Role of thrombolytics & vascular filters in management of thrombosis

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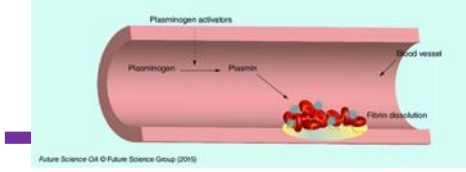
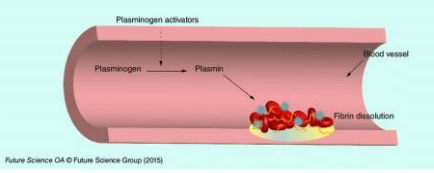
Introduction

- ❖Thrombosis remains a leading cause of morbidity and mortality across cardiovascular and hematologic diseases
- ❖Thrombolytic therapy and vascular filters represent critical—but selectively used—tools beyond standard anticoagulation
- ❖Their optimal application requires careful patient selection, risk stratification, and multidisciplinary decision-making
- ❖This presentation explores the evolving role of thrombolytics in acute pulmonary embolism, mechanical valve thrombosis, and acute ischemic stroke
- ❖We also examine the indications, limitations, and controversies surrounding inferior vena cava filters



Scope of problems

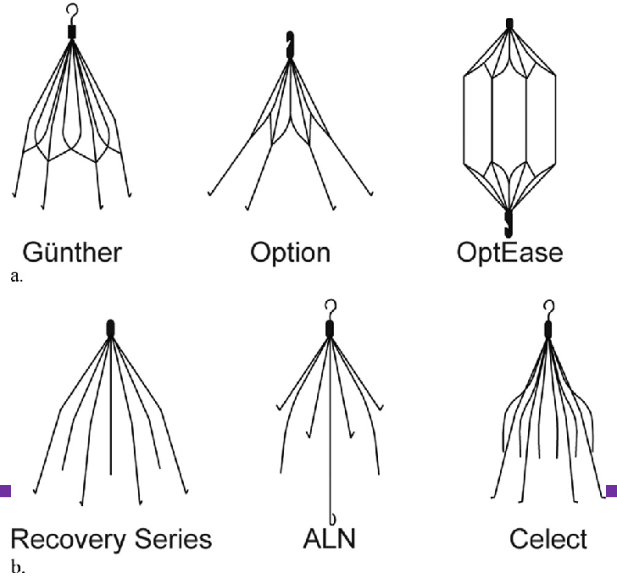
- Inferior vena cava (IVC) filters
- Role of thrombolytics in Acute Pulmonary Embolism (PE)
- Role of thrombolytics in Mechanical Valve Thrombosis
- Role of thrombolytics in Acute Stroke
- Role of thrombolytics in Acute STEMI
- Central Venous Catheter Occlusion



Inferior vena cava (IVC) filters

- The main indication to IVC filter placement is a VTE event in the lower limbs in the presence of an absolute contraindication to anticoagulation

- Because it is uncertain if there is benefit to placement of an IVC filter in anticoagulated patients with severe PE (eg, with hypotension), our recommendation against insertion of an IVC filter in patients with acute PE who are anticoagulated may not apply to this select subgroup of patients.



ESC European Society of Cardiology
European Heart Journal (2019) 00, 1–61
doi:10.1093/eurheartj/ehz405

ESC GUIDELINES

2019 ESC Guidelines for the diagnosis and management of acute pulmonary embolism developed in collaboration with the European Respiratory Society (ERS)

The Task Force for the diagnosis and management of acute pulmonary embolism of the European Society of Cardiology (ESC)

Authors/Task Force Members: Stavros V. Konstantinides* (Chairperson) (Germany/Greece), Guy Meyer* (Co-Chairperson) (F[illegible]), Cecilia Becattini (Italy), Héctor Bueno (Spain), Geert-Jan Geersing (Nethe[illegible]), Menno V. Huisman (Netherlands), Marc H[illegible], Catriona Sian Jennings (United Kingdom), Nils Kucher (Switzerland), Irene Marthe L[illegible] (Germany), Roberto Lorusso (Netherland[illegible]), Meneveau (France), Fionnuala Ní Áinle (Ir[illegible]), Pruszczyk (Poland), Marc Righini (Switzer[illegible]), Eric Van Belle (France), José Luis Zamora[illegible]

[Pulmonary Vascular Guidelines and Consensus Statements]

CHEST

Antithrombotic Therapy for VTE Disease

Second Update of the CHEST Guideline and Expert Panel Report

Check for updates

Scott M. Stevens, MD; Scott C. Woller, MD; Lisa Baumann Kreuziger, MD; Henri Bounameaux, MD; Kevin Doerschug, MD; Geert-Jan Geersing, MD, PhD; Menno V. Huisman, MD; Clive Kearon, MD, PhD; Christopher S. King, MD; Andrew J. Knighton, PhD; Erica Lake, MLS; Susan Murin, MD; Janine R. E. Vintch, MD; Philip S. Wells, MD; and Lisa K. Moores, MD

6.9 Recommendations for inferior vena cava filters

Recommendations	Class[a]	Level[b]
IVC filters should be considered in patients with acute PE and absolute contraindications to anticoagulation.	IIa	C
IVC filters should be considered in cases of PE recurrence despite therapeutic anticoagulation.	IIa	C
Routine use of IVC filters is not recommended.[302–304]	III	A

IVC Filter – Guideline Recommendations

Clinical Scenario	Recommendation
Acute proximal DVT of the leg with contraindication to anticoagulation	**Use of IVC filter is RECOMMENDED (Strong recommendation, moderate-certainty evidence)**
Acute DVT of the leg receiving anticoagulation	**IVC filter is NOT recommended in addition to anticoagulation (Strong recommendation, moderate-certainty evidence)**

Caval Filters – Indications

Category	Indications
Appropriate	**Acute VTE with temporary contraindication to anticoagulation**
Possible	Thrombolysis for iliac-caval thrombosis
Possible	High bleeding risk during peripartum and puerperium
Possible	Prophylaxis in patients at high thromboembolic risk who cannot be anticoagulated
Possible	VTE prophylaxis in surgical/orthopedic patients at high thromboembolic risk
Possible	VTE prophylaxis in bariatric surgery
Possible	VTE recurrence or progression during anticoagulation
Possible	Massive PE treated with thrombectomy

Inferior vena cava (IVC) filters

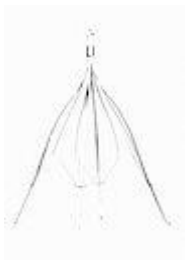
- Given the known risks of harm and significant uncertainty of benefit of IVC filters, the panel continues to endorse a conservative approach to their placement by suggesting use only in patients with acute VTE (eg, diagnosed in the preceding 1 month) in whom anticoagulants are contraindicated

- In these patients, the IVC filter should be promptly removed when anticoagulant therapy has been instituted. Institutions that place IVC filters should use a system to monitor patients who have received IVC filters and ensure that regular reassessment for removal takes place.

Commonly Used Caval Filters

Producer	Filter Name	Type
Boston Scientific	**Greenfield**	**Permanent**
B. Braun	**VenaTech**	**Permanent**
ALN	ALN vena cava filter	Optional
Bard	Denali	Optional
Cook	Celect	Optional
Cook	Günther Tulip	Optional
Cordis	OPTEASE	Optional
Argon	OptionELITE	Optional
Cook	**Bird's Nest**	**Permanent**
Bard	Recovery G2	Optional



DENALI

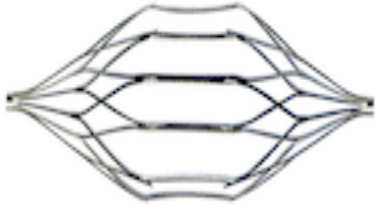
SIMON

CELECT

GUNTHER TULIP

BIRDS NEST

GREEN FIELD



OPTEASE

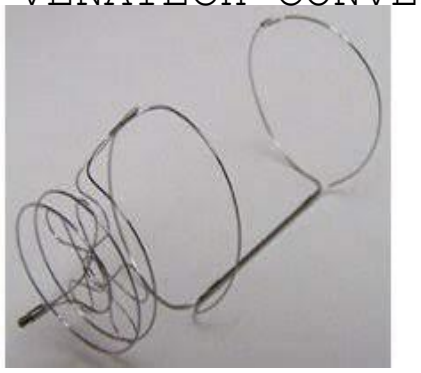
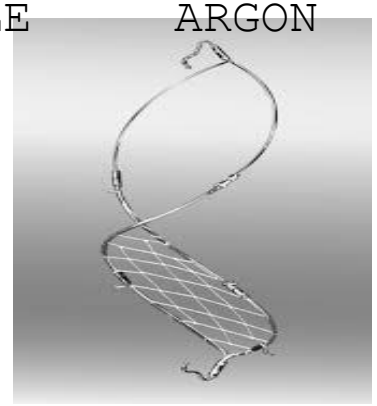
TRAPEASE

