Lungenembolie/Thrombose: interventionelle Therapieoptionen

Enrique Alejandre Lafont

https://www.kssg.ch/netzwerk-radiologie

28.02.2024

Lungenembolie:

Die akute Gesamtmortalität nach PE ist über zwei Jahrzehnte hinweg konstant hoch geblieben (>10%)[1,2]

Nach PE beträgt die 30-Tage-Wiederaufnahmerate fast 25 %[3]

bis zu 50% der Patienten berichten nach 3–6 Monaten über anhaltende Dyspnoe, Belastungsintoleranz und/oder Funktionseinschränkungen[4]

Leitlinien schlagen Katheterverfahren erst vor, wenn Thrombolytika versagen oder kontraindiziert sind oder eine hämodynamische Verschlechterung auftritt[5]

Bei thrombolytisch basierten Behandlungsstrategien besteht aber nach wie vor ein erhebliches Blutungsrisiko, ihr Einsatz wird durch entsprechende Kontraindikationen limitiert und eine zeitintensive intensivmedizinische Überwachung ist erforderlich

Die mechanische Embolektomie reduziert die Rechtsherzbelastung schnell und sicher,

Komplikationen sind selten (in 3 Jahren Einsazt am KSSG keine Major Komplikation, kein Todesfall)

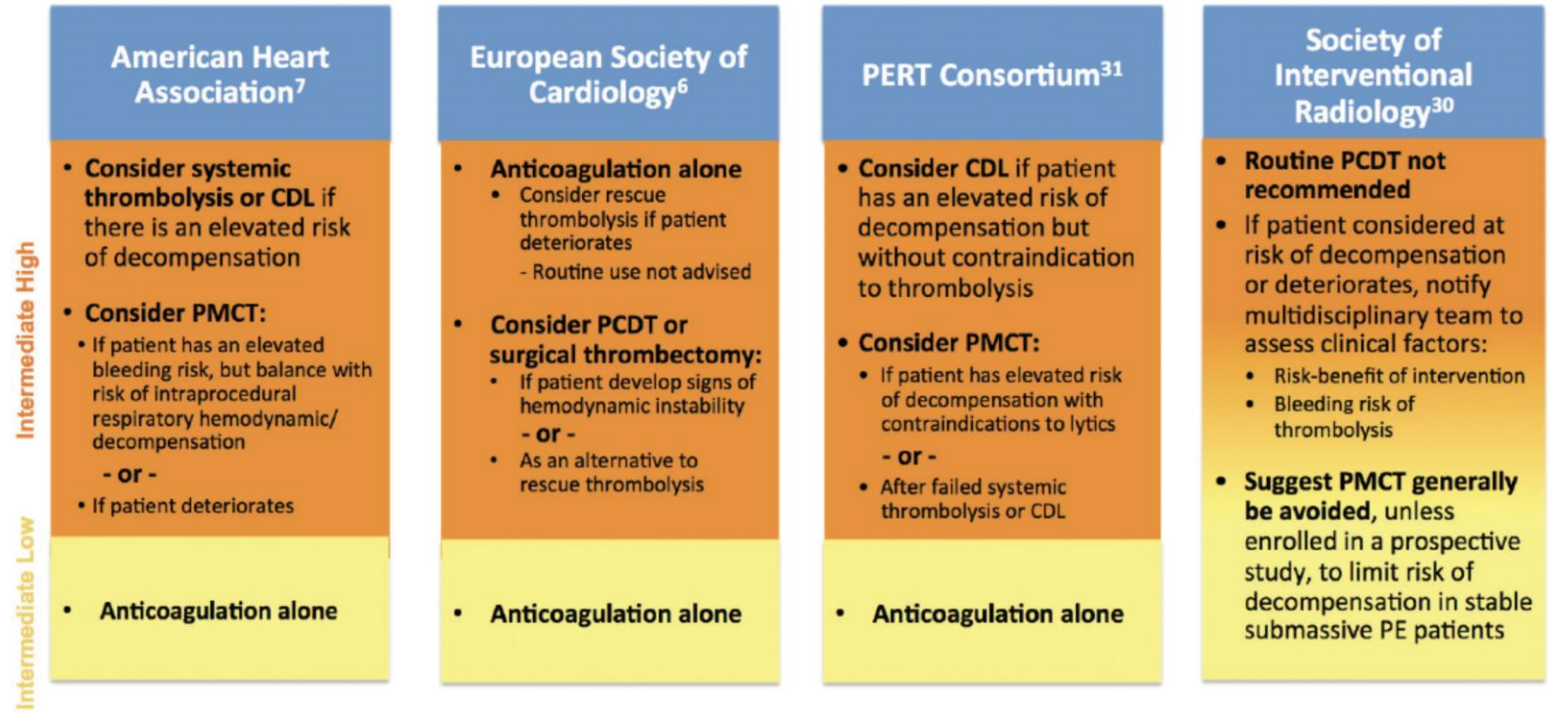
1. Kucher N, et al. Circulation. 2006 (ICOPER)
2. PERT Consortium Quality Database. Presented by E. Secemsky (October 2021)
3. PERT Consortium Quality Database. Presented by R. Lookstein (October 2020)
4. Luijten D, et al. Semin Thromb Hemost. 2022
5. Konstantinides SV, et al. Eur Heart J. 2020 (ESC Guidelines)

ESC Guidelines 2019

6.6 Recommendations for acute-phase treatment of high-risk pulmonary embolism[a]

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

ECMO = extracorporeal membrane oxygenation; PE = pulmonary embolism; UFH = unfractionated heparin.
[a]See *Table 4* for definition of high-risk PE. After haemodynamic stabilization of the patient, continue with anticoagulation treatment as in intermediate- or low-risk PE (*section 6.7*).
[b]Class of recommendation.
[c]Level of evidence.
[d]If appropriate expertise and resources are available on-site.



© ESC 2019

Figure 2. Society recommendations for catheter-directed therapies in submassive PE. CDL, catheter-directed lysis; PCDT, pharmacomechanical catheter-directed therapy. Note: All acronyms have been standardized to match nomenclature in this manuscript; terminology may vary across guidances.

(s)PESI Score
ESC Guidelines 2019

Score um die Schwere einer Lungenembolie zu beurteilen. Abschätzung der **30-Tage-Mortalität** bei Patienten mit akuter Lungenembolie.

TABLE 7 Original and simplified Pulmonary Embolism Severity Index

Parameter	Original version [226]	Simplified version [229]
Age	Age in years	1 point (if age >80 years)
Male sex	+10 points	–
Cancer	+30 points	1 point
Chronic heart failure	+10 points	1 point
Chronic pulmonary disease	+10 points	
Pulse rate ⩾110 b.p.m.	+20 points	1 point
Systolic BP <100 mmHg	+30 points	1 point
Respiratory rate >30 breaths per min	+20 points	–
Temperature <36°C	+20 points	–
Altered mental status	+60 points	–
Arterial oxyhaemoglobin saturation <90%	+20 points	1 point
Risk strata[a]	**Class I: ⩽65 points** very low 30 day mortality risk (0–1.6%) **Class II: 66–85 points** low mortality risk (1.7–3.5%) **Class III: 86–105 points** moderate mortality risk (3.2–7.1%) **Class IV: 106–125 points** high mortality risk (4.0–11.4%) **Class V: >125 points** very high mortality risk (10.0–24.5%)	**0 points** 30 day mortality risk 1.0% (95% CI 0.0–2.1%) **⩾1 point(s)** 30 day mortality risk 10.9% (95% CI 8.5–13.2%)

BP: blood pressure; b.p.m.: beats per minute; CI: confidence interval. [a]Based on the sum of points.

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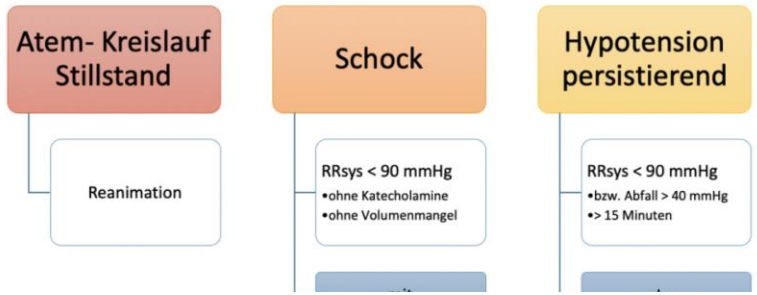
Diagnostik und Therapie der Venenthrombose und Lungenembolie

S2k-Leitlinie

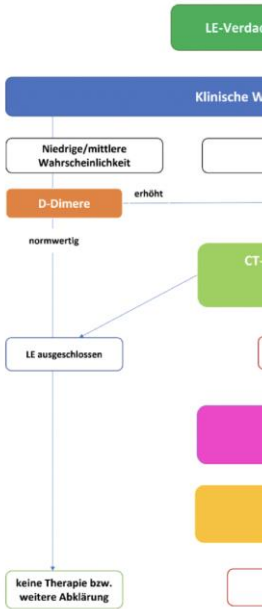
Federführende Fachgesellschaft:
Deutsche Gesellschaft für Angiologie – Gesellschaft für Gefäßmedizin

DGA
Deutsche Gesellschaft für Angiologie
Gesellschaft für Gefäßmedizin e.V.

LE: Definition der hämodynamischen Instabilität



LE-Diagnostik bei hämodynamisch stabilem Patient

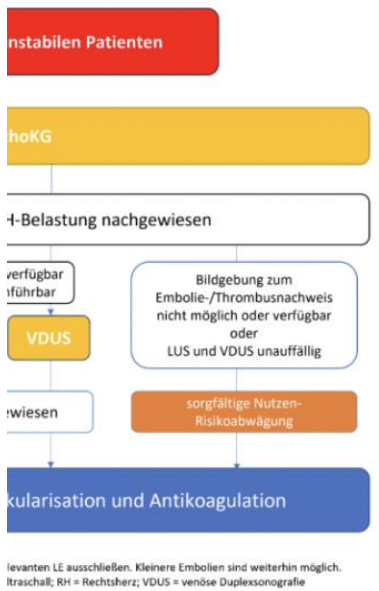


Tab. 3.5: Risikostratifizierung bei nachgewiesener Lungenembolie und frühe Sterblichkeit (30-Tages-Mortalität) (216, 336)

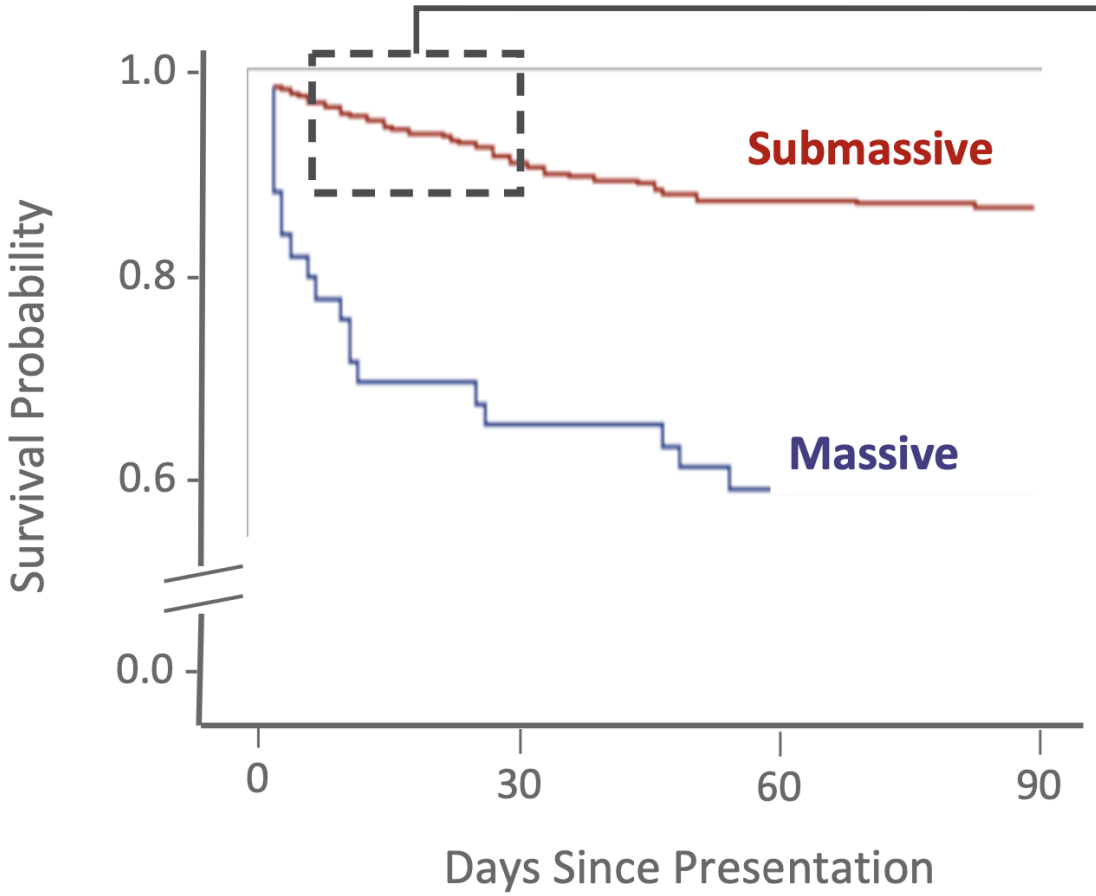
Frühmortalität (innerhalb von 30 Tagen)		Schock oder Hypotension	sPESI ≥ 1	RV-Dysfunktion in EchoKG oder CTPA	Kardiale Biomarker (z.B. Troponin, NT-proBNP)	Anteil der Patienten*
Hoch (> 20%)		ja	ja	ja	ja	12%
Intermediär	intermediär-hoch	nein	ja	RV-Dysfunktion und Biomarker erhöht		30%
	intermediär-niedrig	nein	ja	normale RV-Funktion und Biomarker oder RV-Dysfunktion oder erhöhte Biomarker		37%
Niedrig (< 1%)		nein	nein	nein	nein	22%

Abk.: EchoKG = Echokardiografie; NT-proBNP = N-terminales pro-B-natriuretisches Peptid; sPESI = simplified Pulmonary Embolism Severity Score; RV = rechtsventrikulär. * aus: Beccattini et al. Eur Respir J 2016; 48: 780-786 (336)

LE-Diagnostik bei hämodynamisch instabilem Patient



Limitations of traditional Risk Stratification



Nearly Half

Of submassive 30-day all-cause mortality occurred **after the patient left the hospital**

& nearly 2/3 of 90-day all-cause mortality

1. Secemsky E, et al. Contemporary Management and Outcomes of Patients with Massive and Submassive Pulmonary Embolism. Am J Med. 2018 Dec;131(12):1506-1514.e0

Limitations of traditional Risk Stratification

Diagnosing DVT during PE treatment may reduce PE-related mortality, and prompt timely prevention of post-thrombotic syndrome (PTS) symptoms.[1]

50-65%

Of patients with PE also have **proximal DVT**[1-3].

