

**CARDIO
RUN
2023**

**15^{ème} CONGRÈS
DE PATHOLOGIE
CARDIO-VASCULAIRE**

27-28-29 SEPTEMBRE 2023

Hôtel Saint Alexis
ILE DE LA RÉUNION
France

CARDIORUN.ORG

Prise en charge de l'embolie pulmonaire aux urgences

Dr Tomislav PETROVIC

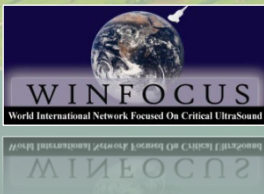
SAMU 93 - Hôpital AVICENNE – BOBIGNY

Dr Philippe PÈS

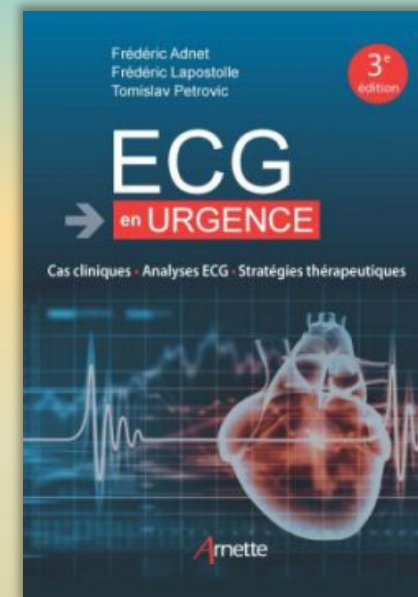
SAMU 44 – NANTES

Pr Frédéric LAPOSTOLLE

SAMU 93- Hôpital Avicenne



Relations d'intérêt





- Thorax & mollet = RAS
- PA = 85/45 mmHg
- FC = 110/min
- SpO₂ = 93%
- FR = 24/min arrivant aux urgences

March 3, 2021

Derivation and Validation of a 4-Level Clinical Pretest Probability Score for Suspected Pulmonary Embolism to Safely Decrease Imaging Testing

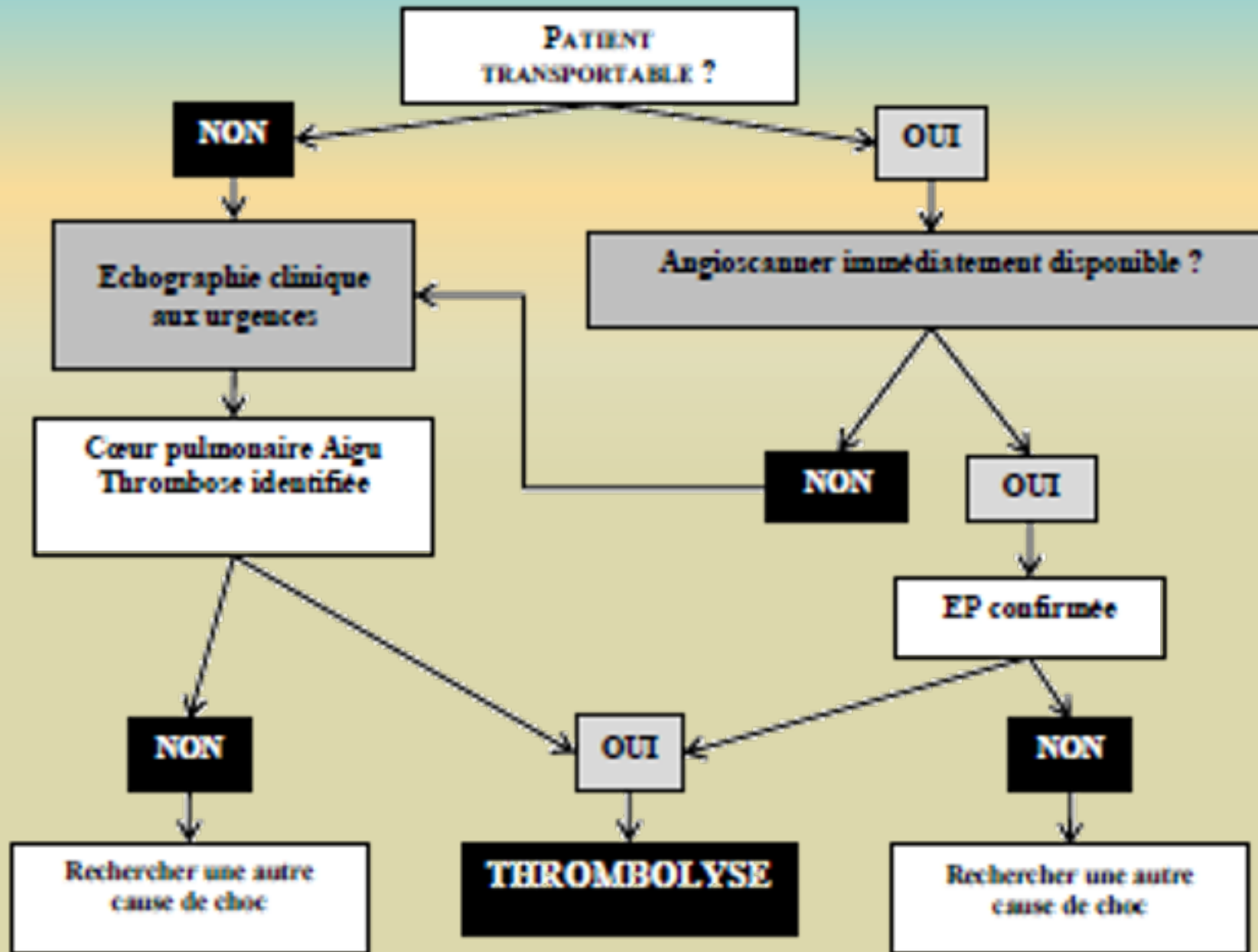
Pierre-Marie Roy, MD, PhD¹; Emilie Friou, MD²; Boris Germeau, MD³; et al

[> Author Affiliations](#) | [Article Information](#)

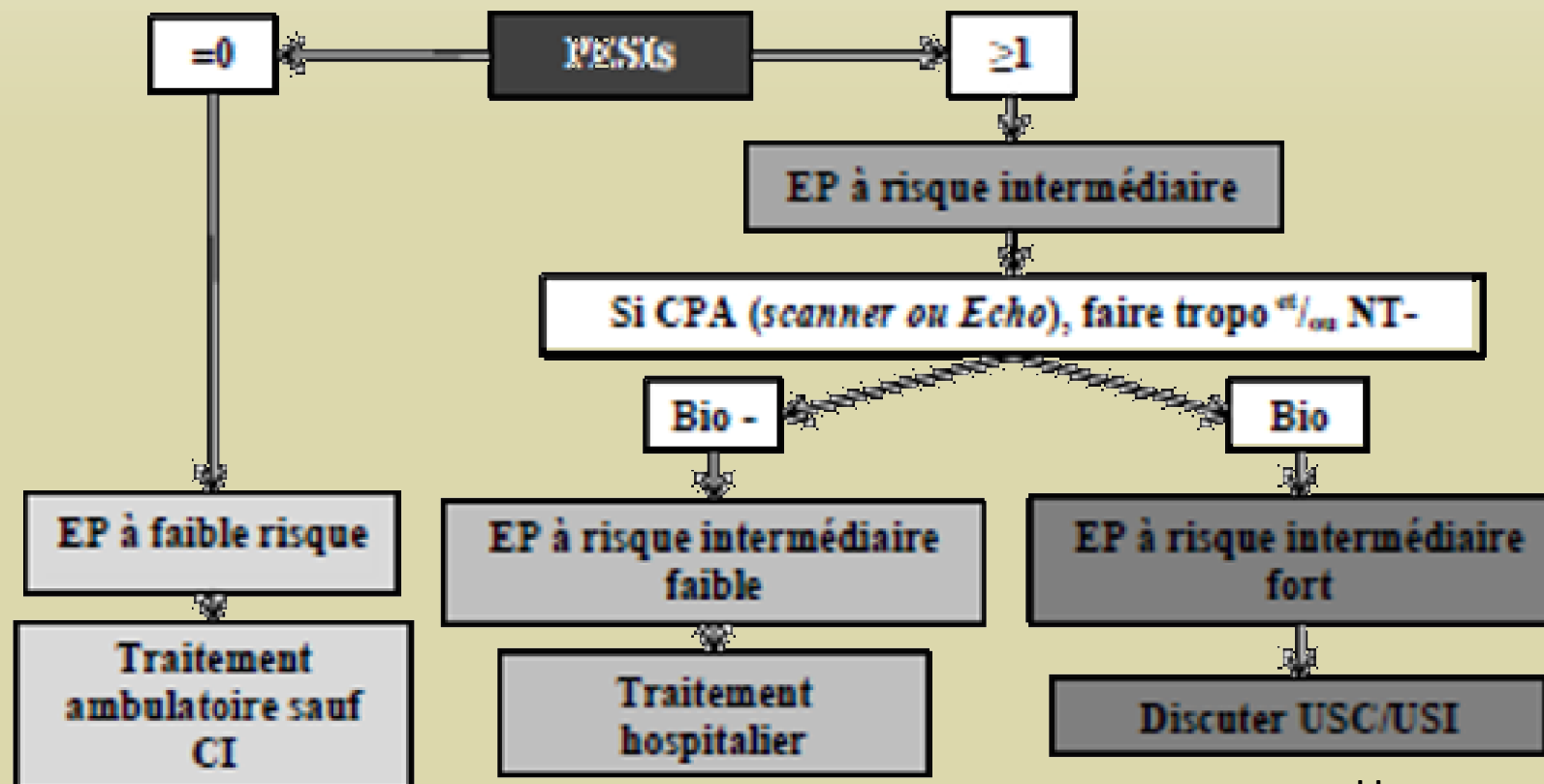
JAMA Cardiol. 2021;6(6):669-677. doi:10.1001/jamacardio.2021.0064

Table 3. 4-Level Pulmonary Embolism Clinical Probability Score (4PEPS)

Variable	Regression coefficient	Points
Age, y		
<50	-0.993	-2
50-64	-0.656	-1
Chronic respiratory disease	-0.570	-1
Heart rate <80 beats per minute	-0.406	-1
Chest pain and acute dyspnea	0.297	1
Male	0.472	2
Hormonal estrogenic treatment	0.608	2
Personal history of VTE	0.711	2
Syncope	0.504	2
Immobility within the last 4 wk ^a	0.509	2
Pulse oxygen saturation <95%	0.832	3
Calf pain and/or unilateral lower limb edema	1.009	3
PE is the most likely diagnosis	1.860	5
Clinical probability, total		
Very low CPP (<2%): PE can be ruled out	<0	
Low CPP (2%-20%): PE can be ruled out if D-dimer level <1.0 µg/mL	0-5	
Moderate CPP (20%-65%): PE can be ruled out if D-dimer level <0.5 µg/mL or <(age × 0.01) µg/mL	6-12	
High CPP (>65%): PE cannot be ruled out without imaging testing	≥13	

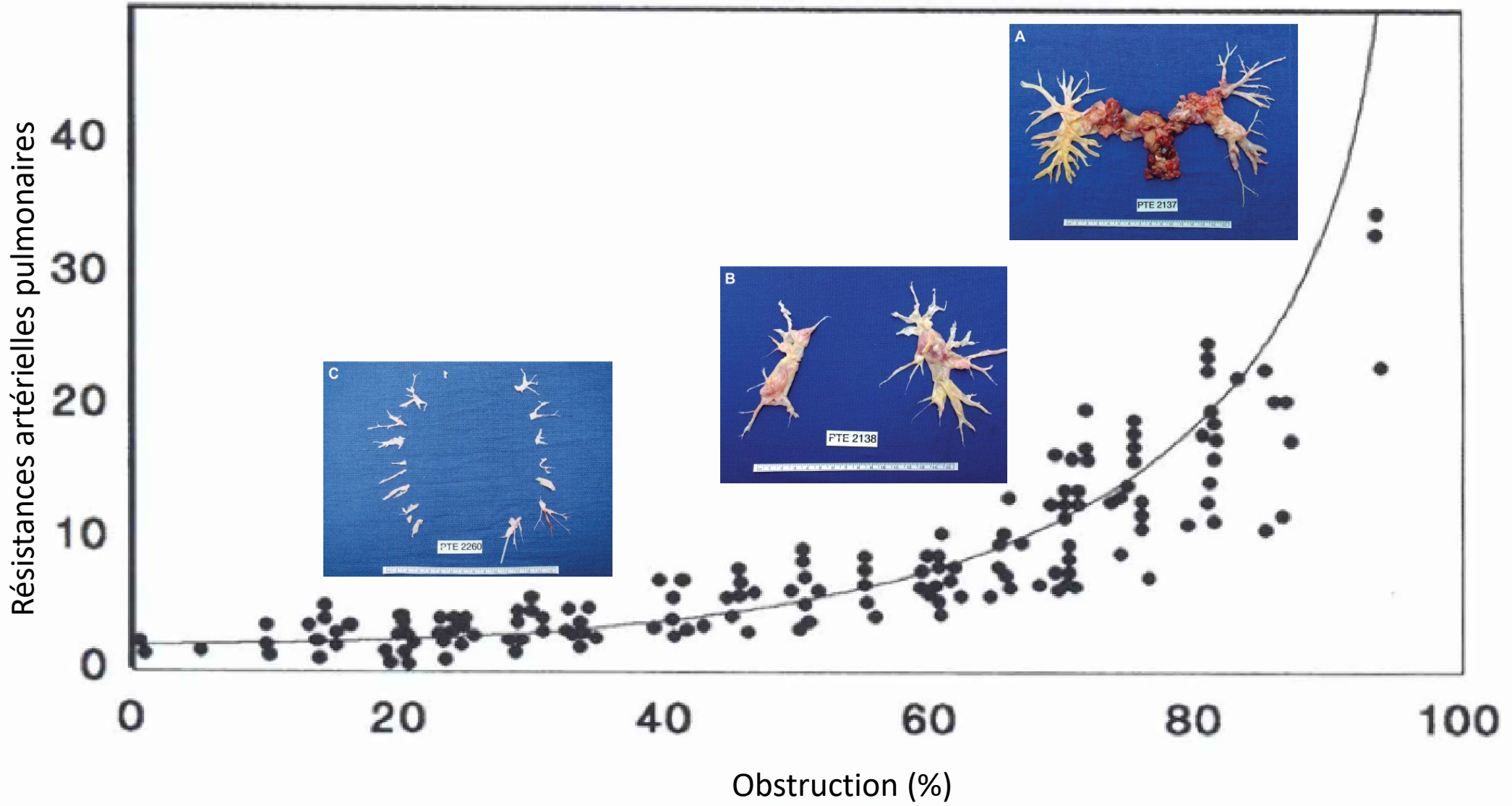


PULMONARY EMBOLISM SEVERITY INDEX SIMPLIFIÉ	
Age > 80 ans	1 point
Sp O2 < 90%	1 point
Pas < 110 mmHg	1 point
FC ≥ 110 BPM	1 point
ATCD Cancer	1 point
Insuffisance cardiaque ou respiratoire chronique	1 point
PESIs = 0	Risque faible (1,0% de décès à 30 j)
PESIs ≥ 1	Risque élevé (10,9% de décès à 30 j)