VENATECH

VENATECH CONVERTIBLE

ARGON

ALN

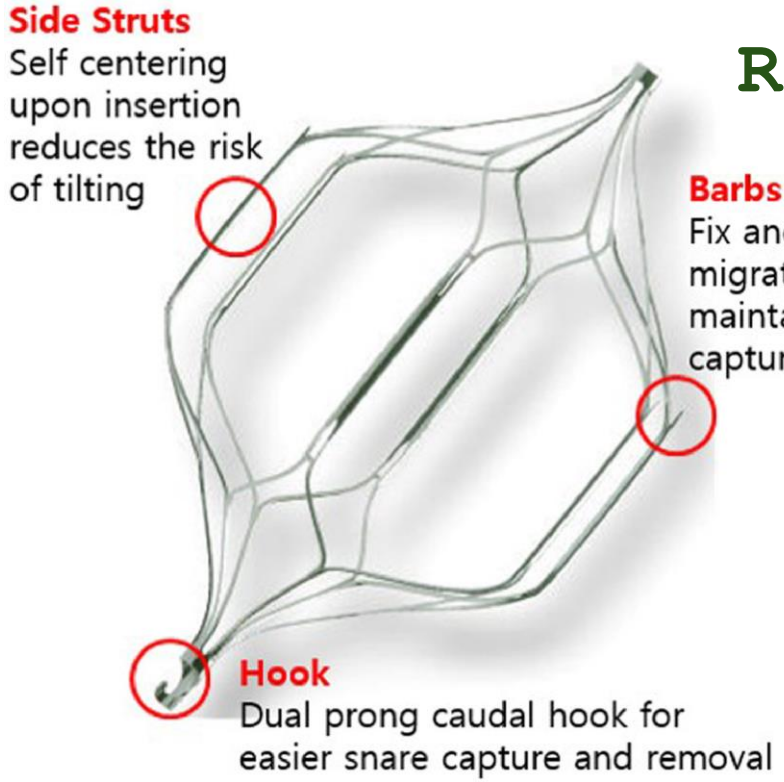



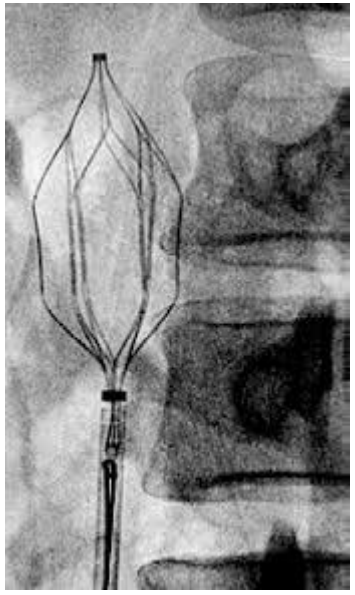
SAFEFLO

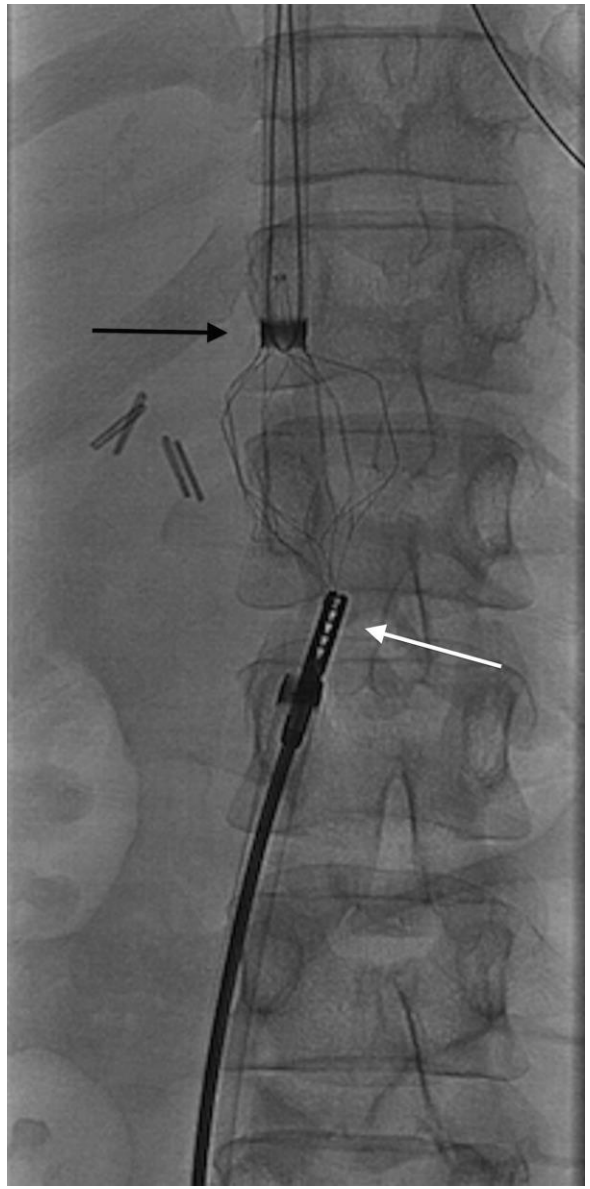
CRUX

erior vena cava (IVC) filters

Cordis OPTEASE® Retrievable Vena Cava Filter

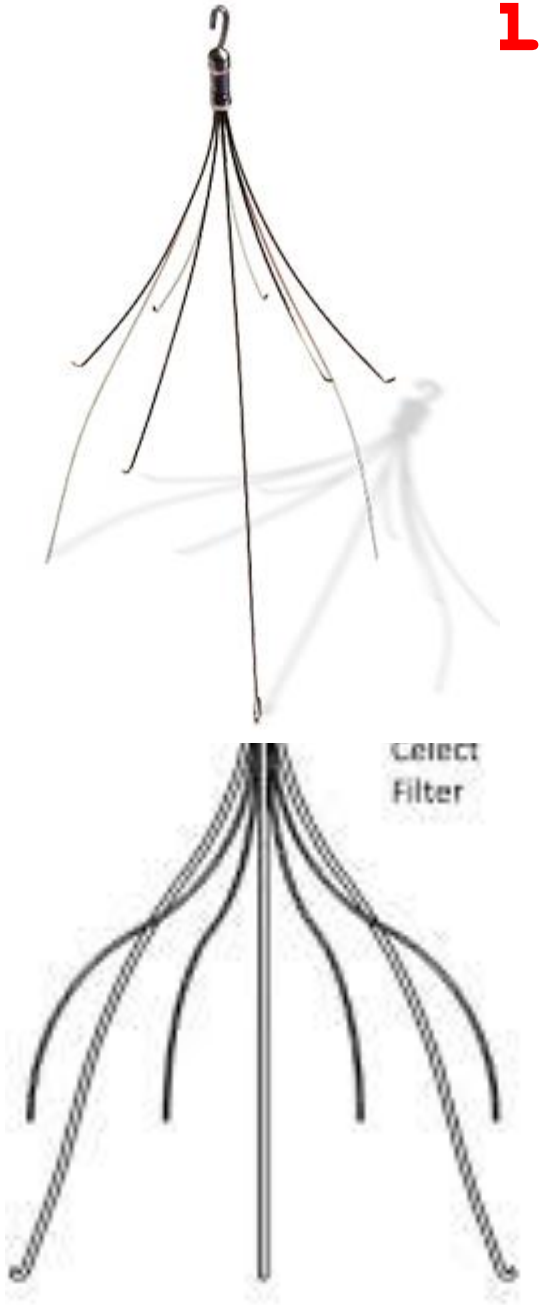


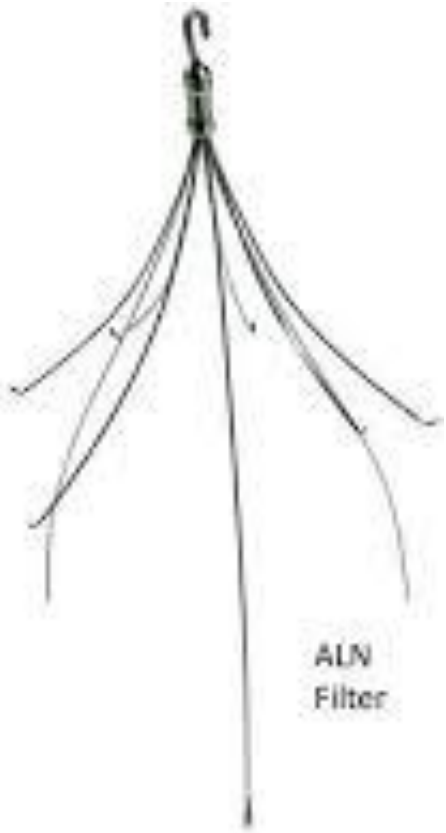


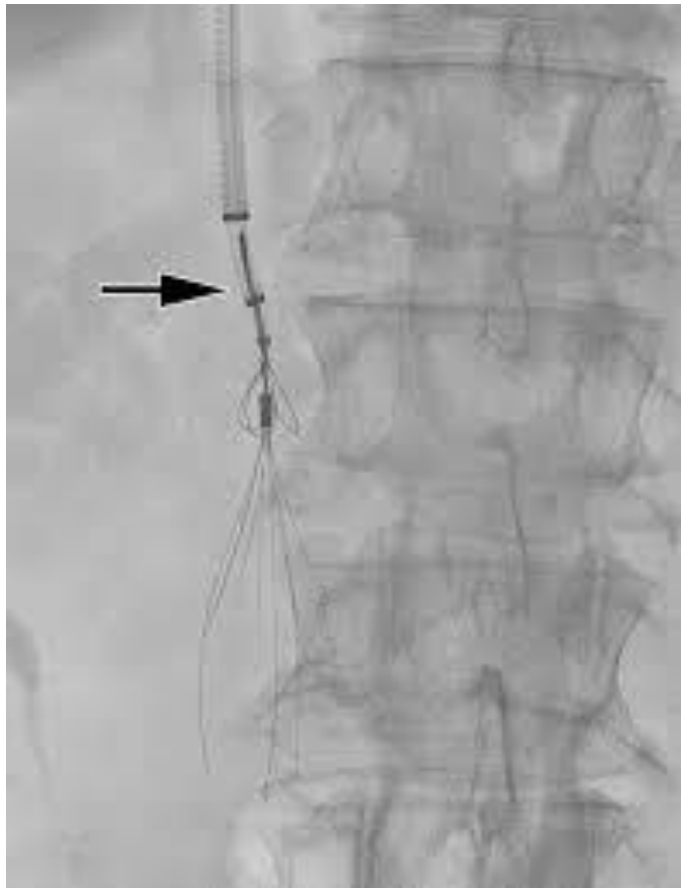


ior vena cava (IVC) filters

ALN IVC filter







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STATE-OF-THE-ART REVIEW

Inferior Vena Cava Thrombosis

Mohamad Alkhouli, MD,[a] Mohammad Morad, MD,[b] Craig R. Narins, MD,[a,c] Farhan Raza, MD,[d] Riyaz Bashir, MBBS[d]

JACC: CARDIOVASCULAR INTERVENTIONS CME

This article has been selected as this issue's CME activity, available online at http://www.acc.org/jacc-journals-cme by selecting the CME tab on the top navigation bar.

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CME Objective for This Article: 1) Identify the clinical context in which inferior vena cava thrombosis should be suspected. 2) Describe the diagnostic tests for inferior vena cava thrombosis. 3) Differentiate the various treatment modalities of inferior vena cava thrombosis with respect to the indications, risks versus benefits, technical aspects and patient selection.

