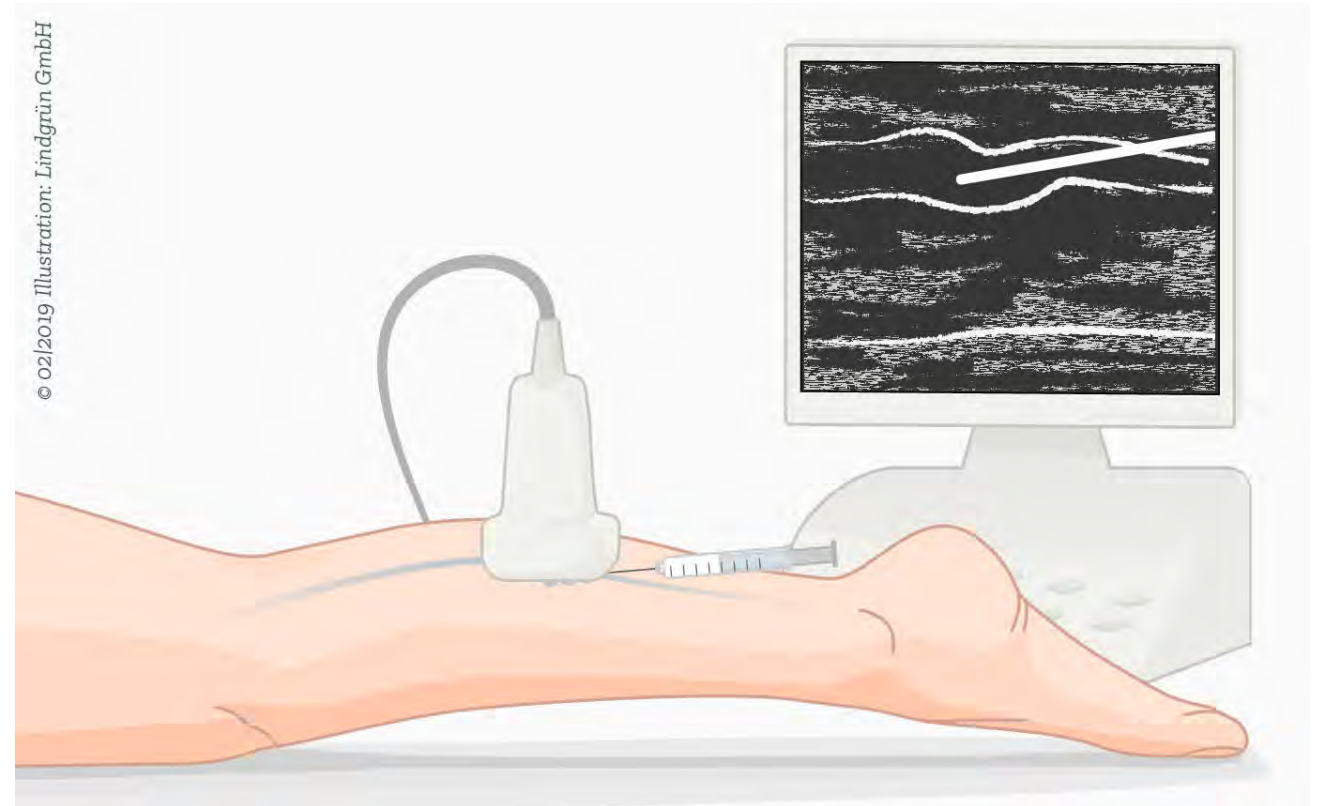


Mini-Phlebektomie



Perforation- Invagination -Stripping

Schaumtherapie



Thanks for your attention





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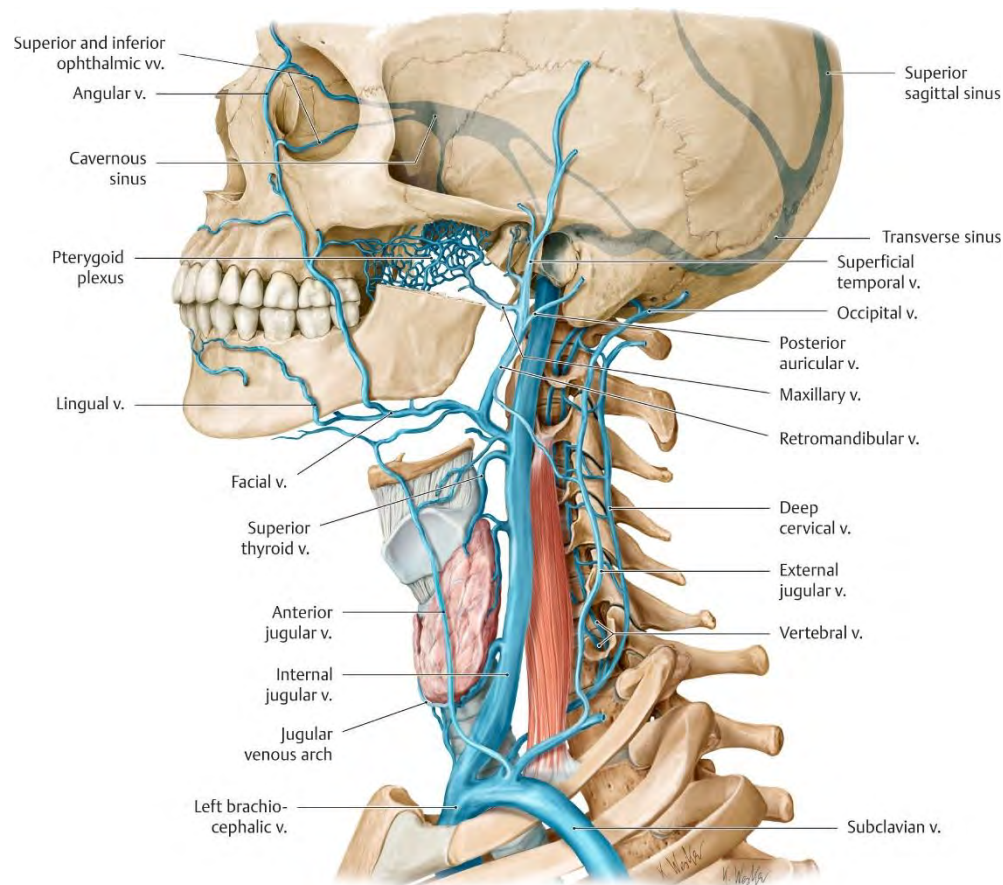
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Back up slides für Selbststudium

VTE Prophylaxis modalities

- **Mechanical**
 - Graduated Compression Stockings
 - Intermittent Pneumatic Compression
 - Inferior Vena Cava Filters
- **Pharmacologic**
 - Heparins/ LMWH
 - Fondaparinux
 - Vitamin K Antagonists/ NOACs
- **Combines** Mechanical - Pharmacologic