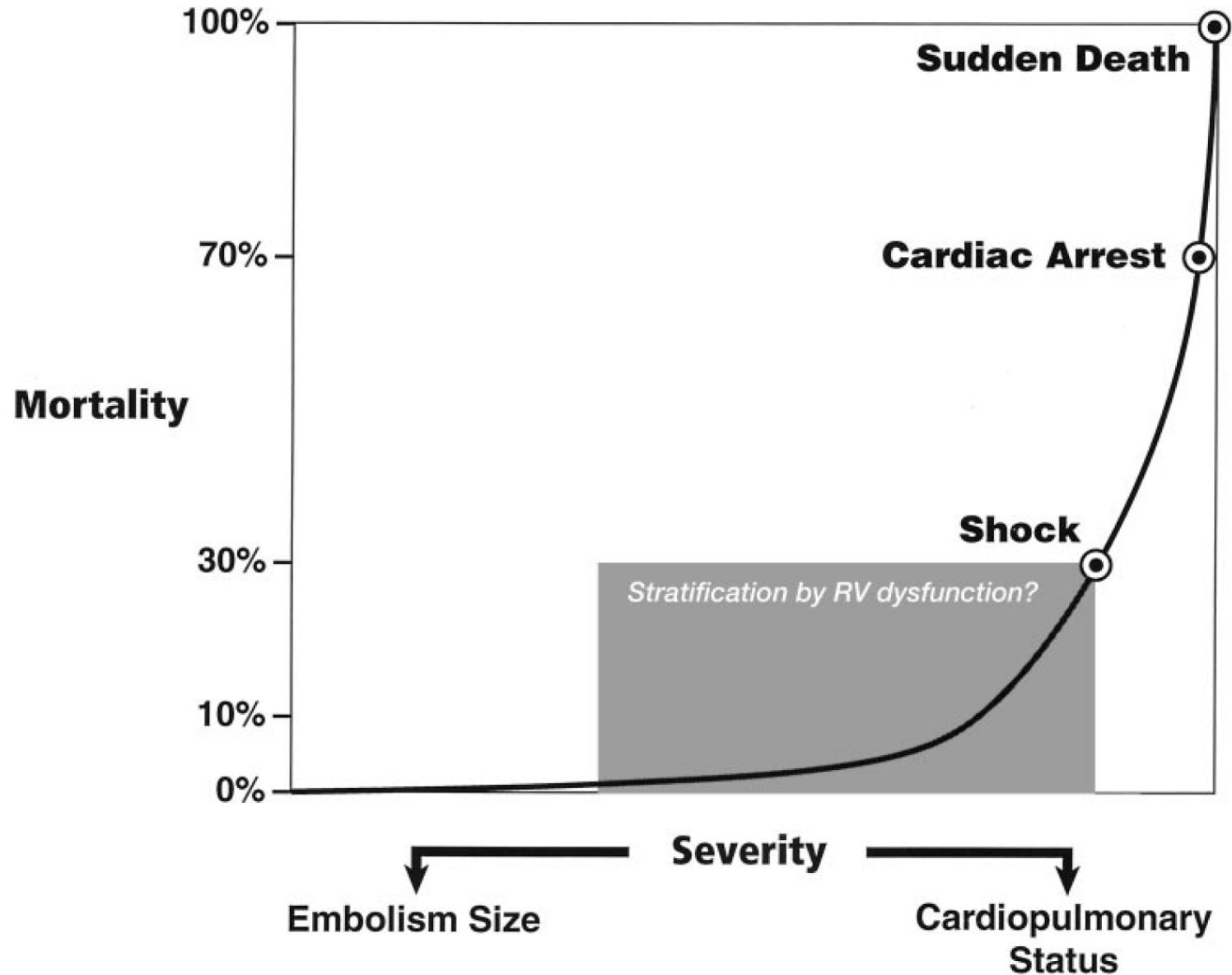




Quels outils ?

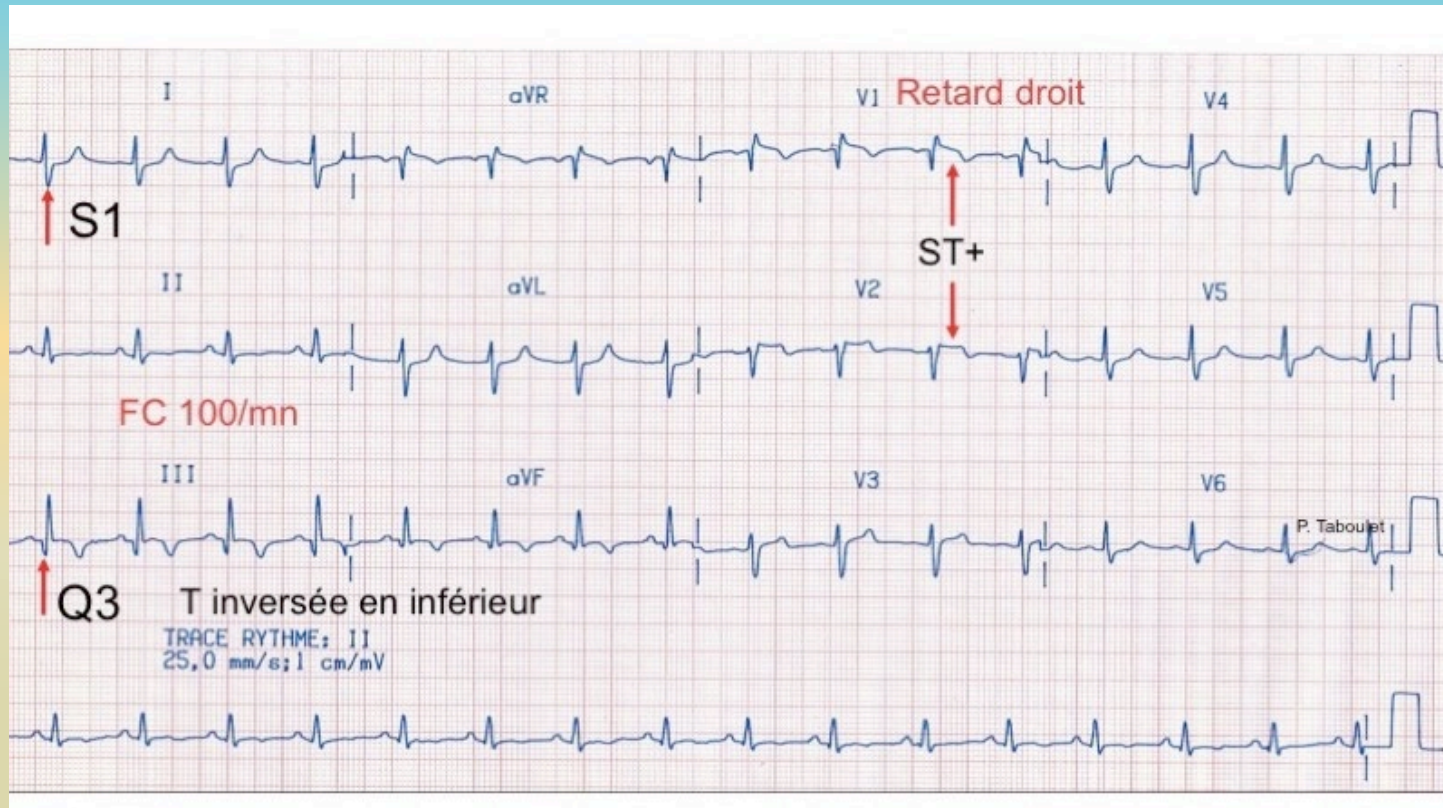


Outcomes in Pulmonary Embolism









Tachycardie

Trouble du rythme SV

Onde P > 2,5 mm

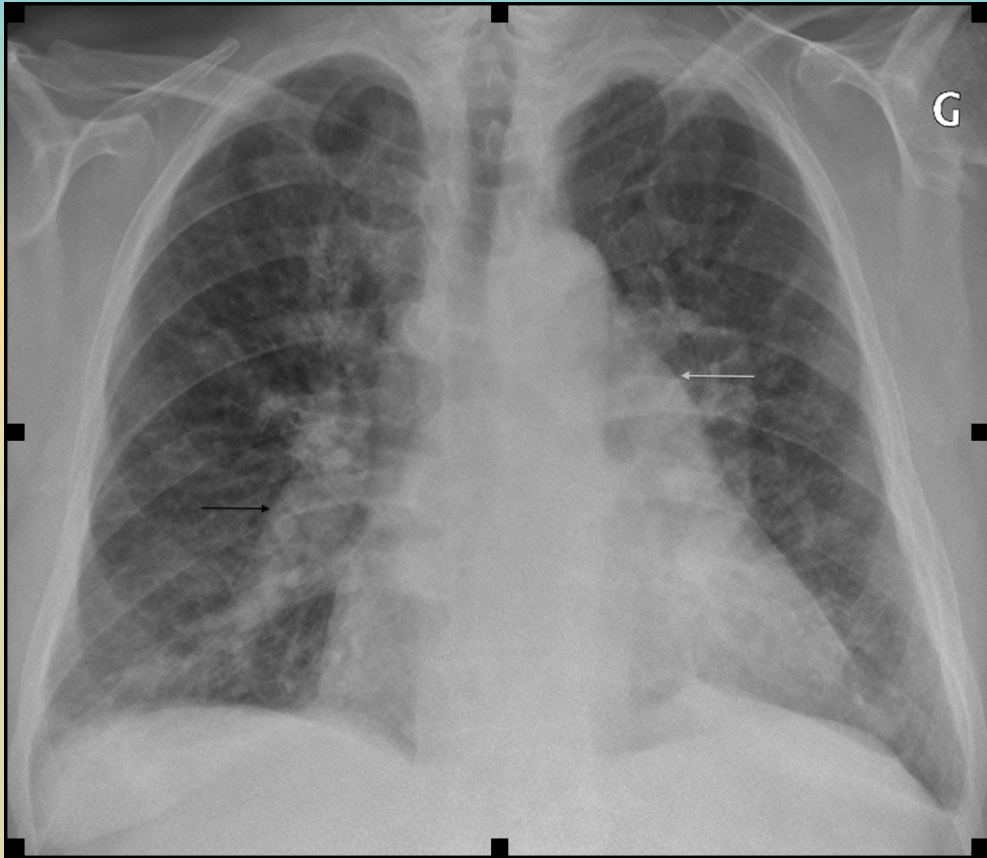
Aspect S1Q3

Déviations axiale droite

Bloc de branche droit

Ondes T négatives en antérieur

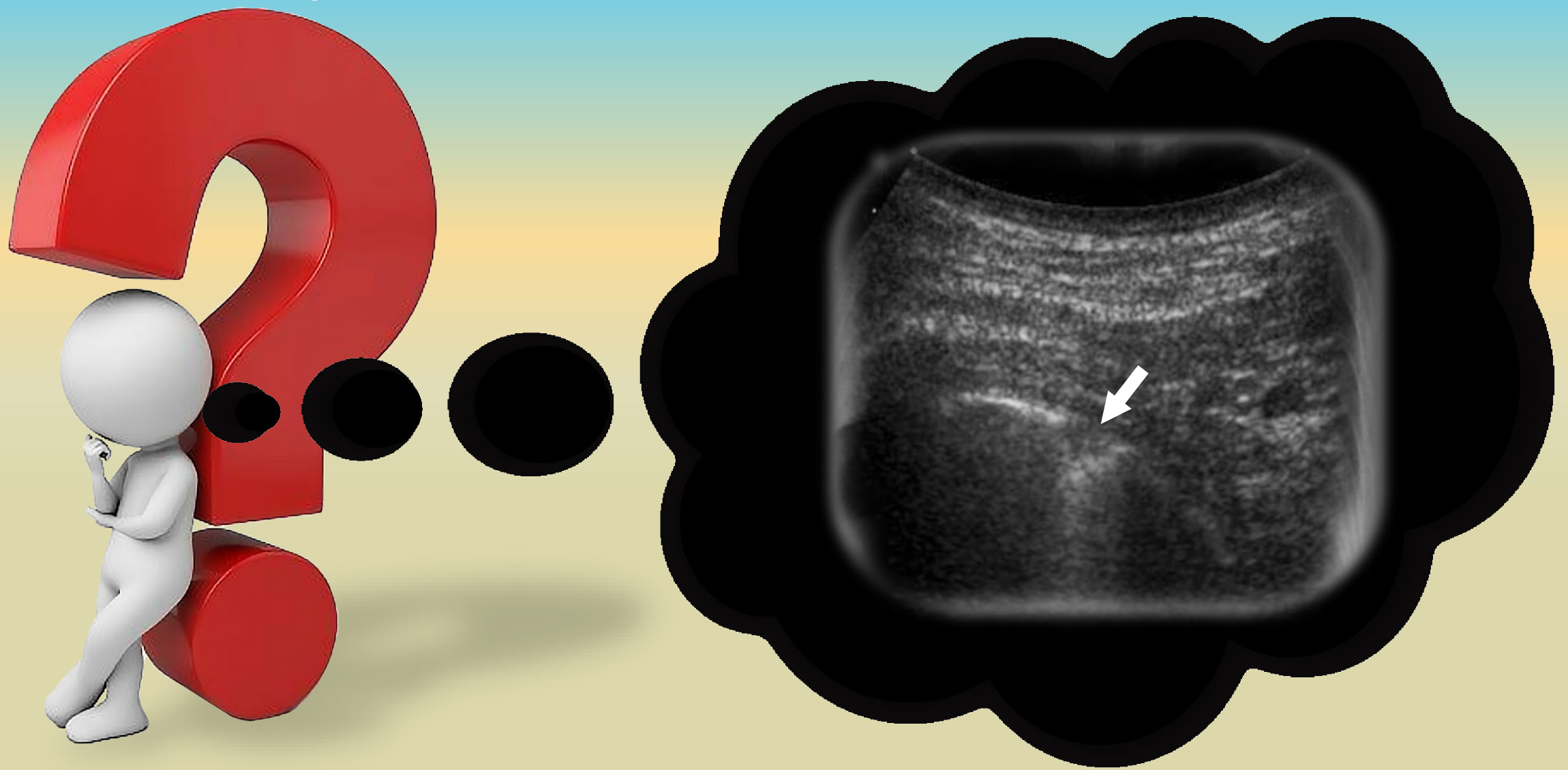
Troubles repolarisation



Souvent normale
=> Diagnostics alternatifs

- Hyperclarté
- Ascension coupole diaphragmatique
- Atelectasie en bande
- Grosse artère pulmonaire
- Opacité triangulaire à base pleurale (infarctus)
- Epanchement pleural