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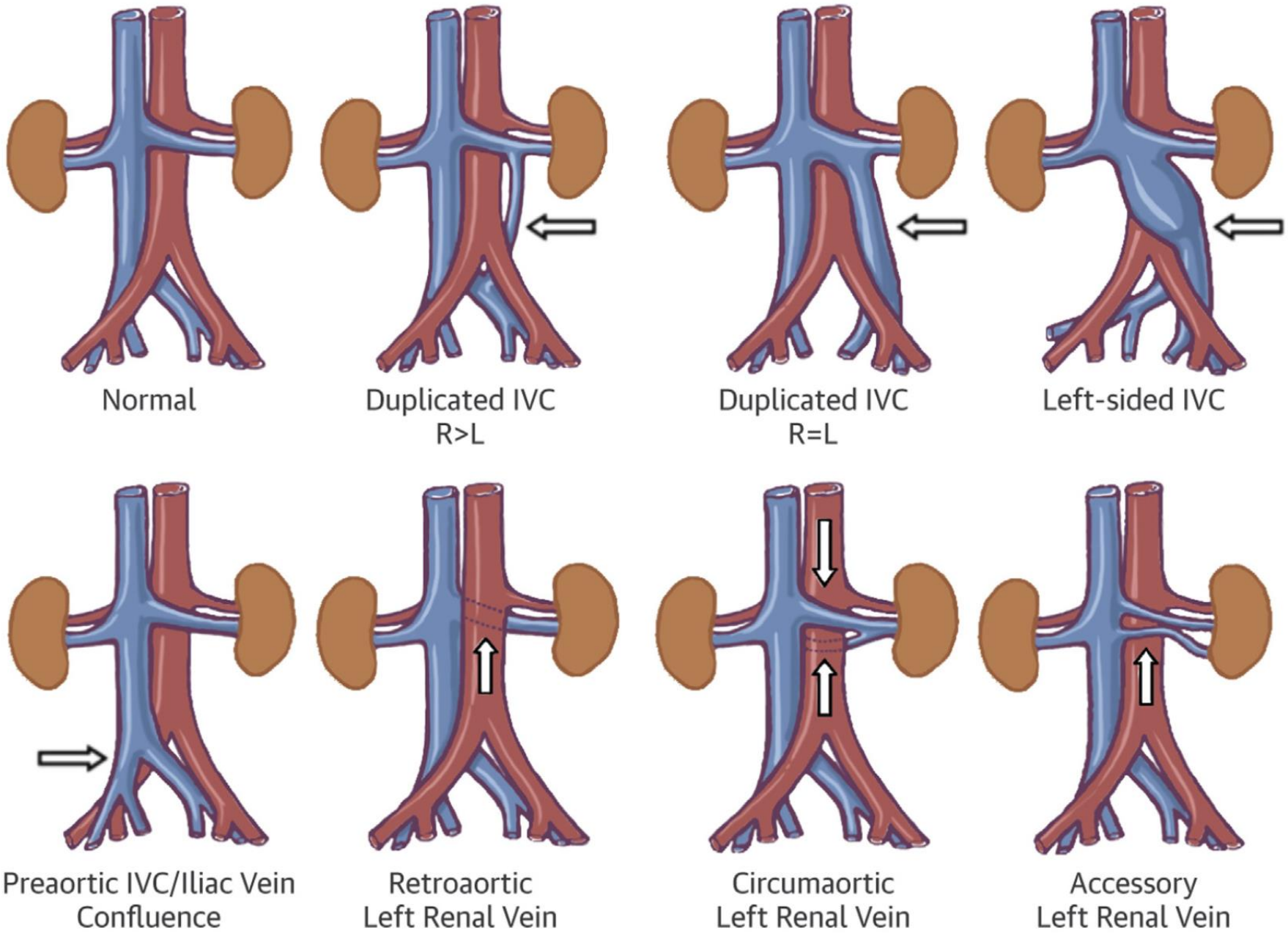
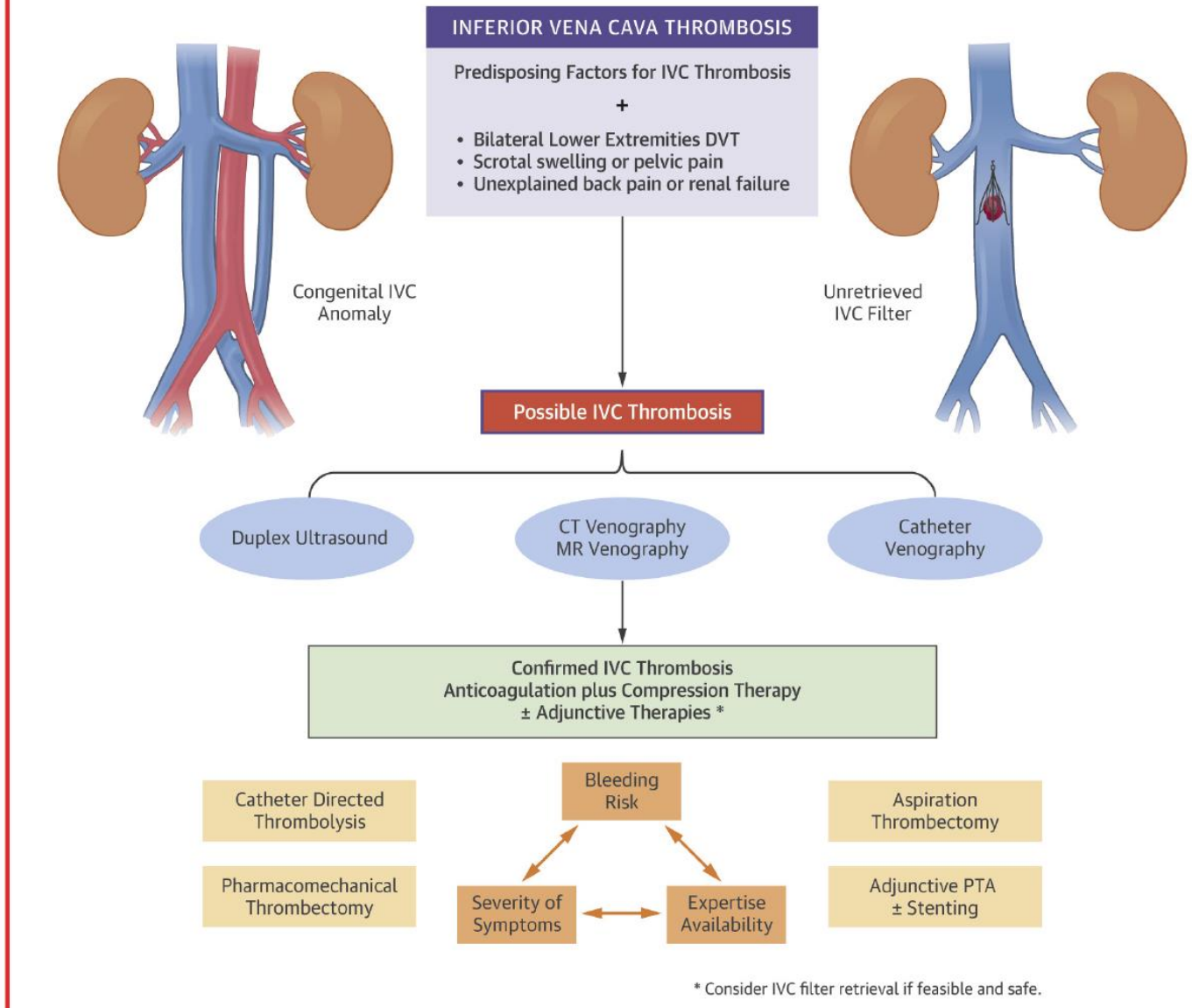
Medium of Participation: Print (article only); online (article and quiz).

FIGURE 1 Graphic Illustration of the Most Common IVC Congenital Anomalies

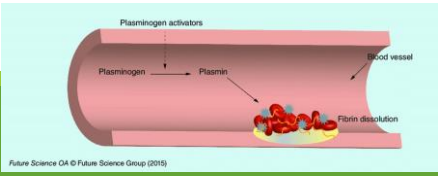


CENTRAL ILLUSTRATION **Diagnosis and Management of Inferior Vena Cava Thrombosis**



Alkhouli, M. et al. J Am Coll Cardiol Intv. 2016; 9(7):629-43.

Role of Thrombolytics in Acute Pulmonary Embolism (PE)



Classification of pulmonary embolism severity and the risk of early (in-hospital or 30 day) death

Early mortality risk		Indicators of risk			
		Haemodynamic instability[a]	Clinical parameters of PE severity and/ or comorbidity: PESI class III–V or sPESI ≥I	RV dysfunction on TTE or CTPA[b]	Elevated cardiac troponin levels[c]
High		+	(+)[d]	+	(+)
Intermediate	Intermediate–high	-	+[e]	+	+
	Intermediate–low	-	+[e]	One (or none) positive	
Low		-	-	-	Assesment optional; if assessed, negative

Treatment in the acute phase

Thrombolytic regimens, doses, and contraindications

Table 10 **Thrombolytic regimens, doses, and contraindications**

Molecule	Regimen	Contraindications to fibrinolysis
rtPA	100 mg over 2 h	**Absolute**
	0.6 mg/kg over 15 min (maximum dose 50 mg)[a]	History of haemorrhagic stroke or stroke of unknown origin
Streptokinase	250 000 IU as a loading dose over 30 min, followed by 100 000 IU/h over 12–24 h	Ischaemic stroke in previous 6 months
	Accelerated regimen: 1.5 million IU over 2 h	Central nervous system neoplasm
Urokinase	4400 IU/kg as a loading dose over 10 min, followed by 4400 IU/kg/h over 12–24 h	Major trauma, surgery, or head injury in previous 3 weeks
	Accelerated regimen: 3 million IU over 2 h	Bleeding diathesis
		Active bleeding
		Relative
		Transient ischaemic attack in previous 6 months
		Oral anticoagulation
		Pregnancy or first post-partum week
		Non-compressible puncture sites
		Traumatic resuscitation
		Refractory hypertension (systolic BP >180 mmHg)
		Advanced liver disease
		Infective endocarditis
		Active peptic ulcer

Recommendations for acute-phase treatment of *High-risk pulmonary embolisms*

Recommendations	Class[b]	Level[c]
It is recommended that anticoagulation with UFH, including a weight-adjusted bolus injection, be initiated without delay in patients with high-risk PE.	I	C
Systemic thrombolytic therapy is recommended for high-risk PE. [282]	I	B
Surgical pulmonary embolectomy is recommended for patients with high-risk PE, in whom thrombolysis is contraindicated or has failed.[d] [281]	I	C
Percutaneous catheter-directed treatment should be considered for patients with high-risk PE, in whom thrombolysis is contraindicated or has failed.[d]	IIa	C
Norepinephrine and/or dobutamine should be considered in patients with high-risk PE.	IIa	C
ECMO may be considered, in combination with surgical embolectomy or catheter-directed treatment, in patients with PE and refractory circulatory collapse or cardiac arrest.[d] [252]	IIb	C

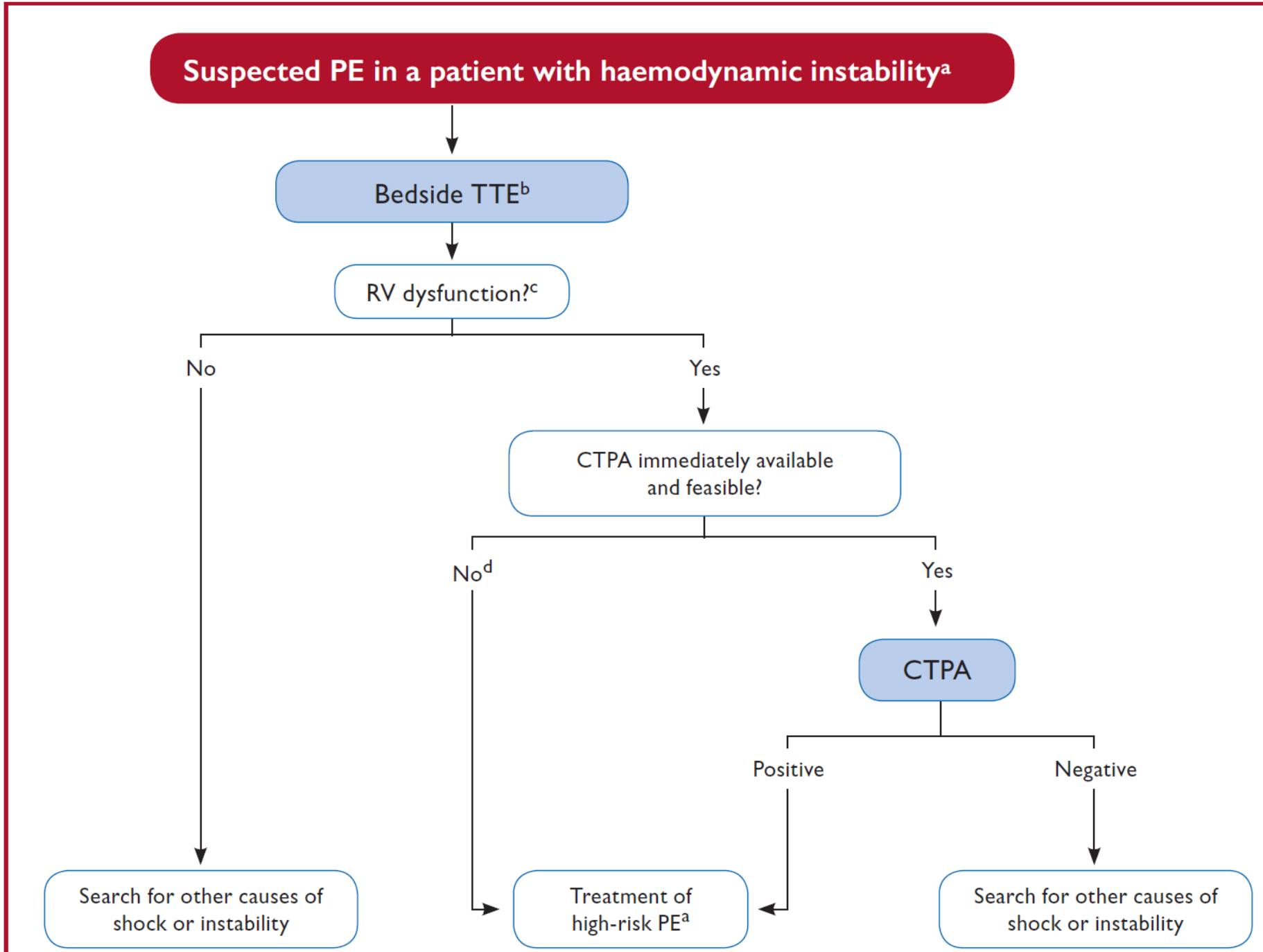
Recommendations for acute-phase treatment of *High-risk pulmonary embolisms*

