

1

Management of Intermediate- and High-risk Pulmonary Embolism: Abbott Northwestern PE Program Experience and AHA/ACC Guidelines

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MHI Grand Rounds

November 2, 2026

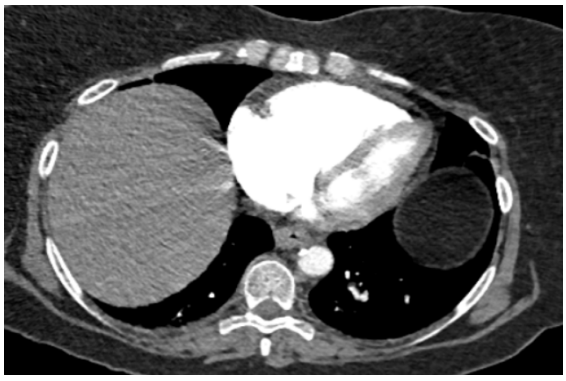
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Objectives

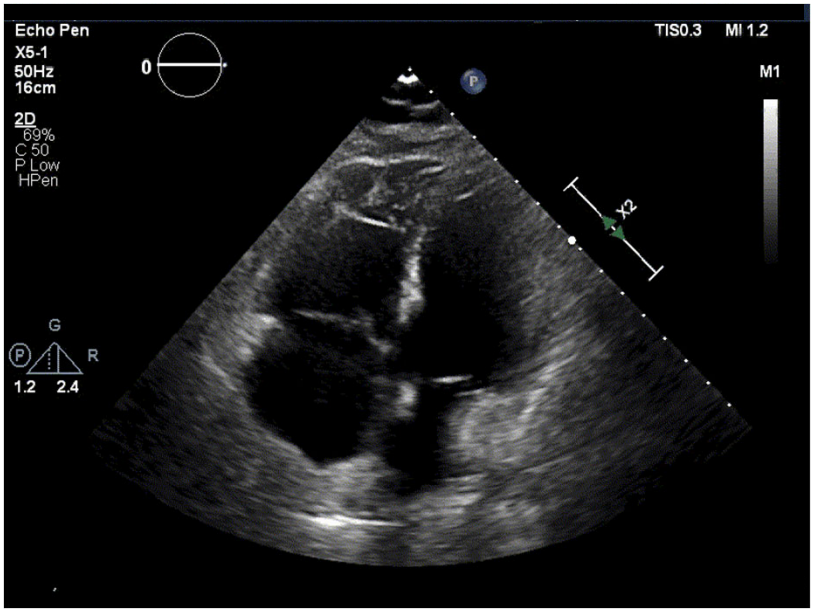
- Discuss outcomes of patients with pulmonary embolism treated at Abbott Northwestern Hospital
- Discuss the 2026 AHA/ACC Pulmonary Embolism Guidelines
- Discuss ANW PE management algorithms

3





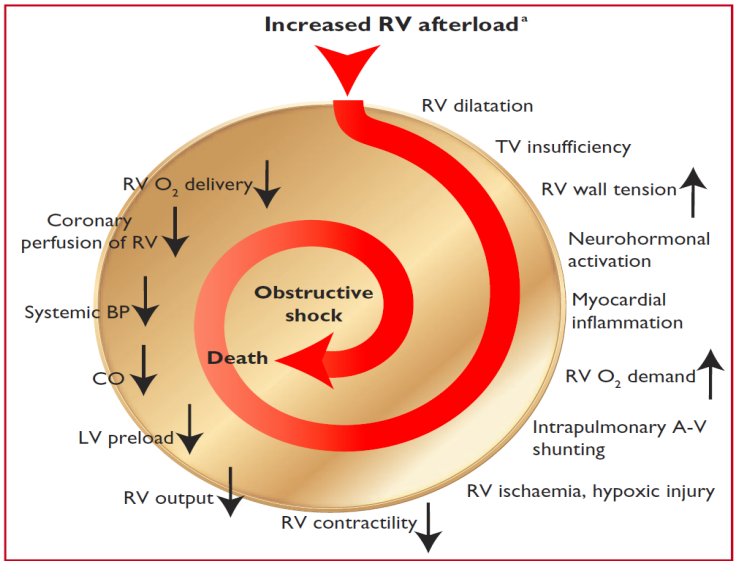
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5

5

Factors in Hemodynamic Collapse in Acute PE



European Heart Journal (2019) 00, 1-61

6

All-cause and PE-related Mortality in Hemodynamically Stable vs. Unstable PE

A

Study or Subgroup	Unstable PE Events	Total	Stable PE Events	Total	Weight	Odds Ratio M-H, Random, 95% CI	Year
ICOPER 2006	56	108	332	2284	25.7%	6.33 [4.27, 9.40]	2006
EMPEROR 2012	8	58	54	1817	21.5%	5.22 [2.36, 11.56]	2012
IPER 2012	64	201	52	1515	25.6%	13.14 [8.76, 19.72]	2012
RIETE 2018	168	1207	1786	33173	27.1%	2.84 [2.40, 3.37]	2018
Total (95% CI)		**1574**		**38789**	**100.0%**	**5.89 [2.67, 13.00]**	
Total events	296		2224				

Heterogeneity: $Tau^2 = 0.59$; $Chi^2 = 54.11$, df = 3 ($P < 0.00001$); $I^2 = 94\%$
Test for overall effect: $Z = 4.39$ ($P < 0.0001$)

Odds Ratio M-H, Random, 95% CI
0.01 0.1 1 10 100
Stable PE Unstable PE

B

Study or Subgroup	Unstable PE Events	Total	Stable PE Events	Total	Weight	Odds Ratio M-H, Random, 95% CI	Year
ICOPER 2006	35	108	119	2284	27.1%	8.72 [5.60, 13.59]	2006
EMPEROR 2012	3	58	16	1817	18.2%	6.14 [1.74, 21.69]	2012
IPER 2012	47	201	21	1515	26.2%	21.71 [12.65, 37.28]	2012
RIETE 2018	113	1207	885	33173	28.6%	3.77 [3.07, 4.63]	2018
Total (95% CI)		**1574**		**38789**	**100.0%**	**8.17 [3.40, 19.66]**	
Total events	198		1041				

Heterogeneity: $Tau^2 = 0.69$; $Chi^2 = 41.72$, df = 3 ($P < 0.00001$); $I^2 = 93\%$
Test for overall effect: $Z = 4.69$ ($P < 0.00001$)

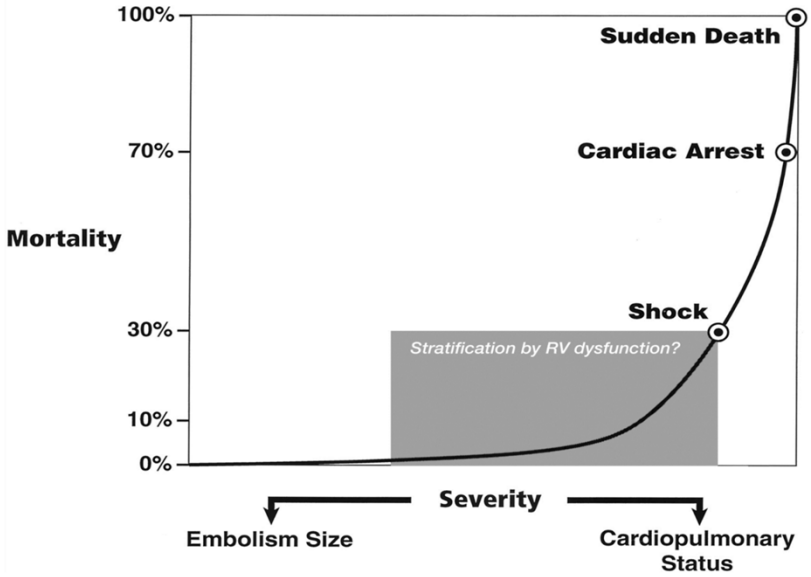
Odds Ratio M-H, Random, 95% CI
0.01 0.1 1 10 100
Stable PE Unstable PE

Figure 2. Odds ratio of short-term mortality based on the presence or absence of hemodynamic instability in patients with acute pulmonary embolism: random-effects meta-analysis. (*A*) All-cause mortality. (*B*) PE-related death. Abbreviations: CI = confidence interval; M-H = Mantel-Hanszel; PE = pulmonary embolism.

Quezada et al. Meta-Analysis of Prevalence and Short-Term Prognosis of Hemodynamically Unstable Patients With Symptomatic Acute Pulmonary Embolism Am J Cardiol 2019;123:684–689

7

Outcomes in Pulmonary Embolism



Wood KE Major Pulmonary Embolism: Review of a Pathophysiologic Approach to the **Golden Hour** of Hemodynamically Significant Pulmonary Embolism. Chest 2002; 121(3):877-905

8

All-Cause and PE-Related Mortality in Hemodynamically Unstable Patients Treated with Systemic Thrombolysis

A

Study or Subgroup	Reperfusion Events	Reperfusion Total	No reperfusion Events	No reperfusion Total	Weight	Odds Ratio M-H, Random, 95% CI	Year
ICOPER 2006	15	35	41	73	16.3%	0.59 [0.26, 1.32]	2006
EMPEROR 2012	1	7	7	51	2.1%	1.05 [0.11, 10.06]	2012
IPER 2012	23	82	41	119	28.7%	0.74 [0.40, 1.37]	2012
RIETE 2018	25	238	143	969	53.0%	0.68 [0.43, 1.06]	2018
Total (95% CI)		**362**		**1212**	**100.0%**	**0.69 [0.49, 0.95]**	
Total events	64		232				

Heterogeneity: Tau² = 0.00; Chi² = 0.35, df = 3 (P = 0.95); I² = 0%
Test for overall effect: Z = 2.26 (P = 0.02)

B

Study or Subgroup	Reperfusion Events	Reperfusion Total	No reperfusion Events	No reperfusion Total	Weight	Odds Ratio M-H, Random, 95% CI	Year
ICOPER 2006	8	35	27	73	17.6%	0.50 [0.20, 1.27]	2006
EMPEROR 2012	1	7	2	51	2.3%	4.08 [0.32, 52.07]	2012
IPER 2012	17	82	30	119	32.8%	0.78 [0.39, 1.52]	2012
RIETE 2018	15	238	98	969	47.2%	0.60 [0.34, 1.05]	2018
Total (95% CI)		**362**		**1212**	**100.0%**	**0.66 [0.45, 0.97]**	
Total events	41		157				

Heterogeneity: Tau² = 0.00; Chi² = 2.64, df = 3 (P = 0.45); I² = 0%
Test for overall effect: Z = 2.10 (P = 0.04)

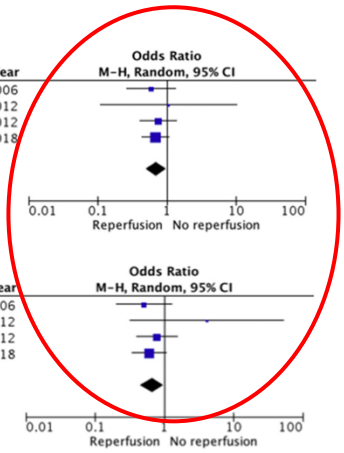


Figure 3. Odds of mortality in patients with unstable pulmonary embolism treated with thrombolytic therapy versus anticoagulation: random-effects meta-analysis. (*A*) All-cause mortality. (*B*) PE-related death. Abbreviation: M-H = Mantel-Hanszel.