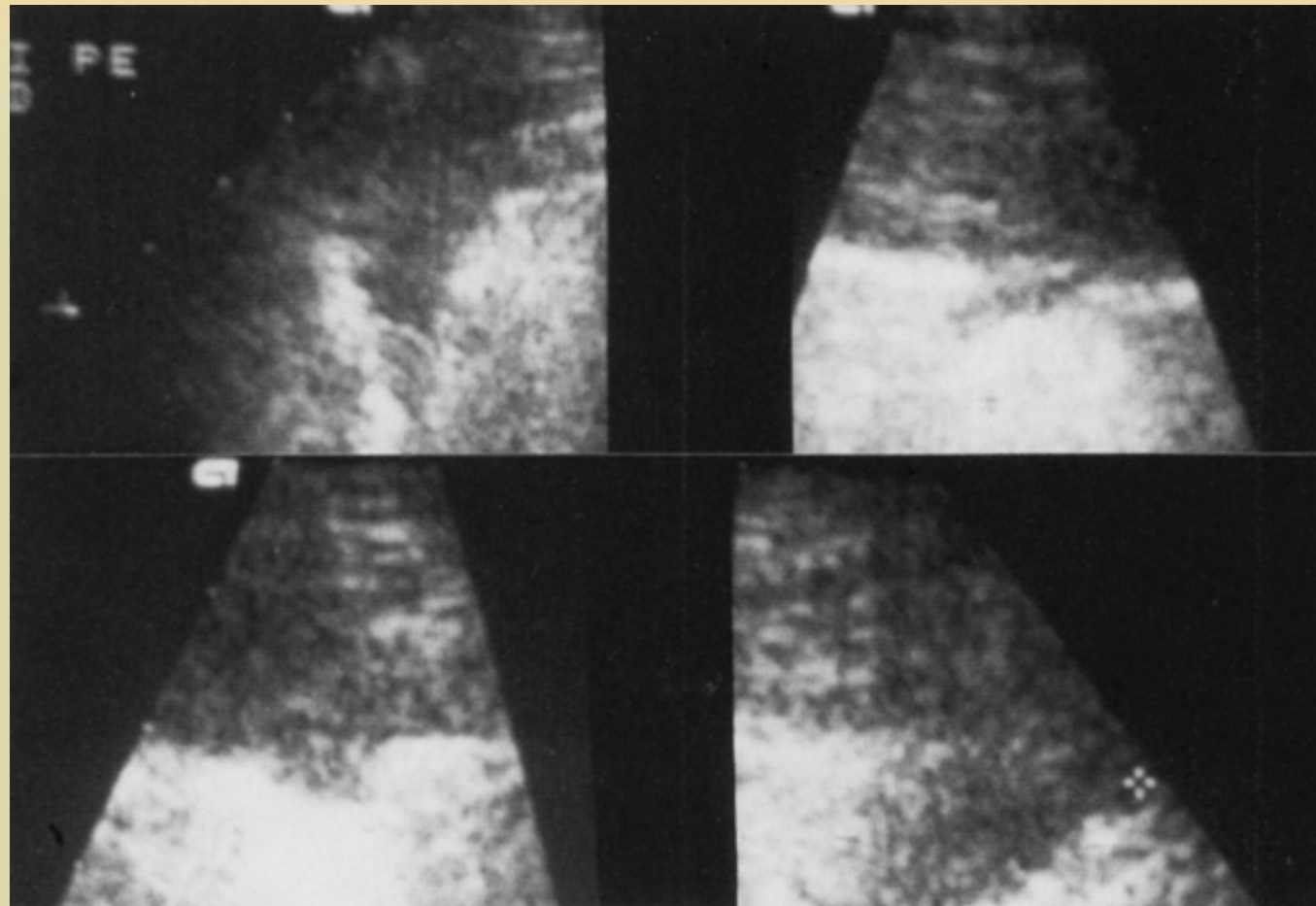
Quelle place pour l'écho pulmonaire ?

● *Review*

**THORAXSONOGRAPHY—PART II: PERIPHERAL
PULMONARY CONSOLIDATION**

GEBHARD MATHIS, M.D.

Department of Internal Medicine, Krankenhaus Hohenems, Hohenems, Austria



CHEST

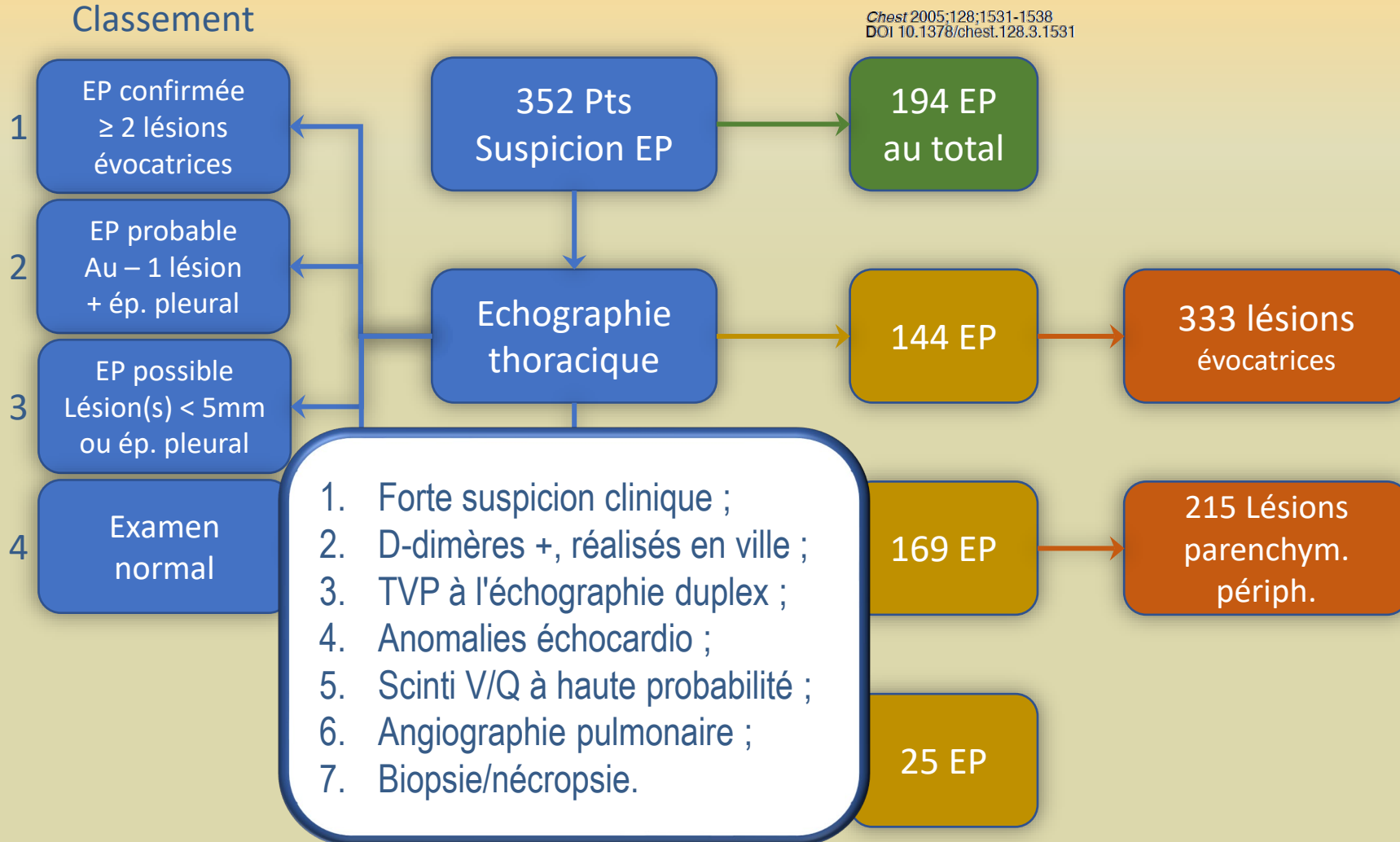
Official publication of the American College of Chest Physicians



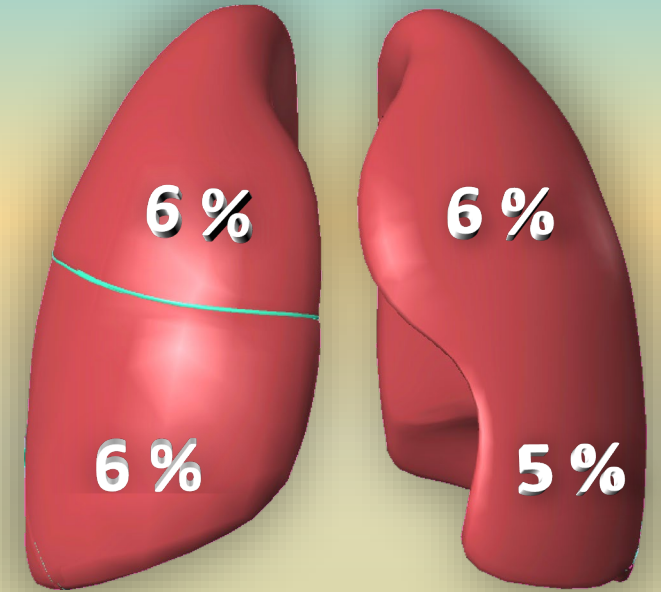
Thoracic Ultrasound for Diagnosing Pulmonary Embolism : A Prospective Multicenter Study of 352 Patients

Gebhard Mathis, Wolfgang Blank, Angelika Reißig, Peter Lechleitner, Joachim Reuß, Andreas Schuler and Sonja Beckh

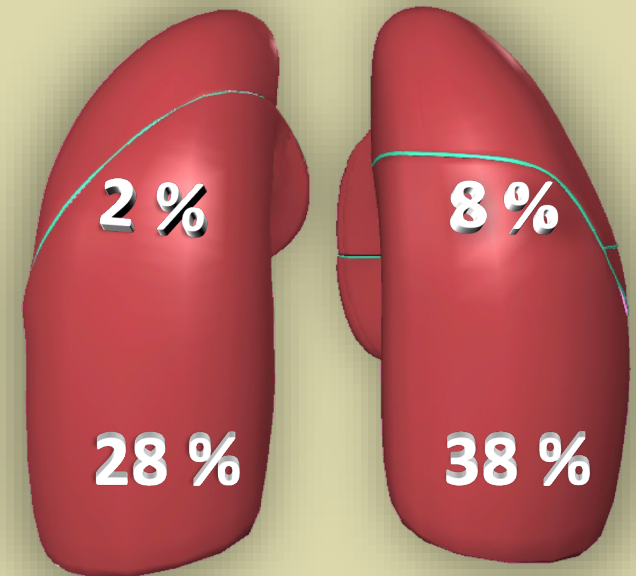
Chest 2005;128:1531-1538
DOI 10.1378/chest.128.3.1531



Antérieur



Postérieur

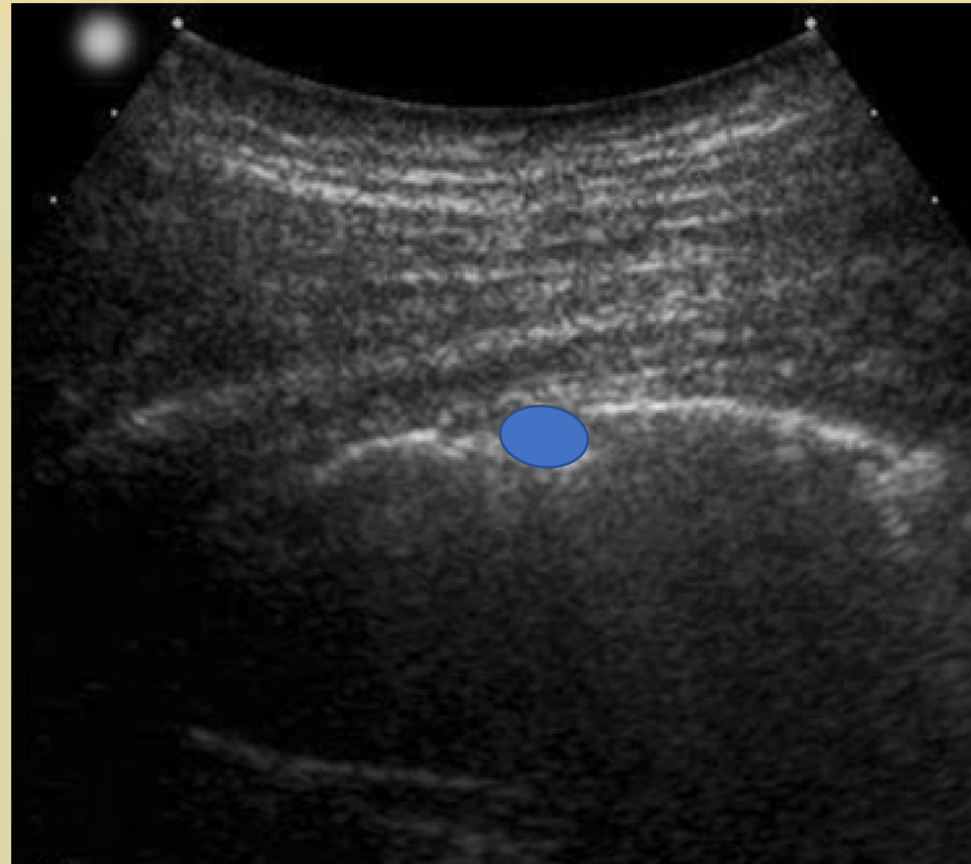
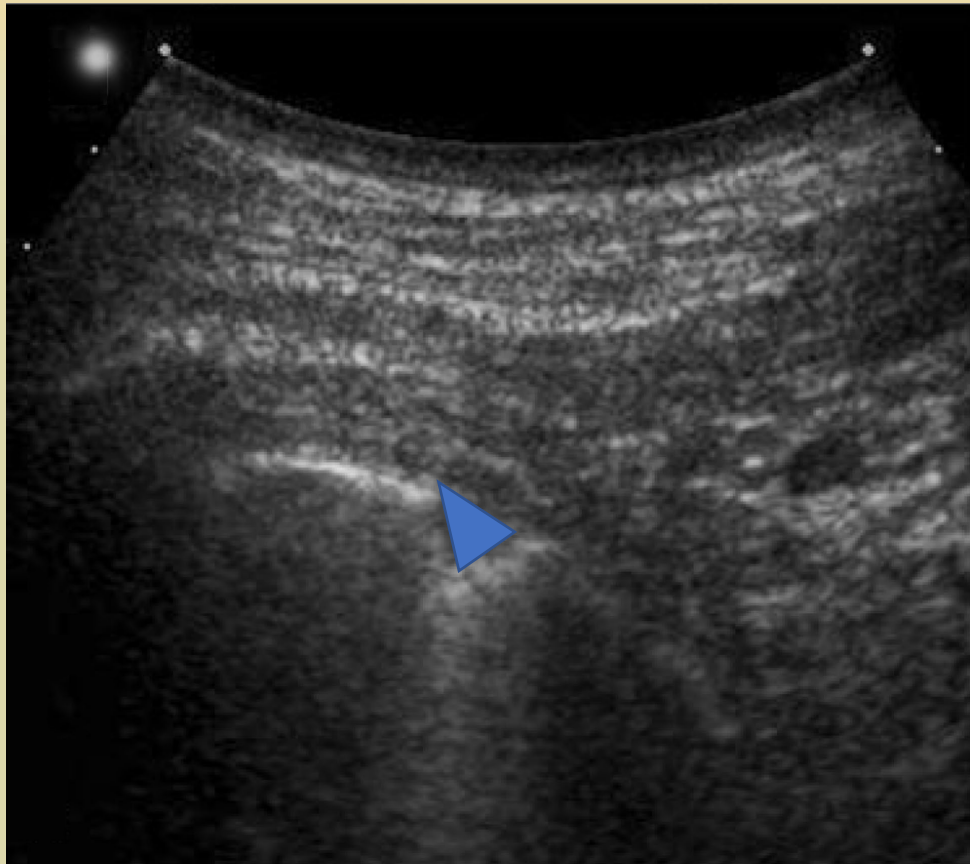