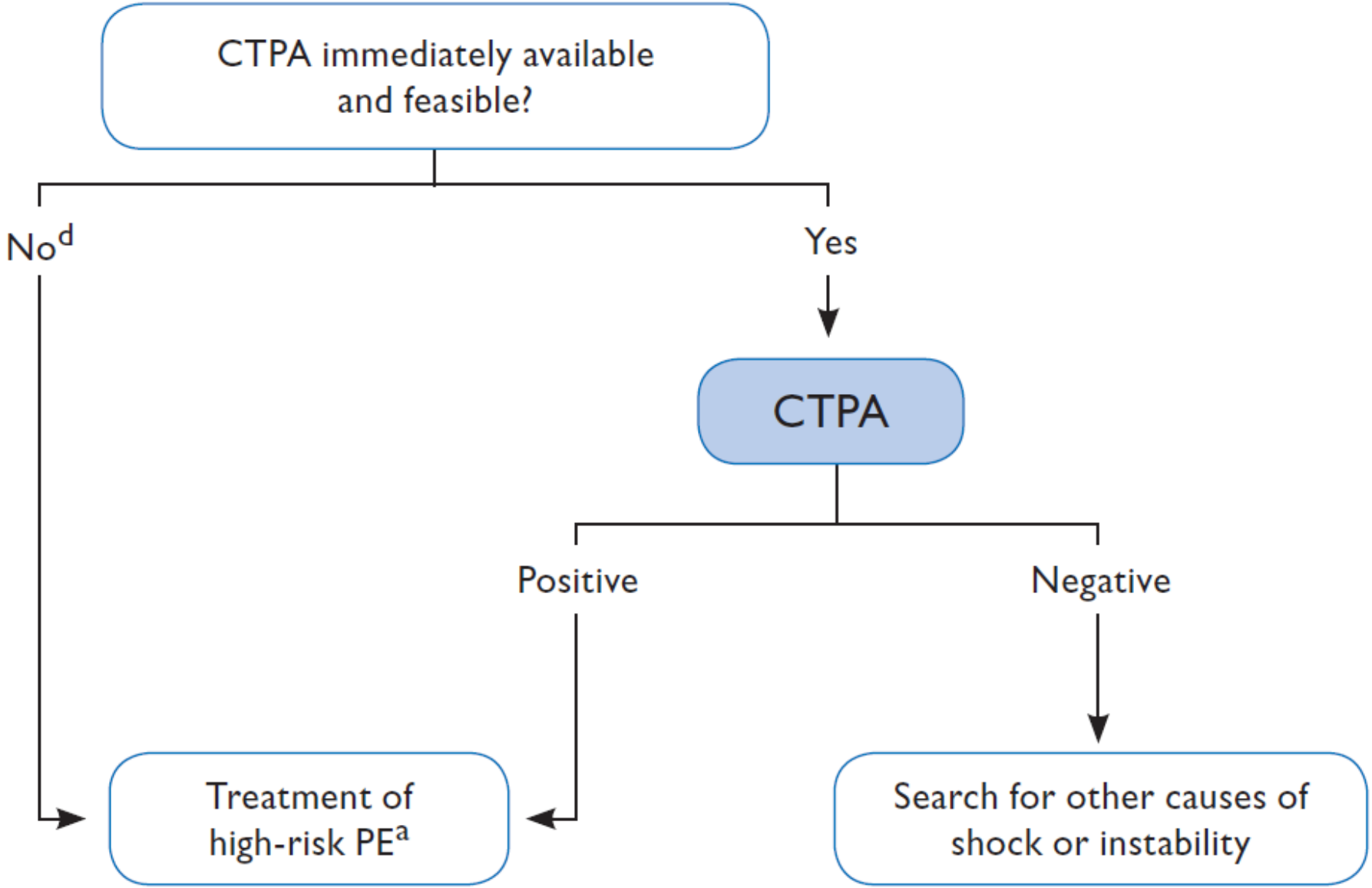
Systemic thrombolytic therapy is recommended for high-risk PE. [282]	I	B

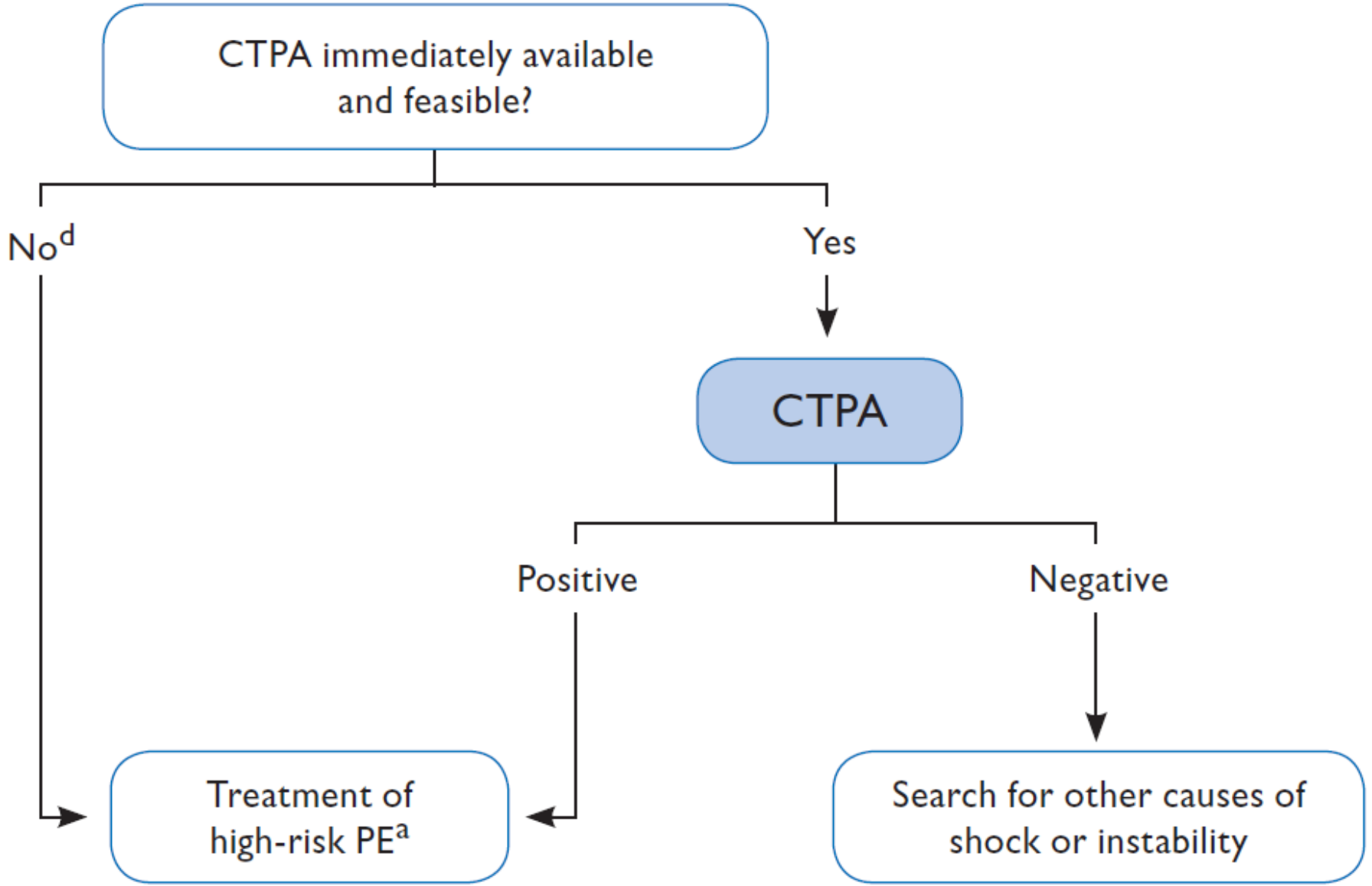
Reperfusion treatment in
Intermediate- or low-risk pulmonary embolism

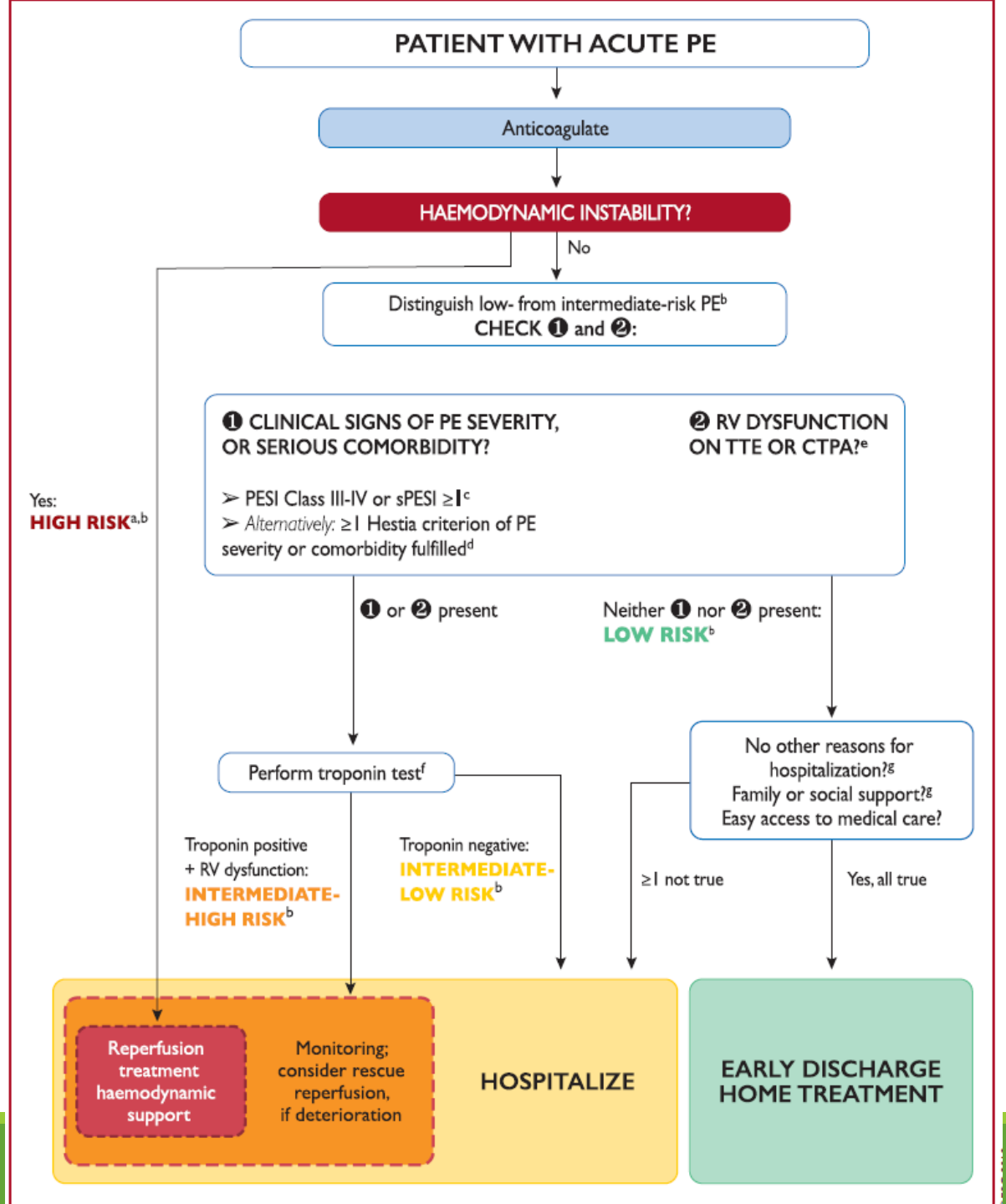
Reperfusion treatment		
Rescue thrombolytic therapy is recommended for patients with haemodynamic deterioration on anticoagulation treatment.[282]	I	B
As an alternative to rescue thrombolytic therapy, surgical embolectomy[e] or percutaneous catheter-directed treatment[e] should be considered for patients with haemodynamic deterioration on anticoagulation treatment.	IIa	C
Routine use of primary systemic thrombolysis is not recommended in patients with intermediate- or low-risk PE.[c,f 179]	III	B