The example of Virchow's triad in jugular vein thrombosis

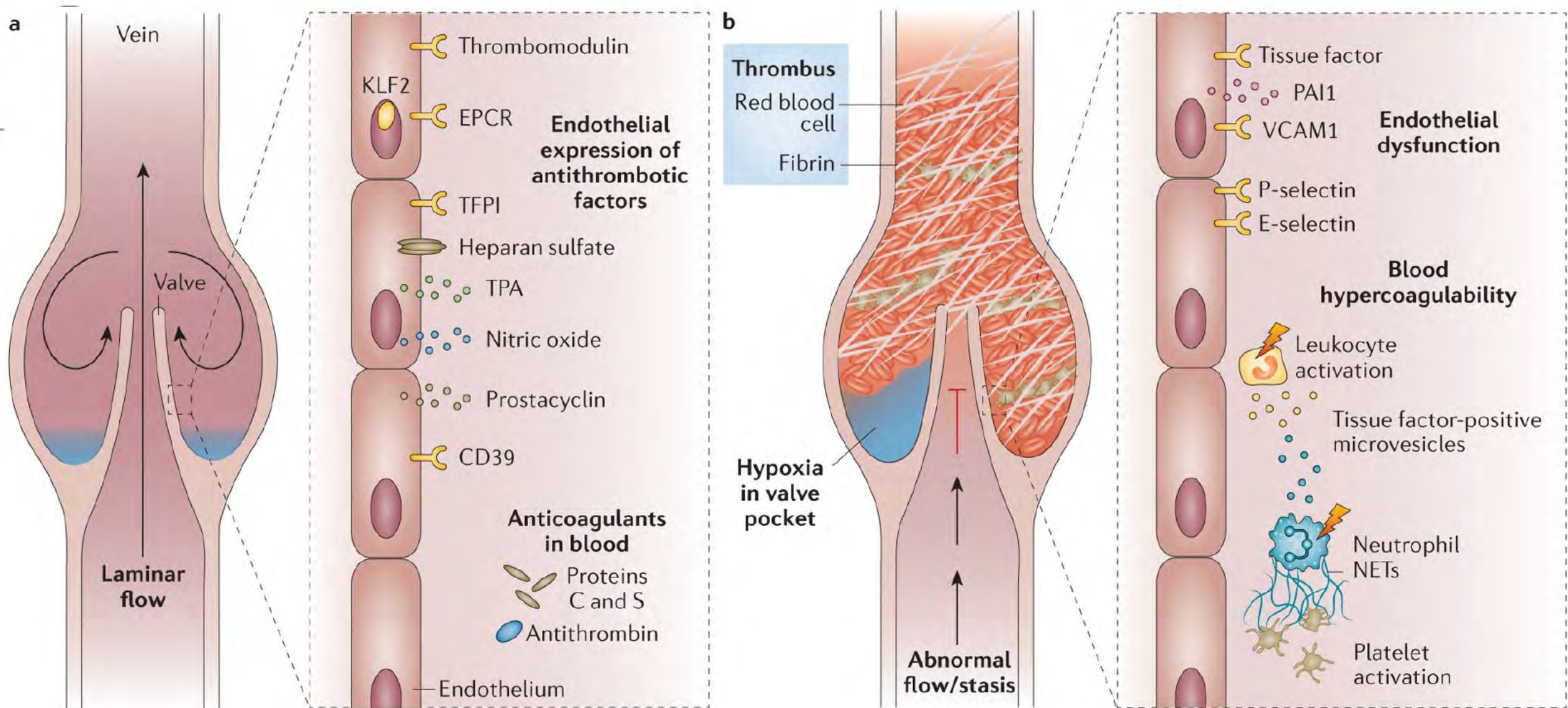


Sigmoid/cavernous/petrosal sinus → **Jugular**