Quezada et al. Meta-Analysis of Prevalence and Short-Term Prognosis of Hemodynamically Unstable Patients With Symptomatic Acute Pulmonary Embolism Am J Cardiol 2019;123:684–689

9

Thrombolysis for Submassive PE

TABLE 2. IN-HOSPITAL CLINICAL EVENTS.*

EVENT	HEPARIN PLUS ALTEPLASE (N=118)	HEPARIN PLUS PLACEBO (N=138)	P VALUE†
	no. (%)		
Primary end point	13 (11.0)	34 (24.6)	0.006
Death from all causes	4 (3.4)	3 (2.2)	0.71
Escalation of treatment	12 (10.2)	34 (24.6)	0.004
Catecholamine infusion (for persistent hypotension or shock)	3 (2.5)	8 (5.8)	0.33
Secondary thrombolysis	9 (7.6)	32 (23.2)	0.001
Endotracheal intubation	3 (2.5)	3 (2.2)	0.85
Cardiopulmonary resuscitation	0	1 (0.7)	1.0
Embolectomy or thrombus fragmentation	0	1 (0.7)	1.0
Secondary end points			
Recurrent pulmonary embolism‡	4 (3.4)	4 (2.9)	0.89
Major bleeding§	1 (0.8)	5 (3.6)	0.29
Fatal bleeding	0	1 (0.7)	1.0
Hemorrhagic stroke¶	0	0	—
Ischemic stroke¶	0	1 (0.7)	1.0

Alteplase + AC vs. AC alone

Konstantinides et al. New Engl J Med, Vol. 347, No. 15 · October 10, 2002

10

Thrombolysis for Intermediate-Risk PE

Table 3. Efficacy Outcomes.*

Outcome	Tenecteplase (N=506)	Placebo (N=499)	Odds Ratio (95% CI)	P Value
Primary outcome — no. (%)	13 (2.6)	28 (5.6)	0.44 (0.23–0.87)	0.02
Death from any cause	6 (1.2)	9 (1.8)	0.65 (0.23–1.85)	0.42
Hemodynamic decompensation	8 (1.6)	25 (5.0)	0.30 (0.14–0.68)	0.002
Time between randomization and primary efficacy outcome — days	1.54±1.71	1.79±1.60		
Recurrent pulmonary embolism between randomization and day 7 — no. (%)	1 (0.2)	5 (1.0)	0.20 (0.02–1.68)	0.12
Fatal	0	3 (0.6)		
Nonfatal	1 (0.2)	2 (0.4)		
Other in-hospital complications and procedures — no. (%)				
Mechanical ventilation	8 (1.6)	15 (3.0)		
Surgical embolectomy	1 (0.2)	2 (0.4)		
Catheter thrombus fragmentation	1 (0.2)	0 (0.0)		
Vena cava interruption	5 (1.0)	1 (0.2)		
Thrombolytic treatment other than study medication	4 (0.8)	23 (4.6)		
Death from any cause between randomization and day 30 — no. (%)	12 (2.4)	16 (3.2)	0.73 (0.34–1.57)	0.42
Patient still hospitalized at day 30 — no. (%)	59 (11.7)	50 (10.0)		
Rehospitalization between randomization and day 30 — no. (%)	22 (4.4)	15 (3.0)		

Tenecteplase (full-dose regimen) + AC vs. AC alone

Meyer, G et al. Fibrinolysis for Patients with Intermediate-Risk Pulmonary Embolism N Engl J Med 370;15 April 10, 2014

11

Thrombolysis for Intermediate-Risk PE - Complications

Table 4. Safety Outcomes in the Intention-to-Treat Population.*

Outcome	Tenecteplase (N=506)	Placebo (N=499)	Odds Ratio (95% CI)	P Value
	no. (%)			
Bleeding between randomization and day 7				
Major extracranial bleeding	32 (6.3)	6 (1.2)	5.55 (2.3–13.39)	<0.001
Minor bleeding	165 (32.6)	43 (8.6)		
Major bleeding†	58 (11.5)	12 (2.4)		
Stroke between randomization and day 7	12 (2.4)	1 (0.2)	12.10 (1.57–93.39)	0.003
Ischemic stroke	2 (0.4)	0		
Hemorrhagic stroke‡	10 (2.0)	1 (0.2)		
Serious adverse events between randomization and day 30	55 (10.9)	59 (11.8)	0.91 (0.62–1.34)	0.63

Meyer, G et al. Fibrinolysis for Patients with Intermediate-Risk Pulmonary Embolism N Engl J Med 370;15 April 10, 2014

12

Long-Term Outcomes of Intermediate-Risk Pulmonary Embolism: TNK vs. Placebo

- Long-term follow-up: median 37.8 months (IQR 24.6 -54.8 months)
- Overall mortality 19.2%, no difference between groups
- Persistent clinical symptoms (mostly mild exertional dyspnea): 36.0% in TNK vs. 30.1% in placebo group (non-significant)
- CTEPH diagnosed 2.1% vs. 3.2% (non-significant)

Konstantinides et al. J Am Coll Cardiol 2017 Mar 28;69(12):1536-1544

13

Long-Term Outcomes of Intermediate-Risk Pulmonary Embolism: TNK vs. Placebo

TABLE 4 Findings in Patients With Echocardiographic Long-Term Follow-Up

	Tenecteplase (N = 144)	Placebo (N = 146)	p Value
Right ventricular end-diastolic diameter >30 mm	34 (23.6)	22 (15.1)	0.058
Missing data	12 (8.3)	11 (7.5)	
Right/left ventricular end-diastolic diameter >0.9	34 (23.6)	22 (15.1)	0.834
Missing data	12 (8.3)	11 (7.5)	
Hypokinesia of the right ventricular free wall (any view)	6 (4.2)	5 (3.4)	0.740
Missing data	4 (2.8)	4 (2.7)	
Tricuspid annulus plane systolic excursion reduced	14 (9.7)	7 (4.8)	0.107
Mean, mm Hg	23.6 ± 4.8	23.9 ± 3.6	
Median, mm Hg	24.0 (20.0-27.0)	24.0 (21.0-26.0)	0.551
Missing data,	19 (13.2)	18 (12.3)	
Tricuspid systolic velocity >2.6 m/s	22 (15.3)	27 (18.5)	0.412
Missing data	11 (7.6)	14 (9.6)	
Systolic pulmonary artery pressure, mm Hg			
Mean	31.6 ± 12.3	30.7 ± 10.2	0.527
Median	30.0 (24.0-35.0)	30.0 (25.0-35.0)	
Missing data	33 (22.9)	39 (26.7)	

Values are n (%), mean ± SD, or median (interquartile range).

Konstantinides et al. J Am Coll Cardiol 2017 Mar 28;69(12):1536-1544

14

Selected CDI Trials

Trial	Comparison	Primary Outcome	Result	N	Comment
CANARY	CDT vs. AC	RV/LV > 0.9 at 3 mo	No difference	94	More RV/LV > 0.9 at 72 h in AC; 1 major bleed in CDI
SUNSET	USAT vs. CDT	Clot reduction at 48 h	No difference	81	2 major bleeds in USAT
PEERLESS	MT vs. CDT	Composite (mortality, ICH, major bleed, clinical decompensation or bailout, ICU admission and LOS)	Fewer clinical deterioration and ICU use in MT	550	No difference in mortality; ICH: 0.7% vs 0.4%; major bleeding 6.9% vs 6.9%
FLASH	MT Registry	Immediate 7.6 mmHg drop in mPAP and 0.3 L/min/m2 mean increase in CI		800	No overnight ICU stay in 62% pts; improved dyspnea and RV/LV at 48h
RESCUE-II	PML using bolus-only r-tPA resulted in improved RV/LV ratio and PA obstruction			9	No complications
STORM-PE	CAVT vs. AC	Change in RV/LV ratio at 48 h	Favored CAVT	100	Two PE-related deaths (4.3%) in the CAVT arm

- JAMA Cardiol. 2022 Dec 1;7(12):1189-1197
- JACC Cardiovasc Interv. 2021 Jun 28;14(12):1364-1373
- Circulation 2025 Feb 4;151(5):260-273
- EuroIntervention. 2023 Feb 20;18(14):1201-1212
- JACC Adv . 2025 Jun;4(6 Pt 1):101789
- Circulation. 2026 Jan 6;153(1):21-34

15

Ultrasound-Facilitated, Catheter-Directed Fibrinolysis for Acute Pulmonary Embolism (HI-PEITHO)

- 544 pts with **intermediate-risk PE** (RV/LV ≥1.0 + elevated troponin) + at least two additional indicators (SBP≤110, HR ≥100, or RR >20) randomized to US-facilitated, catheter-directed fibrinolysis with alteplase plus anticoagulation or anticoagulation alone
- Primary outcome (composite of PE–related death, cardiorespiratory decompensation or collapse, or symptomatic recurrence of pulmonary embolism within 7 days): Intervention group 4.0% vs. AC 10.3%, driven by the lower NEWS score assessed at 7 days post-intervention as a component of cardiorespiratory decompensation