Thoracic Ultrasound for Diagnosing Pulmonary Embolism : A Prospective Multicenter Study of 352 Patients

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Chest 2005;128:1531-1538
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Forme des lésions évocatrice :

- > 5 mm
- Triangulaire ou ovale
- Régulière

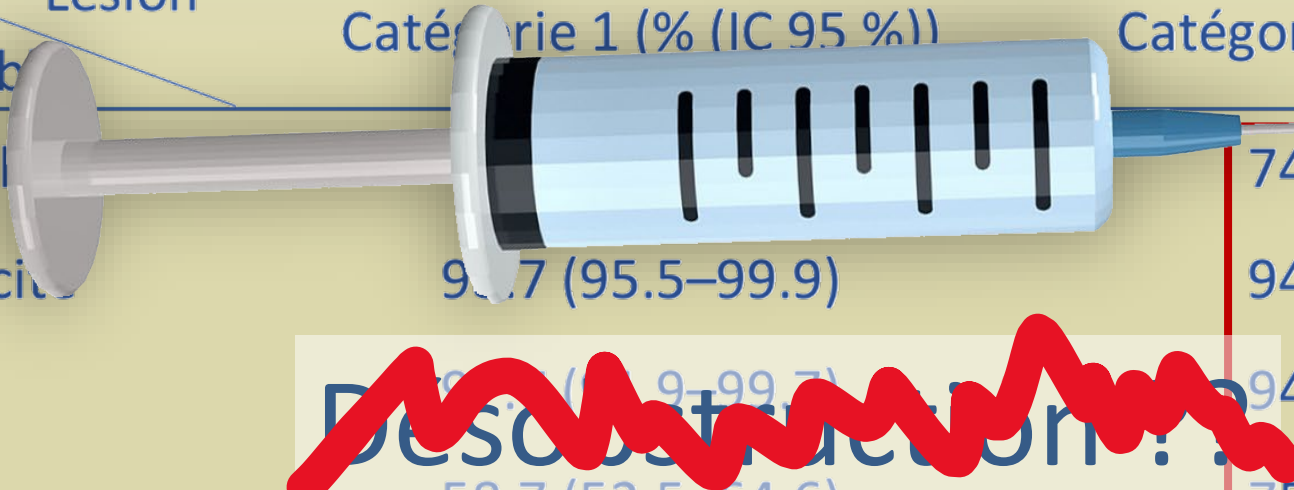


Thoracic Ultrasound for Diagnosing Pulmonary Embolism : A Prospective Multicenter Study of 352 Patients

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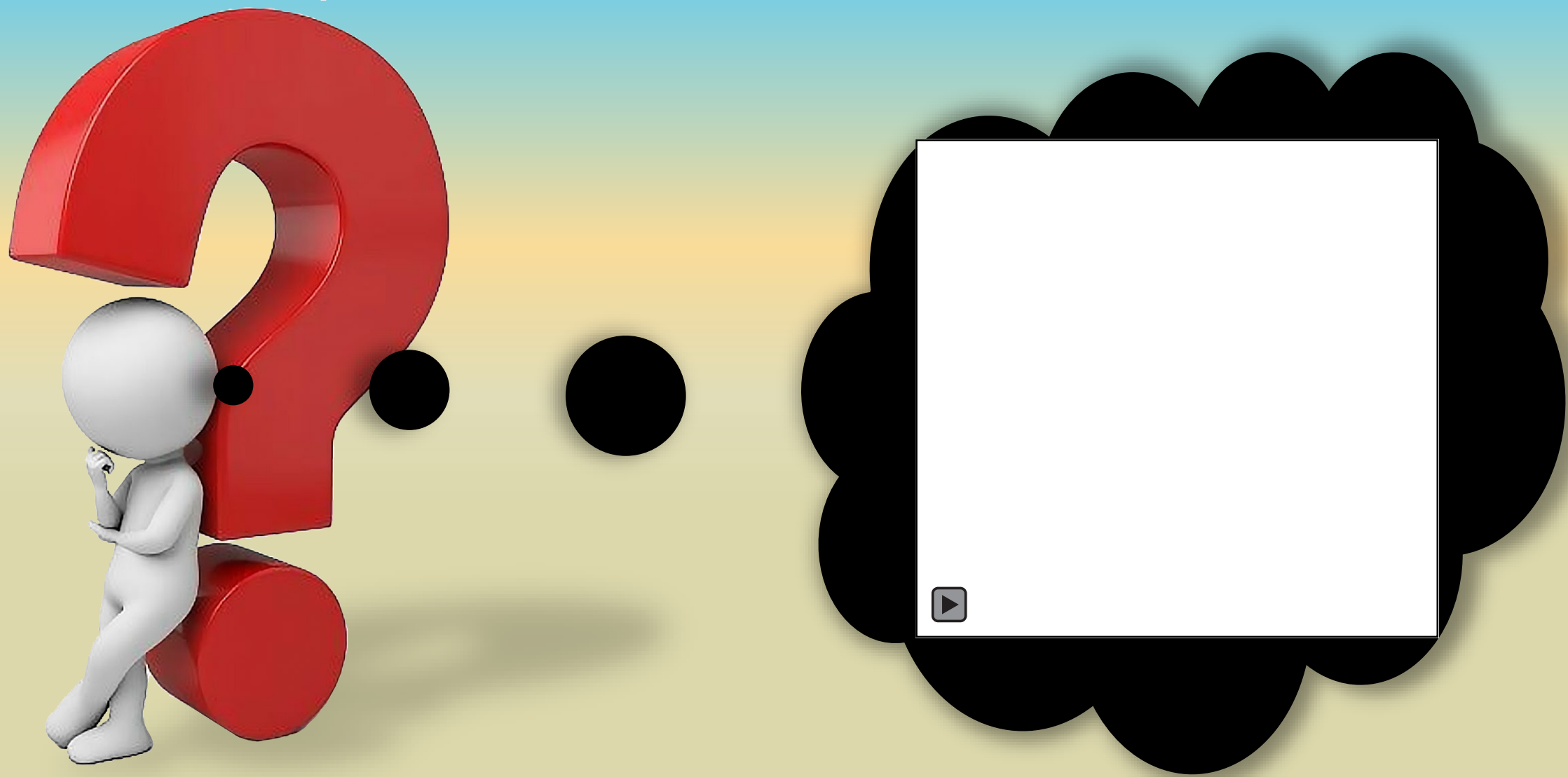
Chest 2005;128:1531-1538
DOI 10.1378/chest.128.3.1531

Performances de l'échographie pulmonaire pour le diagnostic d'EP



Lésion	Catégorie 1 (% (IC 95 %))	Catégorie 1+2 (% (IC 95 %))
Sensibilité	74.2 (67.5–80.2)	74.2 (67.5–80.2)
Spécificité	99.7 (95.5–99.9)	94.9 (90.3–97.8)
VPP	99.7 (95.5–99.9)	94.7 (89.9–97.7)
VPN	58.7 (52.5–64.6)	75.0 (68.4–80.8)
Précision Δg	68.2 (63.0–73.0)	83.5 (79.2–87.2)

ANTICOAGULATION ?



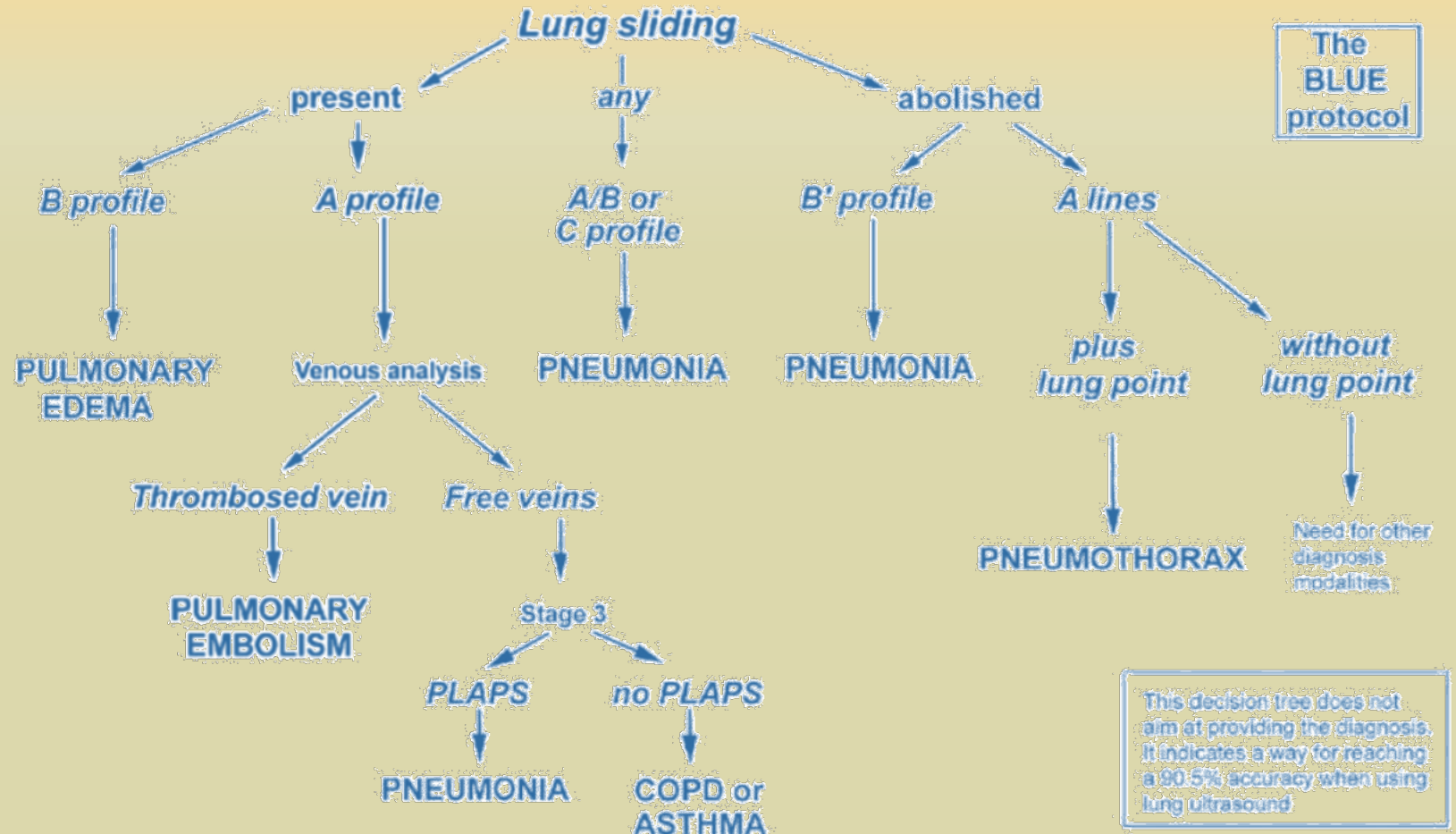
Une TVP à l'écho, ça suffit pour thrombolyser ?



Relevance of Lung Ultrasound in the Diagnosis of Acute Respiratory Failure*

The BLUE Protocol

Daniel A. Lichtenstein, MD, FCCP; and Gilbert A. Mezière, MD





Relevance of Lung Ultrasound in the Diagnosis of Acute Respiratory Failure*

The BLUE Protocol

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Lung sliding

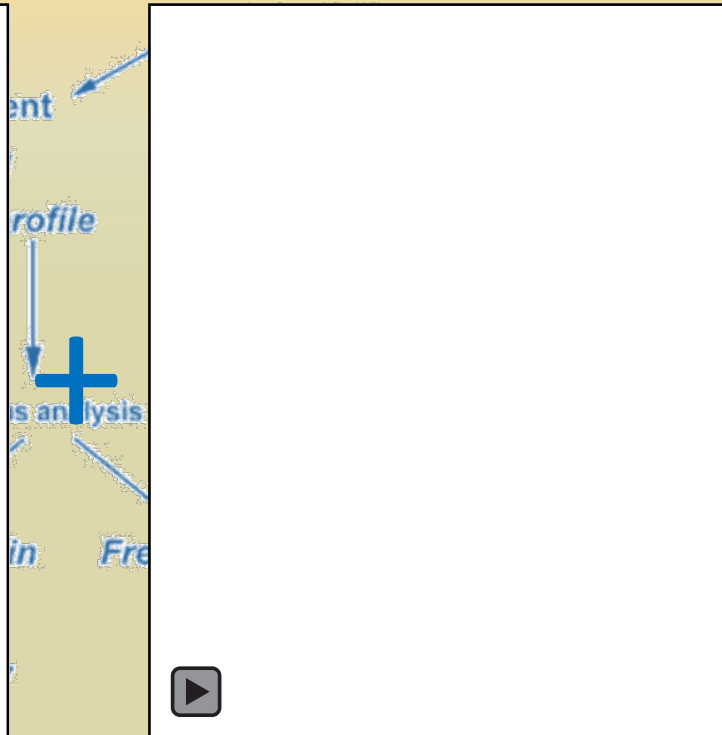
present

A profile

Venous analysis

Thrombosed vein

PULMONARY EMBOLISM



The BLUE protocol

A lines

plus lung point = EP without lung point

NEUMOTHORAX

Need for other diagnosis modalities

PLAPS

no PLAPS

PNEUMONIA

COPD or ASTHMA

Sens. 81% - Spé. 99%

This decision tree does not aim at providing the diagnosis. It indicates a way for reaching a high accuracy when using lung ultrasound



Relevance of Lung Ultrasound in the Diagnosis of Acute Respiratory Failure*

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Lung sliding

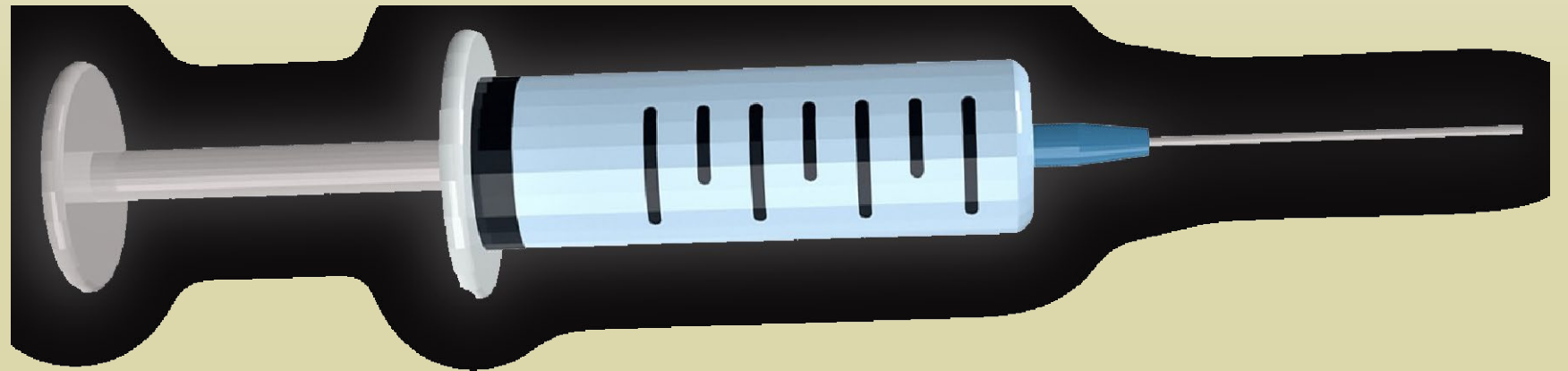
present

A profile

Venous analysis

Thrombosed vein

PULMONARY
EMBOLISM



Désobstruction ??