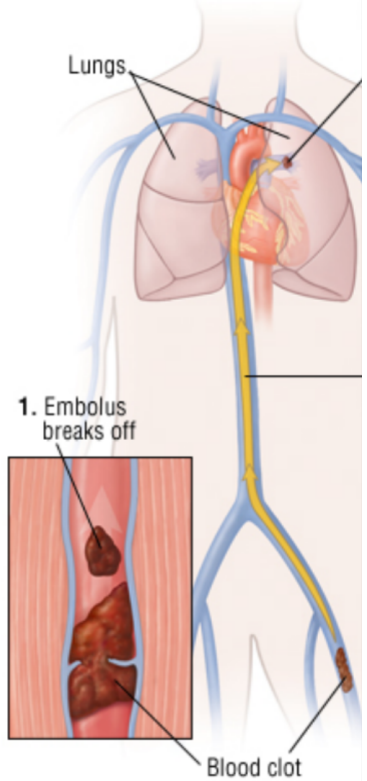
>

>4X

Risk of **90-day PE-related mortality** in PE patients with proximal DVT[4]

>4X

Risk of 90-day **recurrent VTE** in PE patients with proximal DVT[4]

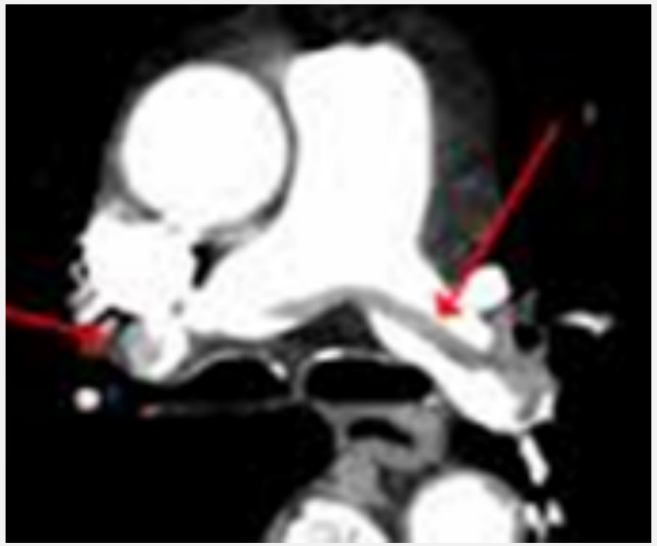


1. Hirmerova, et al. The Prevalence of Concomitant Deep Vein Thrombosis, Symptomatic or Asymptomatic, Proximal or Distal, in Patients With Symptomatic Pulmonary Embolism. Clin Appl Thromb Hemost. 2018 Nov.
2. Becattini, et al. Risk Stratification of Patients With Acute Symptomatic Pulmonary Embolism Based on Presence or Absence of Lower Extremity DVT: Systematic Review and Meta-analysis. Chest. 2016 Jan.
3. Nishiwaki, et al. Impact of Concomitant Deep Vein Thrombosis on Clinical Outcomes in Patients With Acute Pulmonary Embolism. American Heart Association. 2019 Nov.
4. Jiménez, et al. Prognostic significance of deep vein thrombosis in patients presenting with acute symptomatic pulmonary embolism. Am J Respir Crit Care Med. 2010 May

Concomitant DVT is common and predictive of adverse events

Limitations of traditional Risk Stratification

Clot size and location are **not** included in any traditional risk stratification tool



Large and Central Clot Location

Large Clot Burden[1]

>17X

Risk of 6-month all-cause mortality

*+ 2.4X risk of AEs**

Systemic review & meta-analysis, N=260

Central Clot[2]

>2X

Risk of PE-related mortality

10-year Registry (2004-2013)
Average 34-month follow-up, N=530

**Large & central clot burden are significant predictors of adverse events and easily assessed on CT*

**Adverse events include death, Pulmonary Hypertension, Intensive Care Treatment.*

1. Meinell et al. Predictive value of computed tomography in acute pulmonary embolism: Systematic review and meta-analysis. Am J Med. 2015;128:747–59.e2.
2. Martinez et al. 2016. Central Venous Peripheral Pulmonary Embolism: Analysis of the Impact on the Physiological Parameters and Long-Term Survival. N AM J Med Sci. 2016

RV/LV ratio is an independent predictor of death and hemodynamic collapse

ESC Guidelines recommend RV/LV ratio measured for all acute PE patients (2019)[5]

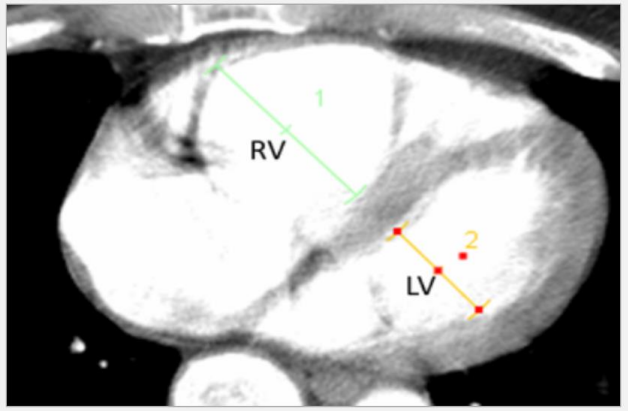


Image: FLARE IDE Study: (Tu et al. 2019)

≥0.9 Independent predictor of death, hemodynamic collapse[1,2,3].

Variables	OR (95% CI)	*P*
Age	1.01 (0.98-1.04)	0.453
TTE RV strain	—	—
CT RV/LV (0.1 increment)	1.14 (1.02-1.27)	0.023
IVC filter	1.06 (0.44-2.55)	0.888
Anticoagulation	0.19 (0.07-0.54)	0.002
Coronary artery disease	1.69 (0.68-4.22)	0.259
CHF	4.09 (1.33-12.6)	0.014
Malignancy	5.79 (2.40-14.0)	< 0.001

+0.1 For every 0.1 increase in RV/LV ratio, the odds ratio for death is 1.14[4]

1. Becattini et al. Multidetector computed tomography for acute pulmonary embolism: diagnosis and risk stratification in a single test. European Heart Journal (2011) 2. Schoepf et al. Right ventricular enlargement on chest computed tomography: a predictor of early death in acute pulmonary embolism. Circulation. 2004 3.) George et al. A retrospective analysis of catheter-based thrombolytic therapy for acute submassive and massive pulmonary embolism. Vascular Medicine. 2015, Vol. 20(2) 122–130 4.) George et al. Computed tomography and echocardiography in patients with acute pulmonary embolism part 2:prognostic value. J Thorac Imaging 2014;29:W7-W12) 5. Konstantindes et al. 2019 ESC Guidelines for the diagnosis and management of acute pulmonary embolism developed in collaboration with the European Respiratory Society (ERS)

Venous Lactate & adverse outcomes in Normotensive PE

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European Journal of Internal Medicine

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

Original article

Venous lactate improves the prediction of in-hospital adverse outcomes in normotensive pulmonary embolism

Matthias Ebner [a,b], Charlotta F. Pagel [c], Carmen Sentler [c], Veli-Pekka Harjola [d], Héctor Bueno [e,f,g], Markus H. Lerchbaumer [h], Karl Stangl [a], Burkert Pieske [b,i,j], Gerd Hasenfuß [c,k], Stavros V. Konstantinides [l,m], Mareike Lankeit [b,c,i,l,*]

Results: An optimised venous lactate cut-off value of 3.3 mmol/l predicted both, in-hospital adverse outcome (OR 11.0 [95% CI 4.6–26.3]) and all-cause mortality (OR 3.8 [95%CI 1.3–11.3]). The established cut-off value for

Conclusion: Venous lactate above the upper limit of normal was associated with increased risk for adverse outcomes and an optimised cut-off value of 3.3 mmol/l predicted adverse outcome and mortality. Adding venous lactate to the 2019 ESC algorithm may improve risk stratification. Importantly, the established cut-off value for arterial lactate has limited specificity in venous samples and should not be used.

Ebner, et al. European Journal of Internal Medicine 86 (2021) 25–31

Heart rate predicts mortality in acute symptomatic PE

[Pulmonary and Cardiovascular Original Research]

CHEST

Heart Rate and Mortality in Patients With Acute Symptomatic Pulmonary Embolism

*Ana Jaureguízar, MD; David Jiménez, MD, PhD; Behnood Bikdeli, MD; Pedro Ruiz-Artacho; Alfonso Muriel, PhD; Victor Tapson, MD; Raquel López-Reyes, MD, PhD; Beatriz Valero, MD; Gili Kenet, MD; Manuel Monreal, MD, PhD; and the Registro Informatizado de la Enfermedad TromboEmbólica Investigators**

INTERPRETATION: In nonhypotensive patients with acute symptomatic PE, a high HR portends an increased risk of all-cause and PE-related mortality. Modifying the HR cutoff in the sPESI and the Bova score improves prognostication of patients with PE.

CHEST 2021; ■(■):■-■

CHEST. 2022 Feb;161(2):524-534.

JACC: CARDIOVASCULAR INTERVENTIONS VOL. 16, NO. 8, 2023
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BACKGROUND Patients with acute pulmonary embolism (PE) and hypotension (high-risk PE) have high mortality. Cardiogenic shock can also occur in nonhypotensive or normotensive patients (intermediate-risk PE) but is less well characterized.

OBJECTIVES The authors sought to evaluate the prevalence and predi

METHODS Intermediate-risk PE patients in the FLASH (FlowTriever dynamics) registry undergoing mechanical thrombectomy with the Flow prevalence of normotensive shock (systolic blood pressure ≥90 mm H A composite shock score consisting of markers of right ventricular func type natriuretic peptide, moderately/severely reduced right ventricula potential additional embolization (concomitant deep vein thrombosis) was prespecified and assessed for its ability to identify normotensive

RESULTS Over one-third of intermediate-risk PE patients in FLASH (131/384, 34.1%) were in normotensive shock. The normotensive shock prevalence was 0% in patients with a composite shock score of 0 and 58.3% in those with a score of 6 (highest score). A score of 6 was a significant predictor of normotensive shock (odds ratio: 5.84; 95% CI: 2.00-17.04). Patients showed significant on-table improvements in hemodynamics post-thrombectomy, including normalization of the cardiac index in 30.5% of normotensive shock patients. Right ventricular size, function, dyspnea, and quality of life significantly improved at the 30-day follow-up.

CONCLUSIONS Although hemodynamically stable, over one-third of intermediate-risk FLASH patients were in normotensive shock with a depressed cardiac index. A composite shock score effectively further risk stratified these patients. Mechanical thrombectomy improved hemodynamics and functional outcomes at the 30-day follow-up.
(J Am Coll Cardiol Intv 2023;16:958-972) © 2023 The Authors. Published by Elsevier on behalf of the American College of Cardiology Foundation. This is an open access article under the CC BY-NC-ND license (http://creativecommons.org/licenses/by-nc-nd/4.0/).

