Management of Acute Pulmonary Embolism in 2023

Mehdi H. Shishehbor, DO, MPH, PhD

University Hospitals Harrington Heart and Vascular Institute

President, Harrington Heart & Vascular Institute

Professor of Medicine, Case Western Reserve University School of Medicine

University Hospitals
Harrington Heart & Vascular Institute
Cleveland | Ohio

Disclosure

NONE

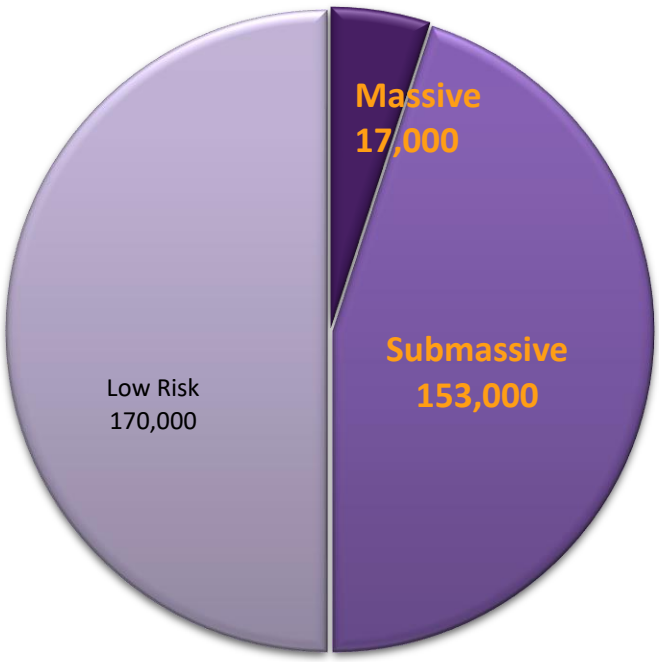
Pulmonary Embolism: Epidemiology

- Incidence of thromboembolism (PE + DVT)
  - 900,000 incident or recurrent cases per year[1]
- Acute PE
  - ~1 of every 1,000-2,000 pts/year[2]
  - Mortality >15% within 3 months[3]
  - Without treatment, mortality can exceed 30%[2]
  - Chronic sequelae
    - Chronic thromboembolic p ulmonary hypertension
    - Right-sided heart failure

[1]Clark et al. *Circulation* 2013; 127: 2458-64.
[2]Reed and Shishehbor. "Contemporary Management of Acute Pulmonary Embolism: A Focus on Intermediate Risk Patients." 31 Mar 2015. ACC Latest in Cardiology.
[3]Piazza et al. *Circulation* 2010; 122: 1124-29.

Pulmonary Embolism: Epidemiology

US Pulmonary Embolisms:
~339,000 Diagnosed in 2014[1]

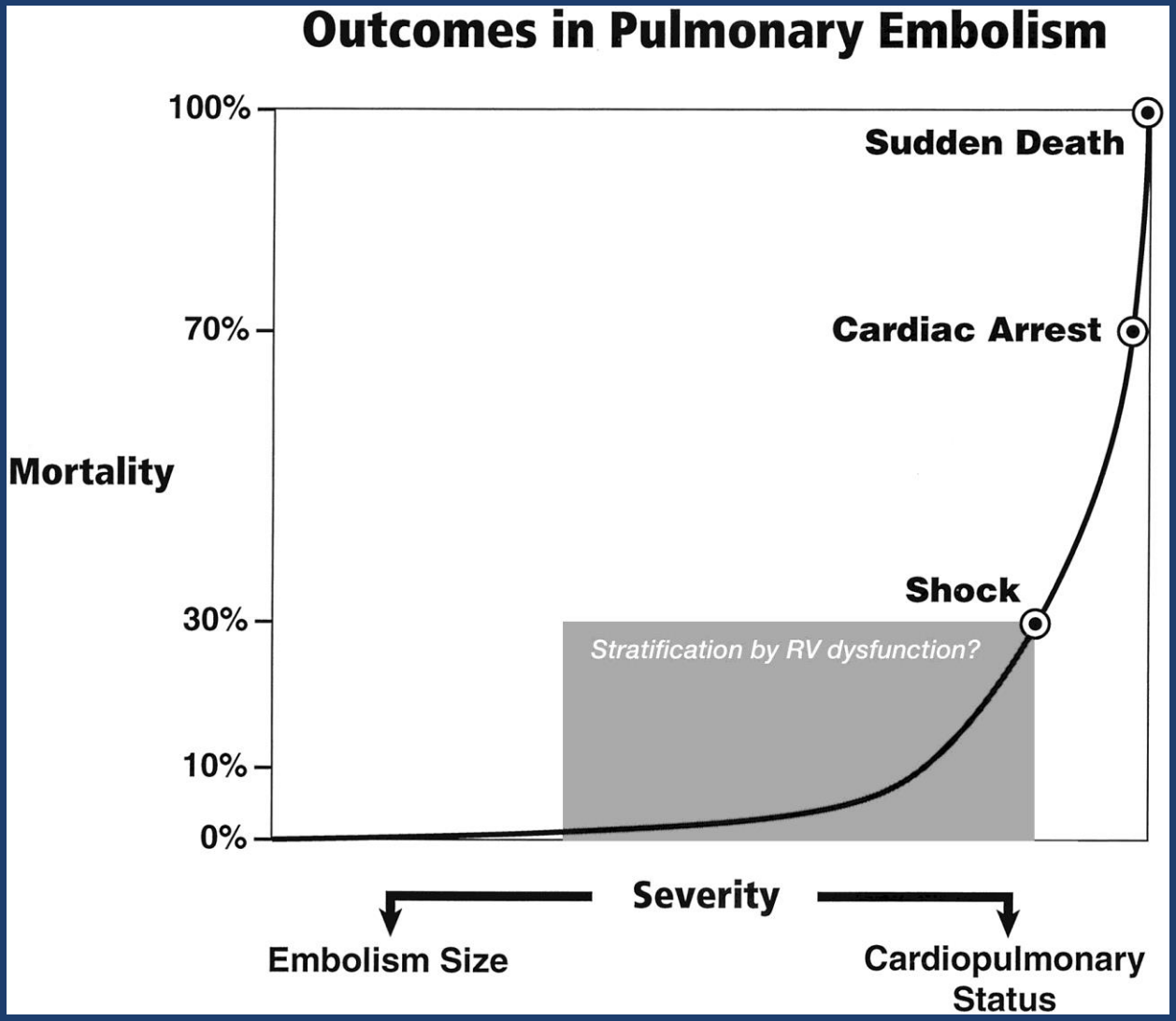


PE Stratification/Definition[2]	Total
Massive	17,000
Submassive	153,000
Total Addressable Patients	**170,000**

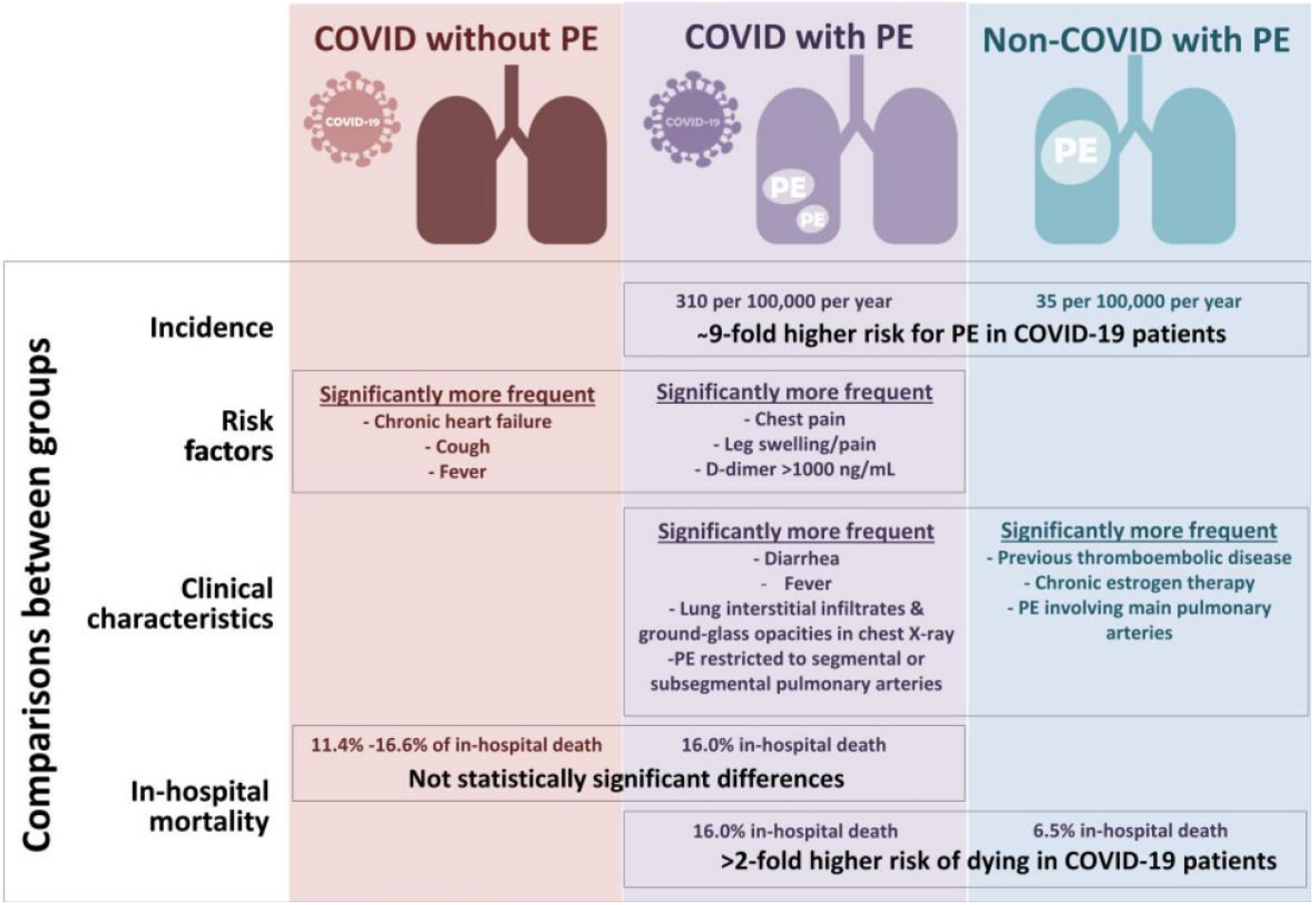
- PE third leading cause of cardiovascular death after MI and Stroke
- More deaths per year from PE than Breast Cancer, Prostate Cancer, Motor Vehicle Accidents and HIV -- *combined*
- PE leading cause of inpatient death

1. Healthcare Cost and Utilization Project (HCUPNET) using 2014 ICD-9 for PE
2. Kearon et al. *Circulation*. 2003;107:122-30.