N Engl J Med 2026;394:1979-90

16

Ultrasound-Facilitated, Catheter-Directed Fibrinolysis for Acute Pulmonary Embolism N Engl J Med 2026;394:1979-90

Table 2. Clinical Efficacy Outcomes (Intention-to-Treat Population).*

Outcome	Intervention (N=273)		Control (N=271)		Relative Risk (95% CI)†
	no. of patients	*% (95% CI)†*	*no. of patients*	*% (95% CI)†*	
Any primary-outcome event	11	4.0 (2.3–7.1)	28	10.3 (7.2–14.5)	0.39 (0.20–0.77)‡
Components of the primary outcome					
Pulmonary embolism–related death	3	1.1 (0.4–3.2)	1	0.4 (0.1–2.1)	3.0 (0.3–28.5)
Cardiorespiratory decompensation or collapse	10	3.7 (2.0–6.6)	28	10.3 (7.2–14.5)	0.4 (0.2–0.7)
Recurrence of pulmonary embolism	1	0.4 (0.1–2.0)	1	0.4 (0.1–2.1)	1.0 (0.1–15.8)

17

Ultrasound-Facilitated, Catheter-Directed Fibrinolysis for Acute Pulmonary Embolism N Engl J Med 2026;394:1979-90

Table 3. Cumulative Major Bleeding Events through 30 Days (Treated Population).*

Event	Intervention (N=271)	Control (N=271)	Relative Risk (95% CI)†	P Value‡
	no. of patients (%)			
Major bleeding according to ISTH criteria				
Within 72 h	10 (3.7)	4 (1.5)	2.5 (0.8–7.9)	0.17
Within 7 days	11 (4.1)	6 (2.2)	1.8 (0.7–4.9)	0.32
Within 30 days	11 (4.1)	8 (3.0)	1.4 (0.6–3.4)	0.64
Moderate-to-severe bleeding within 7 days according to GUSTO criteria	9 (3.3)	4 (1.5)	2.3 (0.7–7.2)	0.26
Ischemic stroke				
Within 7 days	1 (0.4)	0	NE	1.00
Within 30 days	1 (0.4)	0	NE	1.00
Intracranial hemorrhage				
Within 7 days	0	0	NE	1.00
Within 30 days	0	0	NE	1.00

18

Ultrasound-Facilitated, Catheter-Directed Fibrinolysis for Acute Pulmonary Embolism N Engl J Med 2026;394:1979-90

Table S5. Causes of cardiorespiratory collapse or decompensation through 7 days (Intention-to-Treat Population).*

Event	Ultrasound-facilitated catheter-directed fibrinolysis (N=273) number (%)	95% CI (%)	Anticoagulation alone (N=271) number (%)	95% CI (%)
Cardiac arrest or cardiopulmonary resuscitation	6 (2.2)	(1.0 to 4.7)	4 (1.5)	(0.6 to 3.7)
Signs of shock	5 (1.8)	(0.8 to 4.2)	9 (3.3)	(1.8 to 6.2)
Placement on ECMO	1 (0.4)	(0.1 to 2.0)	3 (1.1)	(0.4 to 3.2)
Intubation or non-invasive mechanical ventilation	6 (2.2)	(1.0 to 4.7)	5 (1.8)	(0.8 to 4.2)
National Early Warning Score ≥9	2 (0.7)	(0.2 to 2.6)	19 (7.0)	(4.5 to 10.7)

CI denotes confidence interval; ECMO, extracorporeal membrane oxygenation.

* The primary composite efficacy outcome was evaluated at 7 (+2) days post randomization, or at discharge; 2 patients had missing data. All outcome events were independently adjudicated by a clinical events committee whose members were unaware of the treatment assignments.

19

Ultrasound-Facilitated, Catheter-Directed Fibrinolysis for Acute Pulmonary Embolism N Engl J Med 2026;394:1979-90

Table S1. National Early Warning Score (NEWS).[6]

Physiological Parameters	3	2	1	0	1	2	3
Respiration rate (breaths per minute)	≤8	--	9-11	12-20	--	21-24	≥25
Oxygen saturation (%)	≤91	92-93	94-95	≥96	--	--	--
Any supplemental oxygen	--	Yes	--	No	--	--	--
Temperature (°C)	≤35.0	--	35.1-36.0	36.1-38.0	38.1-39.0	≥39.1	--
Systolic blood pressure (mm Hg)	≤90	91-100	101-110	111-219	--	--	≥220
Heart rate (beats per minute)	≤40	--	41-50	51-90	91-110	111-130	≥131
Level of consciousness	--	--	--	A	--	--	V,P, or U

20

Ultrasound-Facilitated, Catheter-Directed Fibrinolysis for Acute Pulmonary Embolism N Engl J Med 2026;394:1979-90

Table 4. Mortality, Recurrence of Pulmonary Embolism, and Serious Adverse Events through 30 Days (Treated Population).*

Event	Intervention (N=271)	Control (N=271)	Relative Risk (95% CI)†
	no. of patients (%)		
Death from any cause through 7 days	3 (1.1)	2 (0.7)	1.5 (0.3–8.9)
Outcomes through 30 days			
Death from any cause	5 (1.8)	3 (1.1)	1.7 (0.4–6.9)
Symptomatic recurrence of pulmonary embolism	1 (0.4)	2 (0.7)	0.5 (0.0–5.5)
Any serious adverse event‡	40 (14.8)	44 (16.2)	0.9 (0.6–1.3)§

21

RCT of Low-dose ST vs. USAT vs. AC alone in Intermediate high-risk PE N=210

	USAT	IV	Heparin	Mean diff. (95% CI) USAT/IV vs. heparin	Mean diff. (95% CI) USAT vs. IV
rmMS, baseline, mean (SD) no. = 204	20 (4)	20 (4)	19 (4)	0.99 (−0.14–2.13)	−0.29 (−1.58–1.01)
rmMS, 48–96 h follow-up, mean (SD) no. = 192	13 (5)	14 (6)	16 (4)	−2.27 (−3.70 to −0.85)	−0.41 (−2.17–1.34)
Primary endpoints					
Difference in RMS, baseline to 48–96 h follow-up, mean (SD) no. = 189	−6.3 (5.3)	−6.1 (5.0)	−2.6 (3.5)	−3.6 (−5.0 to −2.2) $P < 0.001$	−0.1 (−1.9–1.7) $P = 0.88$
Secondary endpoints					
Bleeding (TIMI classification), no. (%)	10 (14)	10 (14)	3 (4)	3.2 (0.93–11.2)	0.9 (0.4–2.5)
Major	2	2	0		
Minor	3	2	0		
Minimal	5	6	3		
Bleeding (ISTH classification), no. (%)	10 (14)	10 (14)	3 (4)	3.2 (0.93–11.2)	0.9 (0.4–2.5)
Major	6	6	1		
Minor	4	4	2		
Difference in RV/LV diameter ratio, baseline to 48–96 h follow-up, mean (SD) no. = 189	−0.3 (0.3)	−0.4 (0.4)	−0.3 (0.3)	−0.06 (−0.2–0.03)	0.03 (−0.08–0.1)
Days of hospitalization, median (IQR)	5 (4–6)	5 (4–7)	5 (4–7)	−0.1 (−1–1.0)	−0.7 (−2–1)

Kjaergaard et al. Cardiovascular Research (2026) 00, 1–11

22

Catheter-Directed Thrombolysis in Intermediate-High Risk Pulmonary Embolism N Engl J Med 2026 Aug 31

Table 3. Outcomes (Intention-to-Treat Population).*

Outcome	Thrombolysis (N=280)		Standard Care (N=278)		Relative Risk (95% CI)
	no. of patients	*% of patients (95% CI)†*	*no. of patients*	*% of patients (95% CI)†*	
Primary outcome					
Death from any cause, recurrence of pulmonary embolism, or cardiorespiratory decompensation or collapse	2	0.7 (0.0–2.7)	19	6.8 (4.4–10.5)	0.10 (0.02–0.44)‡
Secondary outcomes					
Death from any cause	0	0 (0.0–1.6)	4	1.4 (0.4–3.8)	0
Recurrence of pulmonary embolism	2	0.7 (0.0–2.7)	1	0.4 (0.0–2.2)	1.99 (0.18–21.77)
Cardiorespiratory decompensation or collapse	2	0.7 (0.0–2.7)	15	5.4 (3.2–8.8)	0.13 (0.03–0.57)

Alteplase: 1 mg bolus through each catheter followed by 1 mg/h infusion per up to a total dose of 20 mg (10 mg in patients with unilateral pulmonary embolism). PTT target 50-60 during lysis

23

Catheter-Directed Thrombolysis in Intermediate-High Risk Pulmonary Embolism N Engl J Med 2026 Aug 31

Table S6. Causes of Cardiorespiratory Decompensation or Collapse through 7 Days (Intention-To-Treat Population)

Table S6. Causes of Cardiorespiratory Decompensation or Collapse trough 7 Days (Intention-to-Treat Population) *		
Event	**CDT group (N=2/280)**	**Standard care group (N=15/278)**
	No. (%)	No. (%)
Cardiac arrest or cardiopulmonary resuscitation	1 (0.4%)	0 (0.0%)
Shock	1 (0.4%)	6 (2.2%)
Extracorporeal membrane oxygenation placement	1 (0.4%)	1 (0.4%)
Intubation, or initiation of non-invasive ventilation	1 (0.4%)	7 (2.6%)
National Early Warning Score ≥9	1 (0.4%)	3 (1.1%)

* The cardiorespiratory deterioration or collapse component of the primary outcome was assessed within 7 days after randomization. Cardiorespiratory deterioration or collapse occurred in 2 (0.7%) patients in the CDT group and 15 (5.4%) patients in the Standard care group. One patient in each group scored multiple events.