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The American Journal of Medicine

Volume 108, Issue 5, 1 April 2000, Pages 374-380

Original Articles

ction complicated by
n without hypotension:
al registry ☆

rvey D White DSc [b], Lynn A Sleeper (ScD) [c],

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Tab. 3.5: Risikostratifizierung bei nachgewiesener Lungenembolie und frühe Sterblichkeit (30-Tages-Mortalität) (216, 336)

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Hoch (> 20%)		ja	ja	ja	ja	12%
Intermediär	intermediär-hoch	nein	ja	RV-Dysfunktion und Biomarker erhöht		30%
	intermediär-niedrig	nein	ja	normale RV-Funktion und Biomarker oder RV-Dysfunktion oder erhöhte Biomarker		37%
Niedrig (< 1%)		nein	nein	nein	nein	22%

Abk.: EchoKG = Echokardiografie; NT-proBNP = N-terminales pro-B-natriuretisches Peptid; sPESI = simplified Pulmonary Embolism Severity Score; RV = rechtsventrikulär. * aus: Beccattini et al. Eur Respir J 2016; 48: 780-786 (336)

The SHOCK trial registry prospectively enrolled patients with suspected cardiogenic shock complicating acute myocardial infarction

Cardiogenic shock is usually characterized by inadequate cardiac output and sustained hypotension. However, following a large myocardial infarction, peripheral hypoperfusion can occur with relatively well maintained systolic blood pressure, a condition known as nonhypotensive cardiogenic shock

sPESI can not discriminate between the groups

17.4% of patients with shock had a sPESI score of 0

Limitations of traditional Risk Stratification

"Our current definition and risk stratification tools may not be sufficient to identify these [patients at risk of hemodynamic decompensation] with submassive PE."[2]

Porcaro, et al[1]; Khandhar, et al.[2]

~40%

of normotensive PE patients are in **cardiogenic shock***

FLASH Registry Analysis[3]

~20%

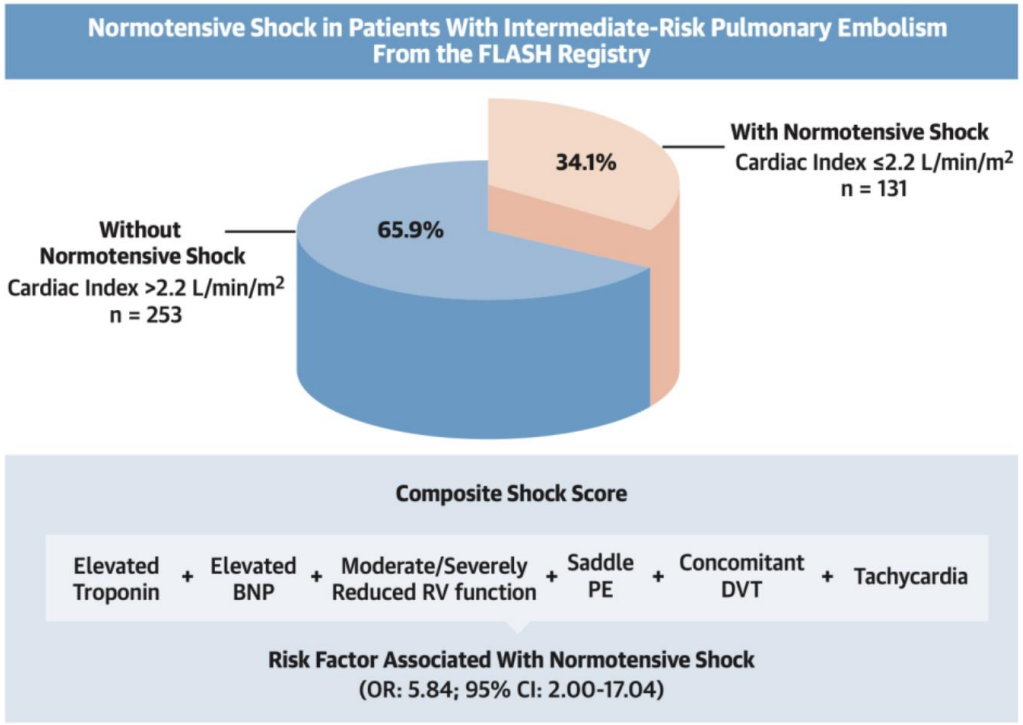
of PE patients with sPESI=0 are in **cardiogenic shock****

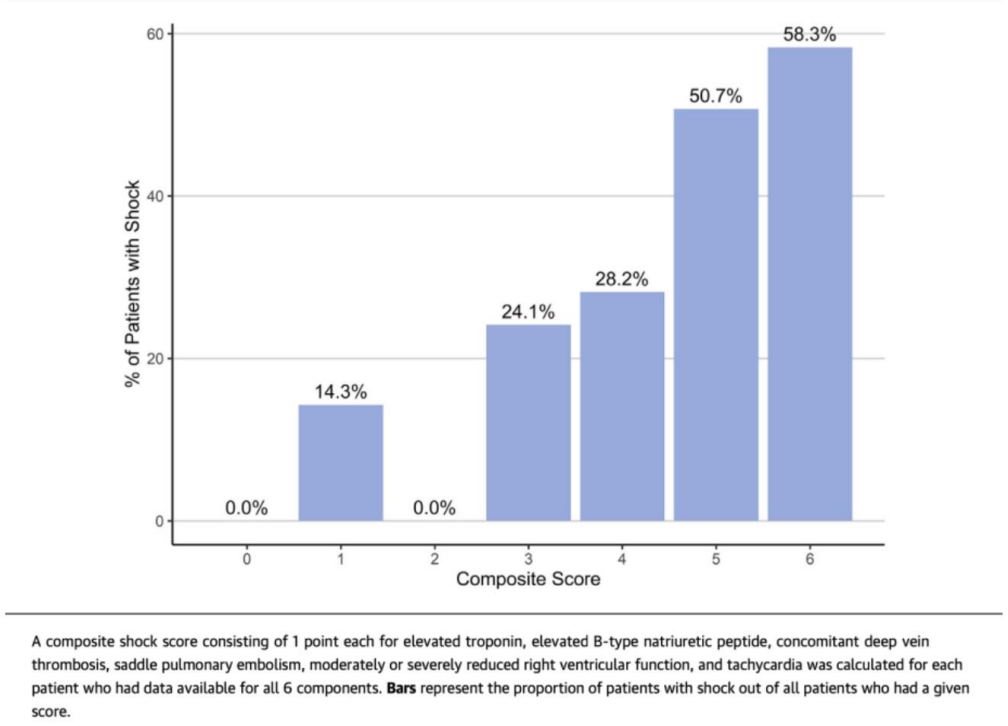
*Porcaro et al defined low CI defined as <2.2 L/min/m^2, Khandhar et al defined low CI defined as <1.8 L/min/m^2
**Low CI defined as <2.0 L/min/m^2
1. Porcaro et al. Submassive Pulmonary Embolism: Are We Falsely Reassured by Normotension? ACC 2019. Poster Session Abstract, Presentation number:1007-15
2. Khandhar et al. Invasive hemodynamic assessment of patients with submassive pulmonary embolism. Catheter Cardiovasc Interv. 2019;1–6.
3. FLASH Registry results. Presented at SCCM 2022.

Many normotensive, even sPESI=0, patients present with low cardiac index, indicative of cardiogenic shock

The composite shock score by Bangalore et al. helps to predict which normotensive patient is at high risk of shock

Herzindex: Herzminutenvolumen bezogen auf die Körperoberfläche (HI= HMV/Körperoberfläche (m^2)). Einheit l/min/m^2.





A composite shock score consisting of 1 point each for elevated troponin, elevated B-type natriuretic peptide, concomitant deep vein thrombosis, saddle pulmonary embolism, moderately or severely reduced right ventricular function, and tachycardia was calculated for each patient who had data available for all 6 components. **Bars** represent the proportion of patients with shock out of all patients who had a given score.

Modern PE treatment plan that considers major predictors of adverse events

Confirmed PE with one or more of the following:

RV Dysfunction* OR Large, Central thrombus OR Concomitant DVT

Anticoagulation

Sub-segmental thrombus

Medical Treatment Candidate

- Consider Thrombolysis
- Admit to ICU and monitor for hemodynamic changes

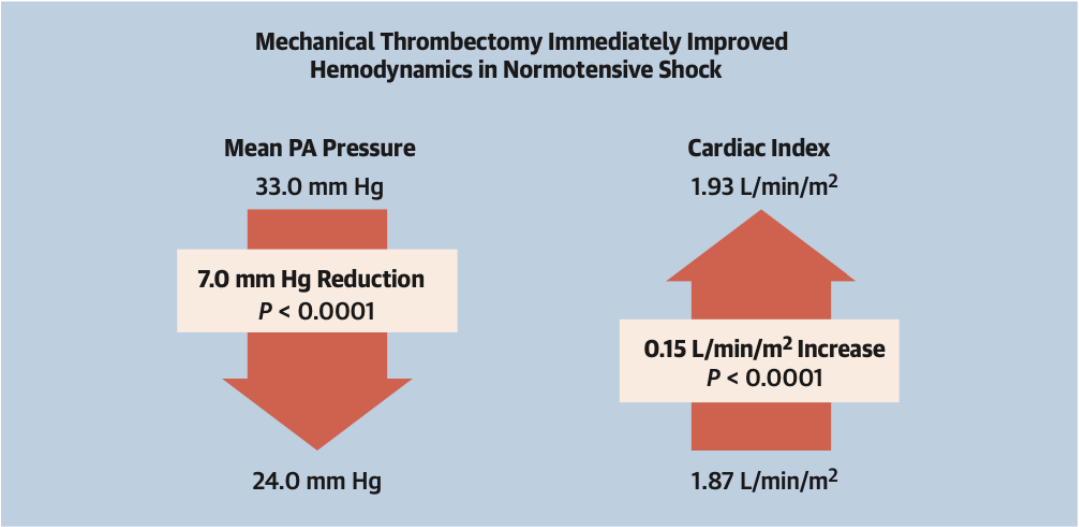
Central or Segmental thrombus

Mechanical thrombectomy candidate

*defined as: RV/LV > 0.9 [1,2,3], RV hypokinesis on ECHO[4,22], or elevated cardiac Biomarkers[21]

Normotensive patients may be sicker than they appear:

Consider lactate, cardiac index, AKI, and HR.



Bangalore S, et al. J Am Coll Cardiol Intv. 2023;16(8):958-972.

Baseline characteristics and clinical presentation

57 patients from 11 EU sites

Interim results from the European cohort of the FLASH registry

Principal Investigator	Site
Nils Kucher	Unispital, Zurich, Switzerland
Stefan Stortecky	Inselspital, Bern, Switzerland
Enrique Alejandre-Lafont	Kantonsspital Sankt Gallen, St. Gallen, Switzerland
Christian Erbel	University Heidelberg, Heidelberg, Germany
Michael Piorkowski	Cardioangiologisches Centrum Bethanien, Frankfurt, Germany
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Maurits Voormolen	UZ Antwerpen, Edegem, Belgium
Irene Lang	AKH Wien, Wien, Austria
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Marc Sapoval	Hôpital Européen Georges Pompidou, Paris, France
Helene Bouvaist	CHU Grenoble Alpes, Grenoble, France
Salim Si-Mohamed	Hôpital Louis Pradel, Hospices Civils de Lyon, Lyon, France
Gilles Lemesle	Institut Cœur Poumon, CHU Lille, Lille, France
Francisco Fernandez Aviles	Hospital Clínico San Carlos, Madrid, Spain

Characteristi	n (%) or mean ± SD
Age, years	23 (40.4)
Male sex	28 (49.1)
History of DV	1 (1.8)
History of PE	5 (8.8)
History of PH	44 (77.2)
Concomitant	35 (61.4)
History of car	55 (96.5)
Lytics contrai	2.1 ± 1.3
	1.4 ± 0.4

N ranges 47-57

*Relative = BP ≥ 180/110 mmHg; recent bleeding, surgery, or invasive procedure; ischemic stroke > 3 months prior; anticoagulation therapy; traumatic CPR; pericarditis or pericardial fluid; diabetic retinopathy; pregnancy; age > 75 years; weight < 60 kg. Absolute = any prior intracranial hemorrhage, ischemic stroke ≤ 3 months, active bleeding, recent head trauma involving fracture or brain injury, bleeding diathesis, structural intracranial disease.