Natural History of Pulmonary Embolism

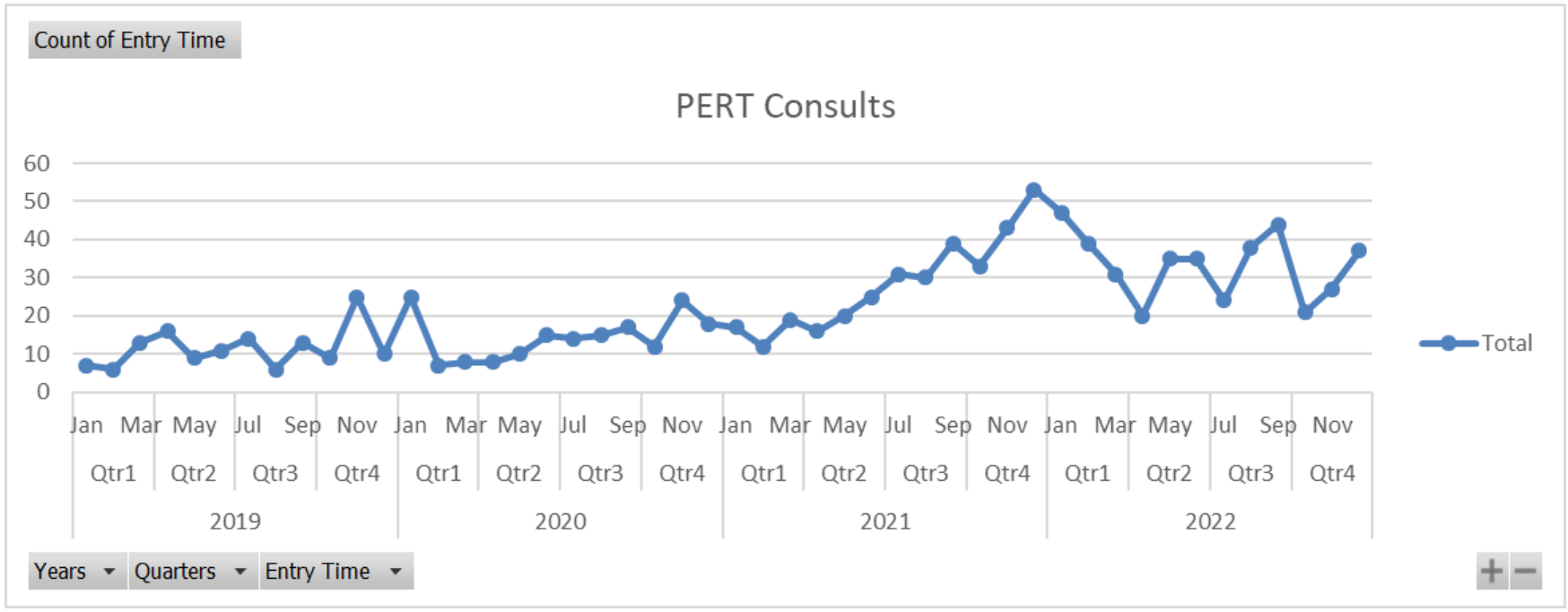


Impact of COVID



Miró et al. *EHJ* 2021;42:3127-42.

Impact of COVID - UH PERT

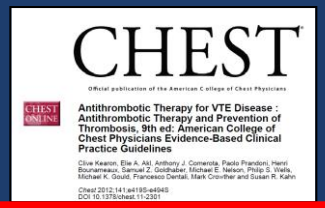


PE Severity Classification

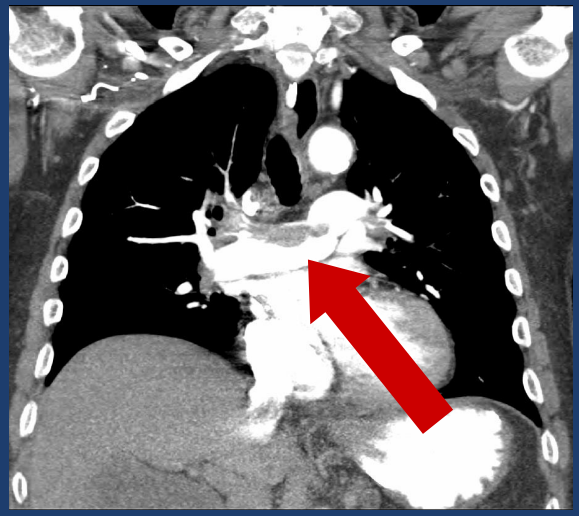
Massive	-Sustained hypotension (systolic BP < 90 mmHg for 15 min or requiring inotropic support) ***-or-*** -Pulselessness ***-or-*** -Sustained heart rate < 40 BPM with signs/symptoms of shock
Sub-massive	Systolic BP > 90 mmHg and RV dysfunction or myocardial necrosis defined by: -RV dilation (apical 4-chamaber RV diameter divided by LV diameter > 0.9) or RV systolic dysfunction on echocardiography ***-or-*** -RV dilation (4-chamber RV diameter divided by LV diameter >0.9) on CT ***-or-*** -Elevation of BNP (>90 pg/mL), or N-terminal proBNP (>500 pg/mL ***-or-*** -EKG changes (new complete or incomplete RBBB, anteroseptal ST elevation or depression, or anteroseptal T-wave inversion) ***-or-*** -Elevation of troponin (>0.4 ng/mL) or troponin T (>0.1 ng/mL
Low risk	Absence of the markers of adverse prognosis that define massive or submassive PE

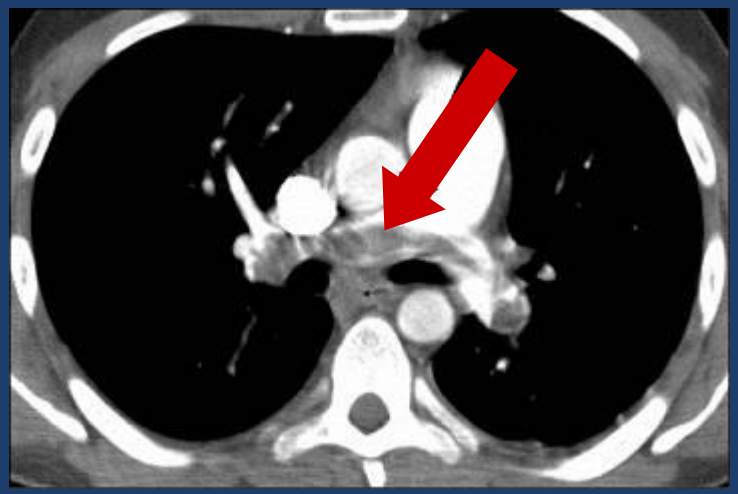
Circulation 2011; 123: 1788-1830
Circulation 2013; 127: 2458-2464

Thrombolytic Therapy for Acute PE



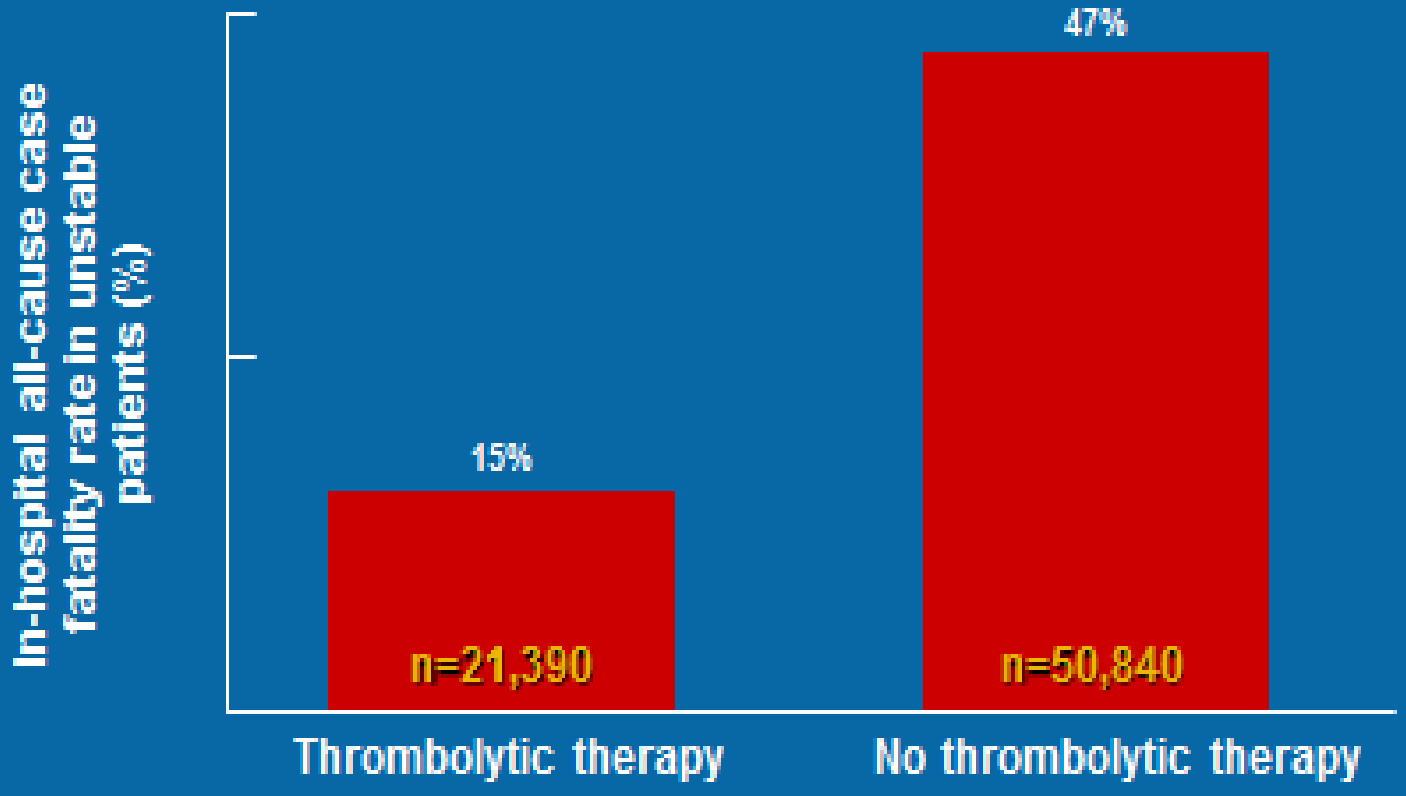
- Hemodynamically unstable patient (Grade 2C) for systemic thrombolysis





CHEST 2012; 141:e419s-494s

Thrombolytic Therapy in Unstable Patients with Acute PE: Saves Lives but is underused



2.1 million patients discharged from hospitals with a diagnosis of PE (1999-2008)
73,000 (3.4%) were unstable (shock or ventilator dependent)

All-cause case fatality rate in unstable patients with thrombolytic therapy was (15%) vs. (47%) without thrombolytic therapy. ($p < .0001$)

PE Severity Classification

Massive	-Sustained hypotension (systolic BP < 90 mmHg for 15 min or requiring ionotropic support) ***-or-*** -Pulselessness ***-or-*** -Sustained heart rate < 40 BPM with signs/symptoms of shock
Sub-massive	Systolic BP > 90 mmHg and RV dysfunction or myocardial necrosis defined by: -RV dilation (apical 4-chamaber RV diameter divided by LV diameter > 0.9) or RV systolic dysfunction on echocardiography ***-or-*** -RV dilation (4-chamber RV diameter divided by LV diameter >0.9) on CT ***-or-*** -Elevation of BNP (>90 pg/mL), or N-terminal proBNP (>500 pg/mL ***-or-*** -EKG changes (new complete or incomplete RBBB, anteroseptal ST elevation or depression, or anteroseptal T-wave inversion) ***-or-*** -Elevation of troponin (>0.4 ng/mL) or troponin T (>0.1 ng/mL
Low risk	Absence of the markers of adverse prognosis that define massive or submassive PE

Circulation 2011; 123: 1788-1830
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Systemic TPA

The NEW ENGLAND JOURNAL of ME

ORIGINAL ARTICLE

Fibrinolysis for Patients with I
Risk Pulmonary Embo

Guy Meyer, M.D., Eric Vicaut, M.D., Thierry Danays, M.D.
Cecilia Becattini, M.D., Jan Beyer-Westendorf, M.D., Eri
Helene Bouvaist, M.D., Benjamin Brenner, M.D., Francis
Claudia Dellas, M.D., Klaus Empen, M.D., Ana Franca, M.D
Annette Geibel, M.D., Samuel Z. Goldhaber, M.D., Davi
Matija Kozak, M.D., Christian Kupatt, M.D., Nils Kucher, M
Mareike Lankeit, M.D., Nicolas Meneveau, M.D., Ph.D.,
Massimiliano Palazzini, M.D., Antoniu Petris, M.D., Ph.D
Matteo Rugolotto, M.D., Aldo Salvi, M.D., Sebastia
Mustapha Sebbane, M.D., Bozena Sobkowicz, M.D., Branislav
Holger Thiele, M.D., Adam Torbicki, M.D., Franck Ver
and Stavros V. Konstantinides, M.D., for the PEIT

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

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

* Odds ratios and P values are provided for efficacy and safety outcomes that were prespecified in the trial protocol.
† Major bleeding was defined according to the criteria of the International Society on Thrombosis and Haemostasis.
‡ Hemorrhagic stroke included hemorrhagic conversion of ischemic stroke.