24

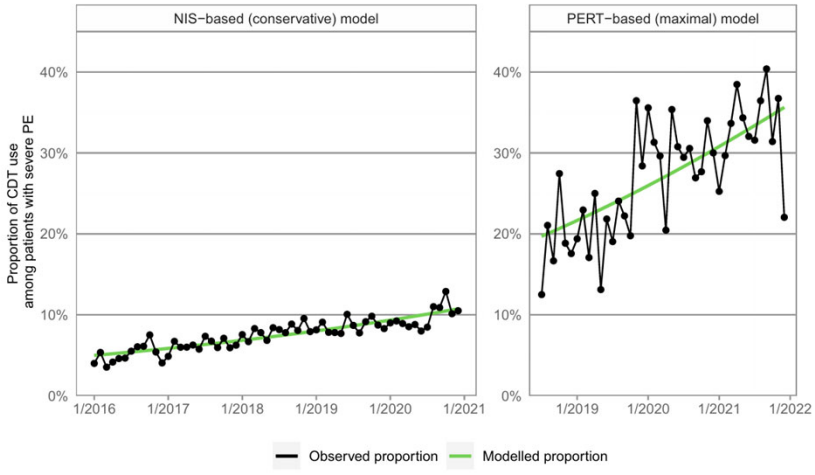


Figure 1 Observed and modelled monthly proportion of use of catheter-directed treatment in the National Inpatient Sample (2016–20) and the Pulmonary Embolism Response Teams (PERT) registry (2018–21). Observed monthly proportion of the use of catheter-directed treatment (CDT; black dots and lines) and modelled monthly proportion based on an individual patient-level binomial (logistic) model (green lines) among patients with severe pulmonary embolism (PE) in the National Inpatient Sample (left panel) and the PERT™ registry (right panel).

Mohr et al. Modelling costs of interventional pulmonary embolism treatment: implications of US trends for a European healthcare system. Eur Heart J Acute Cardiovasc Care. 2024 Jun 30;13(6):501-505.

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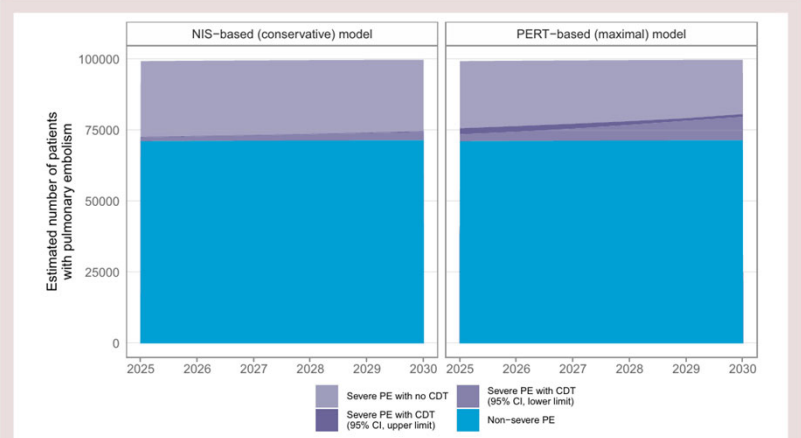


Figure 2 Number of patients with pulmonary embolism (PE) estimated to receive catheter-directed treatment (CDT) in Germany, 2025–30. The total number of patients with PE and the predicted proportion of those with severe PE for the time period 2025–30 were estimated based on (i) a forecast for the German population and (ii) observed trends of the proportion of patients with severe PE between 2016 and 2020, both obtained from the German Federal Statistical Office. The 95% confidence interval for the predicted CDT penetration in the German PE population for this future period was modelled separately from the US Nationwide Inpatient Sample (NIS; left panel) and the Pulmonary Embolism Response Teams (PERT)™ national quality assurance database registry (right panel) using binomial (logistic) regression as shown in *Figure 1*. The NIS model was trained on 2016–20 data, the PERT model was trained on 2018–21 data, and the calculated penetration in the years 2016–20 in each model was applied to the German population for the time period 2025–30.

Mohr et al. Modelling costs of interventional pulmonary embolism treatment: implications of US trends for a European healthcare system. Eur Heart J Acute Cardiovasc Care. 2024 Jun 30;13(6):501-505.

26

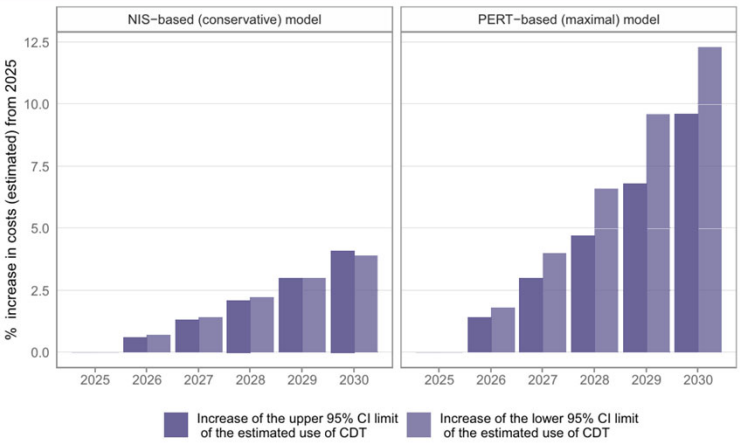


Figure 3 Percent increase in total estimated costs of hospitalizations for pulmonary embolism (PE) in Germany until 2030, compared with the reference year 2025. Costs were calculated based on the estimated annual numbers of patients to be hospitalized with PE as depicted in *Figure 2* and on current German reimbursement for PE hospitalization with vs. without catheter-directed treatment (CDT). Predicted increase of CDT costs was modelled separately from the US Nationwide Inpatient Sample (NIS; left panel) and the US Pulmonary Embolism Response Teams (PERT)™ national quality assurance database registry (right panel). The bars display the relative increase of costs relative to 2025 of each limit of the 95% confidence interval (CI) for the estimated number of patients using CDT. In the PERT-based model, the upper limit of the 95% CI, while always reflecting higher absolute numbers (as visible in *Figure 2*) and costs increases less quickly than the lower limit over time, thus displaying a slower increase relative to its baseline in 2025.

Mohr et al. Modelling costs of interventional pulmonary embolism treatment: implications of US trends for a European healthcare system. Eur Heart J Acute Cardiovasc Care. 2024 Jun 30;13(6):501-505.

27

Circulation

Check for updates

CLINICAL PRACTICE GUIDELINES

2026 AHA/ACC/ACCP/ACEP/CHEST/SCAI/SHM/SIR/SVM/SVN Guideline for the Evaluation and Management of Acute Pulmonary Embolism in Adults: A Report of the American College of Cardiology/American Heart Association Joint Committee on Clinical Practice Guidelines

Developed in Collaboration With and Endorsed by the American College of Clinical Pharmacy, American College of Emergency Physicians, American College of Chest Physicians, Society for Cardiovascular Angiography & Interventions, Society of Hospital Medicine, Society of Interventional Radiology, Society for Vascular Medicine, and the Society of Vascular Nursing

Circulation. 2026;153:e977–e1051

28

Pulmonary Embolism International THrOmbolysis Study-3 (PEITHO-3) – Study-in-progress

- Patients with intermediate-high-risk acute pulmonary embolism, N=650
- Alteplase as a 15 min IV infusion at 0.6 mg/kg, total dose not exceeding 50 mg + AC vs. AC alone
- Primary efficacy outcome: composite of all-cause death, hemodynamic decompensation, or PE recurrence within 30 d
- Multiple secondary outcomes including health care resources

Thromb Haemost. 2021 Oct 31;122(5):857–866

29

2026 Acute Pulmonary Embolism Guideline

- **Five clinical categories** (A-E) with subcategories from low to high risk for adverse outcomes
- **Advanced therapies** (ST, CDL, mechanical thrombectomy, and surgical embolectomy) recommendations
- **PE response teams** (PERT)
- **LMW heparin** is recommended over unfractionated heparin
- **Lower dose systemic thrombolytics** consideration to reduce the risk of bleeding
- **DOACs** are recommended over vitamin K antagonists

30

Table 5. Progression of Acute PE Risk Categorization Schemas

Year	Organization	Risk Category	Clinical Criteria
2011	AHA Scientific Statement[1]	Low risk	Normotensive; no right ventricular dysfunction or myocardial necrosis (elevated troponin)
		Submassive	Systolic BP ≥90 mm Hg and either right ventricular dysfunction or myocardial necrosis
		Massive	Systolic blood pressure <90 mm Hg for >15 minutes or requiring inotropic support
2019	ESC Acute Pulmonary Embolism Risk Scheme[2]	Low risk	Nonelevated risk score (eg, PESI class I-II or sPESI=0) Normal right ventricle on imaging
		Intermediate-low risk	Elevated risk score (eg, PESI class III-IV or sPESI ≥1) None or 1 positive of either troponin or right ventricular dysfunction on imaging
		Intermediate-high risk	Elevated risk score (eg, PESI class III-IV or sPESI ≥1) Both positive troponin and right ventricular dysfunction on imaging
		High risk	Hemodynamic instability
2026	AHA/ACC Acute PE Clinical Categories	A	Subclinical – incidental and asymptomatic PE
		B	Symptomatic PE with low clinical severity score (eg, PESI class I-II, sPESI=0, Hestia=0)
		C	Symptomatic PE with elevated clinical severity score (eg, PESI class III-V, sPESI ≥1, Hestia ≥1)
		D	Incipient cardiopulmonary failure (eg, normotensive shock)
		E	Cardiopulmonary failure

Circulation. 2026;153:e977–e1051

31

2026 Acute Pulmonary Embolism Guideline

- **Quantification of angiographic thrombus burden** for short-term risk stratification is not recommended
- **Continuing anticoagulation beyond the initial treatment phase** (3-6 months) into the extended phase recommendations for first acute PE without a major reversible risk factor and in those with a persistent risk factor
- **Discharge from ED** and hospitalization criteria

32

2026 Acute Pulmonary Embolism Guideline

- **Transfer to a center that can provide advanced therapies** may be considered to ensure access to appropriate interventions for hemodynamically stable patients with high-risk features. Unstable patients with acute PE should not be transferred to another medical center before stabilizing their condition
- **Follow up:** Patients who have had acute PE should be asked about PE-related symptoms and functional limitations at every visit for at least 1 year to screen for chronic thromboembolic pulmonary disease or other causes of dyspnea and functional limitation

33

Table 4. Optimal Methods of RV Dysfunction Assessment on Echocardiogram[44]

	Recommended Technique for Assessment	Definition of Parameter
RV dimension	1) End-diastole from a right ventricle-focused parasternal long view 2) Apical right ventricle-focused view ensuring the RV free wall is visualized throughout the cardiac cycle	1) EDD ≥30 mm[42,51] 2) RV basal EDD ≥41 mm[44,51]
RV/LV	End-diastolic ratio (apical, or sub-costal view)	RV/LV >0.9[42,51]
TAPSE	Measures the distance of systolic excursion of the RV free wall. From the RV focused view, the M-mode cursor is placed along the lateral tricuspid valve annulus and aligned such that the cursor is parallel to annular motion (along the RV free wall, base to apex)[5]	TAPSE <1.7 cm is abnormal[44,51]
TDI S'Velocity	Obtained from RV focused view, placing pulse wave Doppler cursor along lateral tricuspid valve annulus	TDI S' 9.5 cm/s is abnormal[44]
TR velocity	TR velocity, using continuous wave Doppler, obtained from multiple windows; use highest velocity to calculate right ventricular systolic pressure	≥2.9 m/sec suggests pulmonary hypertension[44]

EDD indicates end-diastolic diameter; LV, left ventricle; RV, right ventricle; TAPSE, tricuspid annular plane systolic excursion; TDI, tissue doppler imaging; and TR, tricuspid regurgitant.