†Troponin and/or BNP

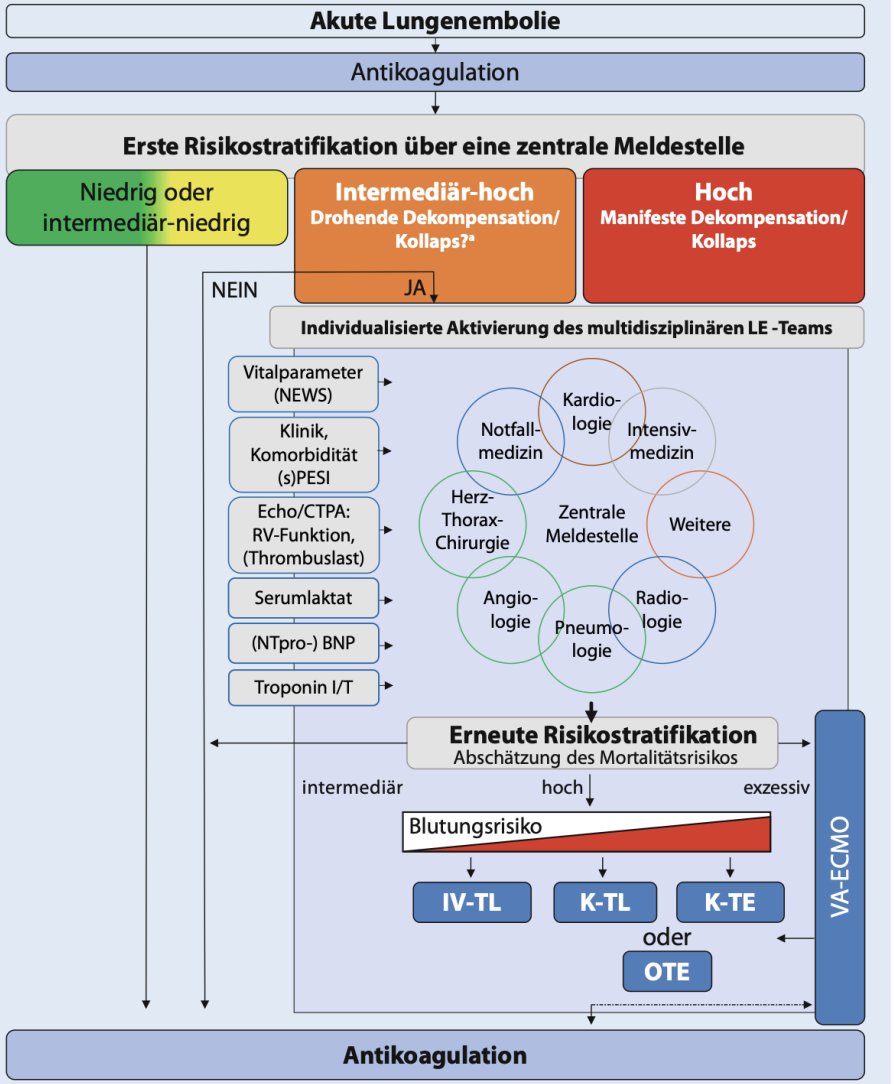

Abb. 1 ◄. Vorschlag zum Aufbau, Aktivierungsprozess und Entscheidungskriterien multidisziplinärer Lungenembolie-Teams. Diese sind der jeweils vor Ort vorhandenen Expertise und Ressourcen anzupassen. [a]Abgeschätzt auf der Basis von Hämodynamik, Oxygenierung, Bildgebung & Labormarkern. *PERT* Pulmonary Embolism Response Team, *NEWS* National Early Warning Score, *sPESI* simplifizierter PESI–Score, *RV* rechtsventrikulär, *LV* linksventrikulär, *IV-TL* intravenöse Thrombolyse, *K-TL* kathetergestützte Thrombolyse, *K-TE* kathetergestützte Thrombektomie, *OE* operative Embolektomie, *VA-ECMO* venoarterielle extrakorporale Membranoxygenierung

Positionspapiere

Kardiologie 2023 · 17:141–159
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Die Kardiologie
vormals **Der Kardiologe**

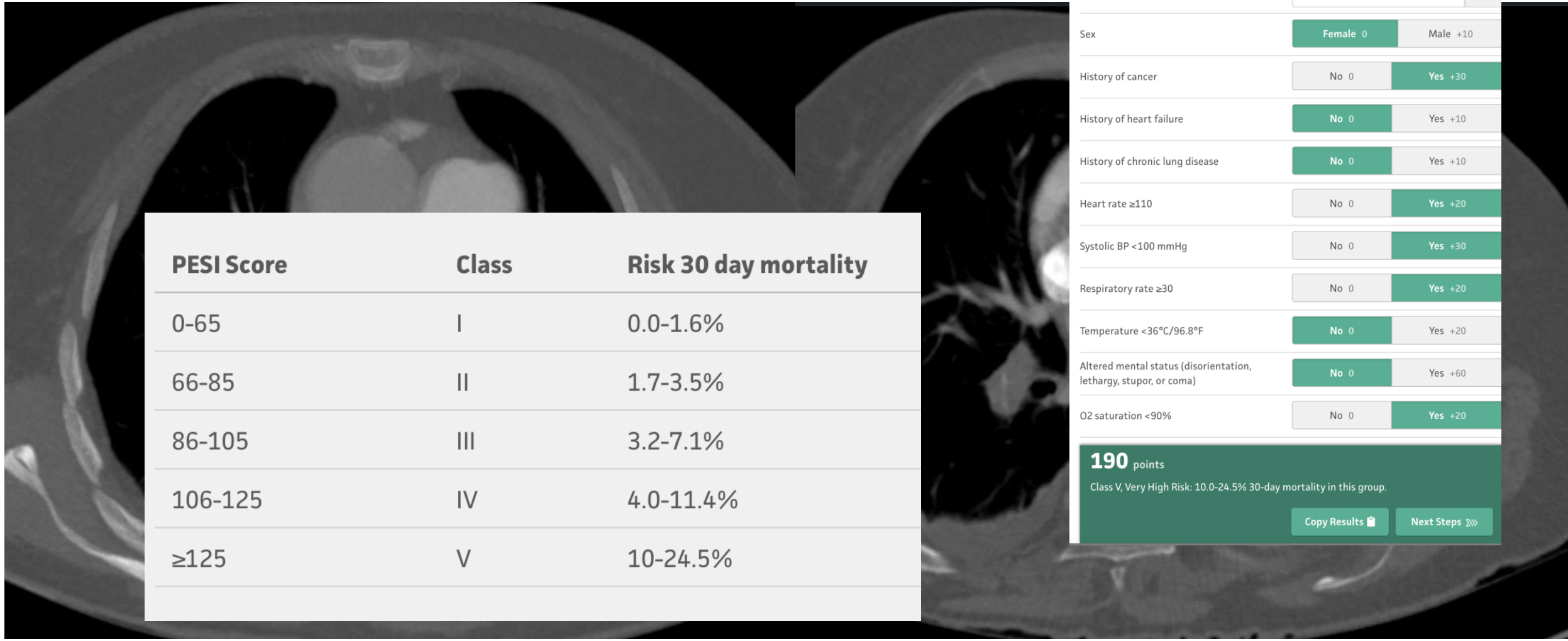
Interventionelle Therapie und multidisziplinäre Managementstrategien für die akute Lungenembolie

Alexander Ghanem[1] · Martin Andrassy[2] · Daniel Dürschmied[3] · Georg Fürnau[4] · Tobias Geisler[5] · Marcus Hennersdorf[6] · Maike Knorr[7] · Tobias J. Lange[8,9] · Antje Masri-Zada[10] · Guido Michels[11] · Stephan Rosenkranz[12] · P. Christian Schulze[13] · Tobias Tichelbäcker[12] · Christiane Tiefenbacher[14,17] · Heinrike Wilkens[15] · Stavros Konstantinides[16]

70yo woman
symptomatic pulmonary embolism 4 days after abdominal surgery
Haemodynamic unstable

BP sys < 90 mmHg > 15 min or Need of Vasopressors and Hypoperfusion of vital organs Laktat ↑

(no other explenations like Hypovolemia , Sepsis or Arrhythmia)



PESI Score	Class	Risk 30 day mortality
0-65	I	0.0-1.6%
66-85	II	1.7-3.5%
86-105	III	3.2-7.1%
106-125	IV	4.0-11.4%
≥125	V	10-24.5%

Age	70	years
Sex	Female 0	Male +10
History of cancer	No 0	Yes +30
History of heart failure	No 0	Yes +10
History of chronic lung disease	No 0	Yes +10
Heart rate ≥110	No 0	Yes +20
Systolic BP <100 mmHg	No 0	Yes +30
Respiratory rate ≥30	No 0	Yes +20
Temperature <36°C/96.8°F	No 0	Yes +20
Altered mental status (disorientation, lethargy, stupor, or coma)	No 0	Yes +60
O2 saturation <90%	No 0	Yes +20

190 points

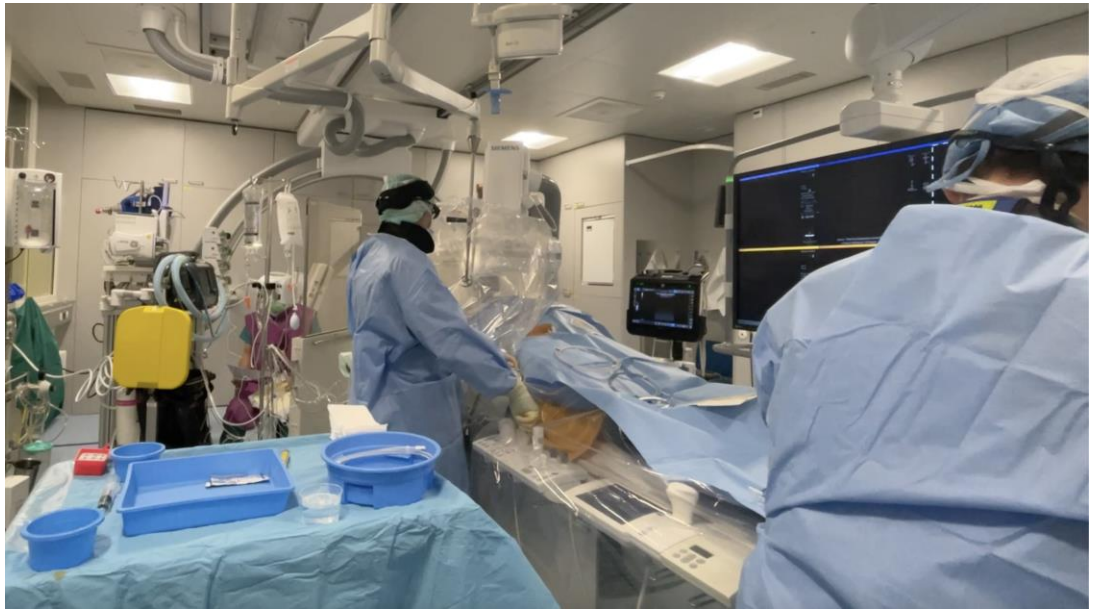
Class V, Very High Risk: 10.0-24.5% 30-day mortality in this group.

Copy Results | Next Steps

https://www.mdcalc.com/calc/1304/pulmonary-embolism-severity-index-pesi#evidence

How we do it: Setting

- Anaesthesiological Survience (TEVAR/f-bEVAR Setting)
- US guided Puncture of a femoral vein, Local anaesthesia (10cc Lidocain 1%)



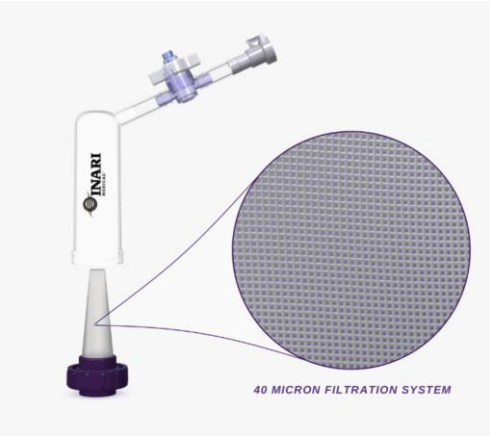
How we do it: Sheathless Access

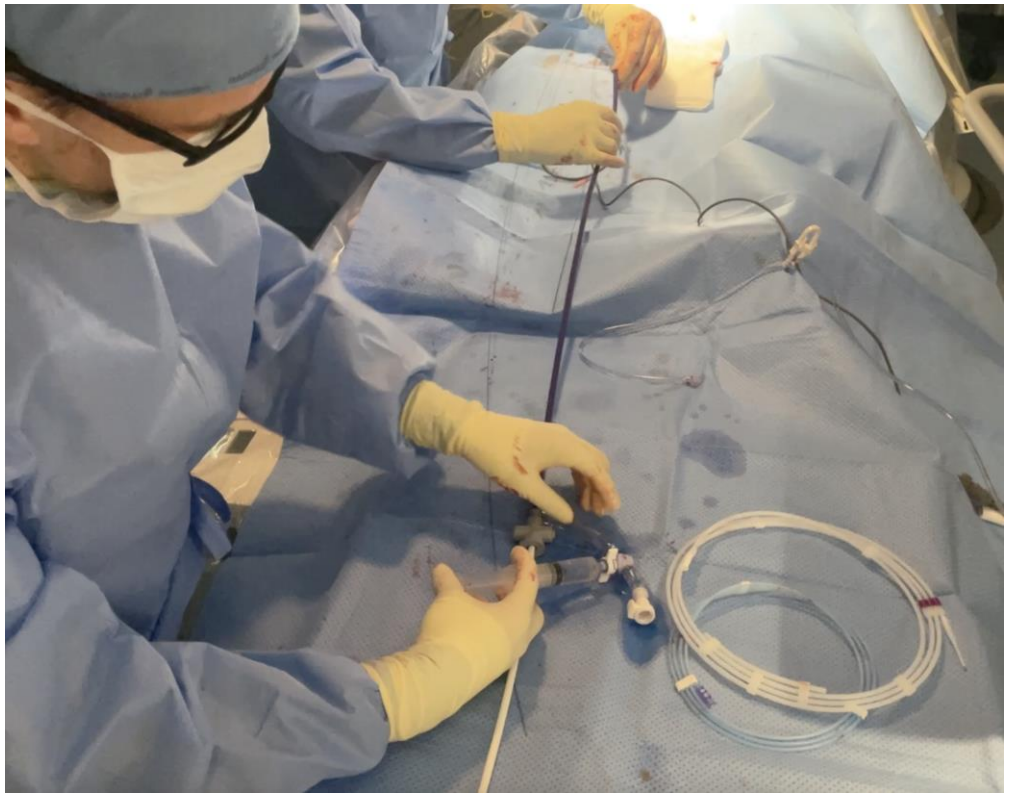
- US guided Puncture of a femoral vein, Local anaesthesia (10cc Lidocain 1%)
- Insertion of an 8F Sheath
- 6F Pigtail + Stiff Terumo Wire -> PA access into the right lower PA
- Change to Amplatz Superstiff Short Tip Wire
- Insert 2nd wire through 8F Sheath
- US guided LA with another 10ml Lidocain 1% around the 8F Sheath