Meyer et al. *NEJM* 2014;370:1402-11.

The NEW ENGLAND JOURNAL of MEDICINE

ORIGINAL ARTICLE

Fibrinolysis for Patients with Intermediate-Risk Pulmonary Embolism

Treatment Allocation	Sex	Age (years)	Weight (kg)	Type of Stroke	Status at Day 30	Modified Rankin Scale¶
Placebo	Male	76	108	Hemorrhagic*	Dead	-
Tenecteplase	Female	80	62	Hemorrhagic*	Alive	Not assessed
Tenecteplase	Female	73	62	Hemorrhagic*	Alive	Grade 2
Tenecteplase	Male	77	110	Hemorrhagic*	Alive	Grade 3
Tenecteplase	Female	65	87	Hemorrhagic*	Alive	Grade 0
Tenecteplase	Male	75	75	Hemorrhagic*	Dead†	-
Tenecteplase	Male	77	65	Hemorrhagic*	Dead†	-
Tenecteplase	Female	69	59	Hemorrhagic*	Alive	Grade 1
Tenecteplase	Male	59	70	Ischemic	Alive	Grade 5
Tenecteplase	Male	70	85	Ischemic	Alive	Grade 1
Tenecteplase	Female	79	70	Hemorrhagic*	Dead†	-
Tenecteplase	Female	76	70	Hemorrhagic*	Alive	Grade 2
Tenecteplase	Male	75	90	Hemorrhagic*	Dead†	-

Treatment Allocation	Sex	Age (years)	Weight (kg)	Type of Stroke	Status at Day 30	Modified Rankin Scale[¶]
Placebo	Male	76	108	Hemorrhagic*	Dead	-
Tenecteplase	Female	80	62	Hemorrhagic*	Alive	Not assessed
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Tenecteplase	Male	77	110	Hemorrhagic*	Alive	Grade 3
Tenecteplase	Female	65	87	Hemorrhagic*	Alive	Grade 0
Tenecteplase	Male	75	75	Hemorrhagic*	Dead[†]	-
Tenecteplase	Male	77	65	Hemorrhagic*	Dead[†]	-
Tenecteplase	Female	69	59	Hemorrhagic*	Alive	Grade 1
Tenecteplase	Male	59	70	Ischemic	Alive	Grade 5
Tenecteplase	Male	70	85	Ischemic	Alive	Grade 1
Tenecteplase	Female	79	70	Hemorrhagic*	Dead[†]	-
Tenecteplase	Female	76	70	Hemorrhagic*	Alive	Grade 2
Tenecteplase	Male	75	90	Hemorrhagic*	Dead[†]	-

The Path to Personalized Medicine

Margaret A. Hamburg, M.D., and Francis S. Collins, M.D., Ph.D.

Can we identify a group of patients with sub-massive PE that would benefit from low dose or CD or USAT thrombolysis or Mechanical thrombectomy?

Predicting Mortality Risk

Table 9 Classification of patients with acute PE based on early mortality risk

Early mortality risk		Risk parameters and scores			
		Shock or hypotension	PESI class III-V or sPESI ≥1[a]	Signs of RV dysfunction on an imaging test[b]	Cardiac laboratory biomarkers[c]
High		+	(+)[d]	+	(+)[d]
Intermediate	Intermediate–high	–	+	Both positive	
	Intermediate–low	–	+	Either one (or none) positive[e]	
Low		–	–	Assessment optional; if assessed, both negative[e]	

PE = pulmonary embolism; PESI = Pulmonary embolism severity index; RV = right ventricular; sPESI = simplified Pulmonary embolism severity index.

[a]PESI Class III to V indicates moderate to very high 30-day mortality risk; sPESI ≥1 point(s) indicate high 30-day mortality risk.

[b]Echocardiographic criteria of RV dysfunction include RV dilation and/or an increased end-diastolic RV–LV diameter ratio (in most studies, the reported threshold value was 0.9 or 1.0); hypokinesia of the free RV wall; increased velocity of the tricuspid regurgitation jet; or combinations of the above. On computed tomographic (CT) angiography (four-chamber views of the heart), RV dysfunction is defined as an increased end-diastolic RV/LV (left ventricular) diameter ratio (with a threshold of 0.9 or 1.0).

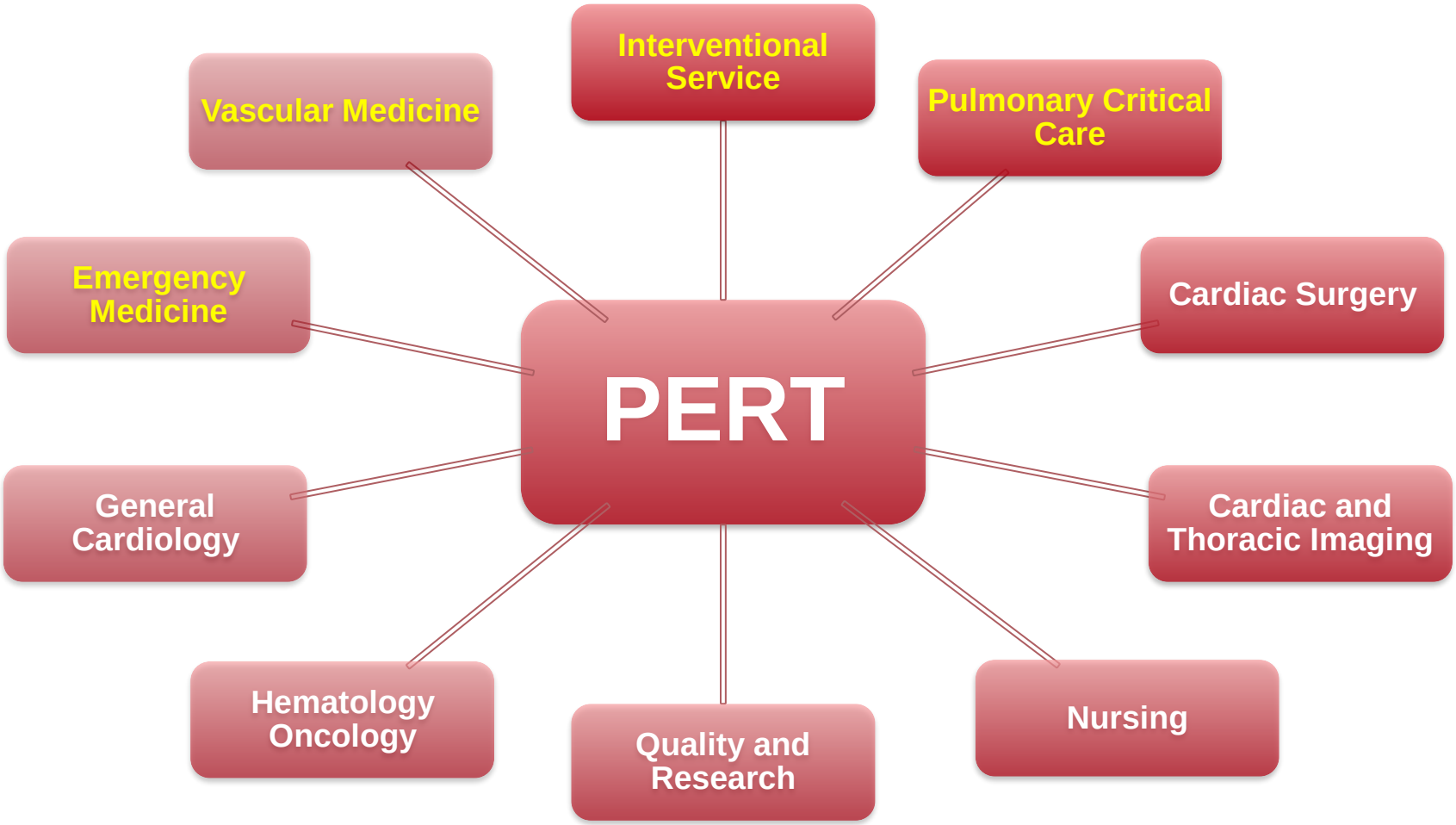
[c]Markers of myocardial injury (e.g. elevated cardiac troponin I or -T concentrations in plasma), or of heart failure as a result of (right) ventricular dysfunction (elevated natriuretic peptide concentrations in plasma).

[d]Neither calculation of the PESI (or sPESI) nor laboratory testing are considered necessary in patients with hypotension or shock.

[e]Patients in the PESI Class I–II, or with sPESI of 0, and elevated cardiac biomarkers or signs of RV dysfunction on imaging tests, are also to be classified into the intermediate-low-risk category. This might apply to situations in which imaging or biomarker results become available before calculation of the clinical severity index.

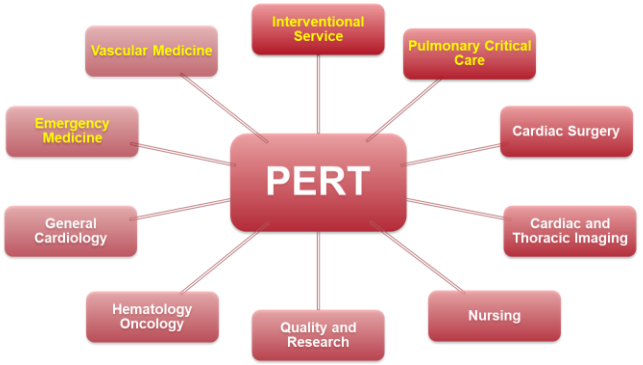
Konstantinides et al. *EHJ* 2014;35(43):3033-69.

Initial PERT Evaluation



Initial PERT Evaluation

- Many risk scores exist
  - ESC, PESI, sPESI, BOVA, FAST,
- Noninvasive hemodynamics
  - HR, BP, O_2 requirements
- Biomarkers
  - Troponin, BNP, lactate
- Imaging characteristics
  - RV/LV, contrast reflux, RV function by echocardiogram



Commonly Used Risk Scores

- PESI – age, sex, PMH (CA, HF, lung disease), vital signs, AMS
- sPESI – age, PMH (CA, lung disease), vital signs
- BOVA – BP, troponin, RV dysfunction, HR
- FAST – troponin, syncope, HR

Predicting Mortality Risk: PESI and sPESI

Table 1. Original and Simplified Pulmonary Embolism Severity Index (PESI)

Variable	Score: Original PESI[a]	Score: Simplified PESI[b]
Age >80 y	Age in years	1
Male sex	+10	
History of cancer	+30	1
History of heart failure	+10	1[c]
History of chronic lung disease	+10	
Pulse ≥110 beats/min	+20	1
Systolic blood pressure <100 mm Hg	+30	1
Respiratory rate ≥30 breaths/min	+20	
Temperature <36°C	+20	
Altered mental status	+60	
Arterial oxyhemoglobin saturation level <90%	+20	1

[a] A total point score for a given patient is obtained by summing the patient's age in years and the points for each predictor when present. The score corresponds with the following risk classes: 65 or less, class I; 66 to 85, class II; 86 to 105, class III; 106 to 125, class IV; and more than 125, class V. Patients in risk classes I and II are defined as being at low risk.

[b] A total point score for a given patient is obtained by summing the points. The score corresponds with the following risk classes: 0, low risk; 1 or more, high risk. Empty cells indicate that the variable was not included.

[c] The variables were combined into a single category of chronic cardiopulmonary disease.

Simplified PESI (Pulmonary Embolism Severity Index) ☆

Predicts 30-day outcome of patients with PE, with fewer criteria than the original PESI.