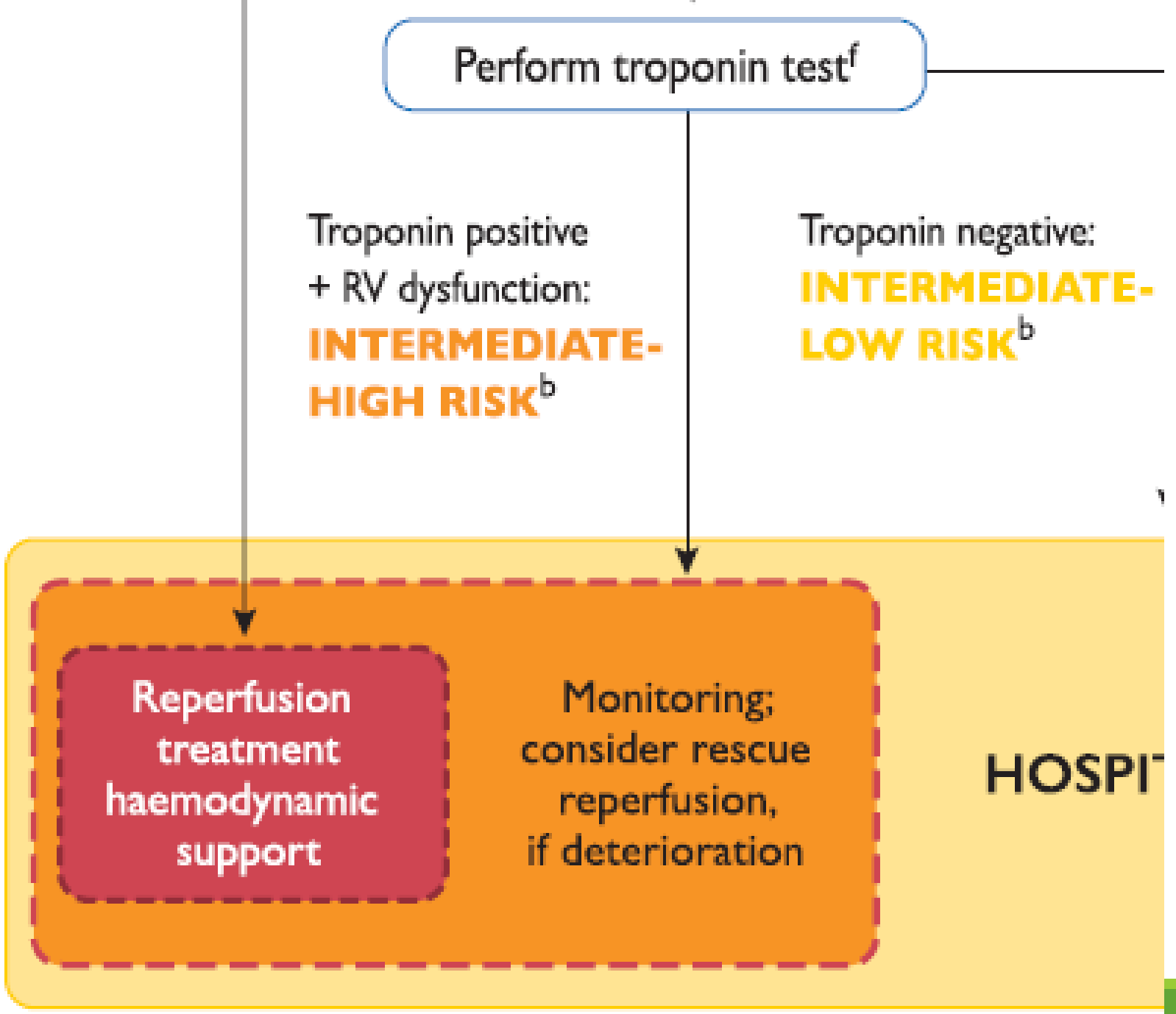
Diagnostic algorithms for pulmonary embolism


Suspected PE in a patient with haemodynamic instability[a]
Bedside TTE[b]
RV dysfunction?[c]
No
Yes
CTPA immediately available and feasible?
No[d]
Yes
CTPA
Positive
Negative
Search for other causes of shock or instability
Treatment of high-risk PE[a]
Search for other causes of shock or instability


CTPA immediately available and feasible?
No[d]
Yes
CTPA
Positive
Negative
Treatment of high-risk PE[a]
Search for other causes of shock or instability

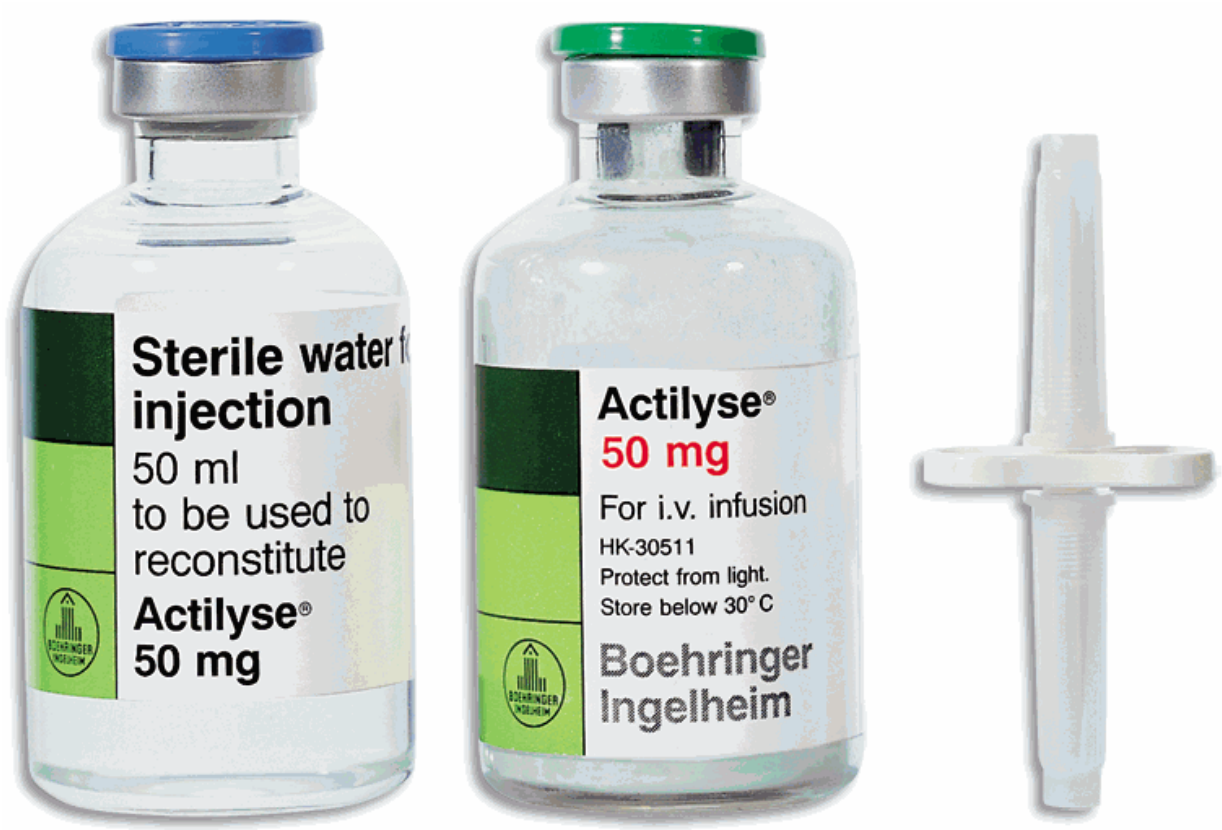

CTPA immediately available and feasible?
No[d]
Yes
CTPA
Positive
Negative
Treatment of high-risk PE[a]
Search for other causes of shock or instability


PATIENT WITH ACUTE PE
Anticoagulate
HAEMODYNAMIC INSTABILITY?
No
Yes:
HIGH RISK[a,b]
Distinguish low- from intermediate-risk PE[b]
CHECK ❶ and ❷:
❶ CLINICAL SIGNS OF PE SEVERITY, OR SERIOUS COMORBIDITY?
➢ PESI Class III-IV or sPESI ≥1[c]
➢ Alternatively: ≥1 Hestia criterion of PE severity or comorbidity fulfilled[d]
❷ RV DYSFUNCTION ON TTE OR CTPA?[e]
❶ or ❷ present
Neither ❶ nor ❷ present:
LOW RISK[b]
Perform troponin test[f]
Troponin positive + RV dysfunction:
INTERMEDIATE-HIGH RISK[b]
Troponin negative:
INTERMEDIATE-LOW RISK[b]
No other reasons for hospitalization?[g]
Family or social support?[g]
Easy access to medical care?
≥1 not true
Yes, all true
Reperfusion treatment haemodynamic support
Monitoring; consider rescue reperfusion, if deterioration
HOSPITALIZE
EARLY DISCHARGE HOME TREATMENT


Perform troponin test[f]
Troponin positive
+ RV dysfunction:
INTERMEDIATE-HIGH RISK[b]
Troponin negative:
INTERMEDIATE-LOW RISK[b]
Reperfusion treatment haemodynamic support
Monitoring; consider rescue reperfusion, if deterioration
HOSPI