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)

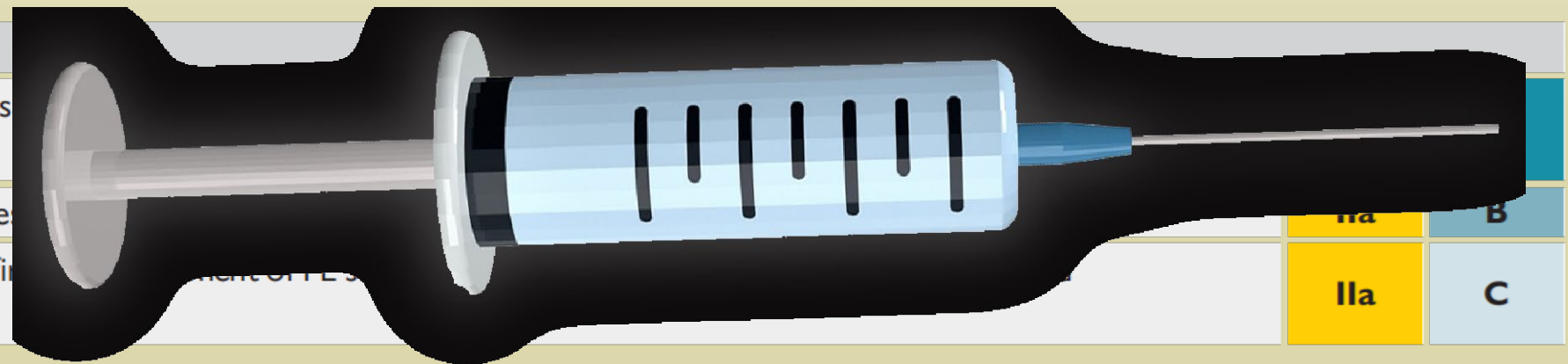


Lower-limb CUS

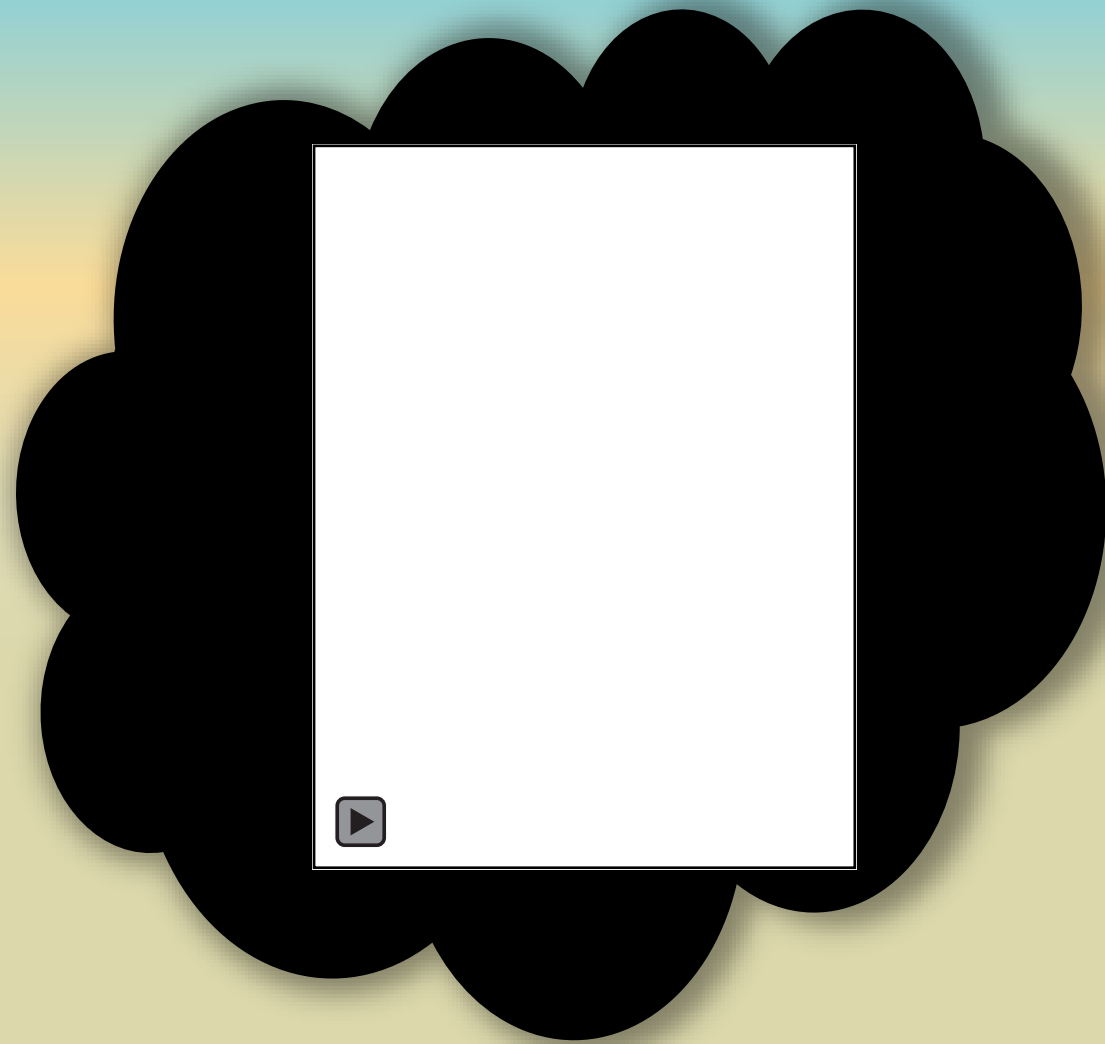
It is recommended to accept the diagnosis of PE.^{164,165}

If CUS shows only a distal DVT, further testing is not recommended.

If a positive proximal CUS is used to confirm the diagnosis of PE, further testing is not recommended for management.^{178,179}

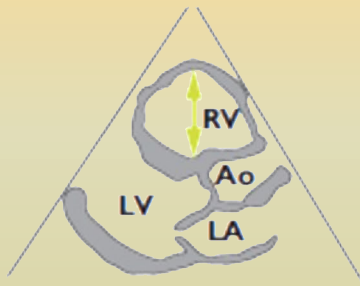


ANTICOAGULATION ??

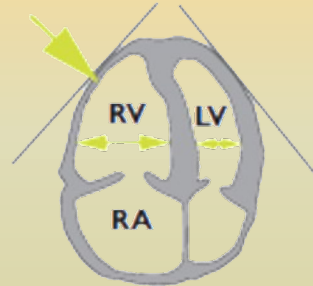


Un 'gros' VD, est-ce que ça suffit ?

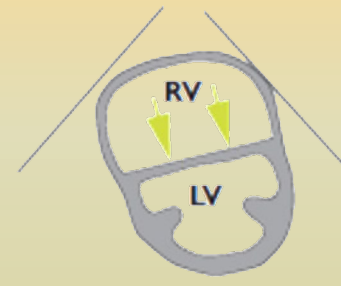
2019 ESC Guidelines for the diagnosis and management of acute pulmonary embolism developed in collaboration with the European Respiratory Society (ERS)



A. Enlarged right ventricle, parasternal long axis view



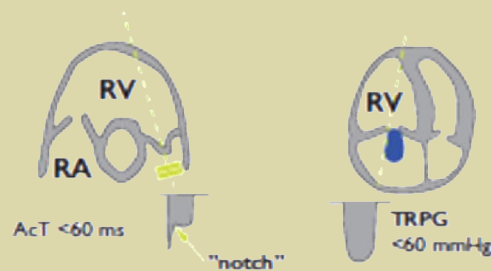
B. Dilated RV with basal RV/LV ratio > 1.0 , and McConnell sign (arrow), four chamber view



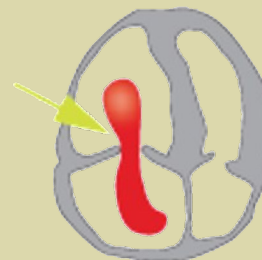
C. Flattened intraventricular septum (arrows) parasternal short axis view



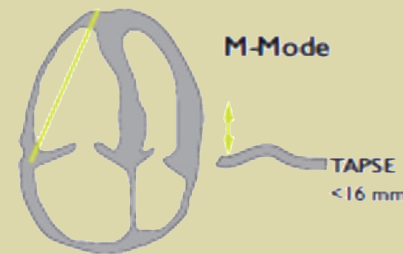
D. Distended inferior vena cava with diminished inspiratory collapsibility, subcostal view



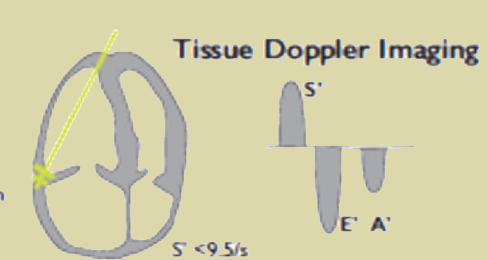
E. 60/60 sign: coexistence of acceleration time of pulmonary ejection < 60 ms and mid-systolic "notch" with mildly elevated (< 60 mmHg) peak systolic gradient at the tricuspid valve



F. Right heart mobile thrombus detected in right heart cavities (arrow)

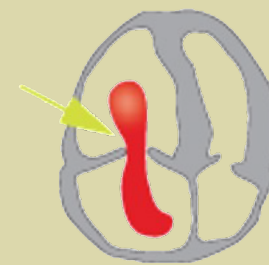
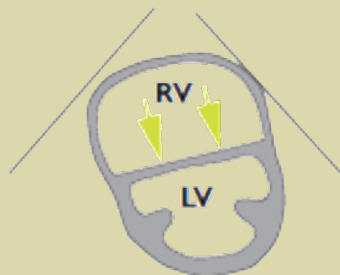
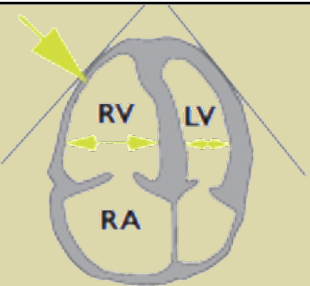


G. Decreased tricuspid annular plane systolic excursion (TAPSE) measured with M-Mode (< 16 mm)



H. Decreased peak systolic (S') velocity of tricuspid annulus (< 9.5 cm/s)

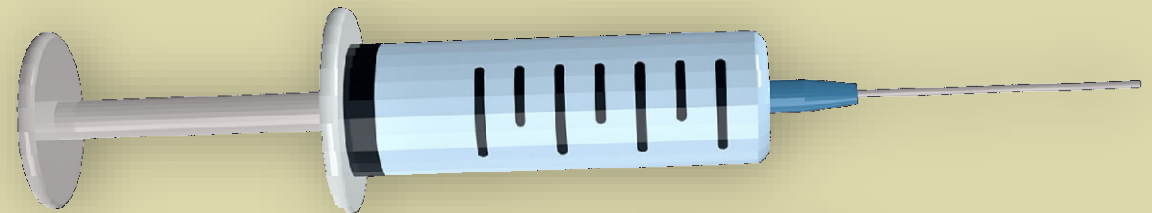
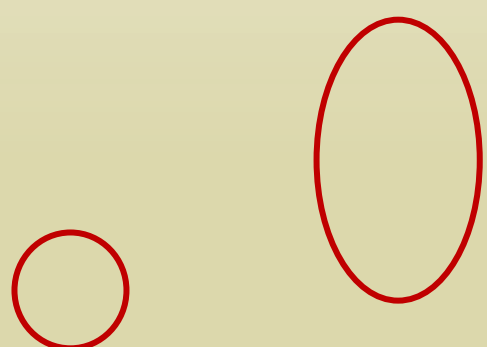
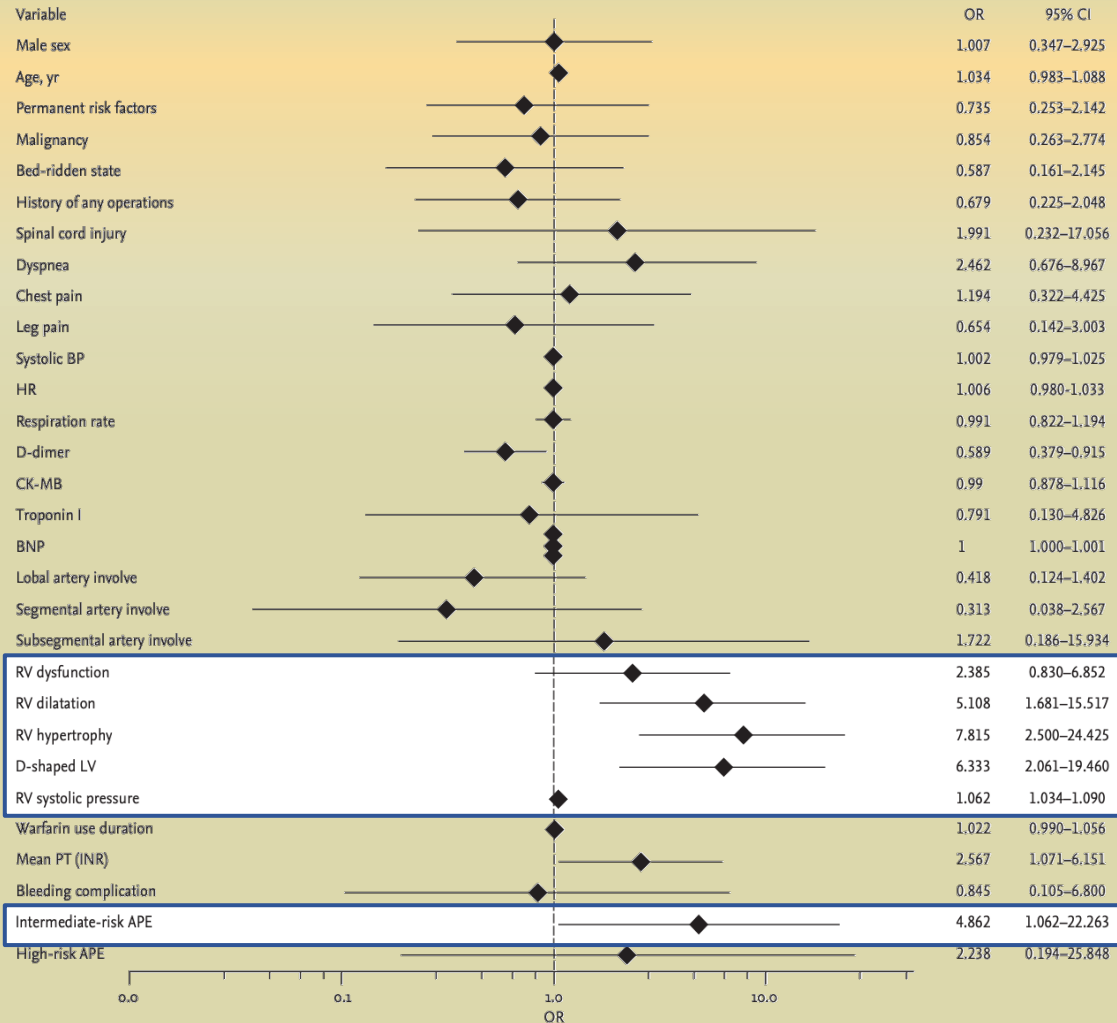
2019 ESC Guidelines for the diagnosis and management of acute pulmonary embolism developed in collaboration with the European Respiratory Society (ERS)



The predictive value of echocardiography for chronic thromboembolic pulmonary hypertension after acute pulmonary embolism in Korea

Jin Sup Park, Jinhee Ahn, Jung Hyun Choi, Hye Won Lee, Jun-Hyok Oh, Han Cheol Lee, Kwang Soo Cha, and Taek Jong Hong

Prévalence de CPC post-EP à 6,1 %



Thrombolyse préventive ??