- Remove 8F sheath + insert it over the Terumo Stiff Wire, parallel insertion of a 14F sheath over the Amplatz wire)
- Remove 14F Sheath + 8F Sheath and insert 24F INARI FlowTriever
- If it doesn`t enter use 8F parallel to the Triever to help

How we do it: Procedure

1. Pressure measurement in the PA
2. Angiography (Fluoroscopy, no DSA)
3. 2-3 x Aspiration
4. Use Flow Saver
5. Angiography and Pressure measurement
6. Repeat until significant pressure drop

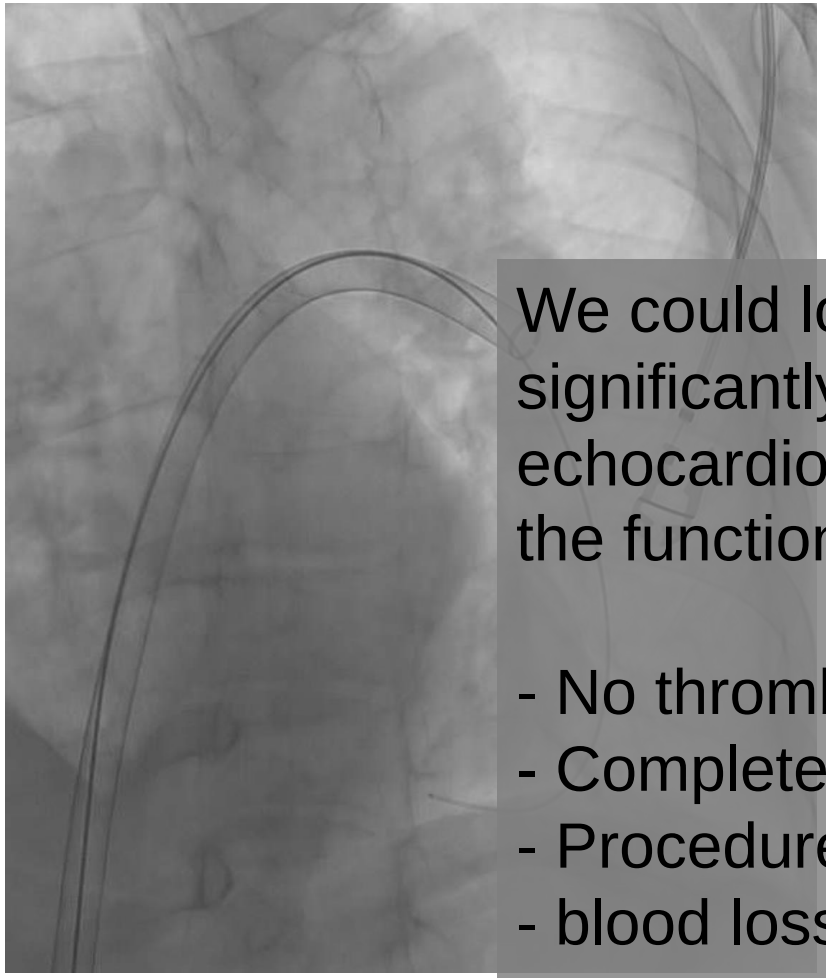


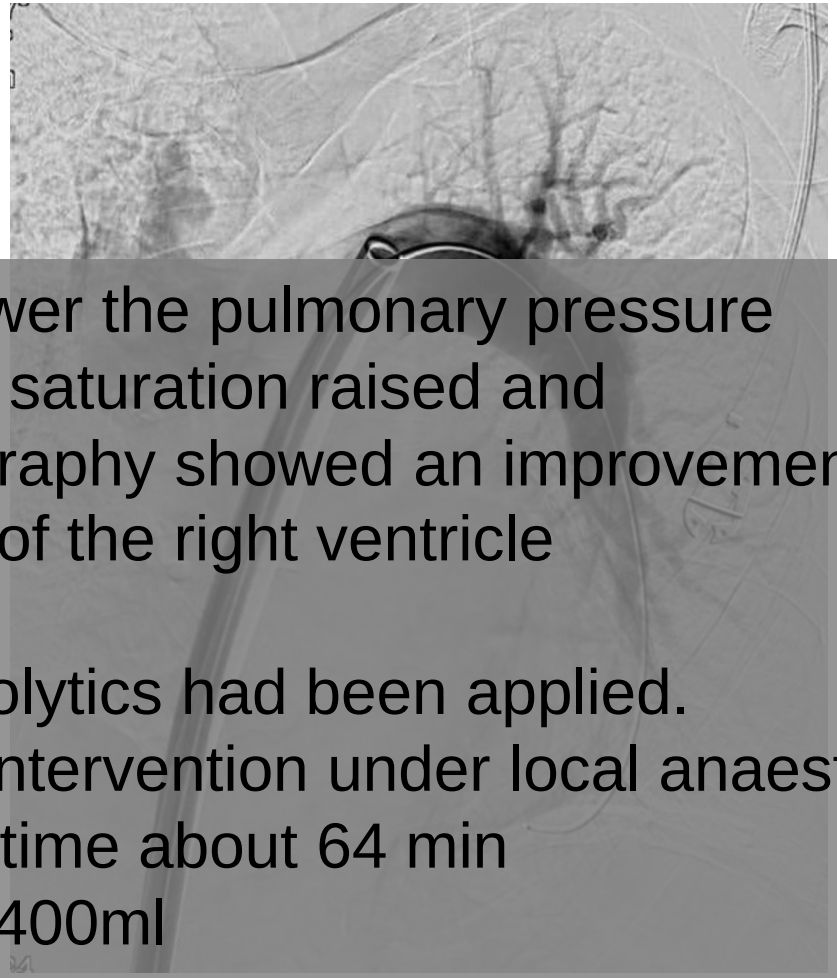


70yo woman
symptomatic pulmonary embolism 4 days after abdominal surgery
Haemodynamic unstable

BP sys < 90 mmHg > 15 min or Need of Vasopressors and Hypoperfusion of vital organs Laktat ↑
(no other explenations like Hypovolemia , Sepsis or Arrhythmia)

repetition of the procedure in the left lobe.





We could lower the pulmonary pressure significantly, saturation raised and echocardiography showed an improvement of the function of the right ventricle

- No thrombolytics had been applied.
- Complete intervention under local anaesthesia
- Procedure time about 64 min
- blood loss 400ml

Next day the patient was discharged from ICU and fully recovered

55 yo man with metastatic bladder cancer
sudden onset of respiratory distress
CT revealed central pulmonary embolisms
PESI SCORE 185
Elevated RV/LV RATIO
O2 saturation 87% under 10 liter o2/min

Sheathless access right femoral vein with a 24 F INARI Flowtriever in local anaesthesia.

PAP 45/17/27
ACT 345s

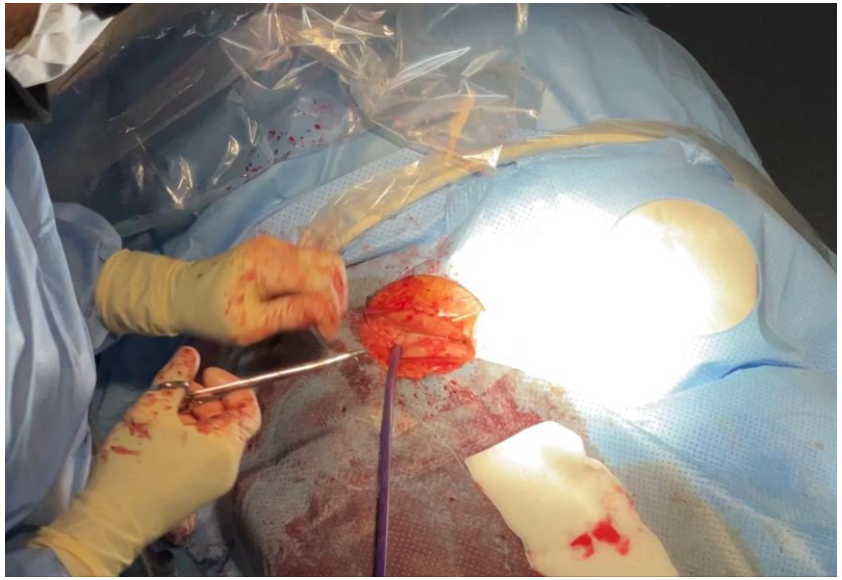
2 aspirations on the left and 2 on the right side.

PAP 22/9/15
O2 saturation after Aspiration 96% at 3l O2

Total procedure time 35 min

INARI
MEDICAL
PRE
POST
FlowTriever®
CM 1 2 3 4 5 6 7 8 9 10 11 12 13 14 15
8 Fr
12 Fr
16 Fr
20 Fr
24 Fr
INARI
MEDICAL
info@inarimedical.com | inarimedical.com | (877) 923-4747
INCH 1 2 3 4 5

Access Closure



- Leave the Sheath in place
- Mersilene 0/0 and a big Needle Holder
- Z-Suture around the sheath
- Insert both ends through a 2-way Stop Cock
- Remove the Sheath and tighten the suture
- Close the Stop Cock as far as possible
- Pressure Bandage
- Remove the bandage and the Suture after 6 hours
- Mobilization possible if the puncture side is ok

Algorithmus massive/submassive LE KSSG
Interne Patienten

PERT: Pulmonary Embolism Response Team
- KA AIM-ZNA 3605
- KA MIPS 1044
- DA/DKA Kardiologie
- Interventionelle Radiologie 1111

1) Prüfe immer zuerst Sinn und Indikation der Behandlung (Patient & klinische Situation)
2) Starte Antikoagulation
3) BD syst < 90 mmHg > 15 min oder Bedarf an Vasopressoren mit Hypoperfusion von End-organen/Laktat↑ (und keine andere Ursache wie Hypovolämie, Sepsis oder Arrhythmie)
4) Kontraindikationen für Thrombolyse (vgl. Tabelle)
5) Verlegung auf IPS (nach Start von rtPA in NFZ)
6) FlowTriever® Intervention mit Anästhesie (oder IPS-Team, falls Pat. auf IPS)
7) va-ECMO durch IPS-Team (in NFZ im Falle einer Reanimation)
8) FlowTriever® Intervention mit Unterstützung von IPS-Team
9) Bettenstation oder IPS (speziell, falls Laktat zwischen 2.3 und 3.3 mmol/L)
10) Bettenstation
11) Kontaktiere PERT (Pulmonary Embolism Response Team) am nächsten Morgen
12) FlowTriever® Intervention mit Anästhesie (falls Pat. auf Bettenstation) oder IPS-Team (falls Pat. auf IPS) am nächsten Tag

Massive, submassive LE[1)]

2)

hämodyn. instabil[3)] oder REA

Ja

Nein

KI für Thrombolyse[4)]

Nein[5)]

Ja

rtPA

Keine Besserung/Verschlechterung nach 2-4h

ESC Consensuspaper

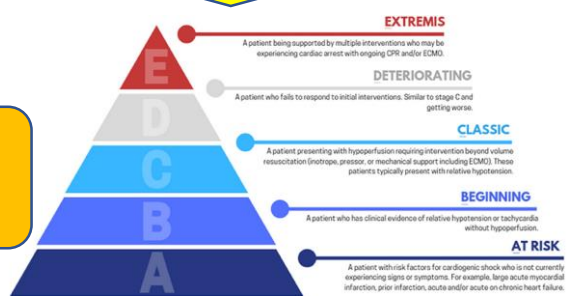
Kardiogener Schock D oder E oder REA

Ja

Nein[6)]

va-ECMO[7)]

FlowTriever®[8)]



FlowTriever®

12)

Risk factors to decide:
- Clot burden.
- Central clot burden
- Concomittant DVT
- Cardic Index
- Lactat

1. PESI ≥ III und/oder RV-Dysfunktion (TTE)

Ja

Nein

2. Troponin ↑

Ja

Nein

1 und 2
Intermediär-hohes Risiko

9)

PERT[11)]