Alteplase Administration Protocol

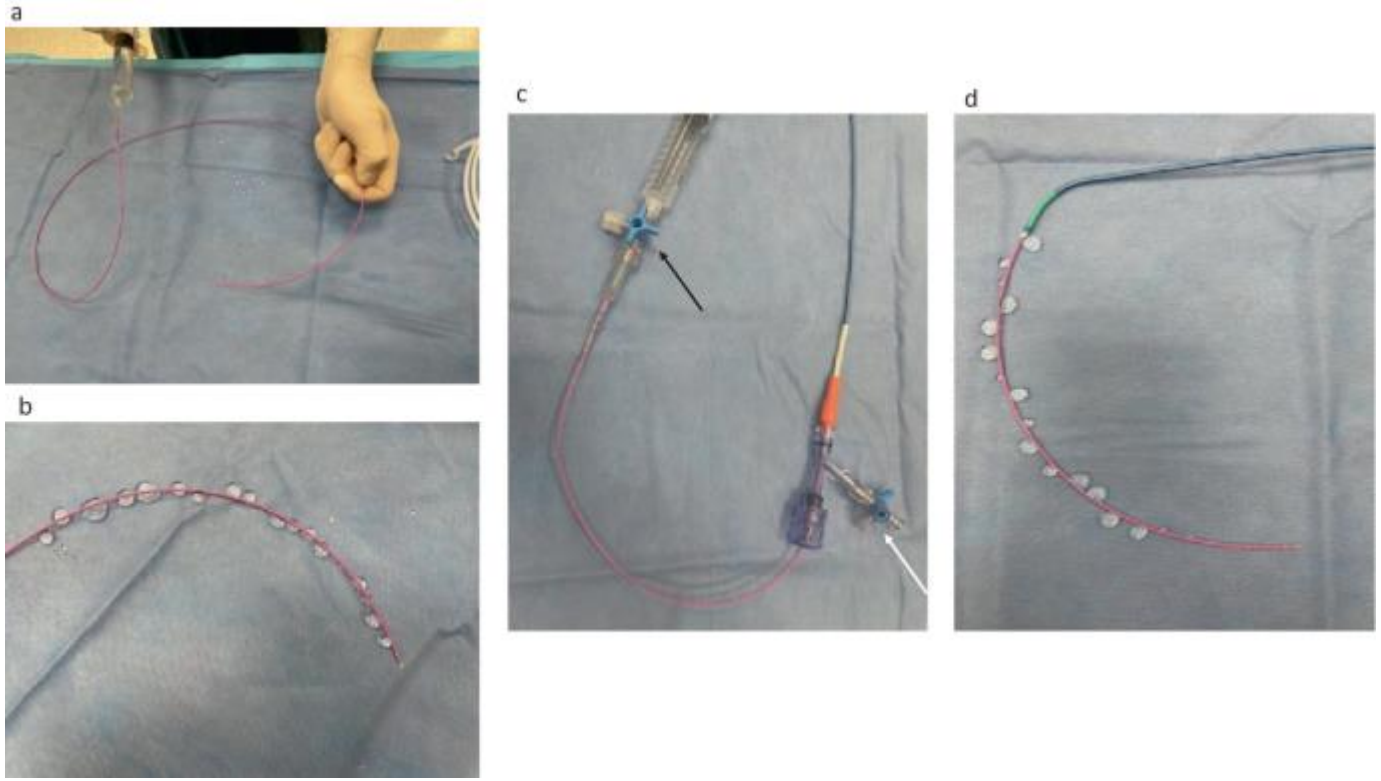
Step	Details
Thrombolytic + Anticoagulation Strategy	• Alteplase 100 mg IV infused over 2 hours • Start parenteral anticoagulation near the end of or immediately after infusion • Initiate anticoagulation when aPTT or thrombin time is < 2× normal

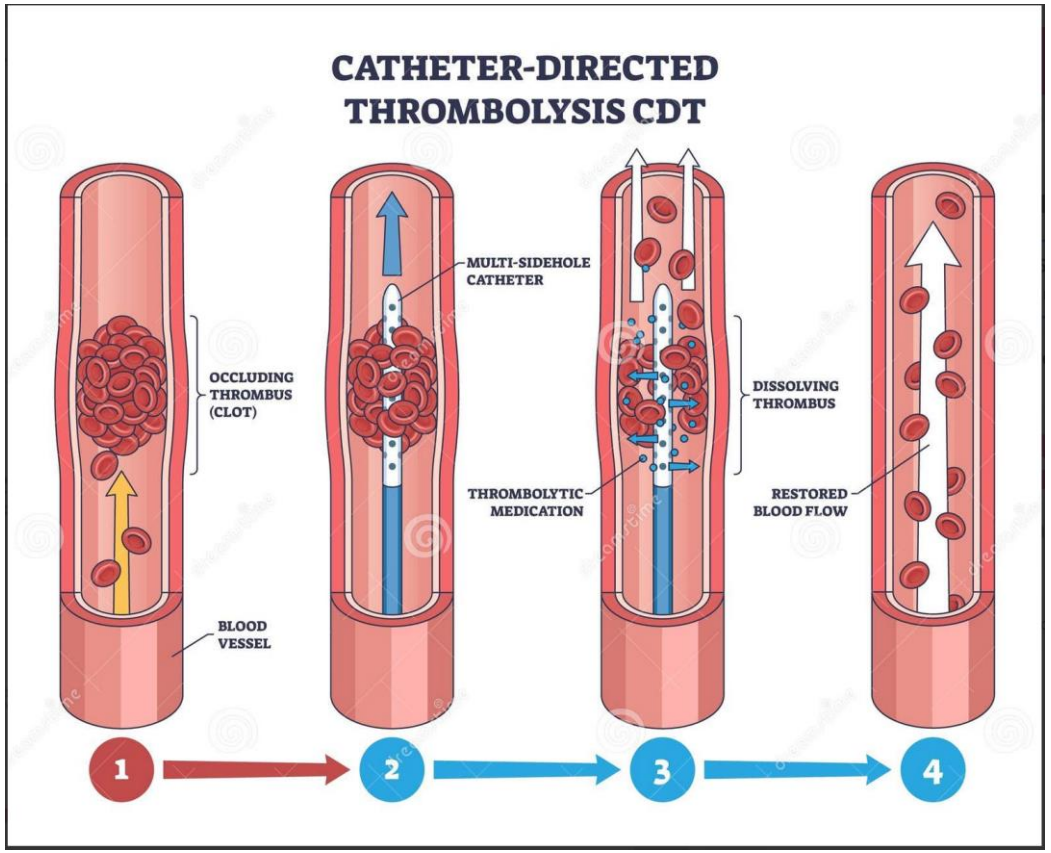

Sterile water f
injection
50 ml
to be used to
reconstitute
Actilyse®
50 mg
Actilyse®
50 mg
For i.v. infusion
HK-30511
Protect from light.
Store below 30° C
Boehringer
Ingelheim

Contraindications for Thrombolytic Therapy

Absolute Contraindications	Relative Contraindications
Structural intracranial disease	Systolic BP >180 mm Hg
Intracranial hemorrhage	Diastolic BP >110 mm Hg
Ischemic stroke within 3 months	Recent non-intracranial bleeding
Active bleeding	Recent surgery / invasive procedure
Recent brain or spinal surgery	Ischemic stroke >3 months
Recent head trauma with fracture or brain injury	Anticoagulation
Bleeding diathesis	Traumatic CPR
	Pericarditis / pericardial fluid
	Diabetic retinopathy
	Pregnancy
	Age >65 years
	Low body weight
	Female sex
	Black race

Catheter-directed thrombolysis of massive pulmonary embolism





Catheter-directed thrombolysis of massive pulmonary embolism

- Systemic thrombolysis is the primary choice, offering lower all-cause mortality

- In cases where systemic thrombolysis fails, endovascular approaches, including CDT, become potential options within a pulmonary embolism response team (PERT) approach, considering extracorporeal membrane oxygenation and surgical embolectomy for life-saving situations

Catheter-directed thrombolysis of massive pulmonary embolism

- Catheter-directed thrombolysis delivers thrombolysis directly into the pulmonary arteries, reducing the dosage of the thrombolytic agent and the risk of bleeding

Catheter-directed thrombolysis of massive pulmonary embolism

❖ There are two primary techniques. The first technique uses a standard pigtail catheter or pulmonary artery catheter to deliver the thrombolysis agent locally to the clot

❖This technique can be combined with high-frequency, low-power ultrasound waves with the intent to separate fibrin strands, maximize the surface area of the thrombus, and allow the thrombolytic agent to penetrate the clot with a lower dosage

Catheter-directed thrombolysis of massive pulmonary embolism

- The second technique is mechanical thrombectomy, which may be used alone or with a thrombolytic agent

Role of thrombolytics in Mechanical Valve Thrombosis

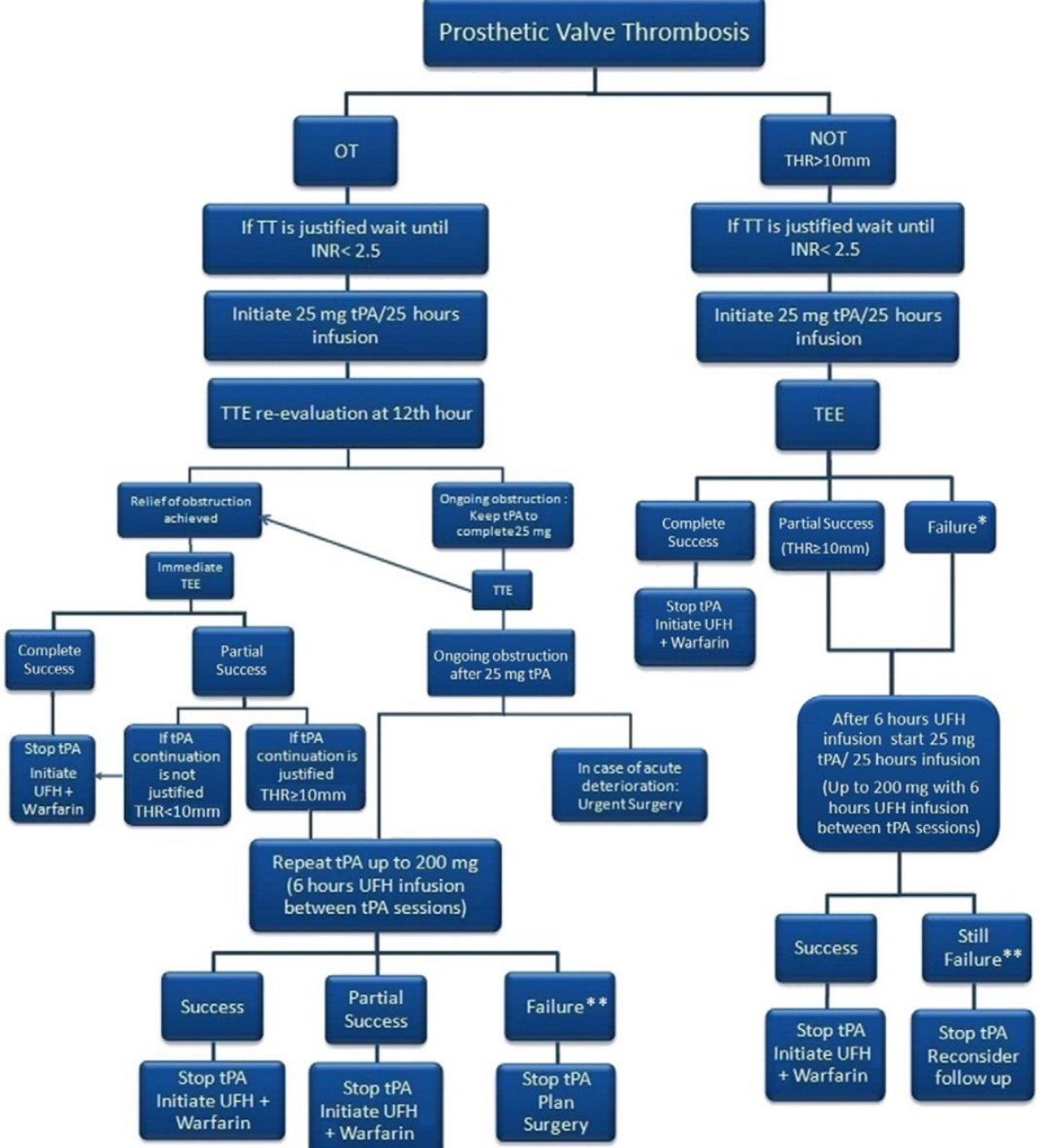
- Slow, low dose infusion appears to lower complication rates, while preserving thrombolytic success rates