When to Use | Pearls/Pitfalls | Why Use

Age > 80 years	**No**	Yes
History of cancer	No	**Yes**
History of chronic cardiopulmonary disease	**No**	Yes
Heart rate ≥ 110	**No**	Yes
Systolic BP < 100 mm Hg	No	**Yes**
O2 saturation < 90%	**No**	Yes

High Risk

8.9% risk of death in the "High" risk group (>0 points).

Jiménez et al. *Arch Intern Med*. 2010;170(15):1383-89.

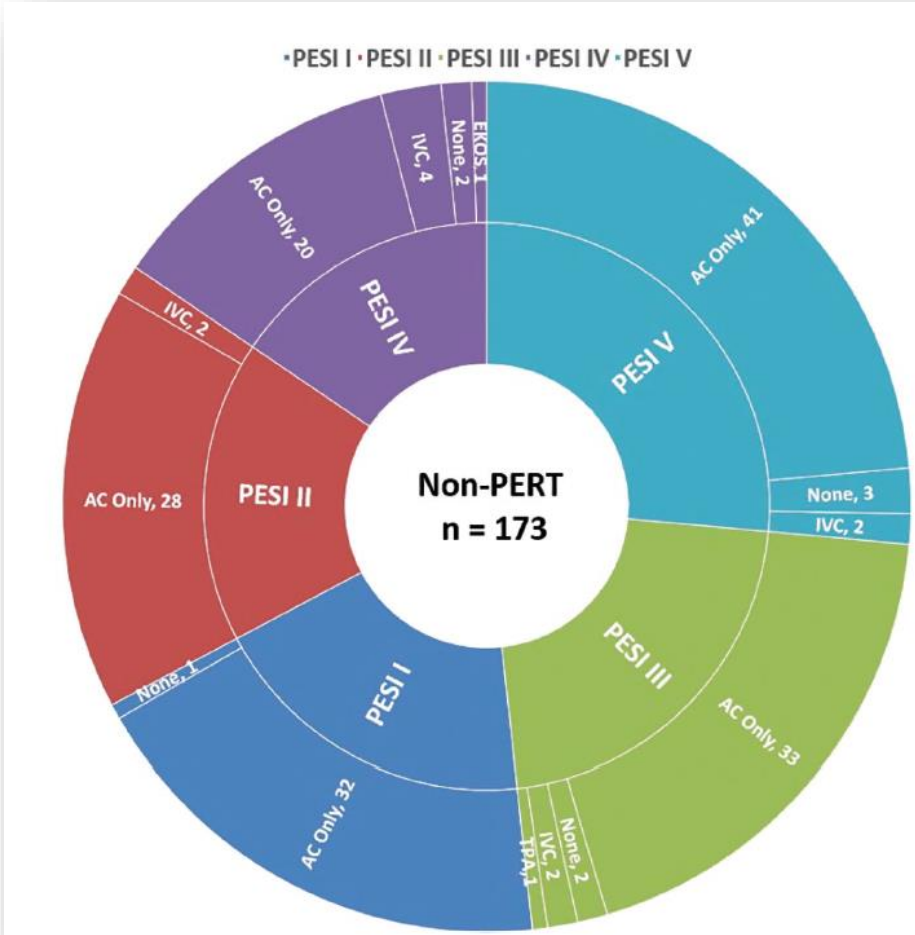
Scoring Systems Remain Imperfect

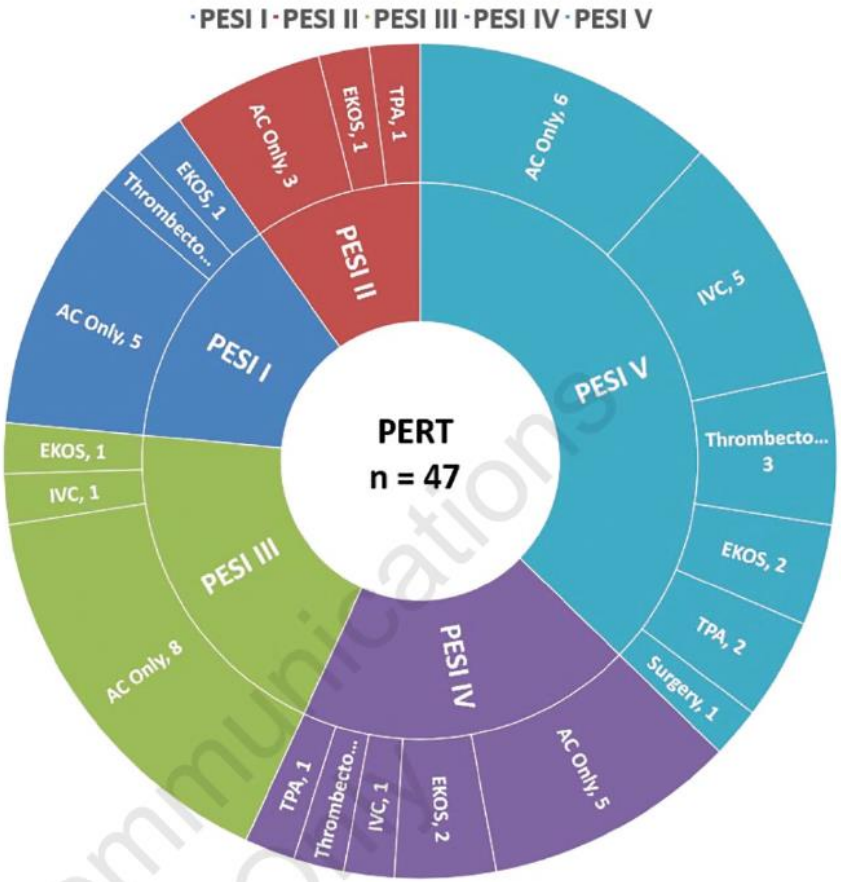
- Takes into account a lot of PMH
  - e.g., 86 yo man with hx CA but normal vital signs = PESI 126, V
    v. 22 yo woman with HR 150 bpm, RR 30, hypoxic = PESI 82, II
- Does not take into account biomarkers
  - Troponin, BNP, lactate
- Does not take into account imaging component
  - RV:LV strain
  - Thrombus burden
  - Other contributing etiologies
- PE decision making remains an individualized treatment approach

PERT at University Hospitals CMC: 2019 Experience

- PERT initiated around late 2018 in UHCMC
- CT PE 1/2019-12/2019 (UHCMC)
  - 307 pts
  - PERT activation 22.5%
    - Typically associated with abnormal vital signs, RV strain
- First question: did PERT activation make a difference in overall outcomes?

PERT at UHCMC: 2019 Experience

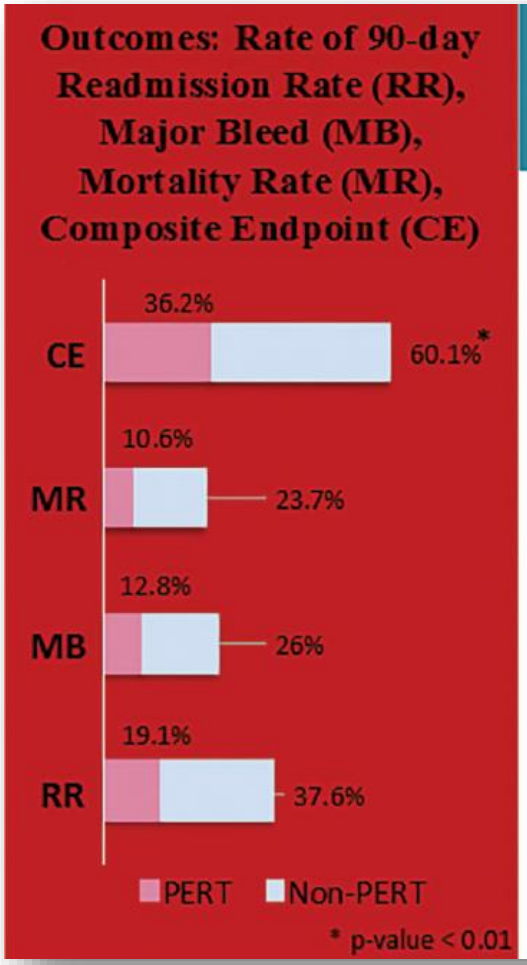


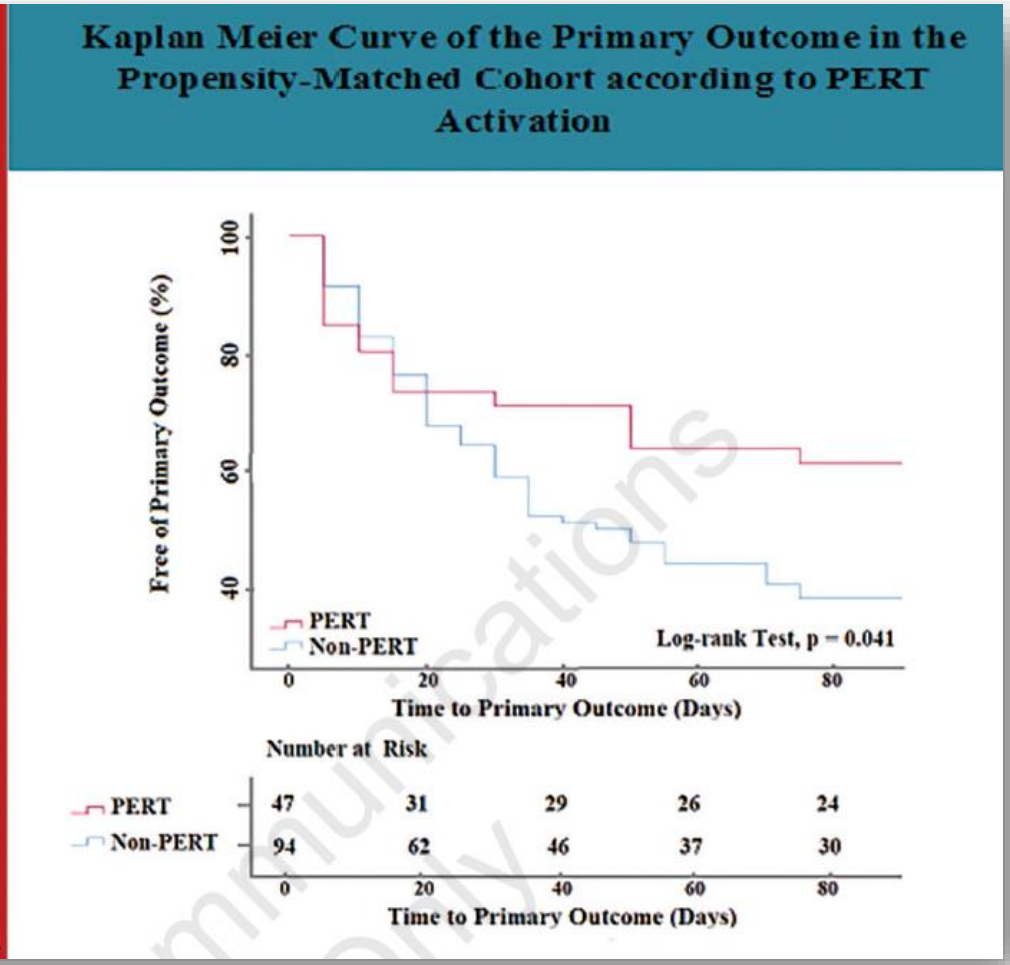


**Only 2 patients in non-PERT cohort received advanced therapies (incl. 1 TPA)

Lacey et al. *J Invasive Cardiol* 2021;33(3):E173-180.

PERT at UHCMC: 2019 Experience





Lacey and Shishehbor *J Invasive Cardiol* 2021;33(3):E173-180.

PERT at UHCMC: 2019 Experience

- Second question: when a PERT activation occurs, which patients are more likely to receive advanced therapies?