1 oder 2
Intermediär-tiefes Risiko

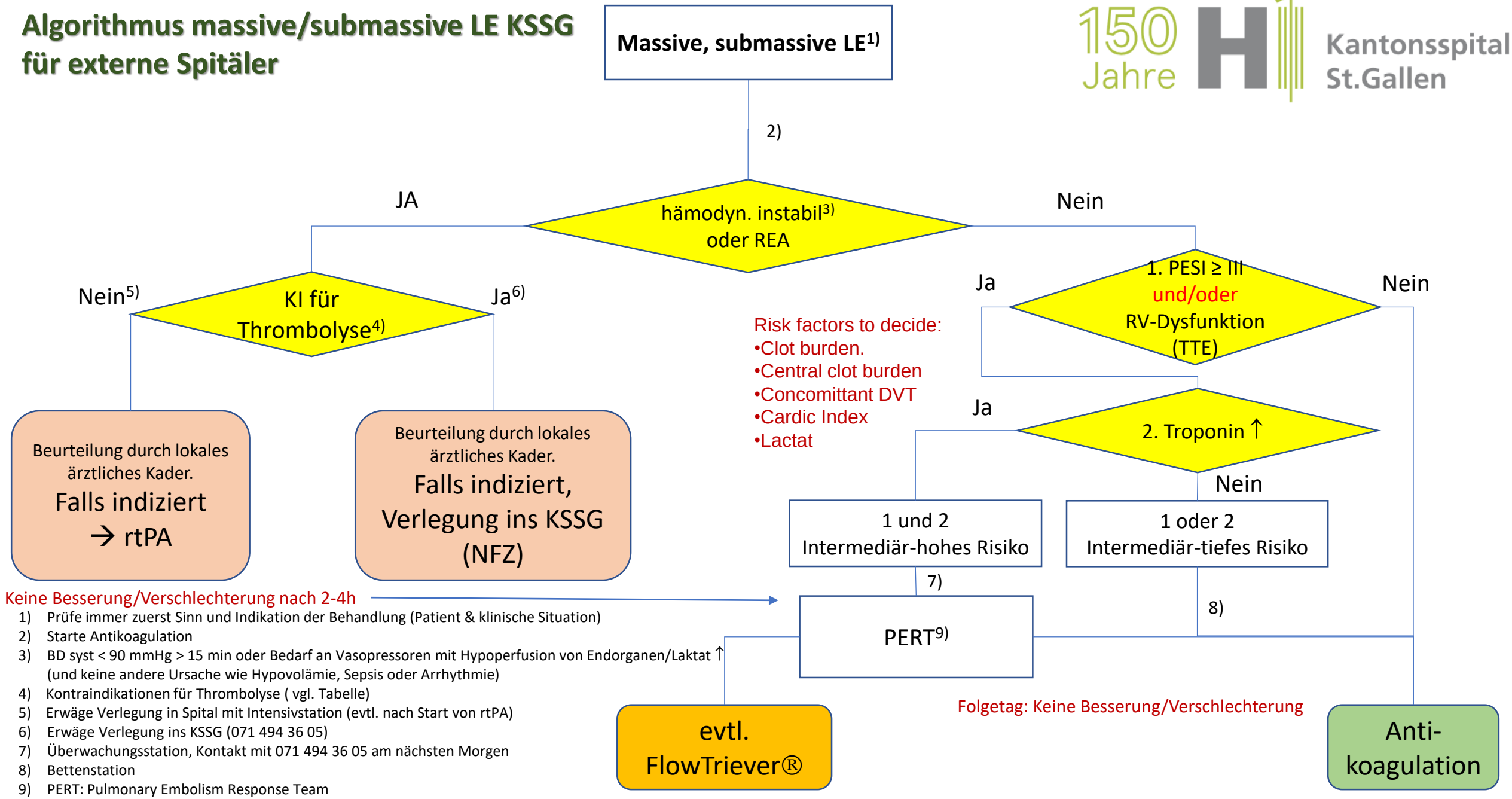
10)

Anti-koagulation

Folgetag: Keine Besserung/Verschlechterung

150 Jahre Kantonsspital St.Gallen

Algorithmus massive/submassive LE KSSG für externe Spitäler



1) Prüfe immer zuerst Sinn und Indikation der Behandlung (Patient & klinische Situation)
2) Starte Antikoagulation
3) BD syst < 90 mmHg > 15 min oder Bedarf an Vasopressoren mit Hypoperfusion von Endorganen/Laktat ↑ (und keine andere Ursache wie Hypovolämie, Sepsis oder Arrhythmie)
4) Kontraindikationen für Thrombolyse (vgl. Tabelle)
5) Erwäge Verlegung in Spital mit Intensivstation (evtl. nach Start von rtPA)
6) Erwäge Verlegung ins KSSG (071 494 36 05)
7) Überwachungsstation, Kontakt mit 071 494 36 05 am nächsten Morgen
8) Bettenstation
9) PERT: Pulmonary Embolism Response Team

Zusammenfassung

CIRSE 2023: Best Scientific Paper Award

October 10, 2023

This year's Best Scientific Paper Award went to Dr. Enrique Alejandre-Lafont for his presentation "Large-bore mechanical thrombectomy for intermediate- and high-risk pulmonary embolism: interim results from the European cohort of the FLASH registry." The Scientific Programme Committee bestows this honour on one presenter every year based on their own evaluation and feedback from session attendees.

Die Prognose konservative behandelter Patienten mit >/= intermediate high Risk LE bleibt eingeschränkt:

- Sterblichkeit 10–16 % nach 30 Tagen (… 90 Tage? 6 Monate?!...)
- 20–50 % haben einen verbleibenden Thrombus
- Bei vielen kommt es zu langfristigen Funktionseinschränkungen

PERT-Team und der Algorithmus sind entscheidend

Bei der Einführung der mechanischen Thrombektomie als Behandlungsoption für Patienten mit Lungenembolie ist der Aufbau eines PERT-Teams und ein definierter, auf das jeweilige Krankenhaus zugeschnittener Algorithmus entscheidend

Die herkömmliche Risikostratifizierung reicht nicht aus, um alle Patienten zu identifizieren, die von einer Intervention profitieren könnten

- Mehrere Prädiktoren für unerwünschte Ereignisse werden ausgeschlossen (Embolieausmass, reitender Embolus, Herzindex, TVT, Laktat ...)
- Normotensive Patienten sind oft kränker, als sie scheinen („Normotensiver Schock“)
- Die moderne Risikostratifizierung sollte Prädiktoren für kurz- und langfristige Ergebnisse, Restthrombus und neuere, lytikafreie Behandlungsoptionen (und z. B. zusammengesetzter Schockscore) umfassen.

TVT Epidemologie

- Inzidenz 50-100/100000, mindestens 25% davon entwickeln eine LE [1]
- Inzidenz verdoppelt sich alle 10 Lebensjahre
- Frauen stärker betroffen zwischen 20-45Lj, Männer stärker betroffen zwischen 45.-60. LJ
- 50% der Patienten mit TVT, die konservativ behandelt werden entwickeln ein PTS [2]

1/12 mittelalten Menschen entwickelt in seinem restlichen Leben eine LE oder ein PTS
60% aller LE`s geschehen bei >65jährigen
Mehr TVT`s im Winter, Peak im Februar
TVT Rezidiv bei TVT ohne ersichtliche Ursachen (unprovoziert): im ersten Jahr 10%, 30% nach 5-8 Jahren

Rekanalisationsrate unter konserv. Therapie: Unterschenkelvenen 80%, Iliakalvenen 20%

Akute TVT = <14 Tage -> Optimal für Interventionelle Therapie!
Subakute TVT 14 Tage bis 3 Monate
Chronische TVT > 3 Monate

1. Kakkos SK, Gohel M, Baekgaard N, et al. (2021) European Society for Vascular Surgery (ESVS) 2021 Clinical Practice Guidelines on the Management of Venous Thrombosis. Eur J Vasc Endovasc Surg 61(1):9-82.
2. Vedantham S, Goldhaber SZ, Julian JA, et al. (2017) ATTRACT trial results. Pharmacomechanical Catheter-Directed Thrombolysis for Deep-Vein Thrombosis. N Engl J Med 377:2240-2252.

Hauptziel Interventionelle Therapie

- Vorbeugung oder Verringerung der Schwere des postthrombotischen Syndroms durch Wiederherstellung der venösen Durchgängigkeit und Erhaltung der Klappenfunktion
- Verringerung des Risikos einer Lungenembolie und wiederkehrender TVT
- Sofortige Linderung der Symptome, deren Besserung mit einer Antikoagulation allein sonst viele Tage bis Wochen dauern kann.

Iliofemorales Segment sollte involviert sein (darunter eher konservativ)

TVT Risikofaktoren

- Unprovoziert: keine Risikofaktoren
- Risikofaktoren: hereditär oder erworben
- Beispiele: APS (x20-80), Faktor V Leiden (x3-8 heterozygot, 20-80 homozygot), Übergewicht, Onkologische Grunderkrankung, Trauma/Immobilisierung, Hormontherapie/abusus, Schwangerschaft, Nicht-0-Blutgruppe (2x), Protein c/Protein-S Mangel, Diabetes, Bluthochdruck, May-Thurner Syndrom bzw. Kompression von aussen (Tumore, Osteophyten, …)

ESVS 2021 Management Guidelines for Venous Thrombosis

Table 5. Core hereditary and acquired thrombophilias

Thrombophilia
Hereditary
Antithrombin deficiency
Protein C deficiency
Protein S deficiency
Factor V Leiden
Activated protein C resistance*
Prothrombin G20210A variants
Dysfibrinogenaemia
Factor XIII 34val
Fibrinogen (G) 10034T
A and/or B alleles of the ABO blood group
Prothrombin Yukuhashi (II R596L)
Acquired
Antiphospholipid antibodies on two occasions more than 12 weeks apart. Three assays are performed: • lupus anticoagulant • anticardiolipin antibodies • anti-beta-2 glycoprotein I antibodies
Paroxysmal nocturnal haemoglobinuria
Myeloproliferative syndromes with JAK2V617F mutation
Other causes
Haemolytic states, e.g., sickle cell crises
Any inflammatory disease such as infections, e.g., pneumonia, rheumatoid arthritis, inflammatory bowel disease, systemic lupus erythematosus, Adamantiades-Behçet disease.
Nephrotic syndrome (loss of antithrombin in the urine)

* Not everyone has factor V Leiden.

Olaf M, Cooney R. Deep venous thrombosis. Emerg Med Clin North Am 2017;35:743e70.

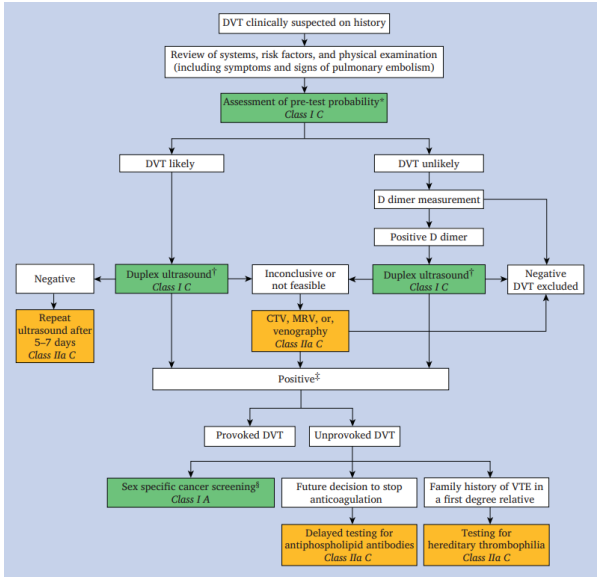


Figure 1. Flowchart of recommendations for the diagnosis and investigation of deep vein thrombosis (DVT), including computed tomography venography (CTV) and magnetic resonance venography (MRV). VTE = venous thromboembolism. *Using a validated tool such as Wells Criteria; †If calf DVT is suspected, whole leg ultrasound is suggested. ‡DVT management should be outpatient based for all but exceptional cases. §Clinical examination and sex specific screening is recommended rather than routine extensive screening for malignancy.