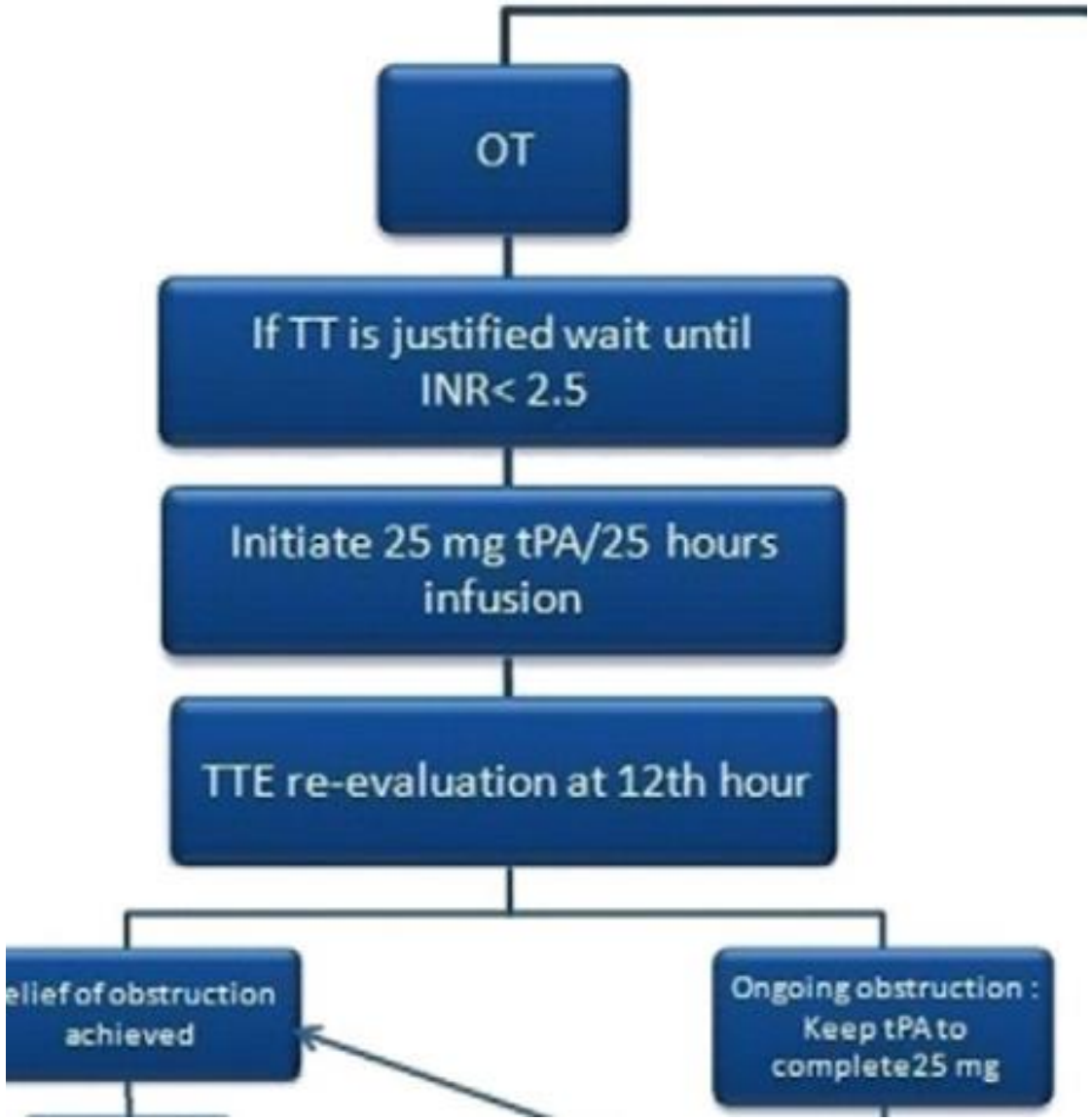
- It is recommended that the decision between surgery and fibrinolysis is taken within the Heart Team, and individualized by weighing clinical factors and local expertise

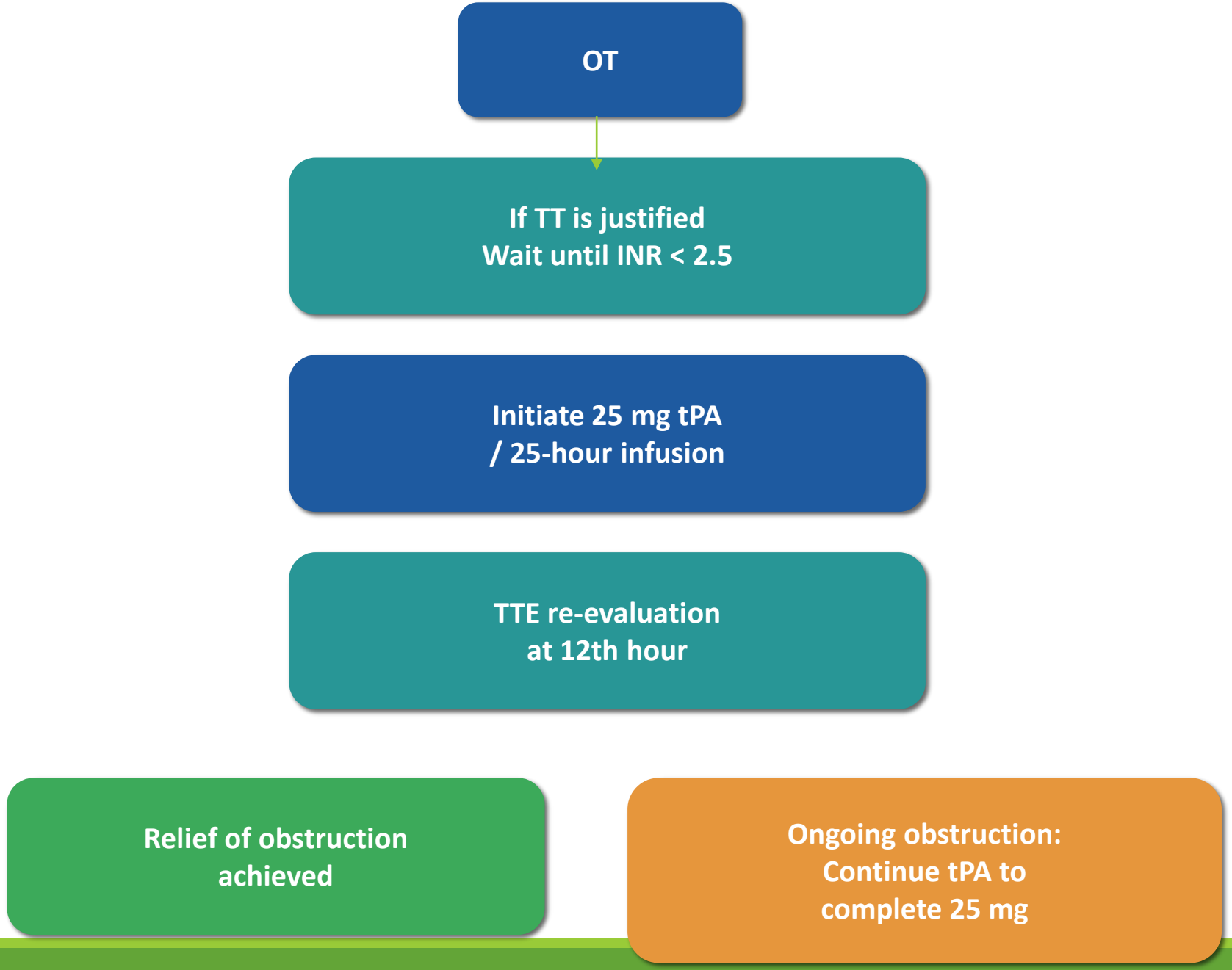
Valvular and Congenital Heart Disease

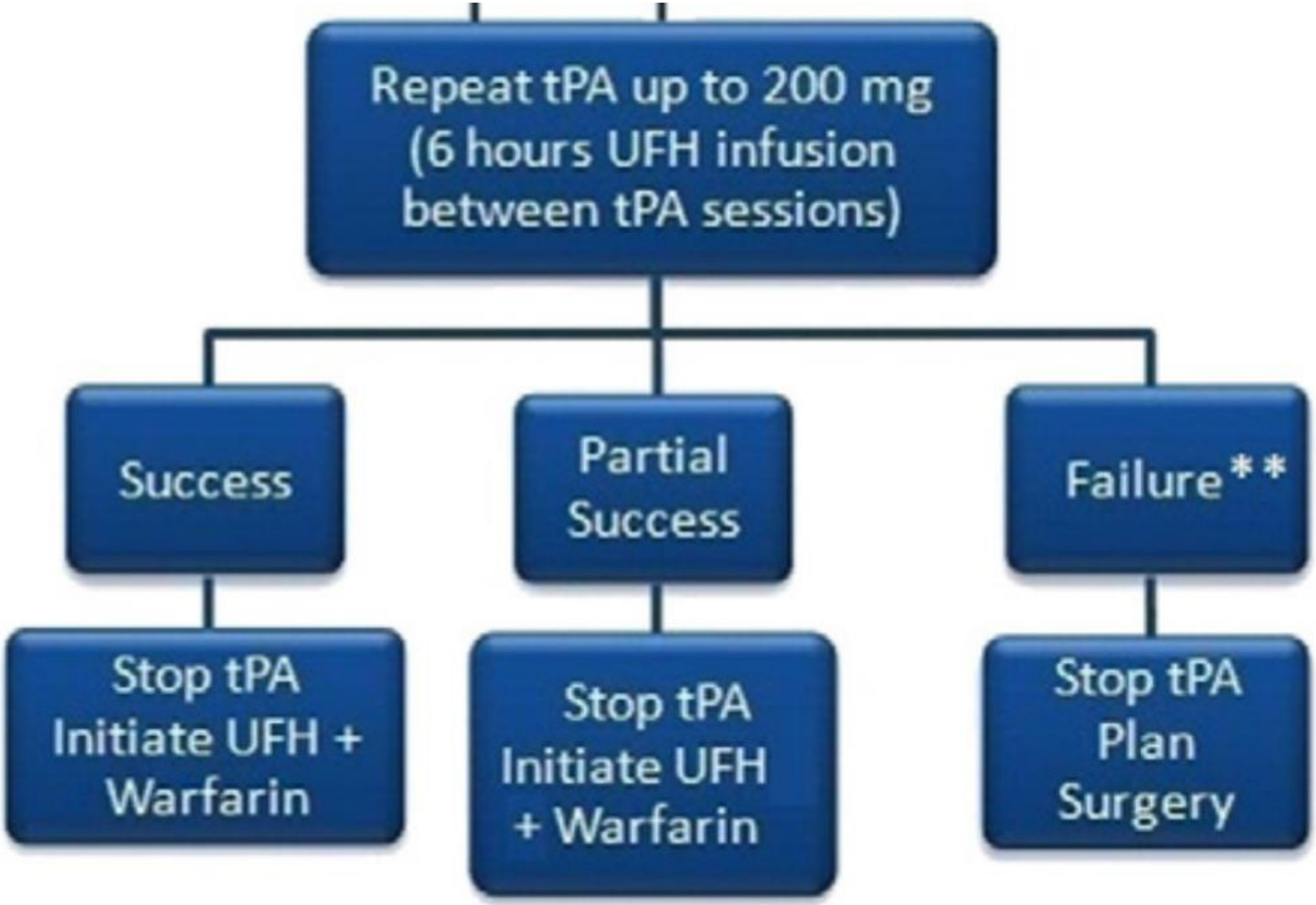
Ultraslow thrombolytic therapy: A novel strategy in the management of PROsthetic MEchanical valve Thrombosis and the prEdictors of outcomE: The Ultra-slow PROMETEE trial