Circulation. 2026;153:e977–e1051

34

4.2.4. Mechanical Circulatory Support

Recommendations for Mechanical Circulatory Support
Referenced studies that support recommendations are summarized in the Evidence Table.

COR	LOE	Recommendations
1	B-NR	1. In patients with known or suspected acute PE on VA-ECMO, continuation of parenteral systemic anticoagulation is recommended in the absence of bleeding to prevent further thrombotic or embolic complications.[1,2]
2a	B-NR	2. In patients with acute, refractory cardiogenic shock as a result of known or suspected acute PE (AHA/ACC PE Category E2), it is reasonable to institute VA-ECMO, provided appropriate resources are available, to stabilize hemodynamics and improve oxygenation.[3–6]
2b	C-LD	3. In patients with acute PE in AHA/ACC PE Category E2 who are placed on VA-ECMO support, the usefulness of additional advanced therapies is not well established.[7–9]

Circulation. 2026;153:e977–e1051

35

Recommendations for Interventional Advanced Management
Referenced studies that support recommendations are summarized in the Evidence Table.

COR	LOE	Recommendations
2a	C-LD	1. In patients with acute PE in AHA/ACC PE Categories C3-E2 who have evidence of free-floating right atrial and/or RV clot-in-transit, the utilization of advanced therapies over anticoagulation alone is reasonable to reduce the risk of clinical deterioration.[1]

Recommendations for Interventional Advanced Management (Continued)

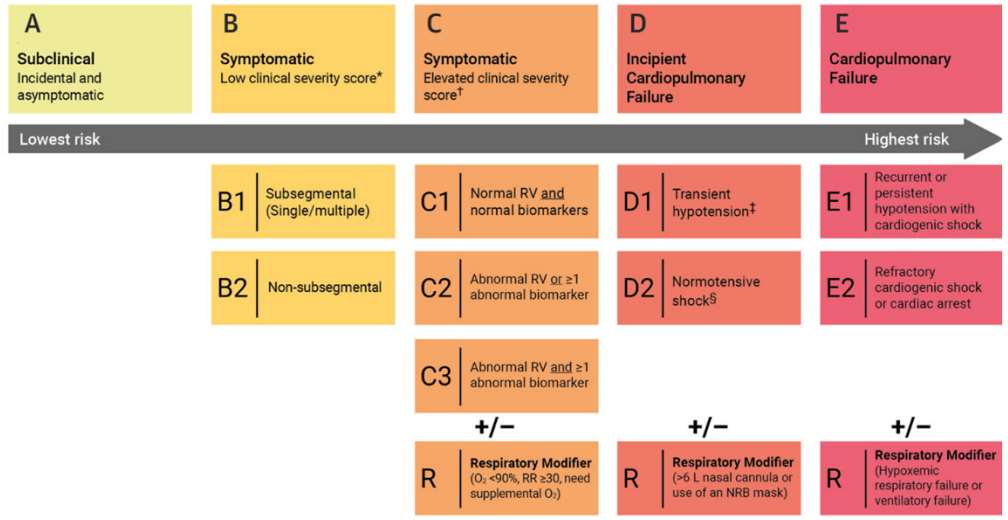
COR	LOE	Recommendations
2b	B-R	2. In patients with acute PE in AHA/ACC PE Categories C2-D2 and without contraindications to thrombolysis, and in whom advanced therapy is being considered, the usefulness of either CDL or MT over the other is uncertain for reduction in mortality or major bleeding.[2]

Intracardiac clot-in-transit: High-quality comparative data are not currently available

Circulation. 2026;153:e977–e1051

36

AHA/ACC Clinical Categories

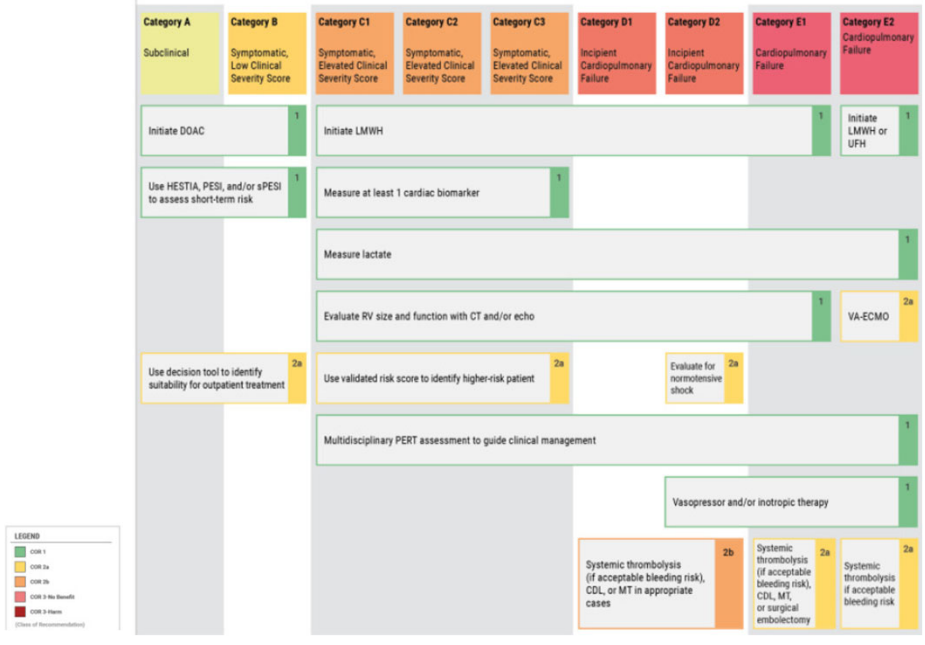


2026 Adults With Acute Pulmonary Embolism
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Circulation. 2026;153:e977–e1051

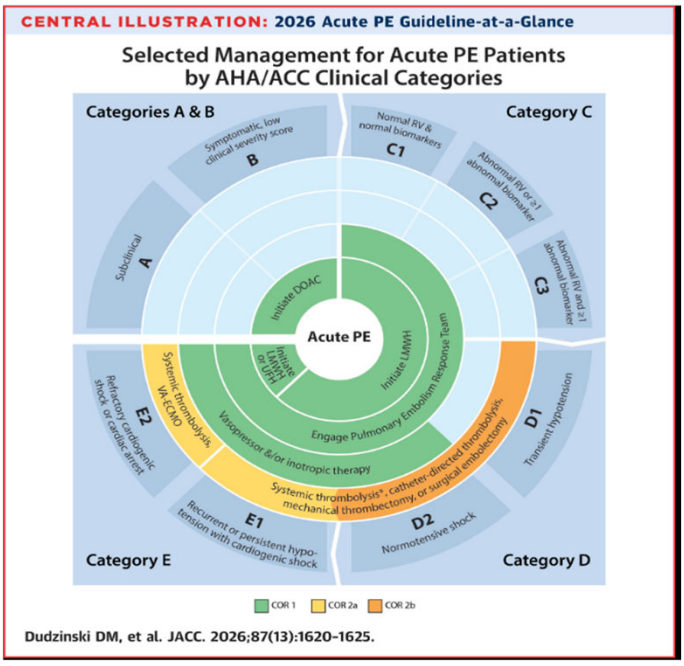
37

Initial Assessment and Management by AHA/ACC Acute PE Clinical Categories



Circulation. 2026;153:e977–e1051

38



Dudzinski DM, et al. JACC. 2026;87(13):1620–1625.

39

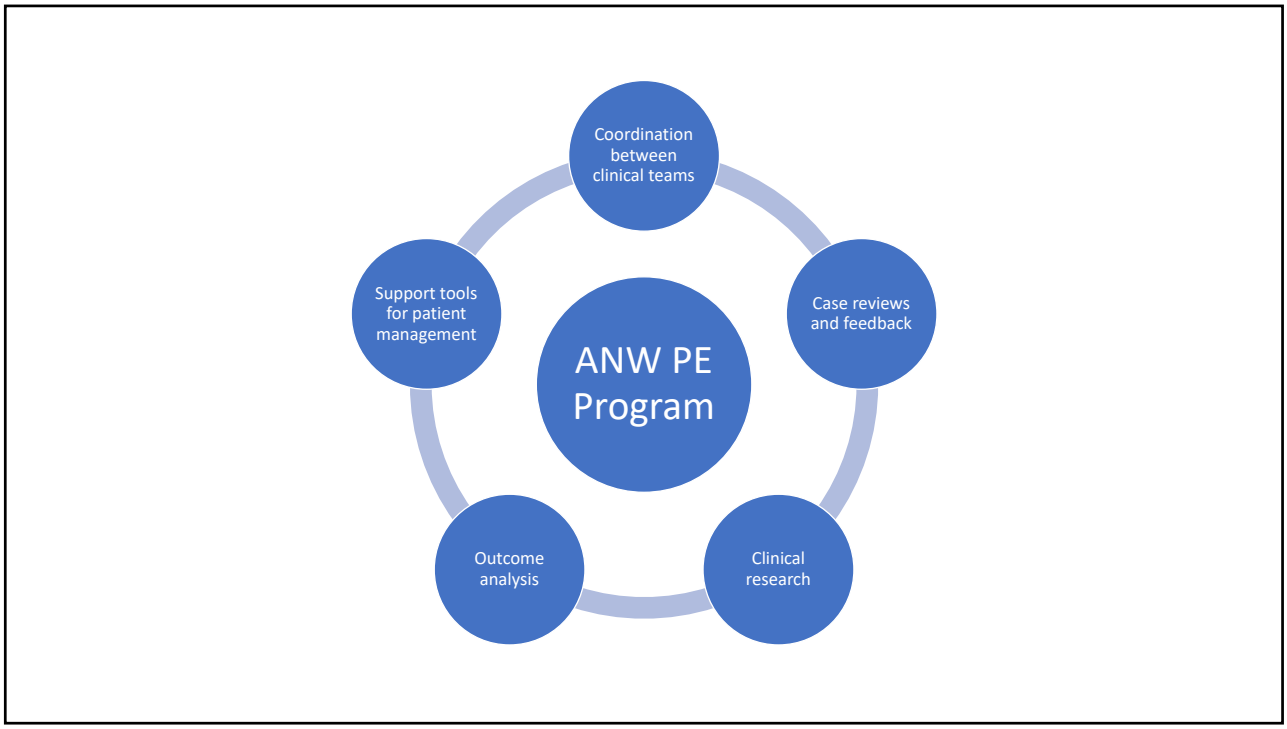
TABLE 7 Summary of Advanced Therapy Recommendations (COR LOE*)