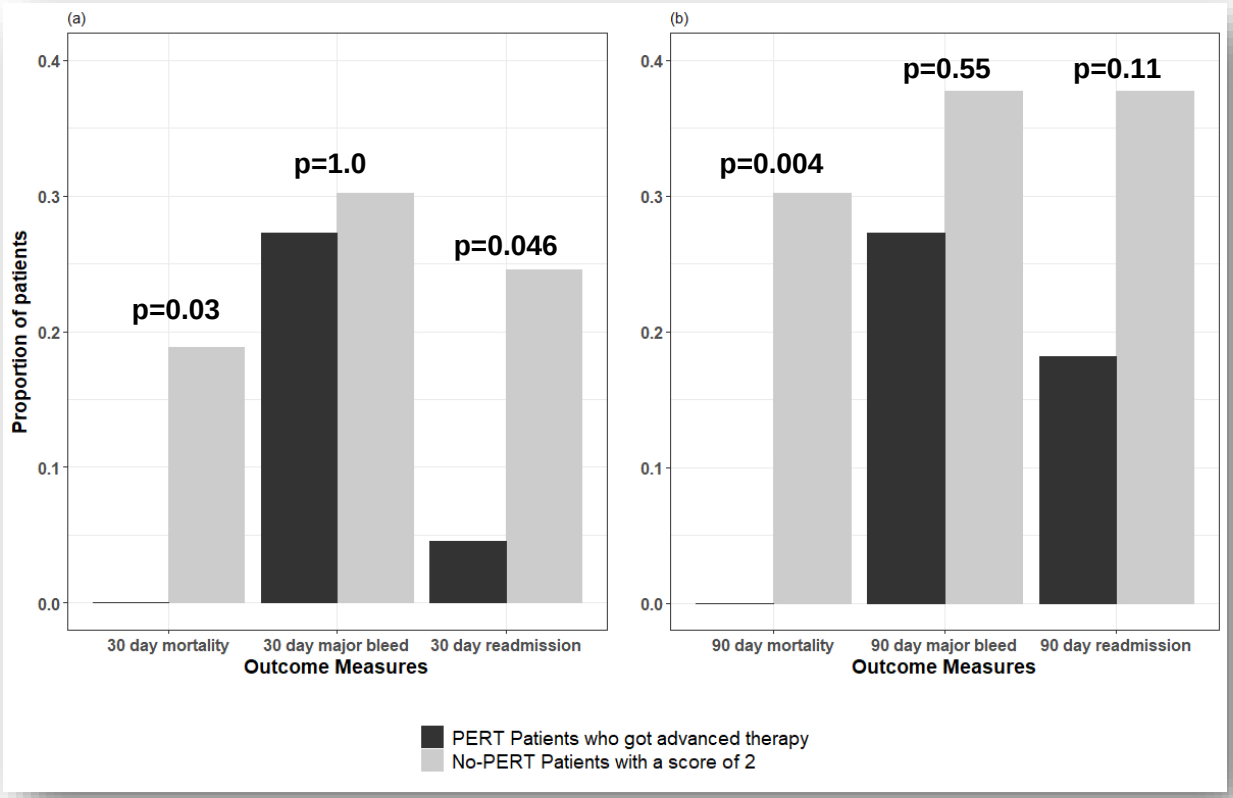
Predictors of Advanced Therapies Utilized
RV:LV >0.9
Clinical markers:
• HR >110 bpm
• SBP <100 mmHg
• RR >30/min
• SpO2 <90% on RA

*Score >2 predictive of advanced therapies

- Third question: did advanced therapies in the PERT cohort make a difference compared to non-PERT cohort?

PERT at UHCMC: 2019 Experience

- Comparison of PERT who received advanced therapies (n=22) v. non-PERT patients who qualified for advanced therapies (n=53)



Parikh et al. *CCI* 2021.

Why Treat?

- Residual thrombus is independent predictor of adverse events

Death

- Death @ 6 mo. : 6.8% vs 1.6% [1]
- 5 year mortality: 31% relative risk[2]

Recurrent VTE

- VTE recurrence @ 6 mo.: 7.8% vs 1.9%[1]
- VTE recurrence @ 48 mo.: 21.2% vs 7.0%[3]

Heart Failure & Dyspnea

- Heart failure or worsening dyspnea @ 6 mo.: 9.8% vs 0.6%[1]
- Heart failure or worsening dyspnea @ 5-years: 41% vs 27%[4]

Chronic Thromboembolic pHTN (CTEPH)

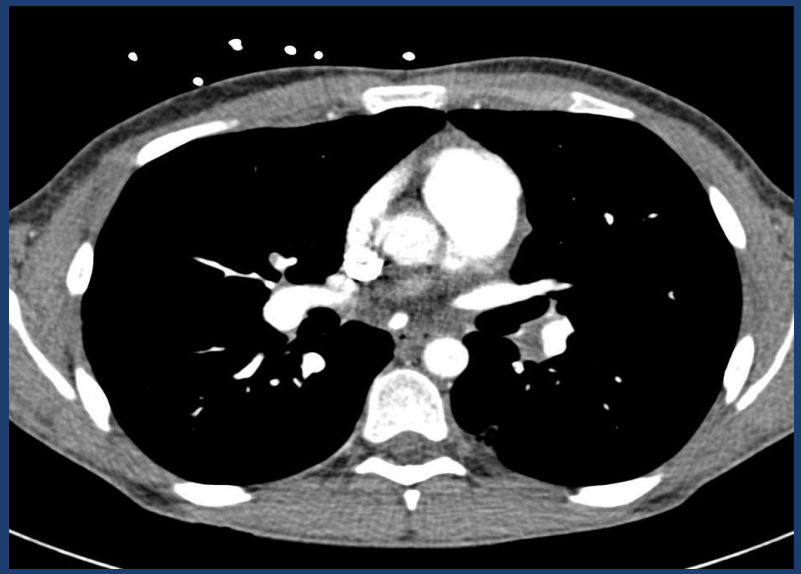
- 5% CTEPH vs 0.6% [4]
- 3.4% CTEPH vs 0%[5]

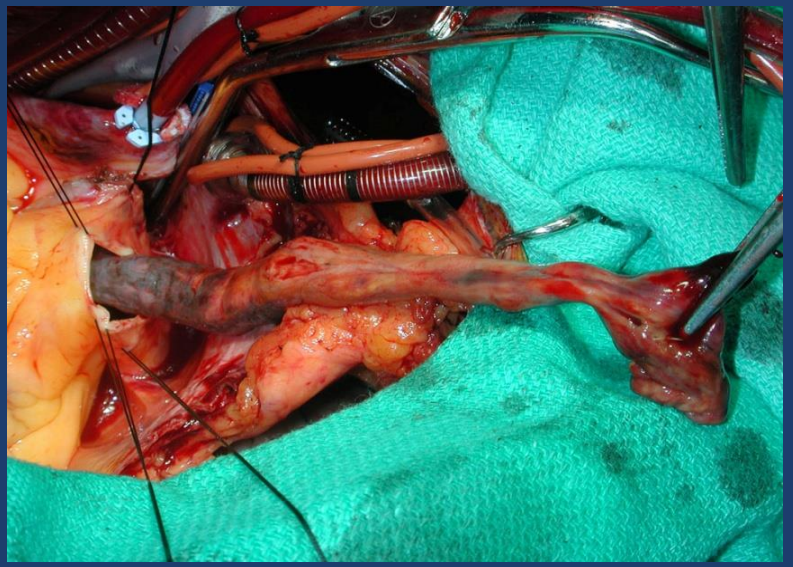
[1]Meneveau et al. 2013
[2]Meneveau et al. 2003
[3]Wan et al. 2018
[4]Chopard et al. 2017
[5]Pesavento et al. 2017

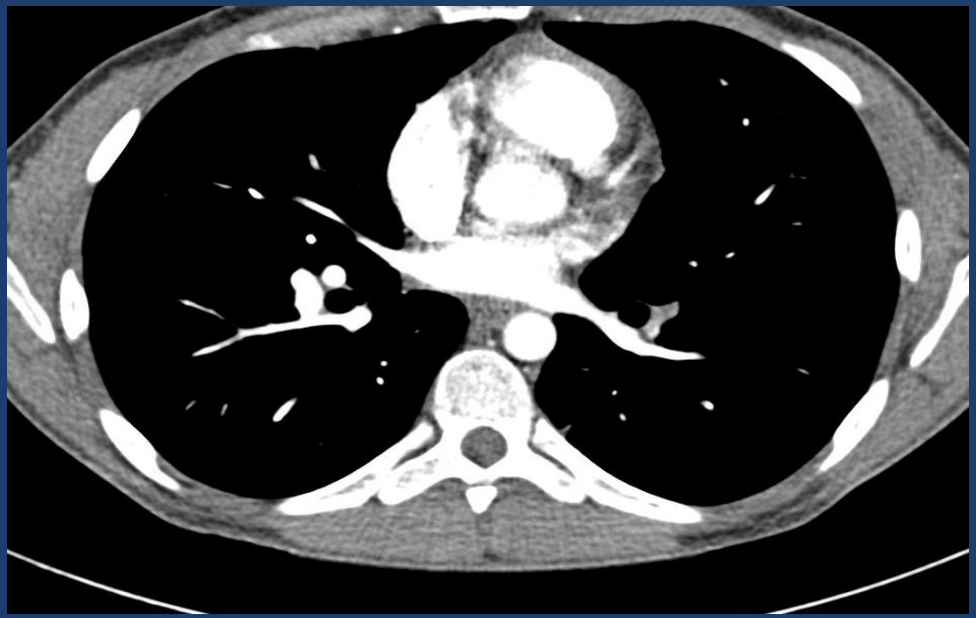
Endovascular Treatment of Acute Pulmonary Embolism

- Contraindications to systemic thrombolysis
- After failure of initial or ongoing systemic thrombolysis
- Rapid central clot-debulking
  - Decrease heart strain
  - Increase pulmonary perfusion
- Exposing greater surface area of thrombus to effects of locally infused thrombolytic agents
- To minimize bleeding associated with systemic lysis

Surgical Embolectomy







Catheter-based Interventions

Absolute contraindications to systemic thrombolysis

- Thrombus fragmentation
- Suction/aspiration thrombectomy
- Rheolytic thrombectomy
- Rotational thrombectomy
- Balloon angioplasty

Absence of absolute contraindications to systemic thrombolysis

- Conventional catheter-directed thrombolysis
- Pharmaco-mechanical thrombolysis (PMT)
- Suction/aspiration thrombectomy

Why Catheter-Directed Interventions (CDI)?