Mehmet Özkan, MD,[a,b] Sabahattin Gündüz, MD,[b] Ozan Mustafa Gürsoy, MD,[b] Süleyman Karakoyun, MD,[b] Mehmet Ali Astarcıoğlu, MD,[b] Macit Kalçık, MD,[b] Ahmet Çağrı Aykan, MD,[b] Beytullah Çakal, MD,[b] Zübeyde Bayram, MD,[b] Ali Emrah Oğuz, MD,[b] Emre Ertürk, MD,[b] Mahmut Yesin, MD,[b] Tayyar Gökdeniz, MD,[b] Nilüfer Ekşi Duran, MD,[b] Mustafa Yıldız, MD,[b] and Ali Metin Esen, MD[b] *Kars and Istanbul, Turkey*


Prosthetic Valve Thrombosis
OT
NOT
THR>10mm
If TT is justified wait until INR< 2.5
If TT is justified wait until INR< 2.5
Initiate 25 mg tPA/25 hours infusion
Initiate 25 mg tPA/25 hours infusion
TTE re-evaluation at 12th hour
TEE
Relief of obstruction achieved
Ongoing obstruction : Keep tPA to complete25 mg
Complete Success
Partial Success (THR≥10mm)
Failure*
Immediate TEE
TTE
Stop tPA Initiate UFH + Warfarin
Complete Success
Partial Success
Ongoing obstruction after 25 mg tPA
Stop tPA Initiate UFH + Warfarin
If tPA continuation is not justified THR<10mm
If tPA continuation is justified THR≥10mm
In case of acute deterioration: Urgent Surgery
After 6 hours UFH infusion start 25 mg tPA/ 25 hours infusion
(Up to 200 mg with 6 hours UFH infusion between tPA sessions)
Repeat tPA up to 200 mg (6 hours UFH infusion between tPA sessions)
Success
Still Failure**
Success
Partial Success
Failure**
Stop tPA Initiate UFH + Warfarin
Stop tPA Reconsider follow up
Stop tPA Initiate UFH + Warfarin
Stop tPA Initiate UFH + Warfarin
Stop tPA Plan Surgery

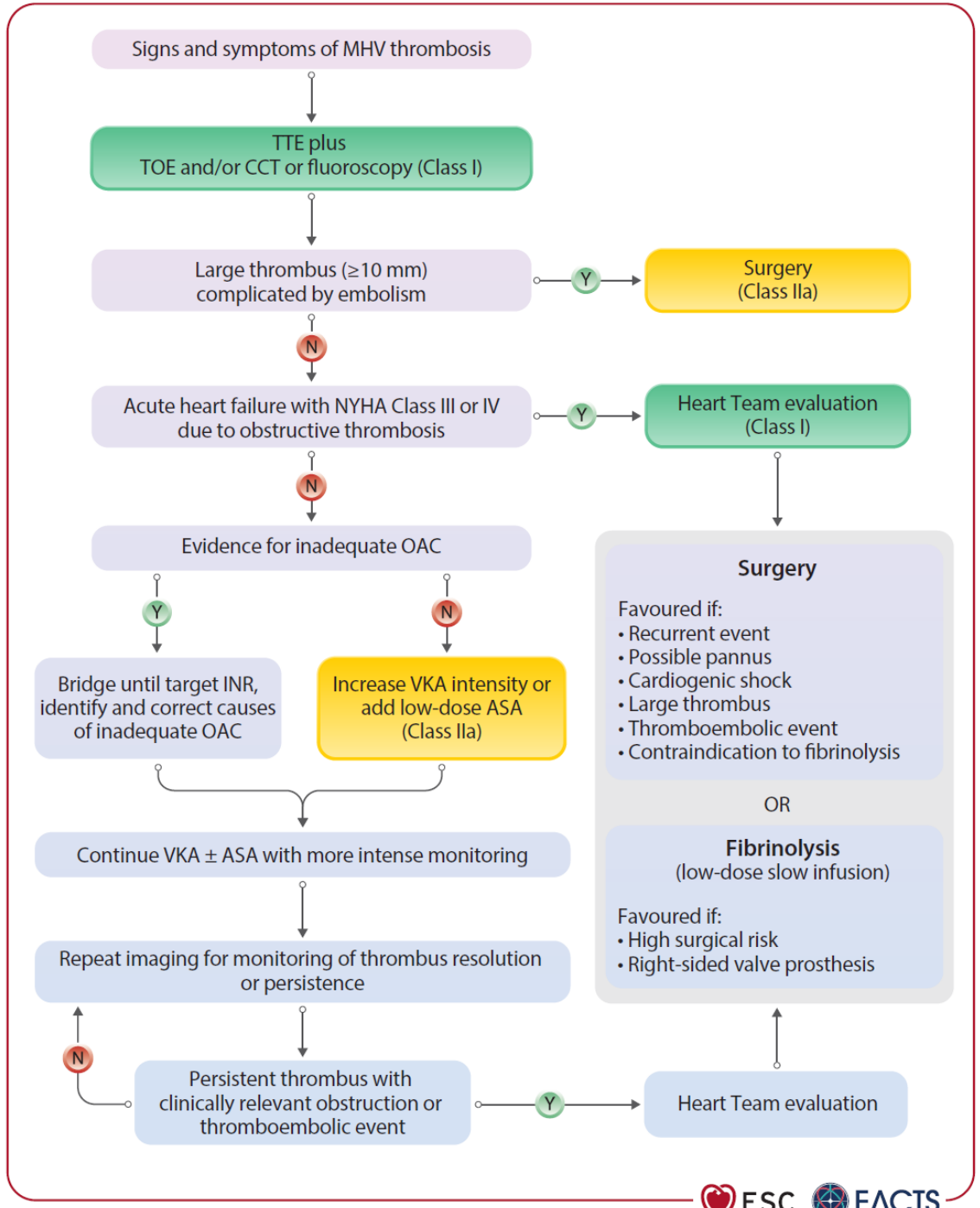

OT
If TT is justified wait until INR< 2.5
Initiate 25 mg tPA/25 hours infusion
TTE re-evaluation at 12th hour
elief of obstruction achieved
Ongoing obstruction : Keep tPA to complete25 mg


OT
If TT is justified
Wait until INR < 2.5
Initiate 25 mg tPA
/ 25-hour infusion
TTE re-evaluation
at 12th hour
Relief of obstruction
achieved
Ongoing obstruction:
Continue tPA to
complete 25 mg


Repeat tPA up to 200 mg (6 hours UFH infusion between tPA sessions)
Success
Partial Success
Failure**
Stop tPA Initiate UFH + Warfarin
Stop tPA Initiate UFH + Warfarin
Stop tPA Plan Surgery

Repeat tPA up to 200 mg
(6-hour UFH infusion between tPA sessions)

Success	Partial Success	Failure **
Stop tPA Initiate UFH + Warfarin	Stop tPA Initiate UFH + Warfarin	Stop tPA Plan Surgery


Signs and symptoms of MHV thrombosis
TTE plus
TOE and/or CCT or fluoroscopy (Class I)
Large thrombus (≥10 mm) complicated by embolism
Y
Surgery (Class IIa)
N
Acute heart failure with NYHA Class III or IV due to obstructive thrombosis
Y
Heart Team evaluation (Class I)
N
Evidence for inadequate OAC
Y
N
Bridge until target INR, identify and correct causes of inadequate OAC
Increase VKA intensity or add low-dose ASA (Class IIa)
Continue VKA ± ASA with more intense monitoring
Repeat imaging for monitoring of thrombus resolution or persistence
N
Persistent thrombus with clinically relevant obstruction or thromboembolic event
Y
Heart Team evaluation
Surgery
Favoured if:
• Recurrent event
• Possible pannus
• Cardiogenic shock
• Large thrombus
• Thromboembolic event
• Contraindication to fibrinolysis
OR
Fibrinolysis
(low-dose slow infusion)
Favoured if:
• High surgical risk
• Right-sided valve prosthesis

Role of thrombolytics in Acute Stroke

0.9 mg/kg IV; not to exceed 90 mg total dose; administer 10% of the total dose as an initial IV bolus over 1 minute and the remainder infused over 60 minutes

Role of thrombolytics in Acute STEMI(Alteplase)

- ≤67 kg: 15 mg IVP bolus over 1-2 minutes, THEN 0.75 mg/kg IV infusion over 30 minutes (not to exceed 50 mg), and THEN 0.5 mg/kg IV over next 60 minutes (not to exceed 35 mg over 1 hr)

- >67 kg (100 mg total dose infused over 1.5 hr): 15 mg IVP bolus over 1-2 minutes, THEN 50 mg IV infusion over next 30 minutes, and THEN remaining 35 mg over next 60 minutes

Role of thrombolytics in Acute STEMI(Alteplase)

Patient Weight	Step 1 (Bolus)	Step 2 (First Infusion)	Step 3 (Second Infusion)	Total Dose / Time
≤ 67 kg	**15 mg IV bolus** over 1–2 min	**0.75 mg/kg IV** over 30 min*(max 50 mg)*	**0.5 mg/kg IV** over next 60 min*(max 35 mg)*	**Weight-based 90 min**
> 67 kg	**15 mg IV bolus** over 1–2 min	**50 mg IV** over next 30 min	**35 mg IV** over next 60 min	**100 mg total 90 min**

Central Venous Catheter Occlusion

- Activase: 2 mg in 2 mL instilled into occluded catheter
- Assess catheter function after 30 minutes of dwell time by attempting to aspirate blood; if unable to aspirate after 120 minutes dwell time, a 2nd dose may be administered and the process repeated
- If catheter function restored, aspirate 4-5 mL blood to remove Cathflo Activase and residual clot
- Gently irrigate with 0.9% NaC

Central Venous Catheter Occlusion

Step	Action	Dose / Timing	Key Notes
1 **Instillation**	Instill **Alteplase (Cathflo®)** into occluded catheter	**2 mg in 2 mL**	Instill directly into **occluded lumen**
2 **Dwell & Assessment**	Allow dwell time, then assess catheter patency	**Assess at 30 min** by attempting blood aspiration	Do **not flush forcefully**
3 **Repeat Dose (if needed)**	If unable to aspirate	**Second dose after 120 min dwell**	Same dose may be repeated once
4 **Clearance**	If catheter function restored	**Aspirate 4–5 mL blood**	Removes alteplase + residual clot
5 **Final Flush**	Gently irrigate catheter	**0.9% NaCl**	Restore normal catheter use

Arterial Thrombosis & Embolism (Off-label)

0.05-0.1 mg/kg/hr by transcatheter intra-arterial infusion for 1-8 hours or until lysis of thrombus

Take Home Messages

Thrombolytics and vascular filters are powerful but selective tools, used beyond standard anticoagulation in carefully chosen patients

Systemic thrombolysis remains first-line therapy for high-risk pulmonary embolism; catheter-directed strategies reduce bleeding in selected cases

IVC filters should be applied conservatively—only for acute VTE with contraindications to anticoagulation—and removed promptly when possible

Low-dose, slow-infusion thrombolysis is an effective option in mechanical valve thrombosis, requiring individualized Heart Team decisions

Optimal thrombosis management relies on guideline-based risk stratification, multidisciplinary collaboration, and continuous reassessment


Thank you


Thank you for your
attention!