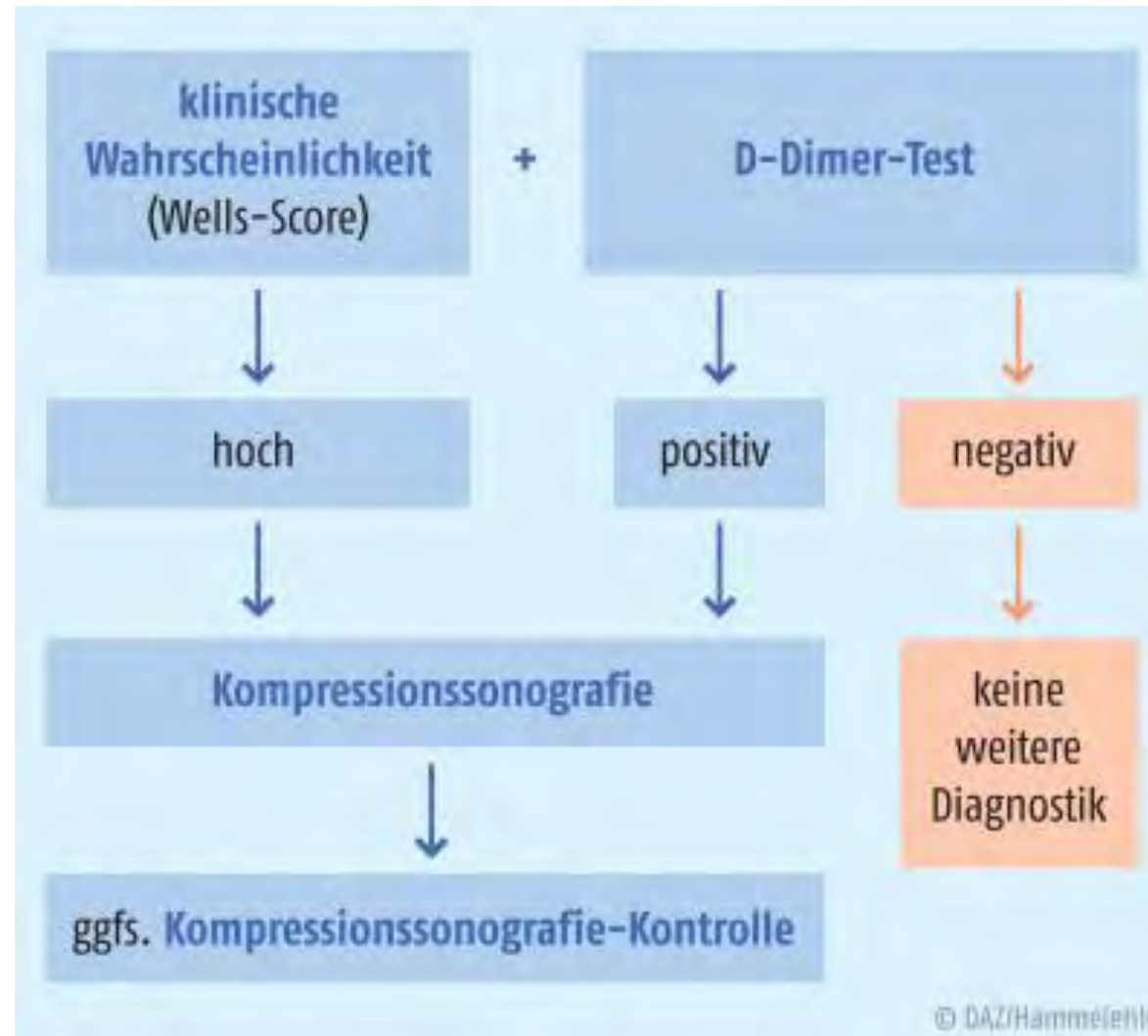
- otitis, mastoiditis, sinusitis
- head injury
- other causes of CVT (cancer, pregnancy, oral contraception, JAK2+ myeloproliferative diseases)