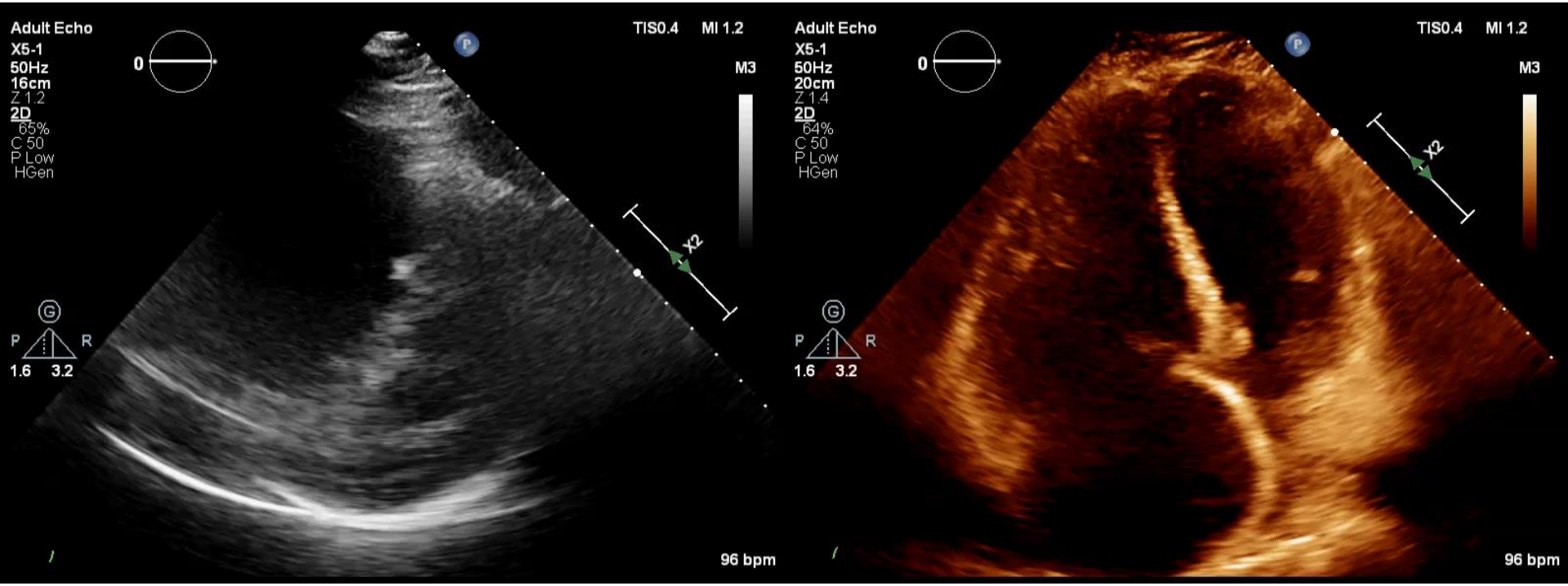
- Contraindication for systemic thrombolysis
- Failure of initial or ongoing systemic thrombolysis
- Rapid central clot-debulking
  - Reduces RV strain
  - Increase pulmonary perfusion
- Exposes greater surface area of thrombus to effects of locally-infused thrombolytic agents (if applicable)
- Minimize bleeding associated with systemic lysis

Case Presentation

- 61 yo man with hx DVT/PE 4 years ago s/p 8 months of warfarin. Presented with submassive PE and DVT.
- HR 110s, BP 100-110s/80s, O_2 saturation mid 90s on RA
  - On exam, some conversational dyspnea
  - Troponin 0.06 ng/mL
  - BNP 658 pg/mL
  - Lactate 1.3 mmol/L
- PESI 91 (intermediate risk, 3.2-7.1% 30 day mortality)

  sPESI 8.9% (high risk)

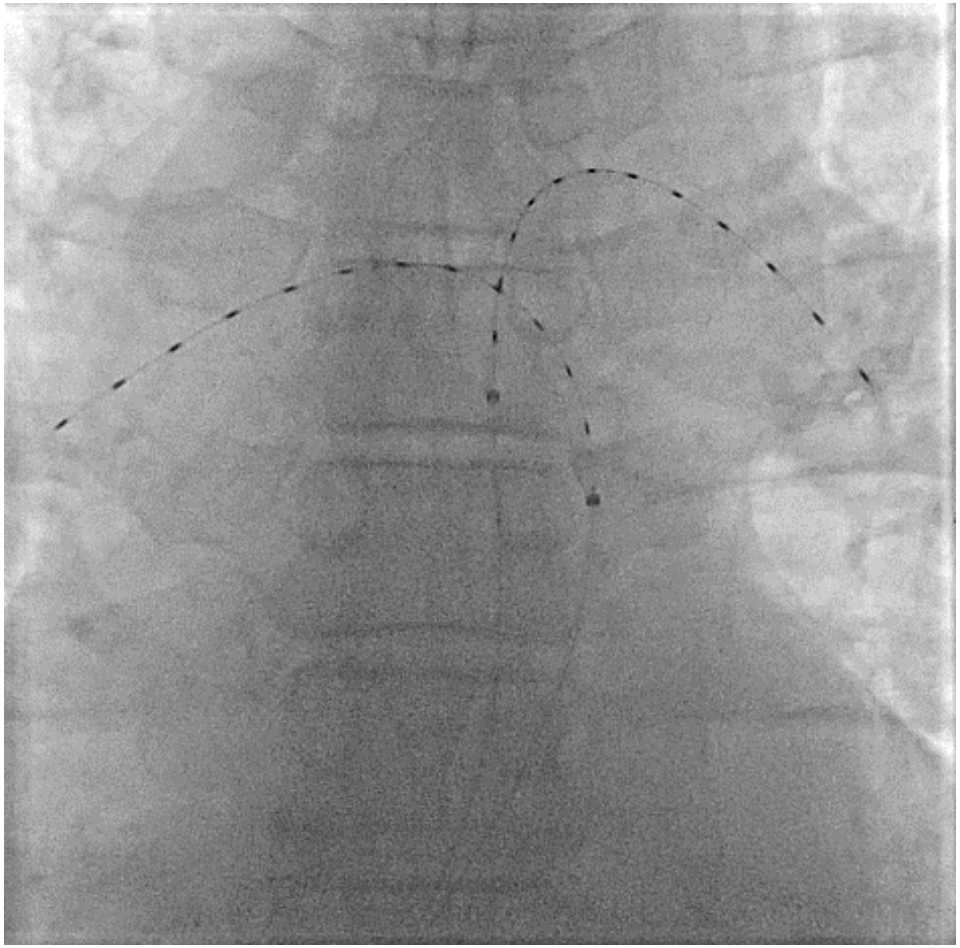
Case Presentation



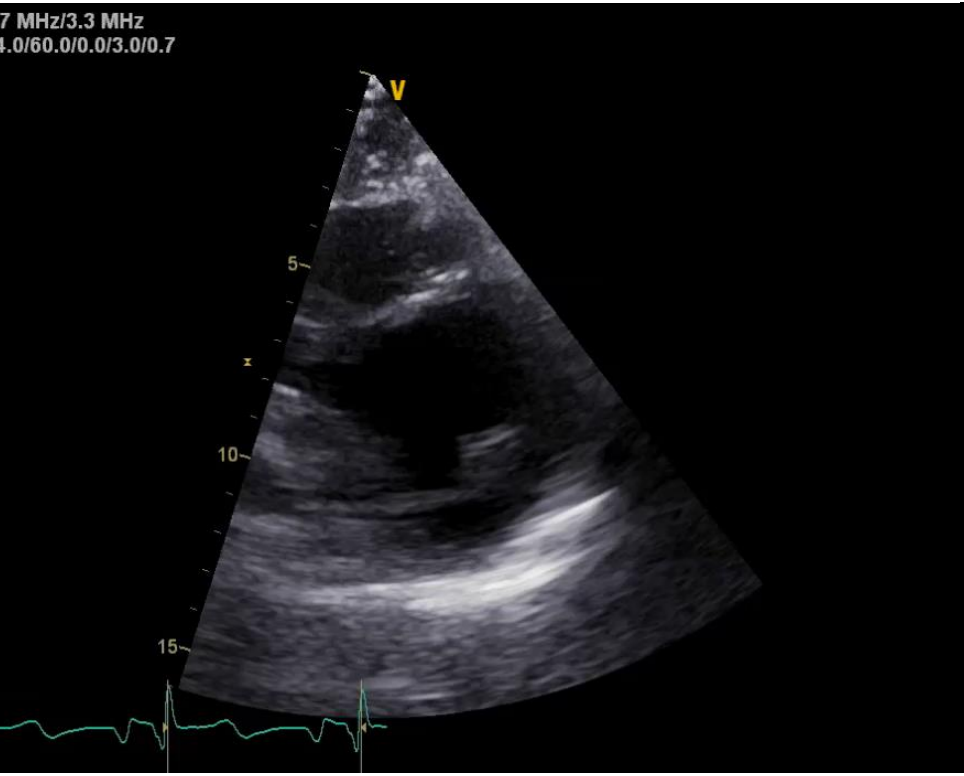
Case Presentation

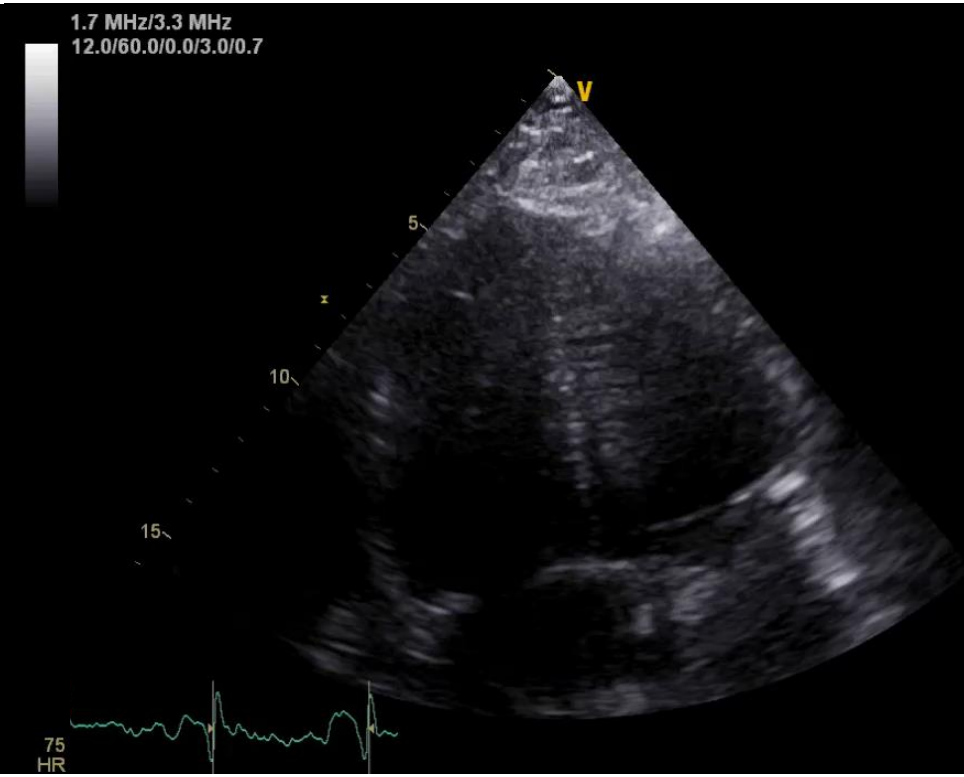
- Decision was made to medically manage and re-evaluate in 3 days
  - TTE unchanged at 3 days