Figure 2. Risk factors for developing chronic thromboembolic pulmonary hypertension on univariate analysis. OR, odds ratio; CI, confidence interval; BP, blood pressure; HR, heart rate; CK-MB, creatine kinase MB fraction; BNP, brain natriuretic peptide; RV, right ventricular; LV, left ventricular; PT, prothrombin time; INR, international normalized ratio; APE, acute pulmonary embolism.

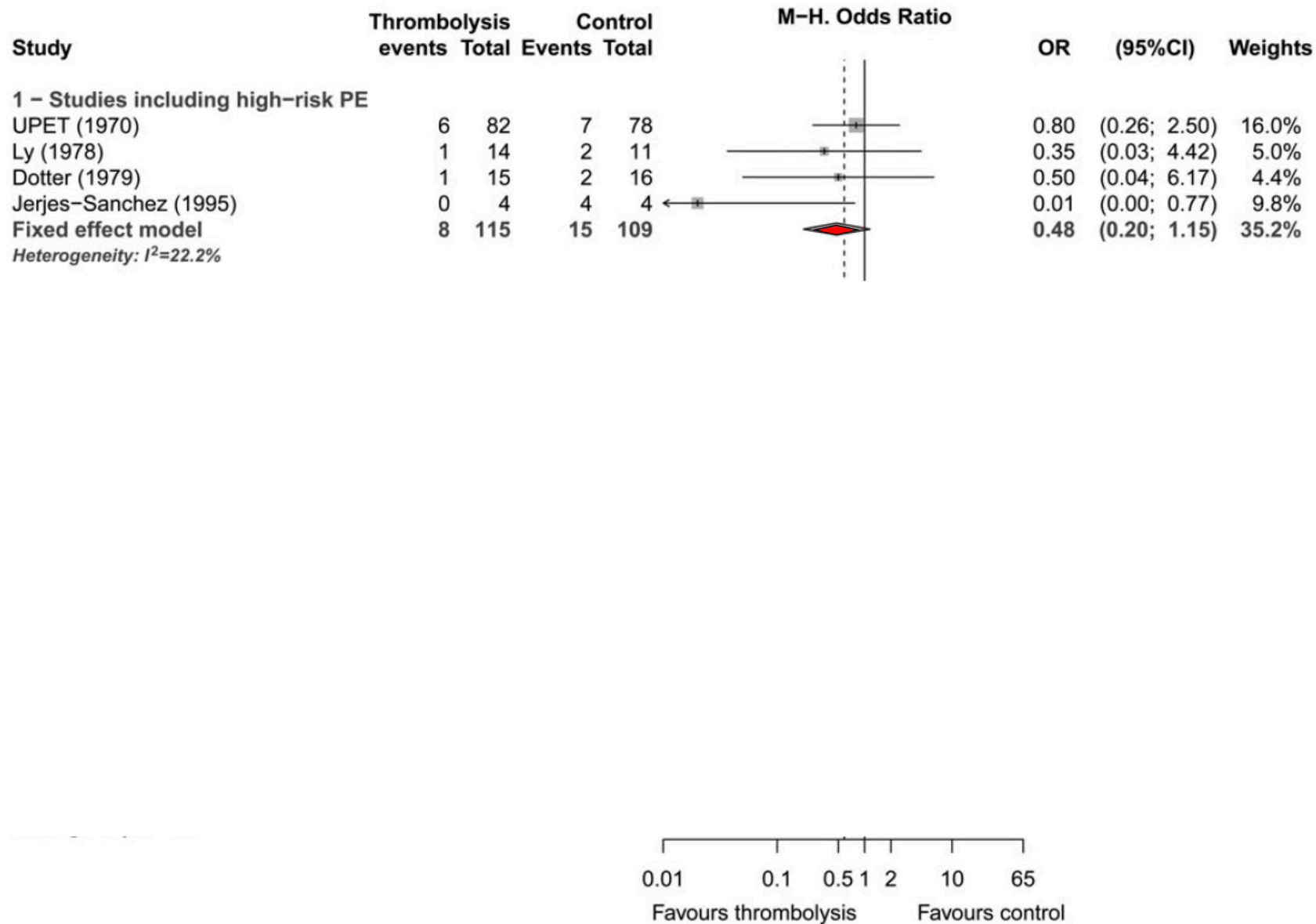
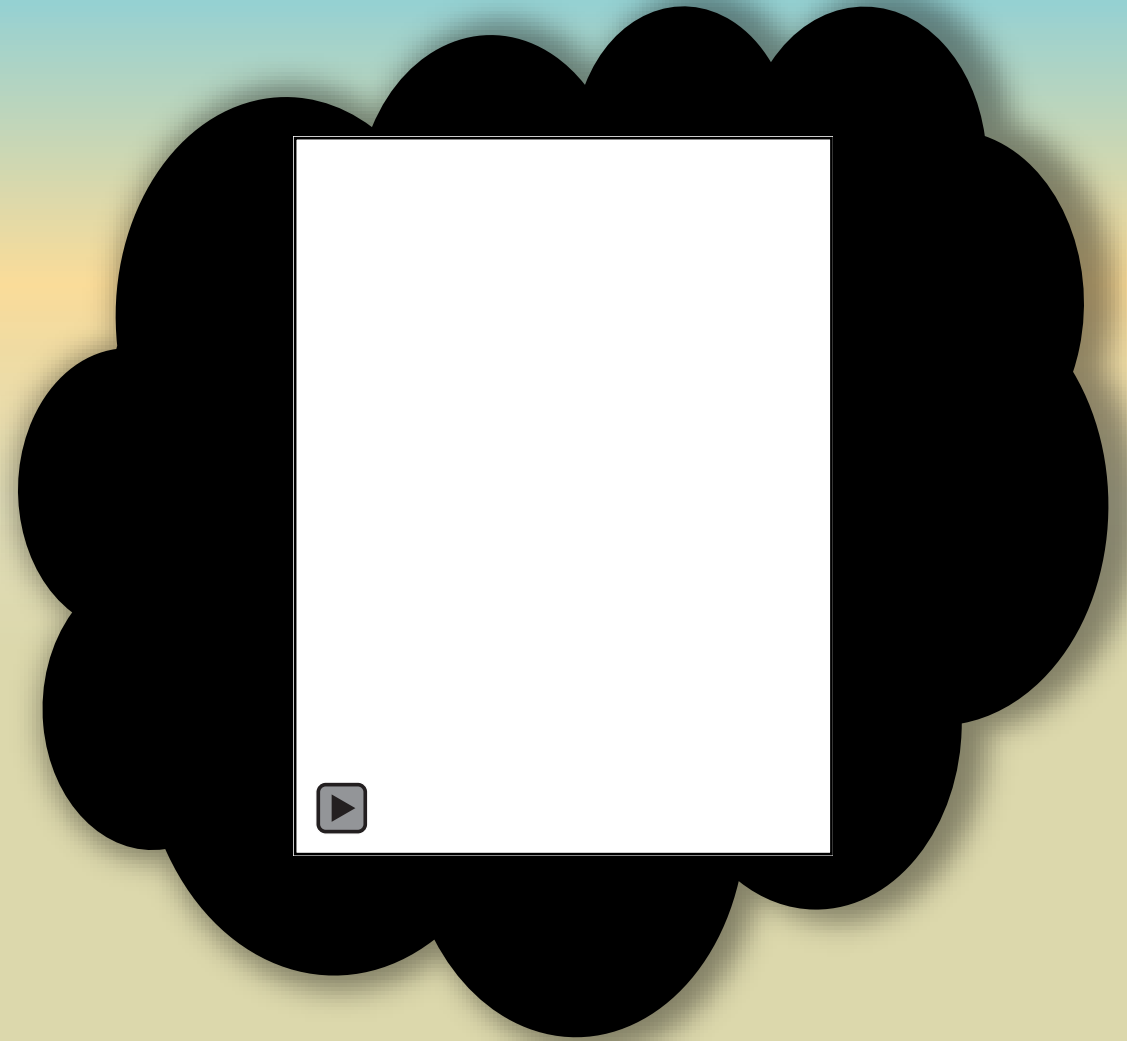
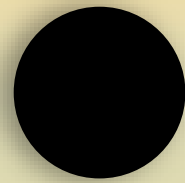


Figure 2 Early mortality by pulmonary embolism severity, Forest plot.

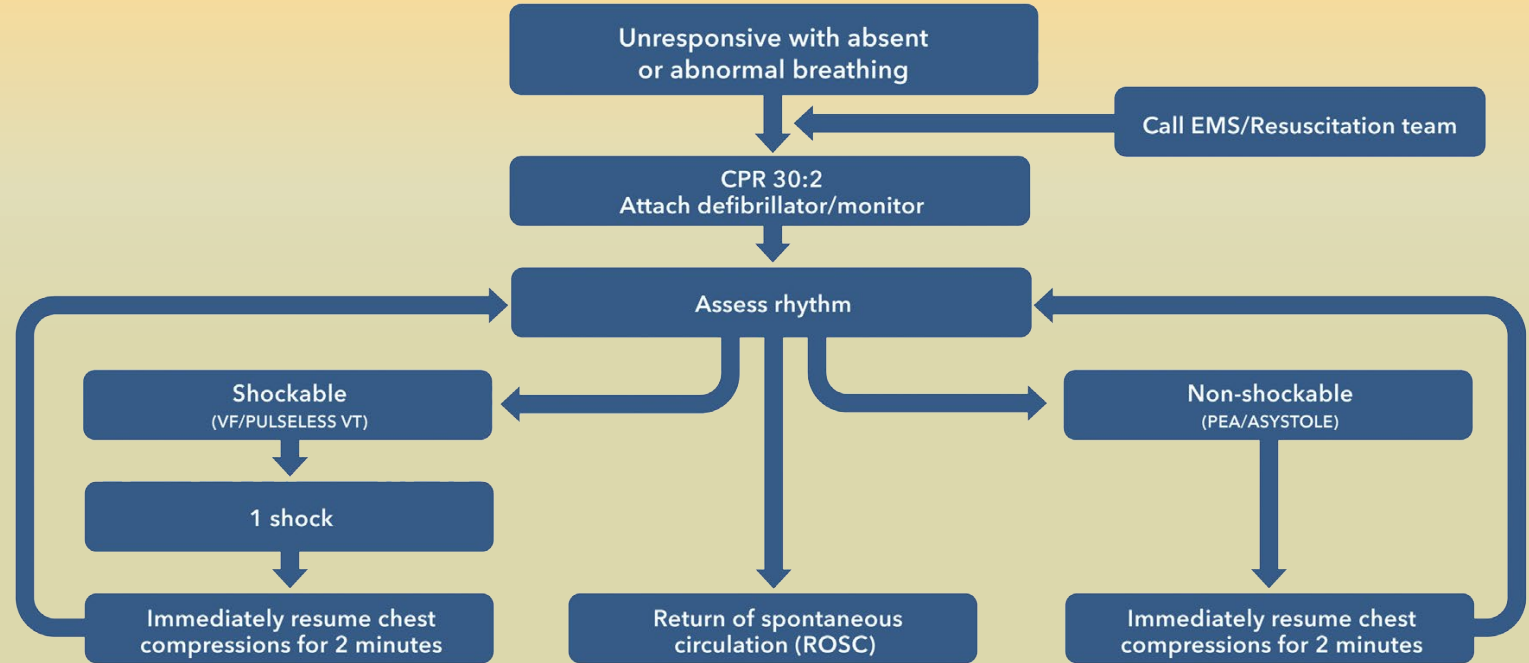


Et sur un arrêt cardiaque ?

European Resuscitation Council Guidelines 2021: Adult advanced life support



The guideline recognises the increasing role of **point-of-care ultrasound (POCUS)** in peri-arrest care for diagnosis, but emphasises that it requires a **skilled operator**, and the need to **minimise interruptions** during chest compression.