PE ← **Upper extremity/Jugular** → Cerebral

- **catheter-related:** chemo, TPN, pacemaker lead
- thoracic outlet syndrome
- neck/mediastinal lymphadenonopathy
- ovarian hyperstimulation syndrome
- cancer
- local surgery or mass
- Lemierre syndrome due to *Fusobacterium* spp
- antiphospholipid syndrome



Diagnosis of acute DVT



Pretest Probability TVT: Wells-Score

klinische Charakteristik	Score
aktive Krebserkrankung	1,0
Lähmung oder kürzlich Immobilisation der Beine	1,0
Bettruhe (>3 Tage) grosse Chirurgie (<12 Wochen)	1,0
Schmerz / Verhärtung entlang der tiefen Venen	1,0
Schwellung ganzes Bein	1,0
Unterschenkelschwellung >3 cm gegenüber Gegenseite	1,0
eindrückbares Ödem am symptomatischen Bein	1,0
Kollateralvenen	1,0
früher dokumentierte TVT	1,0
alternative Diagnose mindestens ebenso wahrscheinlich wie TVT	-2,0
TVT-Wahrscheinlichkeit	Score
hoch	≥2,0
nicht hoch	<2,0
* modifiziert nach Wells 2003 Quelle: Hach-Wunderle V. Diagnostik und Therapie der venösen Thrombose. Hamostaseologie 2005;25:356–366	

2019 ESC Guidelines on the diagnosis and management of acute pulmonary embolism

Predisposing factors for VTE (1)

Strong risk factors (OR >10)
Fracture of lower limb
Previous VTE
Spinal cord injury
Hospitalization for heart failure or atrial fibrillation/flutter (within previous 3 months)
Hip or knee replacement
Major trauma
Myocardial infarction (within previous 3 months)

©ESC

VTE = venous thromboembolism.

2019 ESC Guidelines on the diagnosis and management of acute pulmonary embolism

Predisposing factors for VTE (2)

Moderate risk factors (OR 2–9)
Arthroscopic knee surgery
Autoimmune diseases
Blood transfusion
Central venous lines
Intravenous catheters and leads
Chemotherapy
Congestive heart failure or respiratory failure
Erythropoiesis-stimulating agents
Hormone replacement therapy (depends on formulation)

©ESC

VTE = venous thromboembolism.