Case Presentation

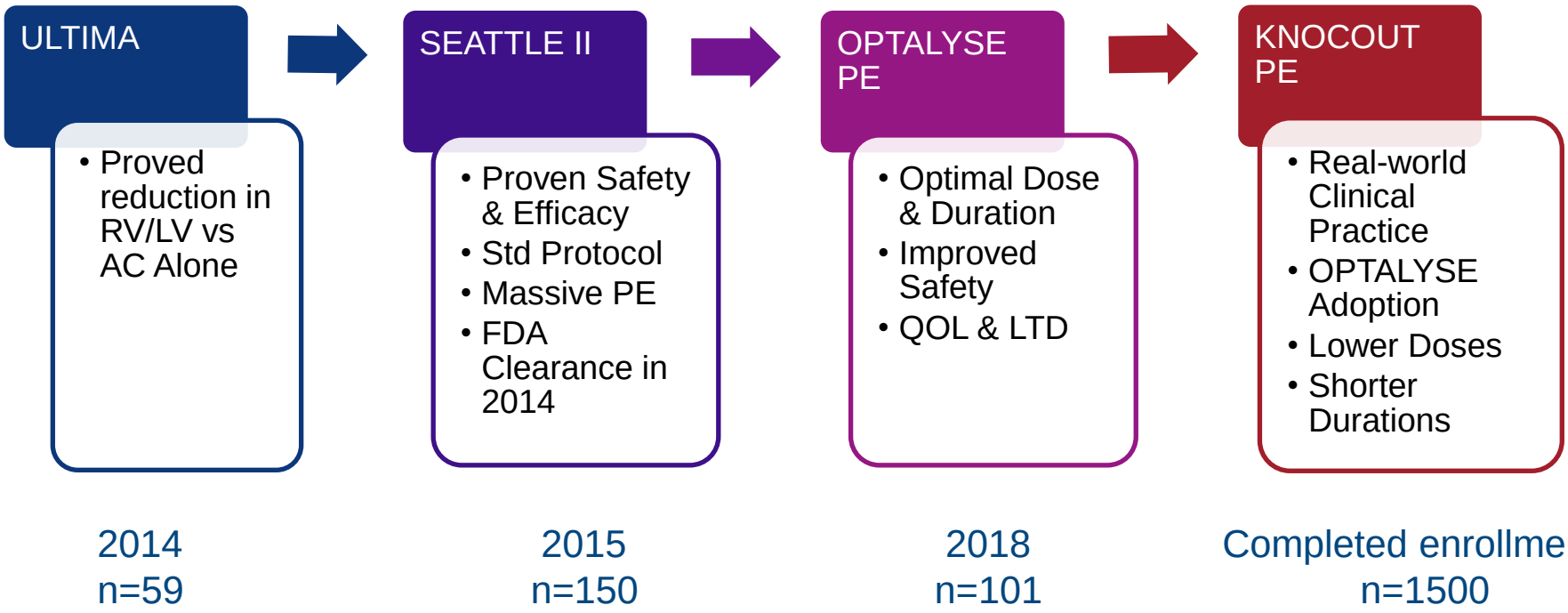


Case Presentation

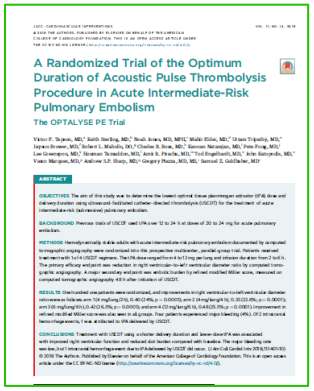




EKOS™ Key PE Studies



OPTALYSE PE STUDY EXPLORED OPTIMAL DURATION AND DOSE USING EKOS™ THERAPY



A Randomized Trial of the Optimum Duration of Acoustic Pulse Thrombolysis Procedure in Acute Intermediate-Risk Pulmonary Embolism

The OPTALYSE PE Trial

Patients

- Acute PE with RV/LV ratio ≥0.9
- (n=101**; 17 centers)

Objectives

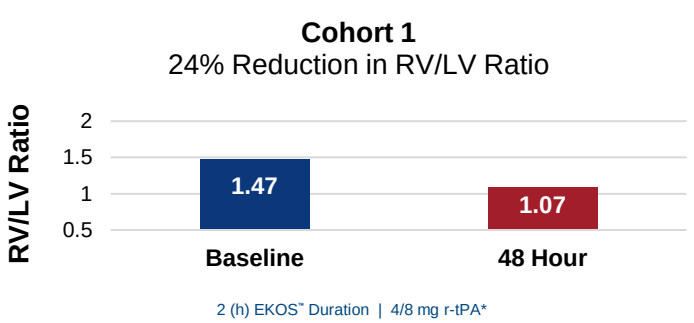
- Evaluate the optimal duration and dose of Acoustic Pulse Thrombolysis™ (APT) treatment using r-tPA administered via the EKOS™ system:
  - Efficacy—Change in RV/LV ratio on CTA at 48hrs
  - Safety—As measured by major bleeding within 72hrs

Randomization			
Cohort 1	**Cohort 2**	**Cohort 3**	**Cohort 4**
27 Patients*** 2(h) EKOS™ 4/8 mg r-tPA*	27 Patients 4(h) EKOS™ 4/8 mg r-tPA*	28 Patients 6(h) EKOS™ 6/12 mg r-tPA*	18 Patients 6(h) EKOS™ 12/24 mg r-tPA*

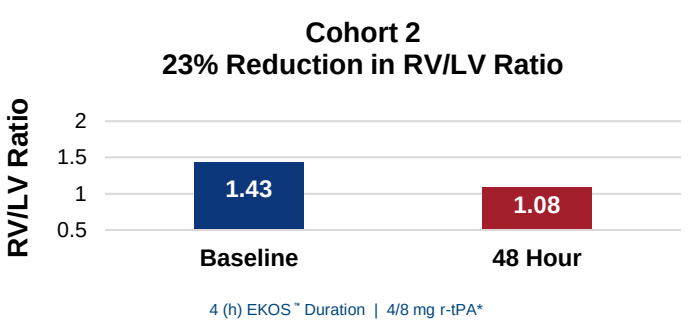
* Total mg r-tPA: one/two catheters
**One of the randomized patients did not receive EKOS treatment
***One of the original 28 patients in this arm did not receive EKOS treatment

Tapson V et al. A randomized trial of the optimum duration of acoustic pulse thrombolysis procedure in acute intermediate-risk pulmonary embolism. JACC: Cardiovascular Interventions 2018; 11(14):1401-1410.

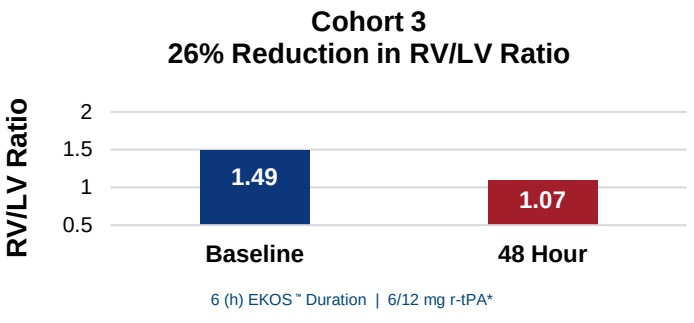
ALL OPTALYSE PE COHORTS SHOWED SIGNIFICANT REDUCTION IN RV/LV AT 48 HOURS POST-INITIATION OF PROCEDURE



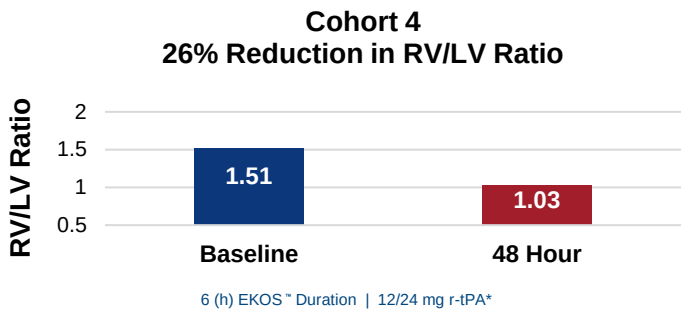
2 (h) EKOS™ Duration | 4/8 mg r-tPA*



4 (h) EKOS™ Duration | 4/8 mg r-tPA*



6 (h) EKOS™ Duration | 6/12 mg r-tPA*



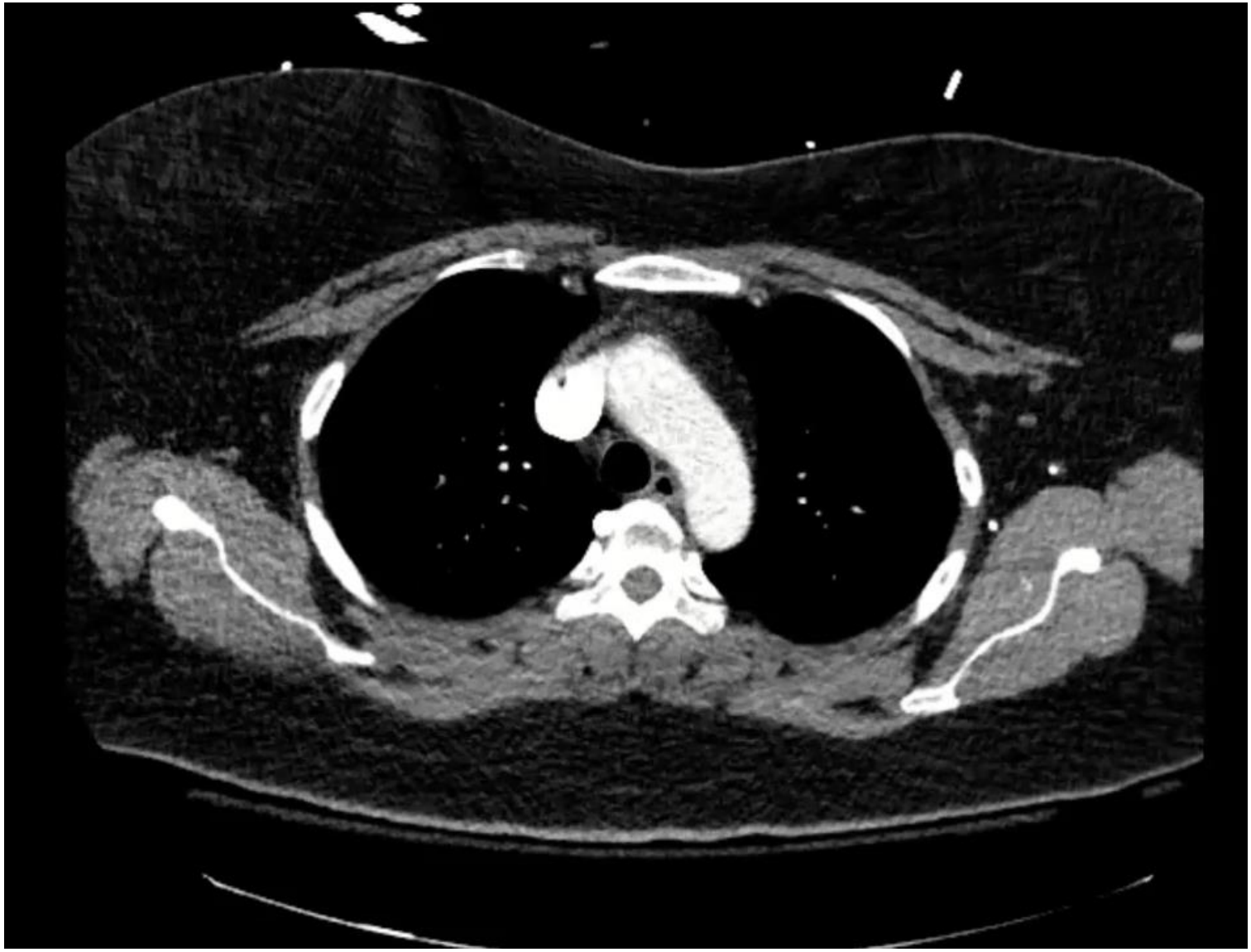
6 (h) EKOS™ Duration | 12/24 mg r-tPA*

*Total mg r-tPA: one/two catheters

Tapson V et al. A randomized trial of the optimum duration of acoustic pulse thrombolysis procedure in acute intermediate-risk pulmonary embolism. JACC: Cardiovascular Interventions 2018; 11(14):1401-1410.