AHA/ACC PE Risk Outcomes Category	Systemic Lysis	CDL	MT	Surgery
A-C1	3-Harm A	3-NB C-EO	3-NB C-EO	3-NB C-EO
C2	3-Harm B-R	2b C-LD (unclear)	2b C-LD (unclear)	3-NB C-EO
C3	2b C-LD (unclear)	2b C-LD (unclear)	2b C-LD (unclear)	3-NB C-EO
D1-2	2b C-LD (may be considered)	2b B-NR (may be considered)	2b B-NR (may be considered)	2b C-LD (unclear)
E1	2a C-LD	2a C-LD	2a B-NR	2a B-NR
E2	2a C-LD	N/A	N/A	3-NB B-NR

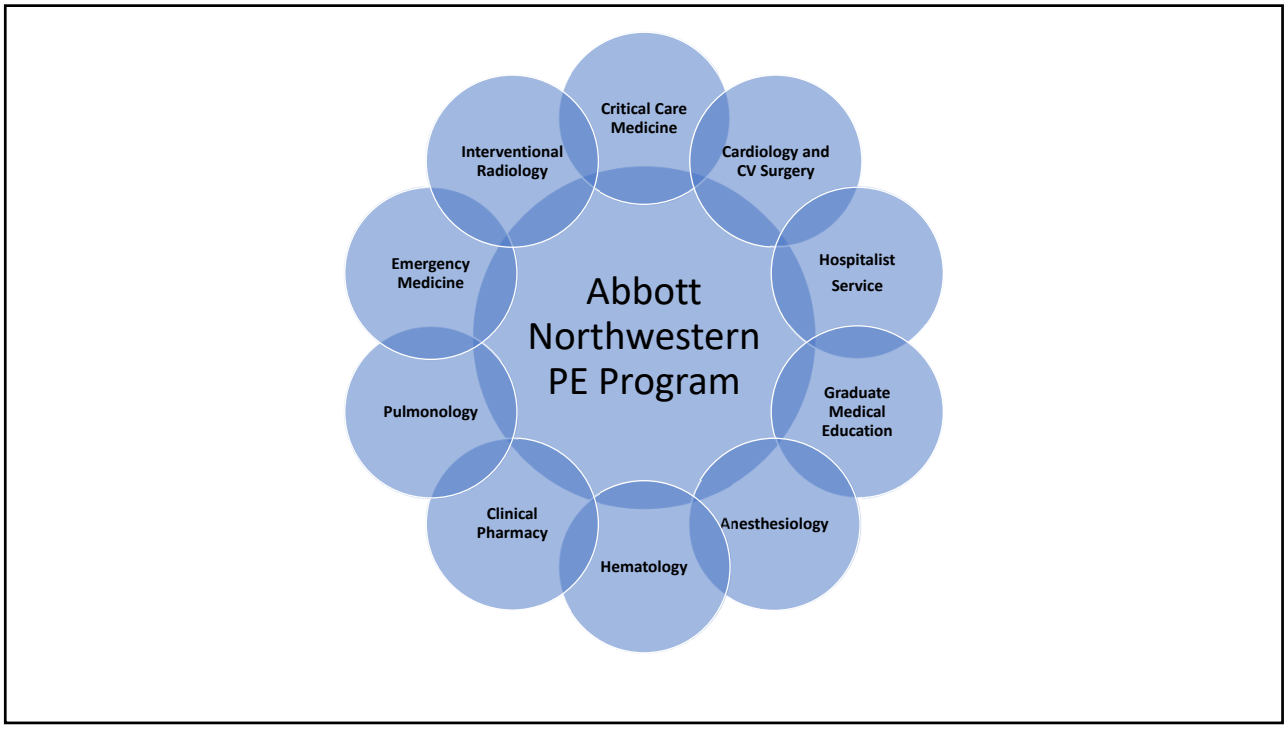
ACC indicates American College of Cardiology; AHA, American Heart Association; CDL, catheter-directed thrombolysis; COR, Class of Recommendation; EO, expert opinion; LD, limited data; LOE, Level of Evidence; MT, mechanical thrombectomy; NB, no benefit; NR, nonrandomized; R, randomized.

Circulation. 2026;153:e977–e1051

40


Coordination between clinical teams
Case reviews and feedback
Clinical research
Outcome analysis
Support tools for patient management
ANW PE Program

41


Critical Care Medicine
Cardiology and CV Surgery
Hospitalist Service
Graduate Medical Education
Anesthesiology
Hematology
Clinical Pharmacy
Pulmonology
Emergency Medicine
Interventional Radiology
Abbott Northwestern PE Program

42

ANW PE Program

Year	2018	2019	2020	2021	2022	2023	2024	2025
Patients, total, n	372	388	383	364	408	579	622	686
Patients, ICU, n	140	141	117	94	128	191	175	185
ICU LOS, Days								
mean			2.27	2.86	1.78	5.26	5.02	3.98
median	1.86	2.09	1.06	0.95	0.92	1.21	1.99	1.67
Hospital LOS, Days								
mean			5.02	5.58	5.84	8.53	8.03	8.11
median	4.95	4.81	3.09	3.60	3.16	4.37	3.86	4.42
IV TPA for PE, n	32	39	48	35	32	41	27	39
CDI, n	16	8	5	3	10	30	15	32
Surgical embolectomy, n	3	7	3	0	0	1	0	0
ECMO, n	4	9	7	5	4	8	1	8

43

Home › Journal of Thrombosis and Thrombolysis › Article

Post-thrombolytic coagulopathy and complications in patients with pulmonary embolism treated with fixed-dose systemic alteplase

Published: 23 March 2022

Volume 54, pages 605–615 (2022) Cite this article

Journal of Thrombosis and Thrombolysis

Critical Care Medicine

Society of Critical Care Medicine

SCCM JOURNALS

Safety and Efficacy of Reduced-Dose Versus Full-Dose Alteplase for Acute Pulmonary Embolism: A Multicenter Observational Comparative Effectiveness Study*

Critical Care Medicine 52(5):729-742, May 2024

[Pulmonary Vascular Special Features]

CHEST

Interhospital Transfer of Patients With Acute Pulmonary Embolism

Challenges and Opportunities

CHEST 2021; 160(5):1844-1852

Clinical and Applied Thrombosis/Hemostasis

Clin Appl Thromb Hemost. 2019 Jun 11;25:1076029619853037. doi: 10.1177/1076029619853037

Diagnosis, Treatment and Follow Up of Acute Pulmonary Embolism: Consensus Practice from the PERT Consortium

frontiers | Frontiers in Medicine

Effects of a Consensus-Based Pulmonary Embolism Treatment Algorithm and Response Team on Treatment Modality Choices, Outcomes, and Complications

Clinical and Applied Thrombosis/Hemostasis
Volume 26: 1-8
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Barriers and facilitators to interhospital transfer of acute pulmonary embolism: An inductive qualitative analysis

44

Advanced Interventions - Interpretation

	Systemic Lysis	Catheter Lysis	Catheter Thrombectomy	Surgery
Shock or cardiac arrest (E2)	Yes	NA	NA	No
Recurrent or persistent hypotension (E1)	Yes	Yes	Yes	Yes
Transient hypotension Normotensive shock (D1, D2)	Consider	Consider	Consider	Unclear
SPESI > 0, abnormal RV and ≥1 abnormal biomarker (C3)	Unclear	Unclear	Unclear	No
Abnormal RV or ≥1 abnormal biomarker (C2)	No	Unclear	Unclear	No
Normal RV and BNP/troponin (C1); Symptomatic with low severity score (B); Subclinical (incidental, asymptomatic) (A)	No	No	No	No

- Normotensive shock, any: lactate > 2, AKI, UO < 0.5 cc/kg/h, mental status change, CI < 2.2, MAP < 60, increased shock score (CPES score of 6)
- Transient hypotension SBP < 90 or 40 mm Hg drop for <15 min

45

ST vs. CDI for PE: A Multicenter Study

- Retrospective study of 316 patients treated with ST and 285 with CDI at 3 AH referral centers (2013 - 2023)
- Inverse probability of treatment weighting used to balance the groups

	Unweighted			Weighted		
	CDI	Systemic lytics	p	CDI	Systemic lytics	p
	285	316		285	316	
PE severity, n (%)			<0.001			0.878
Low risk	1 (0.4%)	2 (0.6%)		(0.4%)	(0.5%)	
Massive	25 (8.8%)	87 (27.5%)		(18.7%)	(18.3%)	
Submassive	259 (90.9%)	227 (71.8%)		(80.9%)	(81.2%)	
ICU stay, n (%)	186 (65.3%)	303 (95.9%)	<0.001	(67.8%)	(96.2%)	<0.001
Hospital Mortality, n (%)	14 (4.9%)	11 (3.5%)	0.501	(5.2%)	(3.0%)	0.187
1-Year Mortality, n (%)	31 (10.9%)	30 (9.5%)	0.670	(10.4%)	(9.3%)	0.697
30-d Readmission, n (%)	22 (7.7%)	24 (7.6%)	0.997	(9.4%)	(7.4%)	0.453
Any hemorrhage, n (%)	34 (11.9%)	39 (12.3%)	0.977	(11.5%)	(12.3%)	0.770
Minor	19 (6.7%)	31 (9.8%)	0.213	(6.0%)	(9.9%)	0.090
Major, Extracranial	14 (4.9%)	7 (2.2%)	0.115	(4.8%)	(2.0%)	0.072
Intracranial	1 (0.4%)	2 (0.6%)	0.988	(0.8%)	(0.7%)	0.972
Cardiac arrest	10 (3.5%)	4 (1.3%)	0.121	(4.6%)	(0.8%)	0.002
Access site hematoma	16 (5.6%)	0 (0.0%)	<0.001	(5.6%)	(0.0%)	<0.001