Single session pharmaco-mechanical thrombectomy for DVT also works well with comparable results to more prolonged catheter directed thrombolysis:

Study or Subgroup	Early thrombus removal Events	Total	Anticoagulation Events	Total	Risk Ratio for any PTS M-H, Random, 95% CI	Risk Ratio M-H, Random, 95% CI	Weight
A Iliofemoral DVT							
ATTRACT (Iliofemoral)	96	196	100	195		0.96 [0.78, 1.16]	32.5%
CAVA	22	77	26	75		0.82 [0.51, 1.32]	23.7%
Total	**118**	**273**	**126**	**270**		**0.93 [0.78, 1.12]**	**56.2%**
Heterogeneity: Tau² = 0.00; *Chi*² = 0.33, df = 1 (*p* = .57); *I*² = 0%							
Test for overall effect: Z = 0.73 (*p* = .46)							
B Any proximal DVT							
CaVenT	37	87	63	89		0.60 [0.45, 0.79]	30.1%
TORPEDO	6	91	24	92		0.25 [0.11, 0.59]	13.7%
Total	**43**	**178**	**87**	**181**		**0.42 [0.18, 1.03]**	**43.8%**
Heterogeneity: Tau² = 0.32; *Chi*² = 4.08, df = 1 (*p* = .04); *I*² = 75%							
Test for overall effect: Z = 1.90 (*p* = .06)							
Total (95% CI)	**161**	**451**	**213**	**451**		**0.67 [0.45, 1.00]**	**100.0%**
Heterogeneity: Tau² = 0.12; *Chi*² = 14.54, df = 3 (*p* = .002); *I*² = 79%							
Test for overall effect: Z = 1.97 (*p* = .05)							
Test for subgroup differences: *Chi*² = 2.95, df = 1 (*p* = .09); *I*² = 66.1%							

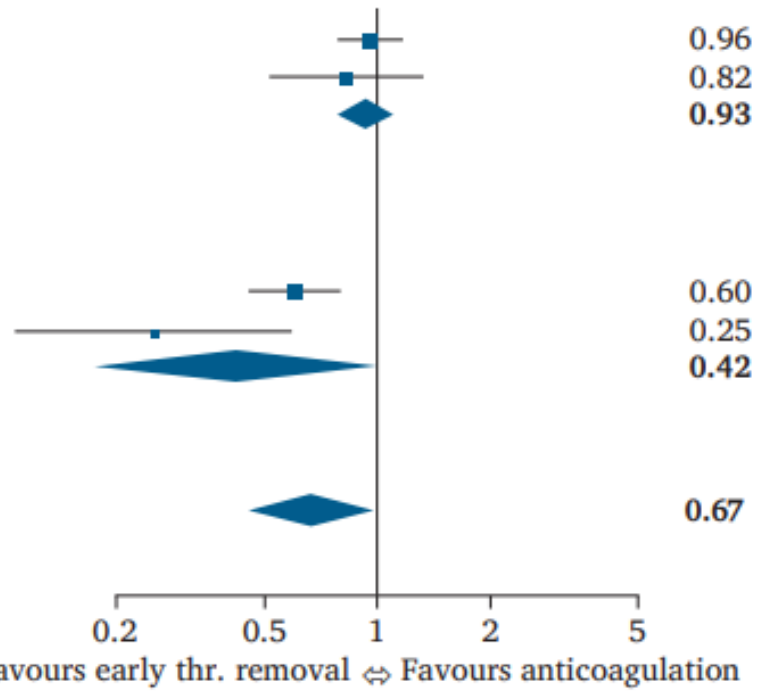


Figure 4. Forest plot analysis of randomised controlled trials comparing early thrombus (thr.) removal techniques with anticoagulation alone regarding the outcome of any post-thrombotic syndrome (PTS) in patients with (A) iliofemoral deep vein thrombosis (DVT) or (B) any proximal DVT. PTS incidence was lower with early thrombus removal techniques than anticoagulation alone. Risk ratio is based on fixed Mantel–Haenszel (M-H) method. There was no significant subgroup difference. CI = confidence interval; ATTRACT = Acute Venous Thrombosis: Thrombus Removal with Adjunctive Catheter-Directed Thrombolysis; CAVA = CAtheter Versus Anticoagulation Alone for Acute Primary Iliofemoral DVT; TORPEDO = Thrombus Obliteration by Rapid Percutaneous Endovenous Intervention in Deep Venous Occlusion.

- Treat the patient not the pictures!!!!
- What is their life expectancy?
- What was their quality of life before this episode?
- What was their leg like before this episode?
- Can they hold still?
- Are they intelligent enough to understand the risks/benefits and alternatives?
- Are they reliable enough to take regular medication?

Indikation für IVC Filter während Intervention

- Large Volume PE
- Rechtsherzbelastungszeichen
- IVC Thrombus
- Keine Stenosen (May-Thurner)
- Wenig erfahrener Interventionalist

Postinterventionelle Therapie

- Pneumatische Kompression in der ersten Nacht
- Klasse II Kompressionssstrümpfe
- US am ersten postinterventionellen Tag
- Min. 3 Monate Antikoagulation
- INR 2,5-3,5
- CT nach 6 Wochen
- Filterentfernung (Denali) falls CT unauffällig

Table 15. Suggested duration of anticoagulation in relation to stratification of the risk of venous thromboembolism recurrence. High risk: anticoagulation should not be stopped unless there is a strong contraindication. Intermediate risk: further factors should be considered, including specific risk factors for thrombosis, bleeding risk and patient preference. Low risk: anticoagulation can be stopped after three or a maximum of six months

Risk of recurrence	Duration of anticoagulation	Underlying risk factors
High	Indefinite anticoagulation, unless there is a high risk of bleeding	Active cancer, persistent major risk factor, e.g., chronic rheumatic disorder, severe thrombophilia*
Medium	Equipoise: consider extended anticoagulation, preferably with lowest bleeding risk	Recurrent venous thromboembolism
		Unprovoked event
		Minor, soft, and transient risk factor, e.g., travel
		Male sex, obesity, heart failure, chronic obstructive pulmonary disease/significant comorbidities
		Pulmonary embolism (more likely to continue) *vs.* deep vein thrombosis
Low	Stop anticoagulation (3 mo)	Clear and major transient risk factor (e.g., surgery, leg injury with a reduced mobility, confined to bed in hospital)
		Combined oral contraceptives or hormonal therapy — now discontinued; pregnancy†, puerperium
		Calf vein thrombosis

* Severe thrombophilia = antithrombin deficiency, antiphospholipid syndrome, homozygous FV Leiden or prothrombin 20210 mutation, combination thrombophilia. Definitions modified from Kearon *et al.*, 2016,[44] and Prins *et al.*, 2018.[122]

† Treatment should continue for three months and at least until the end of puerperium (6 weeks post partum).

Eur J Vasc Endovasc Surg (2021) 61, 9–82

CLINICAL PRACTICE

Editor's Choice

ESVS 2021 Management Guidelines for Venous Thrombosis

Practice Guidel

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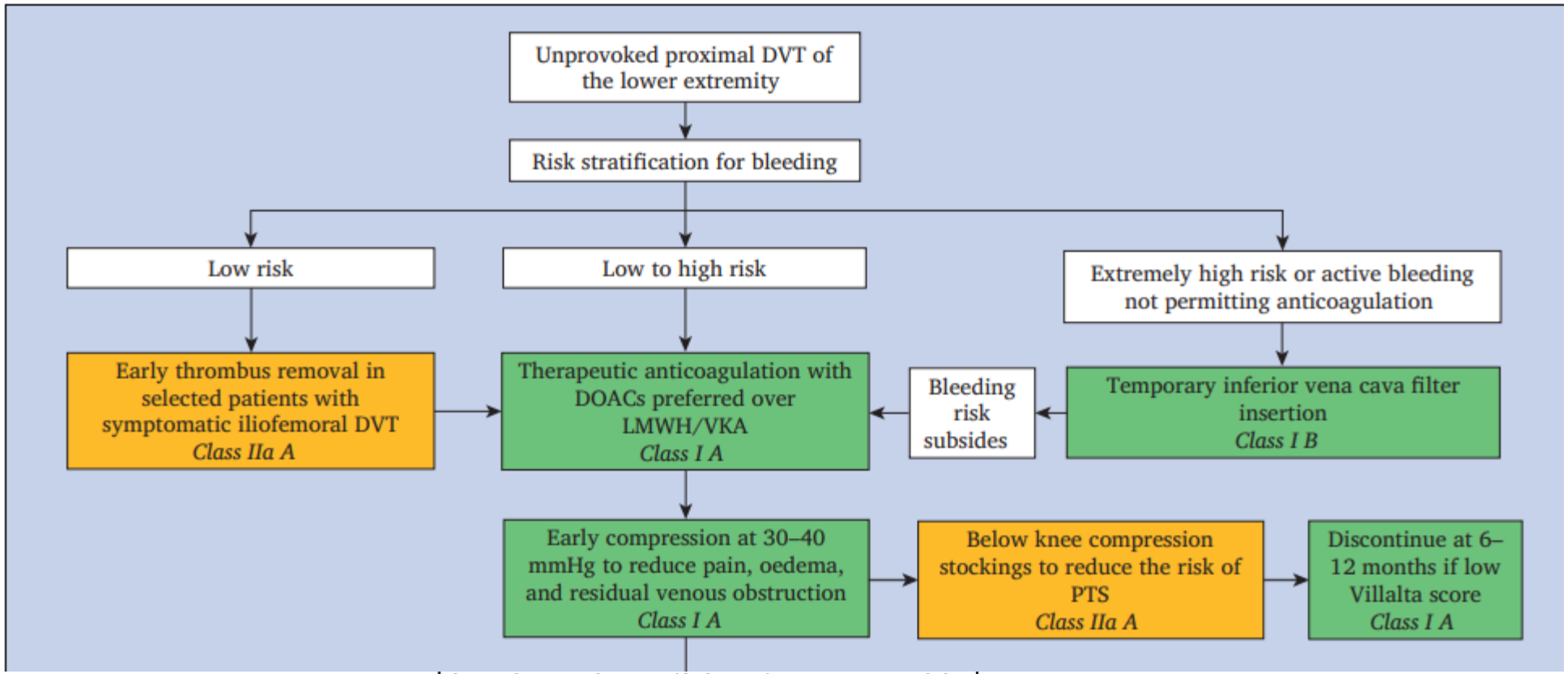


Recommendation 34

In selected patients w
thrombosis, early thr
considered.

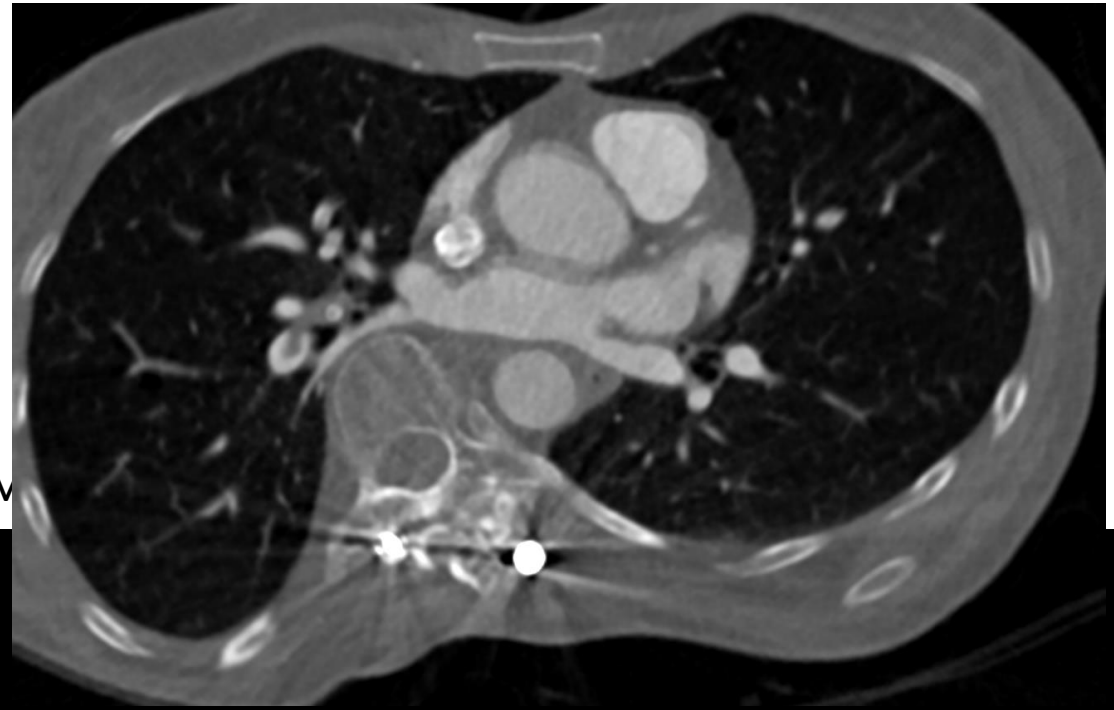
Class	Level
IIa	A

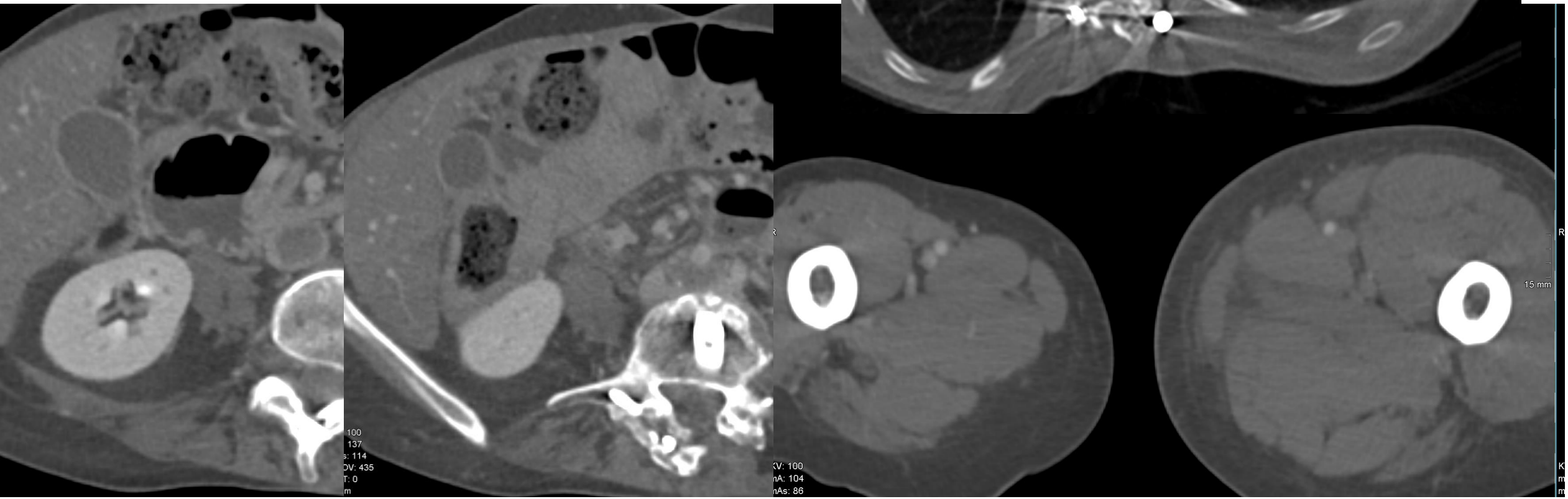
be at least as long as if the patients were treated by anticoagulation alone and at the discretion of the treating physician.