2019 ESC Guidelines on the diagnosis and management of acute pulmonary embolism

Predisposing factors for VTE (3)

Moderate risk factors (cont'd)
In vitro fertilization
Oral contraceptive therapy
Postpartum period
Infection (specifically pneumonia, urinary tract infection, and HIV)
Inflammatory bowel disease
Cancer (highest risk in metastatic disease)
Paralytic stroke
Superficial vein thrombosis
Thrombophilia

©ESC

VTE = venous thromboembolism.

2019 ESC Guidelines on the diagnosis and management of acute pulmonary embolism

Predisposing factors for VTE (4)

Weak risk factors (OR <2)
Bed rest >3 days
Diabetes mellitus
Arterial hypertension
Immobility due to sitting (e.g. prolonged car or air travel)
Increasing age
Laparoscopic surgery (e.g. cholecystectomy)
Obesity
Pregnancy
Varicose veins

©ESC

VTE = venous thromboembolism.

PE Differential Diagnosis

- Myocardial Infarction
- Aortic Dissection
- Pneumonia/Pleuritis
- Pneumothorax
- Pericarditis
- Congestive Heart Failure
- Musculoskeletal Syndromes
- Anxiety/ Hyperventilation

Treatment of RV failure in acute high-risk PE (3)

Mechanical circulatory support		
Veno-arterial ECMO/ extracorporeal life support	Rapid short-term support combined with oxygenator	Complications with use over longer periods (>5–10 days), including bleeding and infections; no clinical benefit unless combined with surgical embolectomy; requires an experienced team

© ESC

ECMO = extracorporeal membrane oxygenation; RV = right ventricular.

Recommendations for the regimen and duration of anticoagulation after PE in patients without cancer (3)

Recommendations	Class	Level
Patients in whom extension of anticoagulation beyond 3 months should be considered		
Extended oral anticoagulation of indefinite duration should be considered for patients with a first episode of PE and no identifiable risk factor.	Ila	A
Extended oral anticoagulation of indefinite duration should be considered for patients with a first episode of PE associated with a persistent risk factor other than the antiphospholipid antibody syndrome.	Ila	C
Extended oral anticoagulation of indefinite duration should be considered for patients with a first episode of PE associated with a minor transient or reversible risk factor.	Ila	C

©ESC

Recommendations for the regimen and duration of anticoagulation after PE in patients without cancer (2)

Recommendations	Class	Level
Patients in whom extension of anticoagulation beyond 3 months is recommended		
Oral anticoagulant treatment of indefinite duration is recommended for patients presenting with recurrent VTE (that is, with at least one previous episode of PE or DVT) not related to a major transient or reversible risk factor.	I	B
Oral anticoagulant treatment with a VKA for an indefinite period is recommended for patients with the antiphospholipid antibody syndrome.	I	B

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DVT = deep vein thrombosis; VKA = vitamin K antagonist.

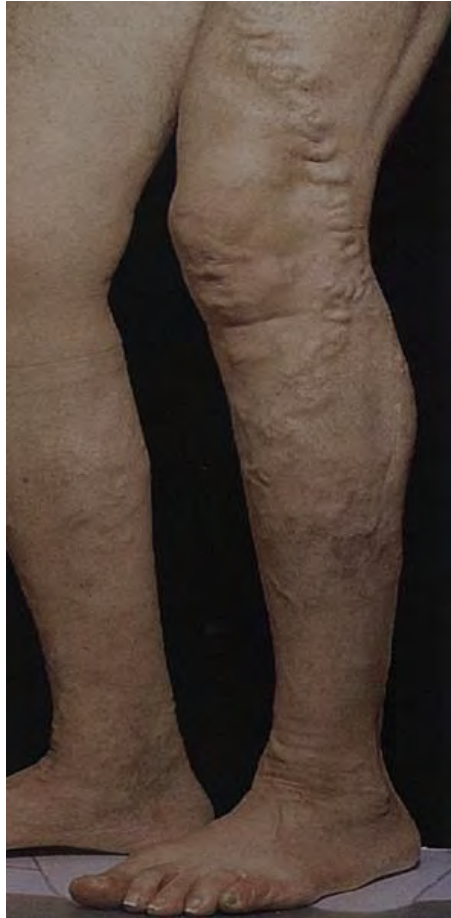
CEAP – Klassifikation Chronisch venöse Insuffizienz