- No difference in mortality, ICU or hospital LOS, or 30-d readmission
- No difference in outcomes between ST or CDI-preferring centers except for hospital LOS 3.8 vs. 3.2 d

Critical Care Medicine 54(3S), March 2026

46

Systemic Thrombolysis for Pulmonary Embolism Administered at Regional Hospitals Under Tele-ICU Service Direction

	Total n=35	Transfer Status		p
		No n=11	Yes n=24	
Status prior to ST administration				
PE severity				
Massive	9 (25.7)	0 (0.0)	9 (37.5)	*0.03*
Submassive	26 (74.3)	11 (100)	15 (62.5)	
Troponin elevated	33 (94.3)	10 (90.9)	23 (95.8)	0.54
Pro-BNP elevated	28 (90.3)	9 (81.8)	19 (95.0)	0.28
Lactate elevated	13 (40.6)	1 (10.0)	12 (54.6)	*0.02*
SBP, nadir	113 (102-129)	135 (110-140)	108 (94-123)	*0.006*
HR, peak	109 (92-122)	93 (88-126)	111 (97-122)	0.36
RR, peak	23 (20-26)	24 (20-24)	22 (20-28)	0.94
spO2, nadir	93 (91-96)	93 (91-96)	93 (91-96)	0.74
RV dysfunction on echo/CT	34 (97.1)	10 (90.9)	24 (100)	0.31
Outcomes				
Hospital LOS, days	2.9 (2.0-5.1)	2.9 (1.8-5.7)	3.0 (2.3-5.1)	0.47
ICU LOS, days	1.7 (1.0-2.8)	1.7 (1.0-3.7)	1.8 (1.0-2.8)	0.97
Alive at discharge	34 (97.1)	10 (90.9)	24 (100)	0.31
Discharge destination				
Home	27 (77.1)	8 (72.7)	19 (79.2)	0.69*
Rehab/SNF	4 (11.4)	1 (9.1)	3 (12.5)	--
Hospice/Comfort care	1 (2.9)	0 (0.0)	1 (4.2)	--
Died in hospital	1 (2.9)	1 (9.1)	0 (0.0)	--
Transferred outside of system	2 (5.7)	1 (9.1)	1 (4.2)	--
Readmission ≤30 days	0	--	--	---

American Journal of Respiratory and Critical Care Medicine, Volume 212, Issue Supplement_1, May 2026

47

Patients with massive PE treated with VA ECMO at ANW, 2023-2026(Q1, 2)

N	23
Mortality	11 (48%)
Presented with cardiac arrest	16
Mortality when presented with cardiac arrest	9 (56%)
Systemic lysis prior to ECMO	14

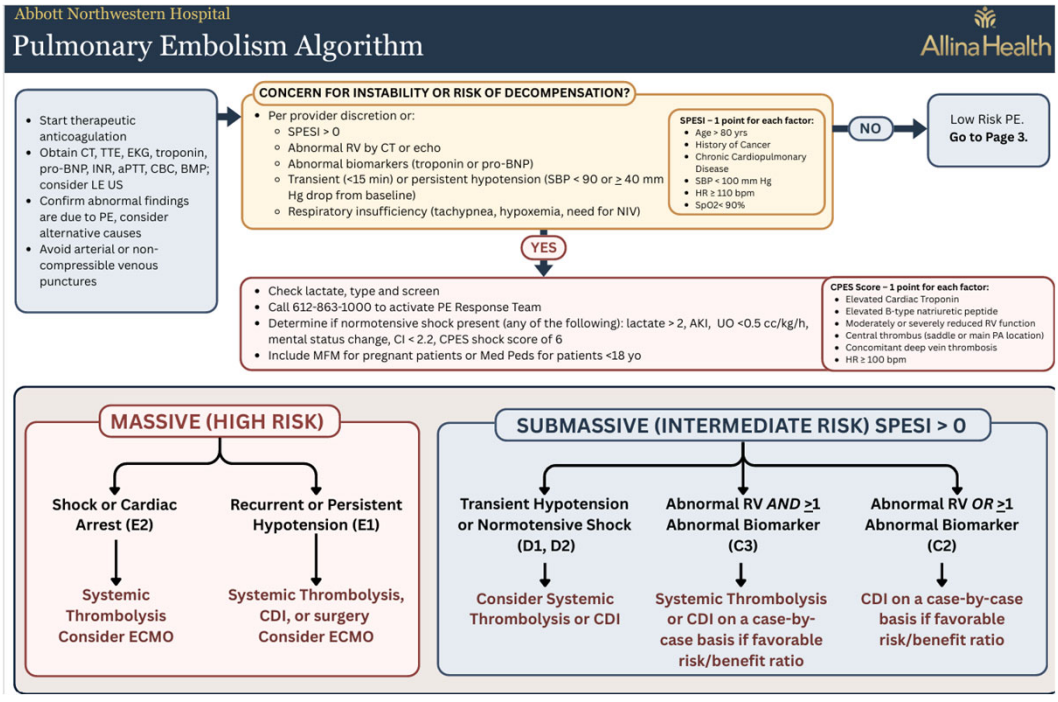
48

Characteristics of Survivors of High-Risk Pulmonary Embolism Receiving VA ECMO: A Meta-Analysis

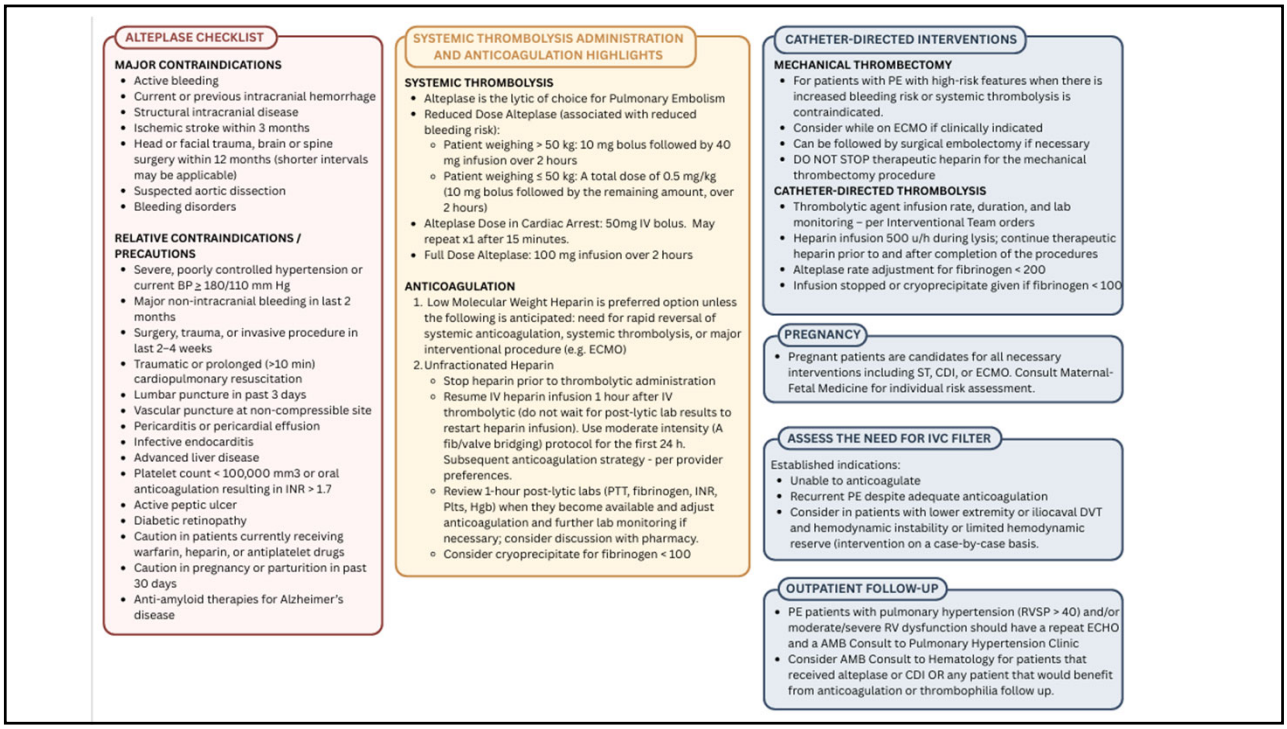
- 50 observational studies comprising 1,125 patients with high-risk PE treated with V-A ECMO, 63% with cardiac arrest, and 48.8% with contraindications to thrombolysis
- Most common reperfusion therapies were US-guided thrombolysis and systemic thrombolysis
- Pooled in-hospital mortality: 40.6%; 30-day mortality: 44.4%
- Survivors were younger, less frequently presented with cardiac arrest, had shorter durations of cardiopulmonary resuscitation, and lower lactate levels (7.2 ± 6.1 vs. 13.1 ± 7.1 mmol/L, p<0.001)
- **Among survivors, 84.4% were neurologically intact**

ASAIO Journal 71(Supplement 4):p 3-3, September-October 2025

49



50



51

Safety and Efficacy of Reduced-Dose Versus Full-Dose Alteplase for Acute Pulmonary Embolism: A Multicenter Observational Comparative Effectiveness Study (ANW + Mayo Clinic)

Hemorrhagic Complications

		Unweighted Cohort			Weighted Cohort		
	Total ($n = 284$)	Full Dose ($n = 98$)	Reduced Dose ($n = 186$)	p	Full Dose ($n = 98$) (%)	Reduced Dose ($n = 186$) (%)	p
Hemorrhage, any	48 (17.0%)	24 (24.5%)	24 (13.0%)	0.014	24.7	15.4	0.12
Minor	37 (13.1%)	17 (17.4%)	20 (10.8%)	0.17	17.2	12.8	0.32
Major extracranial	8 (2.8%)	6 (6.1%)	2 (1.1%)	0.022	7.1	1.3	0.067
Intracranial	3 (1.1%)	1 (1.0%)	2 (1.1%)	0.99	0.5	1.5	0.46
Among those with any hemorrhage							
Invasive procedure	15 (31.3%)	10 (41.7%)	5 (20.8%)	0.12	39.9	16.1	0.053
Systemic anticoagulation	44 (91.7%)	22 (91.7%)	22 (91.7%)	0.99	94.9	86.8	0.32
Supratherapeutic anticoagulation[a]	18 (37.5%)	8 (33.3%)	10 (41.7%)	0.55	34.6	45.6	0.42

[a]Supratherapeutic anticoagulation = activated partial thromboplastin time > 2.5 times of control value or heparin activity > 0.7 units/mL.