Class	Level	References
I	C	Kearon *et al.* (2019),[234] Eijgenraam *et al.* (2014)[236]

Case Example

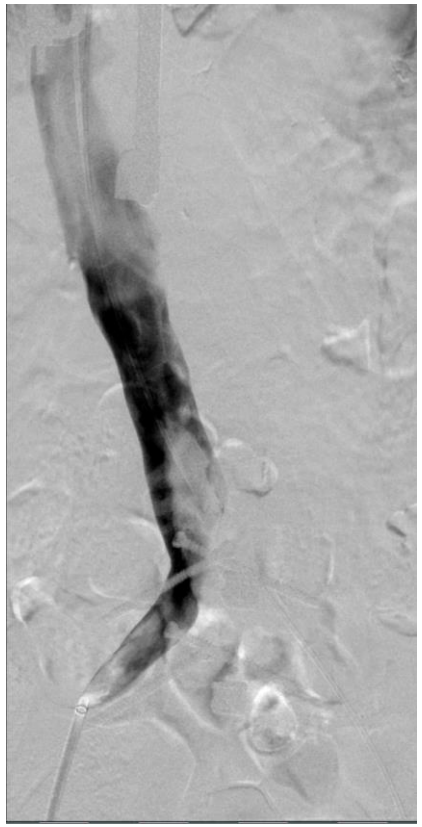
Selbständige Frau, jahrgang 1962
4-Etagen Thrombose
May-Thurner
Vermehrte Immobilisation nach Zahnbehanldung 04.02.24
Tochter hat nachgewiesene heterozygote Faktor V Leiden M



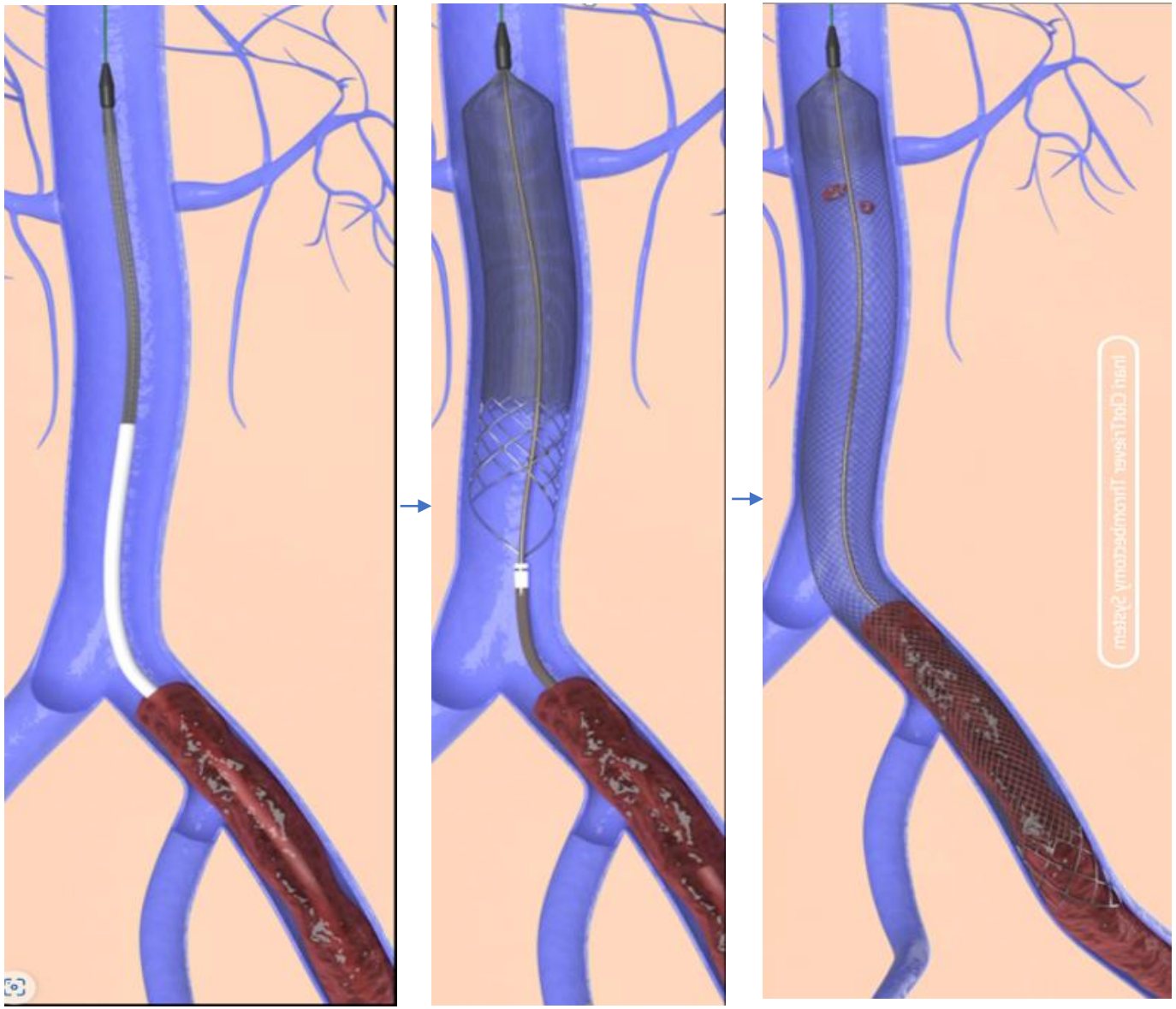


Thrombektomie am 15.2.24

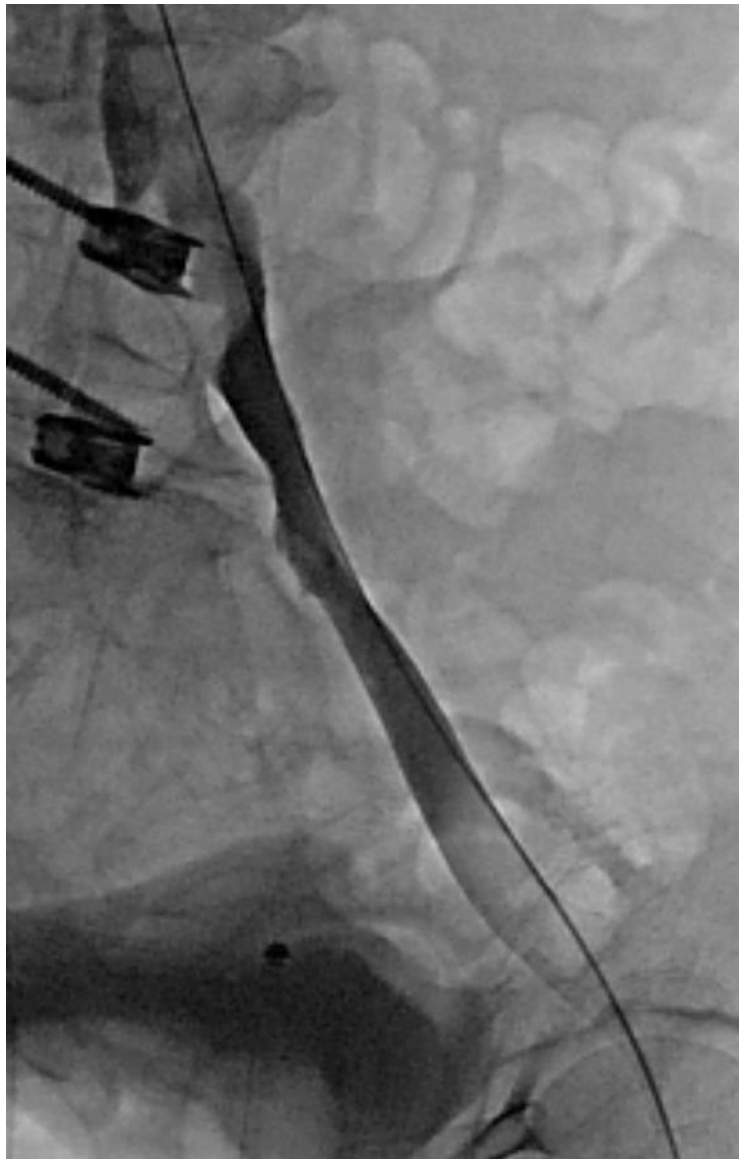
- ITN
- Zugang rechts inguinal und links popliteal (Frog-Leg-position)



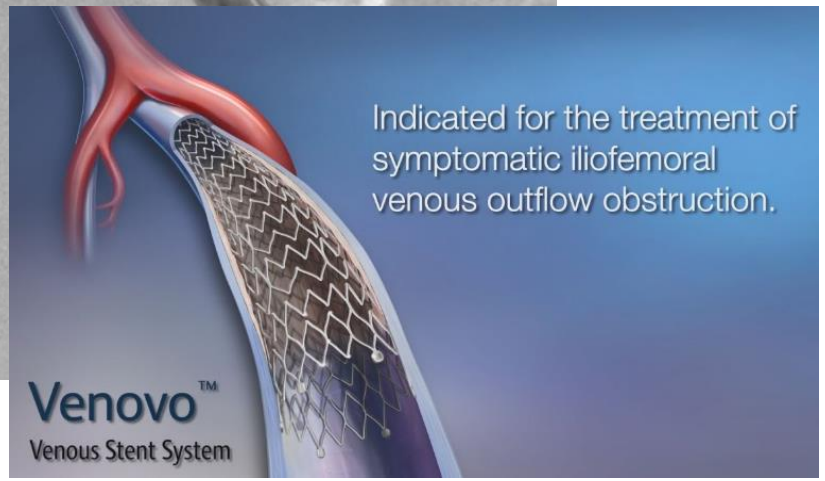
Clot-Triever Prozedur



Was nun?



Venovo 16/80

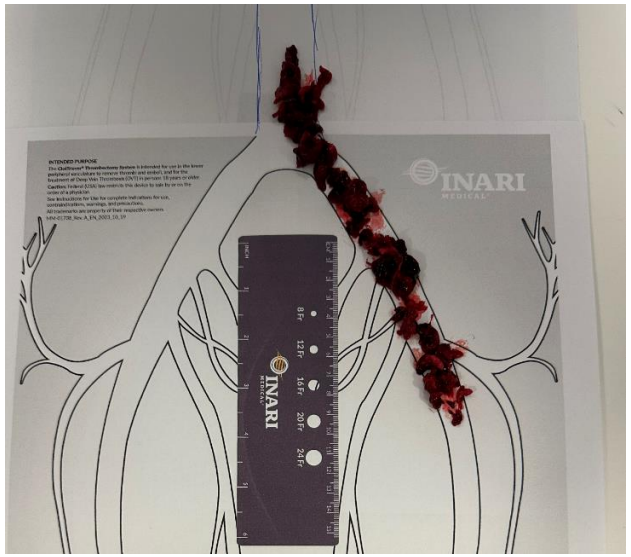

Indicated for the treatment of symptomatic iliofemoral venous outflow obstruction.
Venovo™
Venous Stent System

- Entlassung beschwerdefrei am Folgetag
- Angiologische Untersuchung mit normalem venösen Flussmuster iliofemoral. Keine Restthromben.

14:37Uhr

Knapp 1,5 Stunden

Keine Thrombolytika



15:53Uhr

Zusammenfassung

- Bei iliofemoraler akuter TVT ist die mechanische Thrombektomie ein sicheres und zuverlässiges Therapieverfahren
- Vermeidung eines PTS
- Behandlung der Ursache (May-Thurner, …)
- Vermeidung von Komplikationen (LE)
- Entlassung am Folgetag
- Kein erhöhtes Blutungsrisiko wie bei CDT
- Antikoagulation und Kompressionsstrümpfe dennoch erforderlich

Vielen Dank

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