Give high-quality chest compressions and

- Give oxygen
- Use waveform capnography
- Continuous compressions if advanced airway
- Minimise interruptions to compressions
- Intravenous or intraosseous access
- Give adrenaline every 3-5 min
- Give amiodarone after 3 shocks
- Identify and treat reversible causes

Identify and treat reversible causes

- Hypoxia
 - Hypovolaemia
 - Hypo-/hyperkalemia/metabolic
 - Hypo-/hyperthermia
 - Thrombosis - coronary or pulmonary
 - Tension pneumothorax
 - Tamponade- cardiac
 - Toxins
- Consider ultrasound imaging to identify reversible causes

Consider

- Coronary angiography/percutaneous coronary intervention
- Mechanical chest compressions to facilitate transfer/treatment
- Extracorporeal CPR

After ROSC

- Use an ABCDE approach
- Aim for SpO₂ of 94-98% and normal PaCO₂
- 12 Lead ECG
- Identify and treat cause
- Targeted temperature management

European Resuscitation Council Guidelines 2021: Adult advanced life support



Identify and treat reversible causes

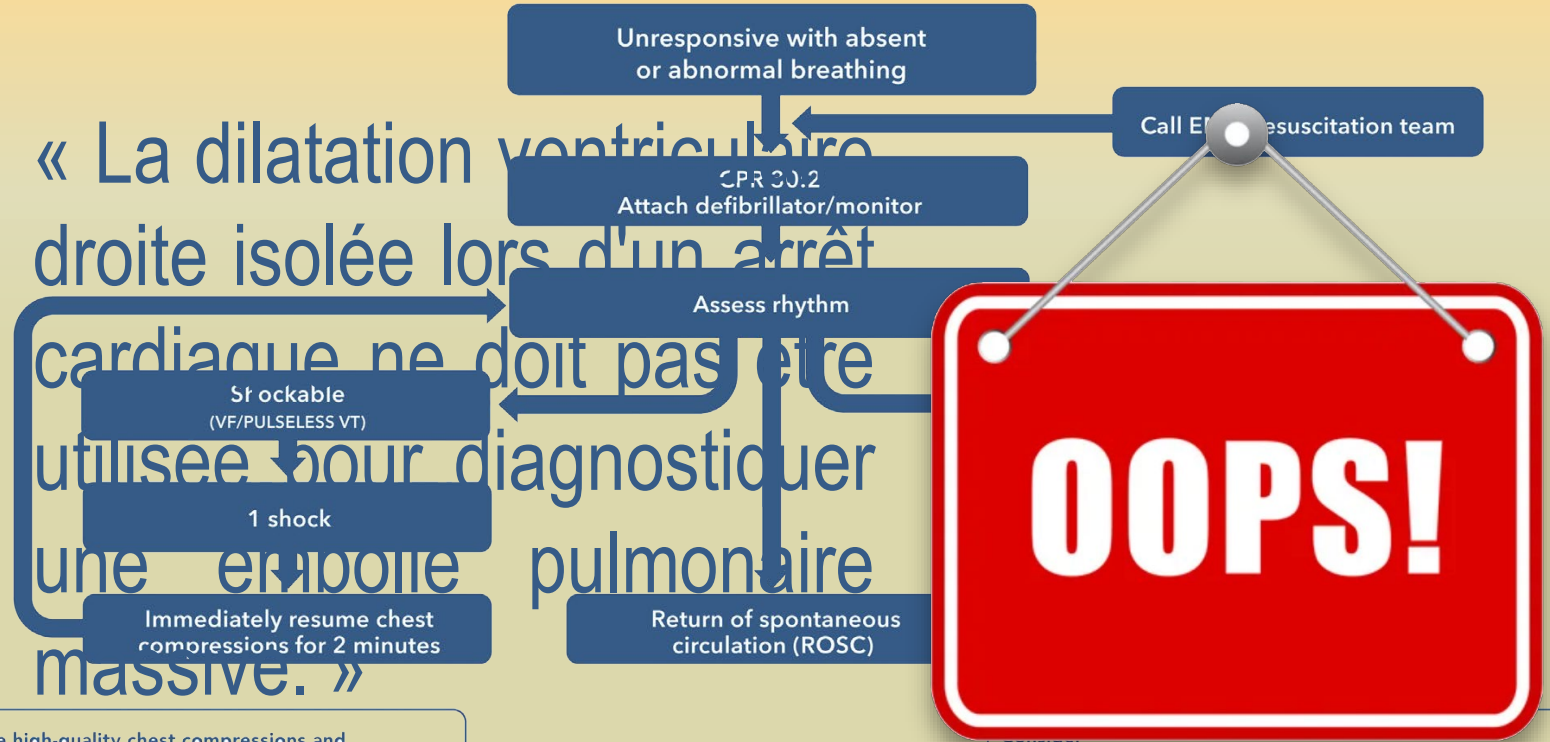
- Hypoxia
- Hypovolaemia
- Hypo-/hyperkalemia/metabolic
- Hypo-/hyperthermia
- Thrombosis - coronary or pulmonary
- Tension pneumothorax
- Tamponade- cardiac
- Toxins

Consider ultrasound imaging to identify reversible causes

« La dilatation ventriculaire droite isolée lors d'un arrêt cardiaque ne doit pas être utilisée pour diagnostiquer une embolie pulmonaire massive. »

Give high-quality chest compressions and

- Give oxygen
- Use waveform capnography
- Continuous compressions if advanced airway
- Minimise interruptions to compressions
- Intravenous or intraosseous access
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- ### After ROSC
- Use an ABCDE approach
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European Resuscitation Council Guidelines 2021: Adult advanced life support



$$VD/VG = 1$$

Compressions
thoraciques

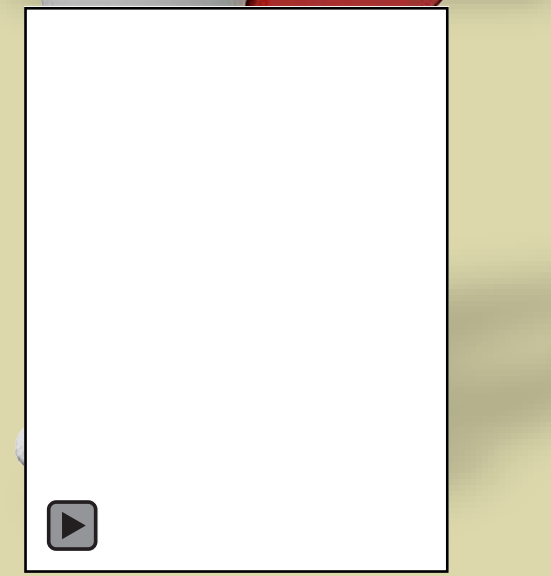
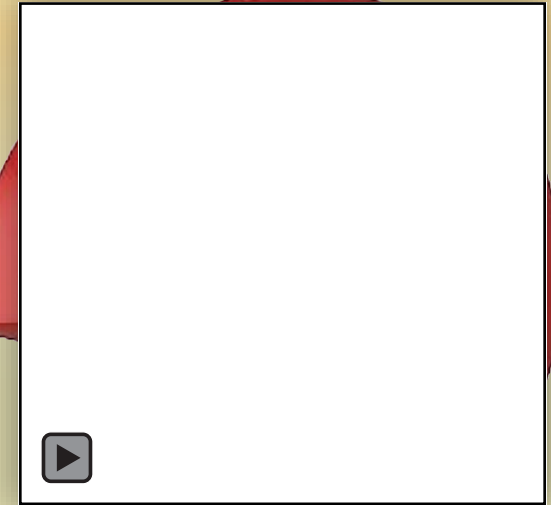
$$VD/VG < 1$$



En cas d'ACR,
VD rapidement = VG

Compressions
thoraciques

$$VD/VG \geq 1$$



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)

Suspicion d'EP avec instabilité hémodynamique

Echo cardiaque transthoracique au lit du malade

Dysfonction VD (VD/VG > 1)

Non

Oui

Angioscanner immédiatement disponible et réalisable

Non

Oui

Négatif

Angioscanner

Positif

Rechercher une autre cause de choc ou d'instabilité HD

Traitement d'une EP à haut risque

Recommendations	2014	2019
Rescue thrombolytic therapy is recommended for patients who deteriorate haemodynamically.	IIa	I





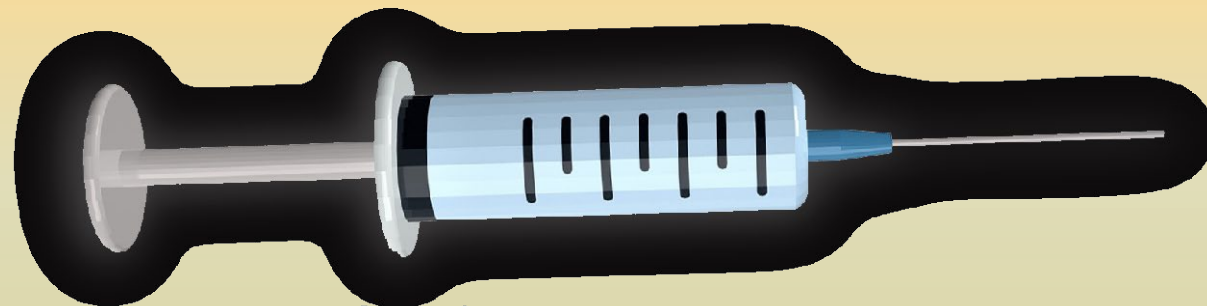
Available online at www.sciencedirect.com

Resuscitation

journal homepage: www.elsevier.com/locate/resuscitation



European Resuscitation Council Guidelines 2021: Adult advanced life support



Désobstruction !!

$$VD/VG = 1$$

Compressions
thoraciques

$$VD/VG \geq 1$$



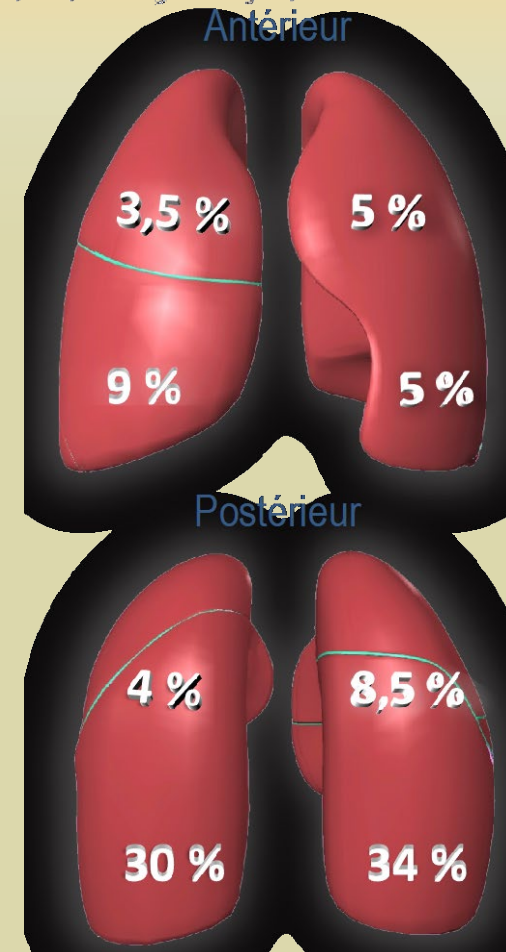
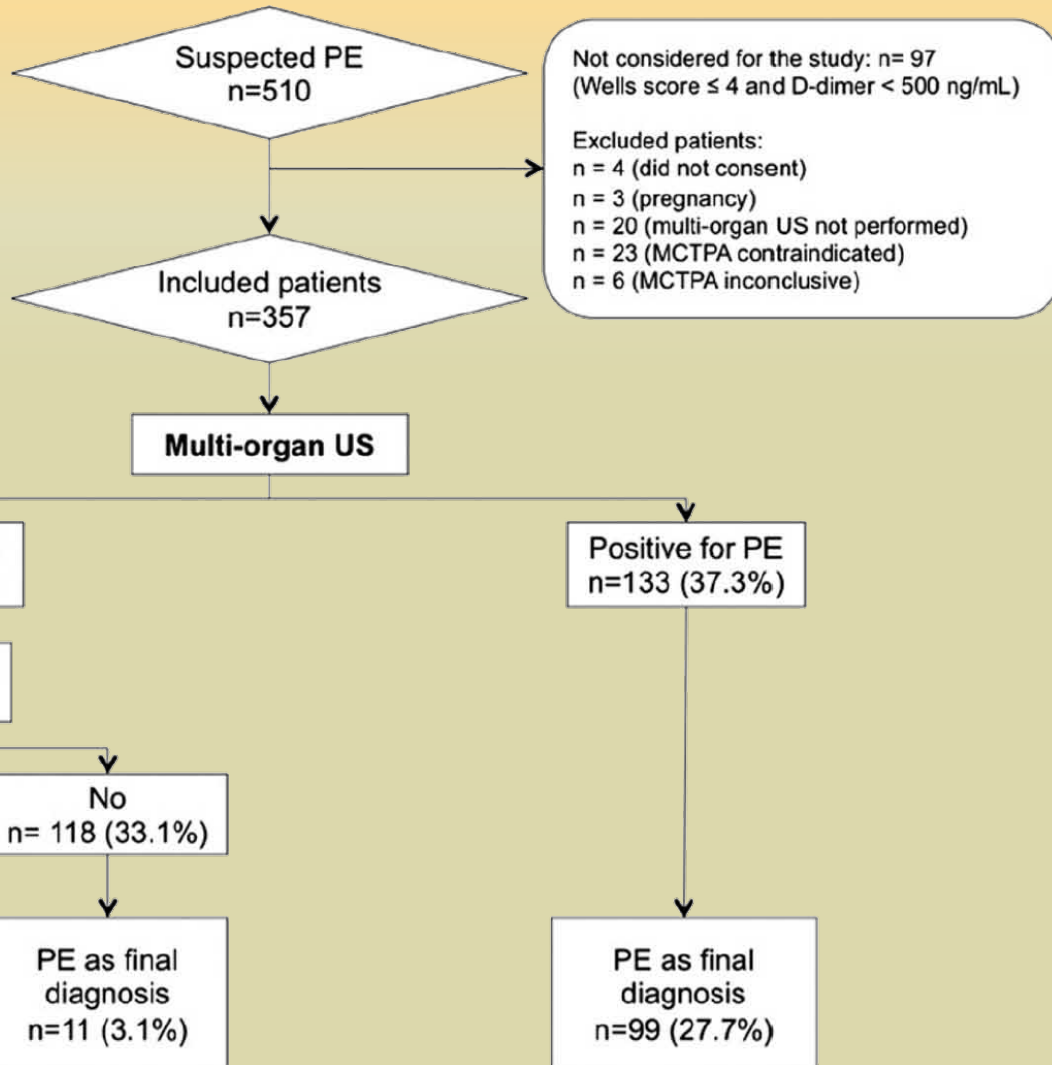


Approche multi-organe ?