Melamed et al. Critical Care Medicine 52(5):p 729-742, May 2024

52

BACS Score: 30-day risk of major bleeding in PE patients treated with systemic thrombolysis

Recent major bleeding	3 points
Age >75 years	1 point
Active cancer	1 point
Syncope	1 point

TABLE 3 The staging system

	Risk classification		
	Low	Intermediate	High
Points n	0	1–3	>3
RIETE derivation cohort			
Patients	38.1	61.2	0.8
30-day major bleeding	2.9	7.3	44.4
30-day intracranial bleeding	0.9	1.8	11.1
30-day fatal bleeding	0	1.1	22.2
COMMAND VTE validation cohort			
Patients	51.4	46.2	2.4
30-day major bleeding	1.3	6.7	28.6
30-day intracranial bleeding	0	2.2	14.3
30-day fatal bleeding	0	0	0

Data are presented as %, unless otherwise stated. Points are assigned for each variable of the scoring system to obtain a total point score (range 0–6): previous major bleeding (3 points), age >75 years (1 point), cancer (1 point), syncope (1 point). The total point score is used to classify patients as low risk (0 points), intermediate risk (1–3 points) or high risk (>3 points). Model-predicted 30-day major bleeding events are shown by stage. RIETE: Registro Informatizado de la Enfermedad Tromboembólica; COMMAND VTE: Contemporary Management and Outcomes in Patients with Venous Thromboembolism.

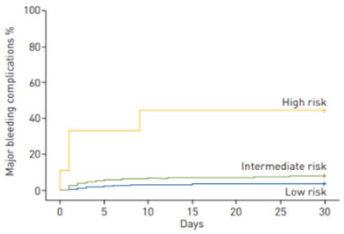
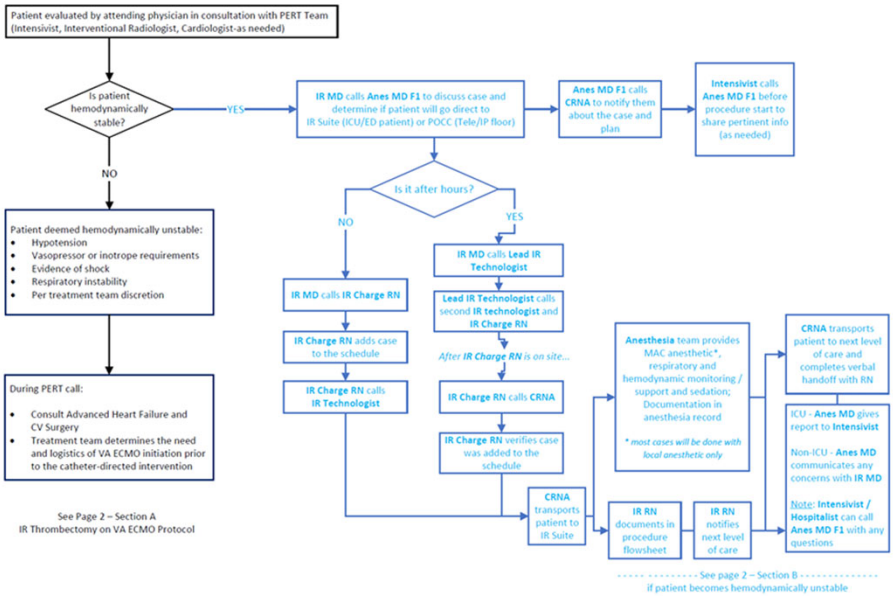


FIGURE 2 Cumulative major bleeding complications stratified by stage for the risk index. BACS score: previous major bleeding (3 points), age >75 years (1 point), cancer (1 point), syncope (1 point). Points are assigned for the presence of each variable. The sum of the variable points produces the total point score (range 0–6). BACS risk staging increased with point totals: low risk (0 points), intermediate risk (1–3 points) or high risk (>3 points).

Eur Respir J . 2020 Dec 3;56(6):2002336

53

Catheter-Directed Intervention for Pulmonary Embolism (page 1 of 2)



54

Catheter-Directed Intervention for Pulmonary Embolism (page 2 of 2)

Section A
IR Thrombectomy on VA ECMO Protocol

1. Patient Selection

- PE with hemodynamic compromise
- On moderate doses of vasoactive medications (norepinephrine > 3 mcg/min, vasopressin 0.04 U/min, dobutamine > 2.5 mcg/kg/min, dopamine > 2.5 mcg/kg/min, epinephrine at any dose)
- At the discretion of interventional radiologist / intensivist / AHF cardiologist

2. VA ECMO cannulation

- To occur in the cath lab, PRIOR to IR thrombectomy then patient will be transported to Interventional Radiology suite

3. At the time of IR thrombectomy

- Have Advanced Heart Failure Cardiologist, Intensivist, Perfusionist & ECMO Specialist available and in Interventional Radiology suite during procedure
- Have backup primed circuit, clamped out and circuit change supplies available and in room
- Discuss during time out potential need for circuit change and have a plan how to proceed, eg where to position back up pump in the room in order to easily access it when circuit change needed
- Have neosynephrine stick available in case severe hypotension occurs

4. ECMO Specialist Process

Supplies Needed	Special Considerations	Procedure
• Primed secondary ECMO circuit • 2- 3/8 x 3/8 Connectors • ECMO Clamp Tray • Basin • 1L 0.9% NaCl • Decanter • Bulb syringe • Sterile gloves • Gown • Chloroprep • Sterile towels	• Circuit might suck in clot/clot off • Flow impedance from IR catheter • Have both Perfusionist & ECMO Specialist available and in room for procedure • Have backup primed circuit, clamped out and circuit change supplies available and in room • Circuit warmed • Understanding circuit configuration and where you would change out the circuit	• Communicate with the interventional radiologist when thrombectomy happening • Say 1, 2, 3 as VA ECMO tubing is to be clamped • Immediately release/unclamp when thrombectomy not happening (This might need to be repeated several times depending how many passes are planned) • Clamp venous cannulas about 20 cm from the oxygenator to facilitate removal of the thrombus if occurred, by cutting out the portion of the tubbing and replacing it with the new one

Section B
Hemodynamic Instability in Patient Not on ECMO

Hemodynamic Instability / Shock / Cardiac Arrest During IR Intervention for Pulmonary Embolism

Cardiac Arrest

Call Code Blue; activate VA ECMO/ECPR by calling 3-1102; contact Heart Failure Hotline (612) 246-9460, and Intensivist (3-9999)

Perfusion/ECMO team to deliver all the necessary equipment for VA cannulation and ECMO initiation to the IR suite.

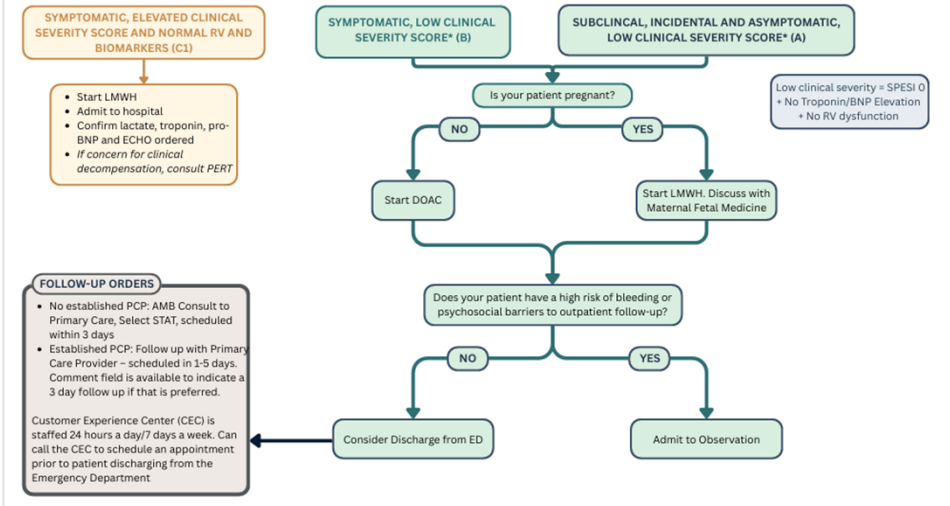
Hemodynamic Instability/Shock

Activate VA ECMO/ECPR by calling 3-1102; contact Heart Failure Hotline (612) 246-9460, and Intensivist (3-9999)

The patient to be transferred to CV lab for cannulation and ECMO initiation if condition allows.
If unable to transfer due to patient condition or CV lab availability, cannulation and ECMO initiation to occur at the IR suite.

55

Low-Risk Pulmonary Embolism



Guidelines were developed by a review committee and are subject to confidentiality and other protections provided therein. Guidelines inform clinical judgement, which take into consideration other relevant information, including facts and pateint circumstances for each case. Guidelines are not meant to replace clinical judgement or establish professional standards of care. References: Creager, et al. (2026). 2026 AHA/ACC/ACCP/ACEP/CHEST/ SCAI/SHM/SIR/SVM/SVN Guideline for the Evaluation and Management of Acute Pulmonary Embolism in Adults. JACC, doi.org/10.1016/j.acc.2025.11.005; Konstantinides,, et al. (2019). 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, European Heart Journal, doi: 10.1093/eurheartj/ehz405

56