C Clinical Classification



- 0 keine Zeichen
- 1 Teleangiektasien/retikuläre Venen
- 2 Stamm/ Astvaricosis
- 3 Oedem
- 4 Hautveränderungen
- 5 geheiltes Ulkus
- 6 florides Ulkus

CEAP – Klassifikation Chronisch venöse Insuffizienz



E Etiology Classification

Ec kongenital

Ep primär

Es sekundär

A Anatomic Classification

+ Segmente (1-18)

A_s oberflächliche Venen

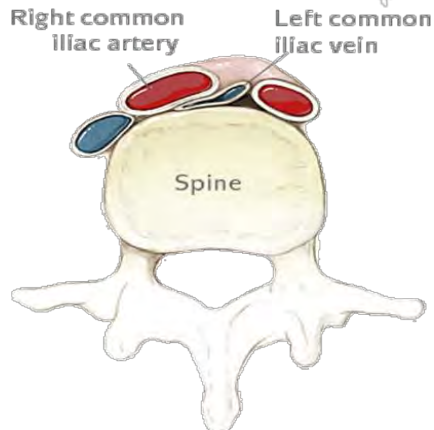
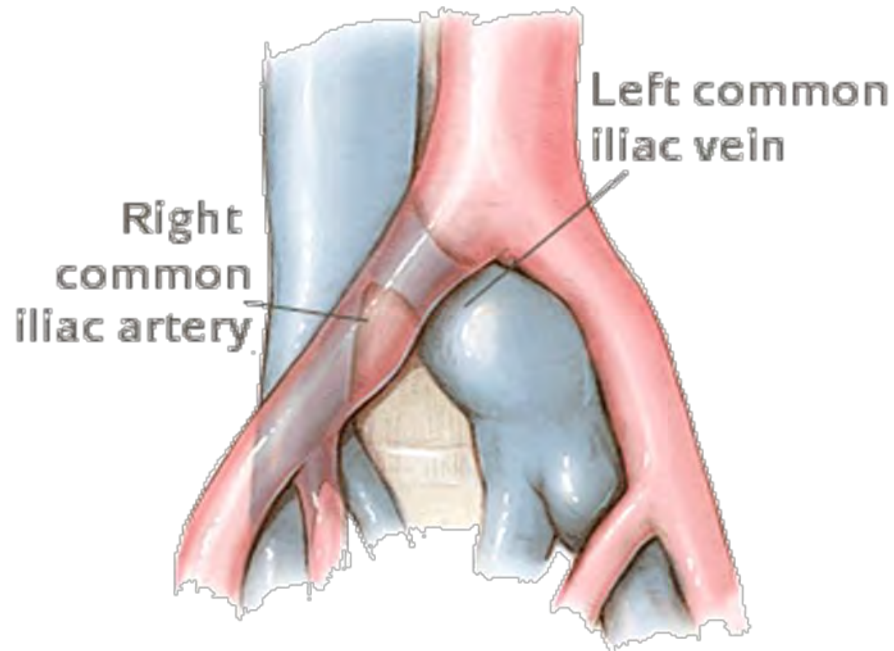
A_D tiefe Venen

A_P Perforans- Venen

May-Thurner-Syndrom

- Inzidenz der May-Thurner-Anatomie: 22%
- Häufig asymptomatisch
- Erhöhte Inzidenz für linksseitige DVT bei Vorliegen der anatomischen Variante
- Entwicklung einer DVT abhängig von weiteren Faktoren
- Frauen im Alter zwischen 20 und 50 J. am häufigsten betroffen: Lendenlordose verstärkt sich in Pubertät und Schwangerschaft

May-Thurner Syndrom – (Iliac Vein Compression Syndrome)



- Beobachtung von Virchow 1851
- 1956 May and Thurner: Beschreibung einer Stenosierung der linken Vena iliaca communis unter der rechten Arteria iliaca communis
- Repetitive Kompression der Vene: Fibrose, Synechiaen, Sporn
- **Stenose/Okklusion der Vene**

Behandlungsoptionen bei Postthrombotischen Syndrom

- Antikoagulation
- Kompression
- Endovaskuläre Stentrekonstruktion
- Varizenbehandlung (Kompression, Schaum, Laser, RF, Varizenchirurgie)