Accuracy of Point-of-Care Multiorgan Ultrasonography for the Diagnosis of Pulmonary Embolism

Peiman Norouzi, MD; Simon Vanni, MD, PhD; Giovanni Volpicelli, MD, FCCP; Chiara Cighi, MD; Maurizio Zanchetti, MD; Maurizio Bartolucci, MD; Antonio Cavatone, MD; Alessandro Lomarte, MD; Andrea Feltri, MD; Andrea Fabrizi, MD; and Stefano Carfoni, MD





CHEST 2014; 145(5):950–957

PULMONARY PROCEDURES

Accuracy of Point-of-Care Multiorgan Ultrasonography for the Diagnosis of Pulmonary Embolism

Peiman Nazarian, MD; Simonis Vanni, MD, PhD; Giovanni Volpicelli, MD, FCCP; Chiara Cighi, MD; Maurizio Zanabetti, MD; Maurizio Bartolucci, MD; Antonio Chavattone, MD; Alessandro Lomarte, MD; Andrea Feltri, MD; Andrea Fabrizi, MD; and Stefano Carfoni, MD

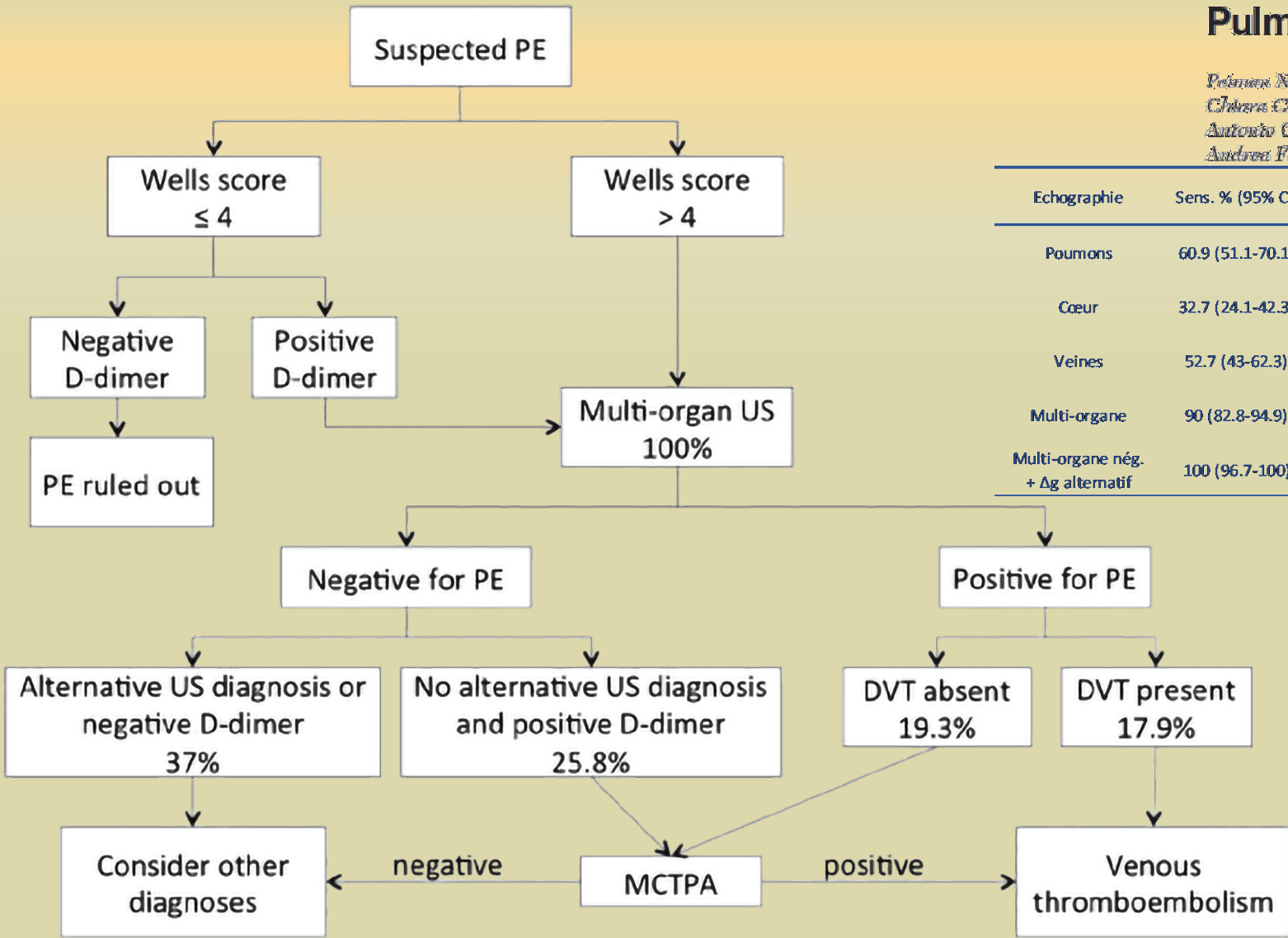
Echographie	Sens. % (95% CI)	Spéc. % (95% CI)	VPP % (95% CI)	VPN % (95% CI)	RV + (IC 95 %)	RV - (IC 95%)
Poumons	60.9 (51.1-70.1)	95.9 (92.7-98)	87 (77.4-93.6)	84.6 (79.9-88.7)	15 (8-28.1)	0.4 (0.3-0.5)
Cœur	32.7 (24.1-42.3)	90.9 (86.6-94.2)	62.1 (48.4-74.5)	74.8 (69.5-79.7)	3.6 (2.2-5.8)	0.7 (0.6-0.8)
Veines	52.7 (43-62.3)	97.6 (94.8-99.1)	90.6 (80.7-96.5)	82.2 (77.4-86.4)	21.7 (9.7-48.8)	0.5 (0.4-0.6)
Multi-organe	90 (82.8-94.9)	86.2 (81.3-90.3)	74.4 (66.1-81.6)	95.1 (91.4-97.5)	6.5 (4.8-8.9)	0.12 (0.07-0.2)
Multi-organe nég. + Δg alternatif	100 (96.7-100)	42.9 (36.7-49.3)	43.8 (37.6-50.2)	100 (96.5-100)	1.75 (1.6-1.9)	0



Accuracy of Point-of-Care Multiorgan Ultrasonography for the Diagnosis of Pulmonary Embolism

Peiman Norouzi, MD; Simon Vanni, MD, PhD; Giovanni Volpicelli, MD, FCCP; Chiara Cighi, MD; Maurizio Zambetti, MD; Maurizio Bartolucci, MD; Antonio Chivattone, MD; Alessandro Lomarte, MD; Andrea Feltri, MD; Andrea Fabrizi, MD; and Stefano Carfoni, MD

Echographie	Sens. % (95% CI)	Spéc. % (95% CI)	VPP % (95% CI)	VPN % (95% CI)	RV + (IC 95%)	RV - (IC 95%)
Poumons	60.9 (51.1-70.1)	95.9 (92.7-98)	87 (77.4-93.6)	84.6 (79.9-88.7)	15 (8-28.1)	0.4 (0.3-0.5)
Cœur	32.7 (24.1-42.3)	90.9 (86.6-94.2)	62.1 (48.4-74.5)	74.8 (69.5-79.7)	3.6 (2.2-5.8)	0.7 (0.6-0.8)
Veines	52.7 (43-62.3)	97.6 (94.8-99.1)	90.6 (80.7-96.5)	82.2 (77.4-86.4)	21.7 (9.7-48.8)	0.5 (0.4-0.6)
Multi-organe	90 (82.8-94.9)	86.2 (81.3-90.3)	74.4 (66.1-81.6)	95.1 (91.4-97.5)	6.5 (4.8-8.9)	0.12 (0.07-0.2)
Multi-organe nég. + Ag alternatif	100 (96.7-100)	42.9 (36.7-49.3)	43.8 (37.6-50.2)	100 (96.5-100)	1.75 (1.6-1.9)	0



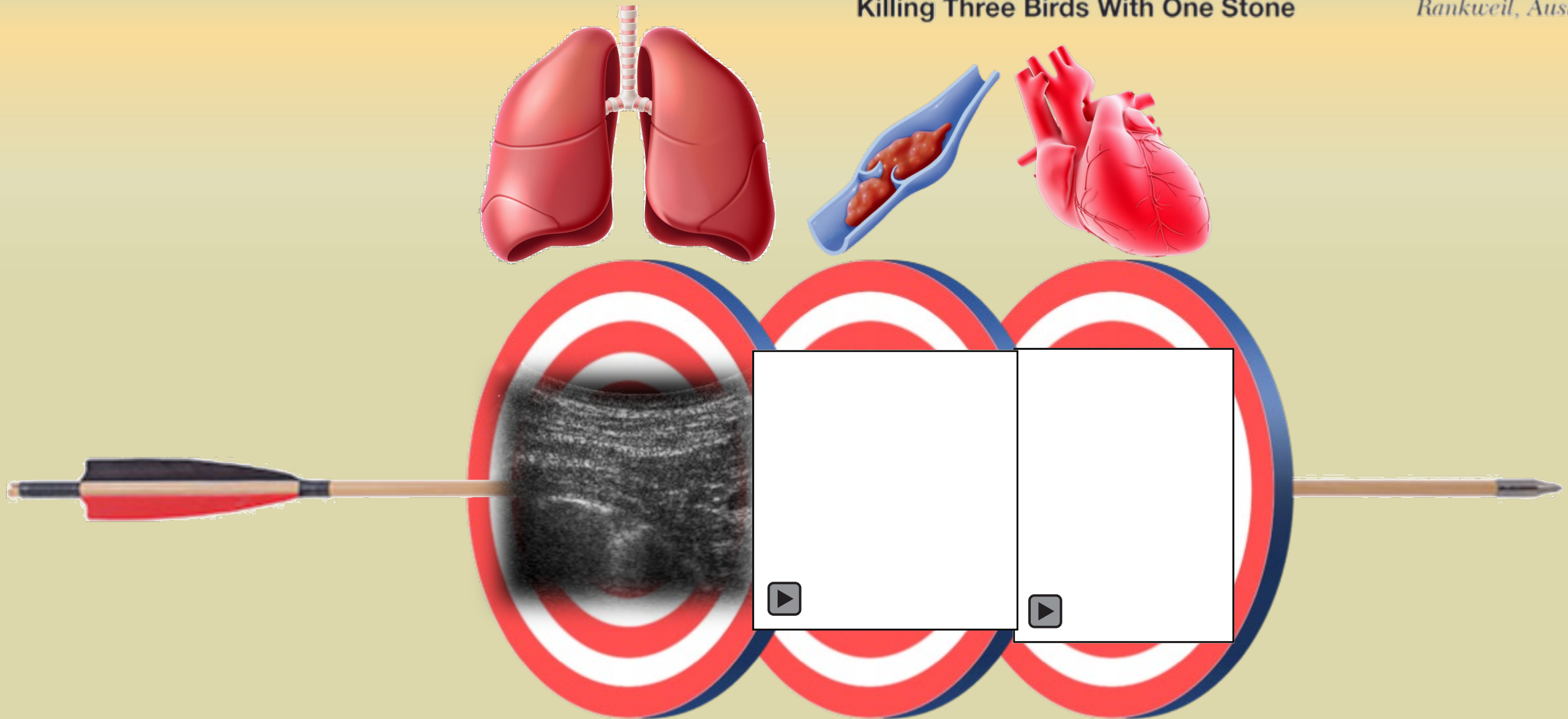
Potentiellement, près d'1 patient sur 2 pourrait éviter l'angioscanner !



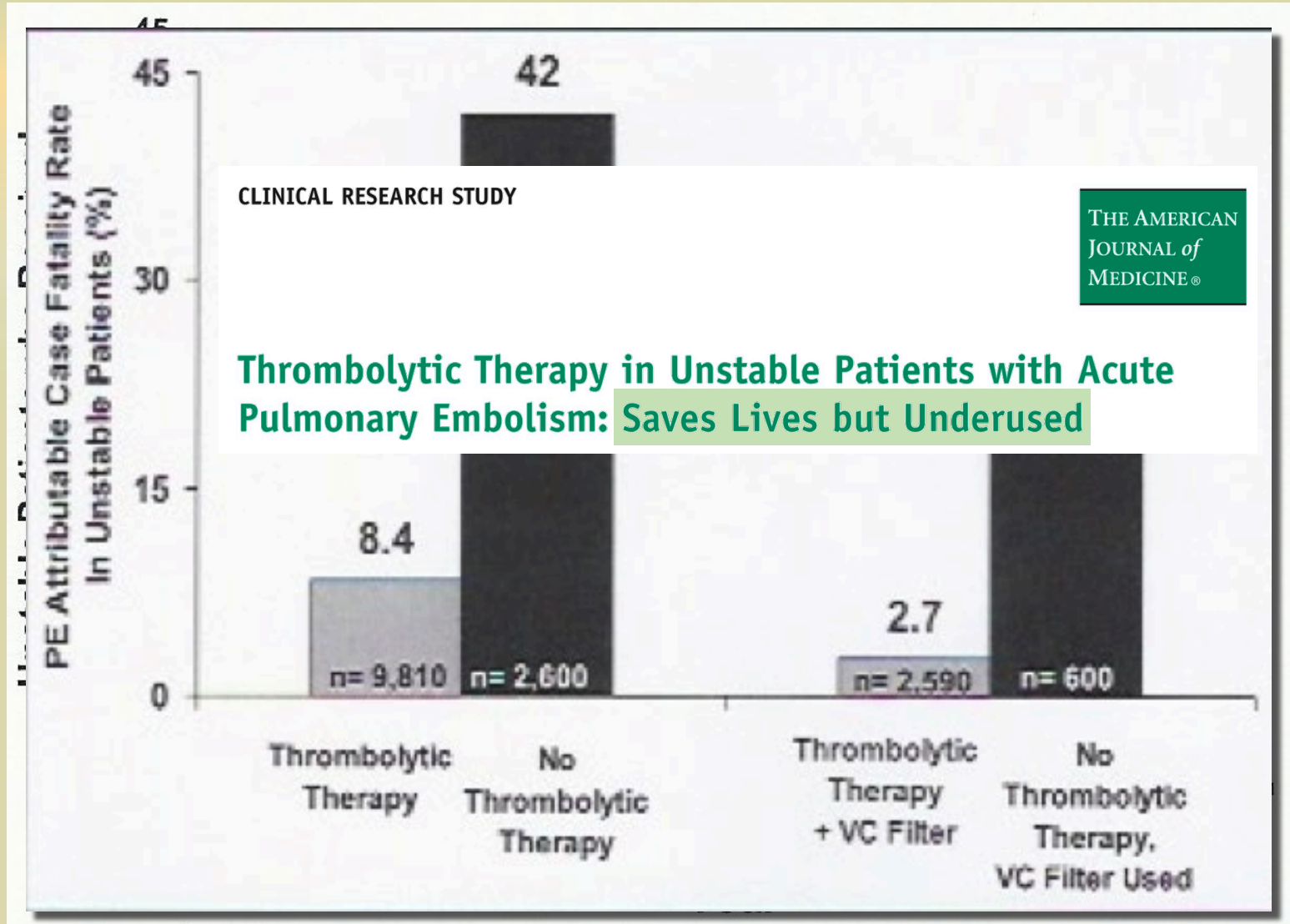
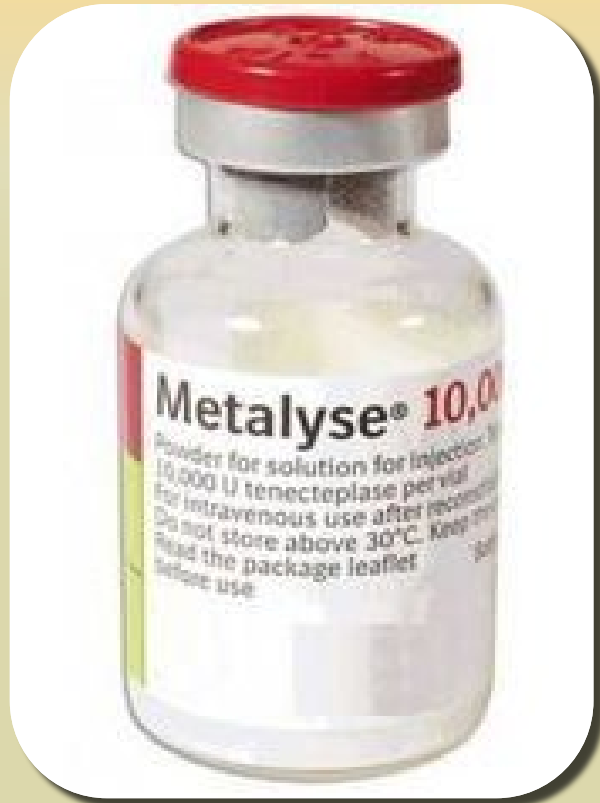
Thromboembolism in Ultrasound

Killing Three Birds With One Stone

Gebhard Mathis, MD
Rankweil, Austria



Dans la "vraie vie" : 72.230 EP + choc / ventilation



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