Case Presentation

- 39 yo Amish woman with large orbital rim meningioma, admitted following elective bifrontal craniotomy for tumor resection on 11/2/18.
  - PMH:
    - Infrapopliteal DVT LLE in 2017 on 3 months of Xarelto
    - On “homeopathic” anticoagulant
  - FH: DM, cancer, DVT
  - SH: occasional EtOH, never smoker
- POD #5
  - Acute onset tachycardia and oxygen requirement

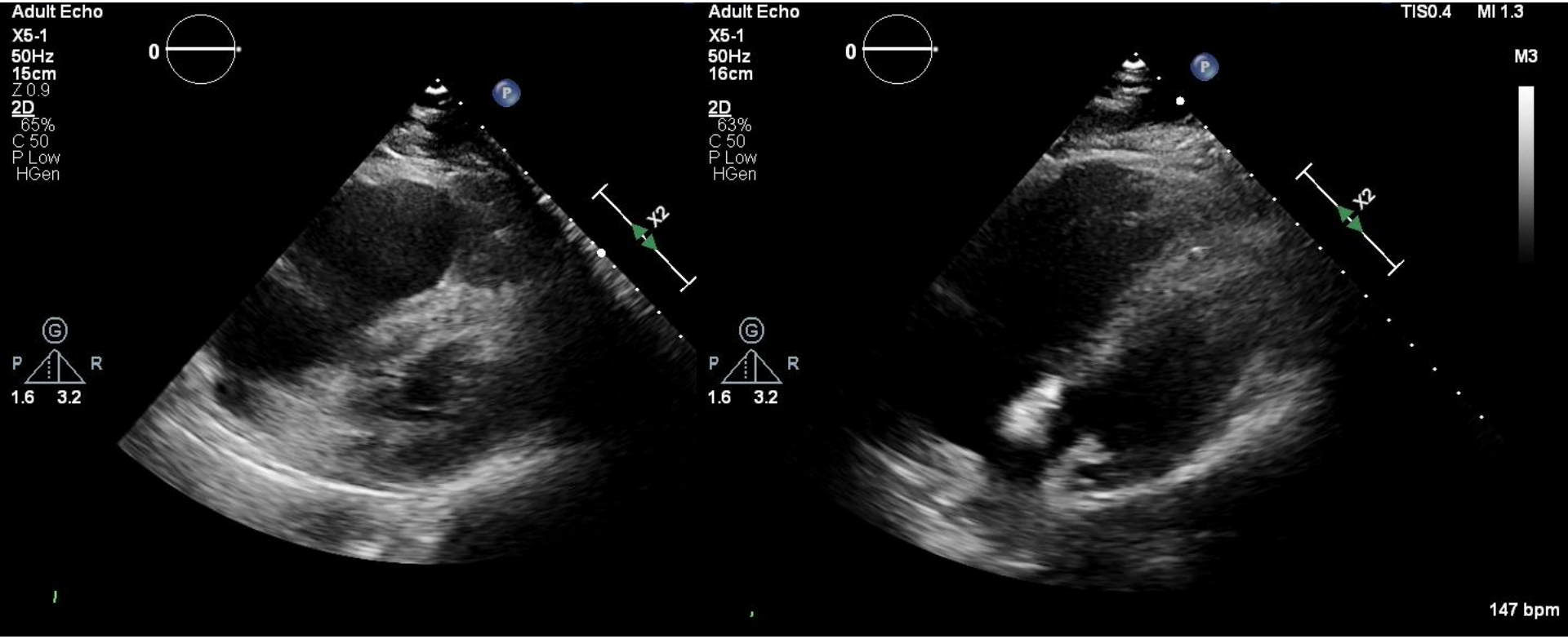


Case Presentation

- Physical exam
  - HR 120-140s, BP 76/42, RR 30, 82% on RA
  - Tachypneic and in distress
  - Initiated on phenylephrine and electively intubated
- PESI 159 (very high risk, 10-24.5% 30 day mortality)

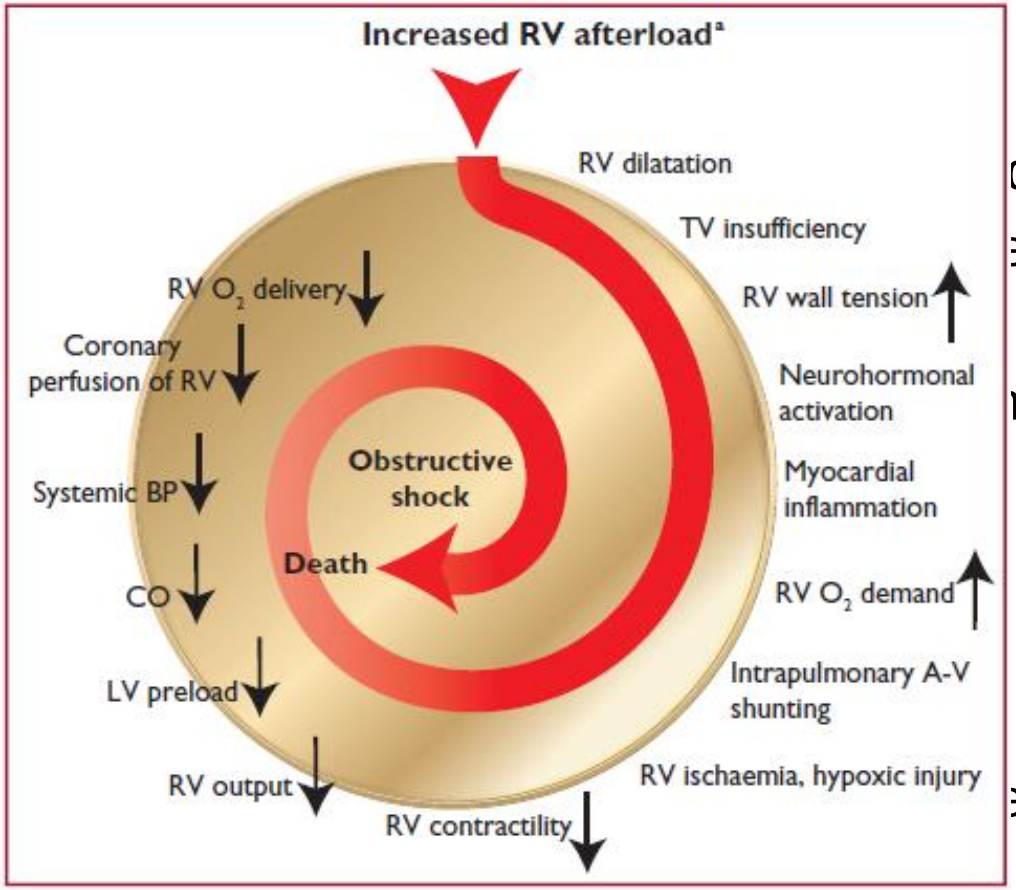
  sPESI 8.9% (high risk)

TTE


Adult Echo
X5-1
50Hz
15cm
Z 0.9
2D
65%
C 50
P Low
HGen
0
X2
P
R
1.6
3.2
Adult Echo
X5-1
50Hz
16cm
2D
63%
C 50
P Low
HGen
0
X2
P
R
1.6
3.2
TIS0.4
MI 1.3
M3
147 bpm

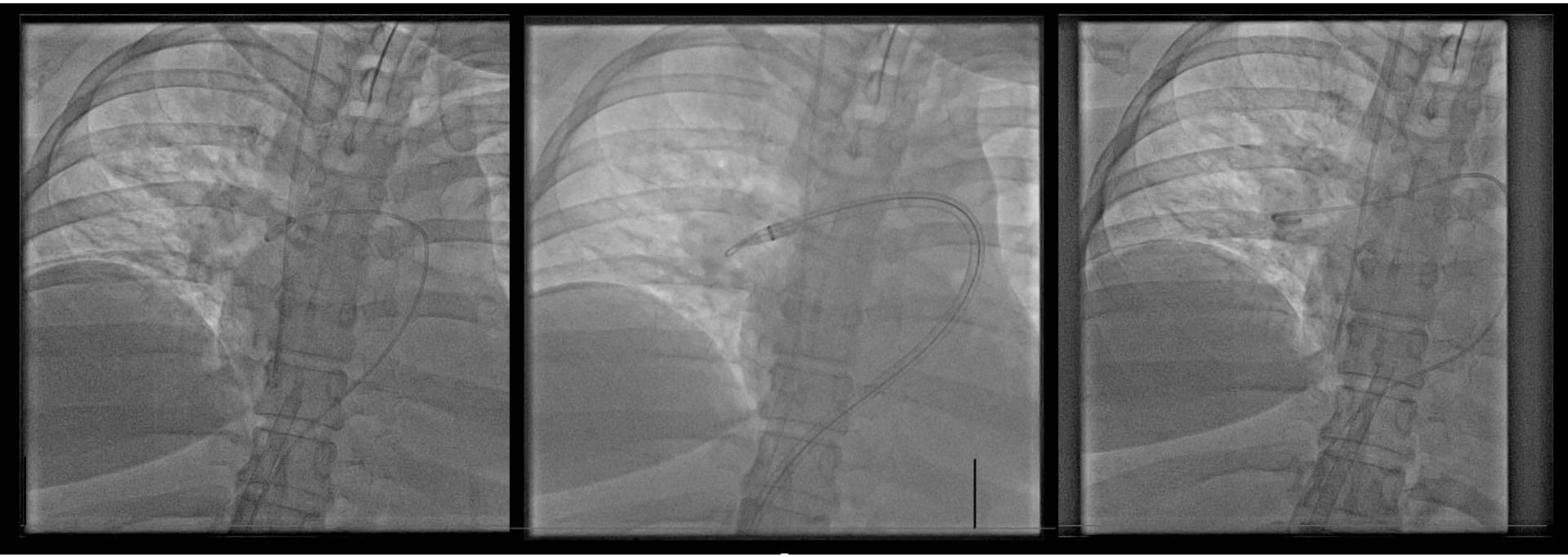
Case Presentation

- Pt taken e
  - After ar dycardic
    - Epir ement
  - PEA
    - CPF ne
    - VT r
  - ROSC a
  - PEA ag
- Decision n
  - Stabiliz ectomy



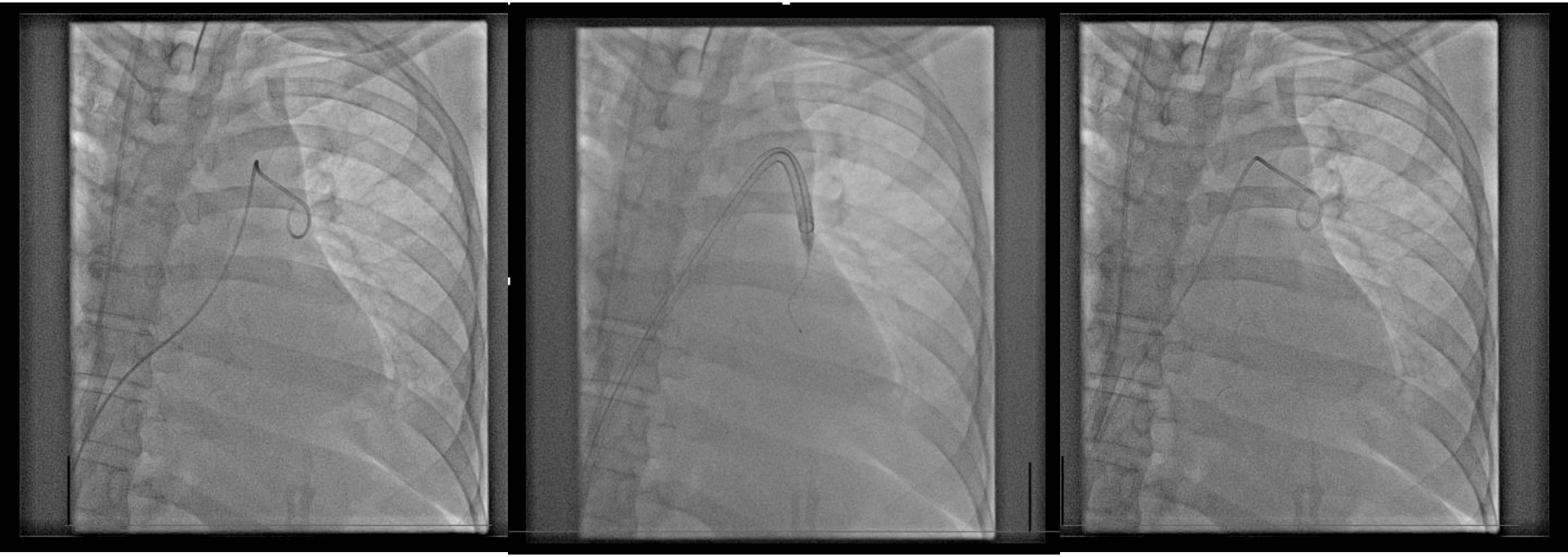
RPA Embolectomy

Before **Embolectomy** **After**

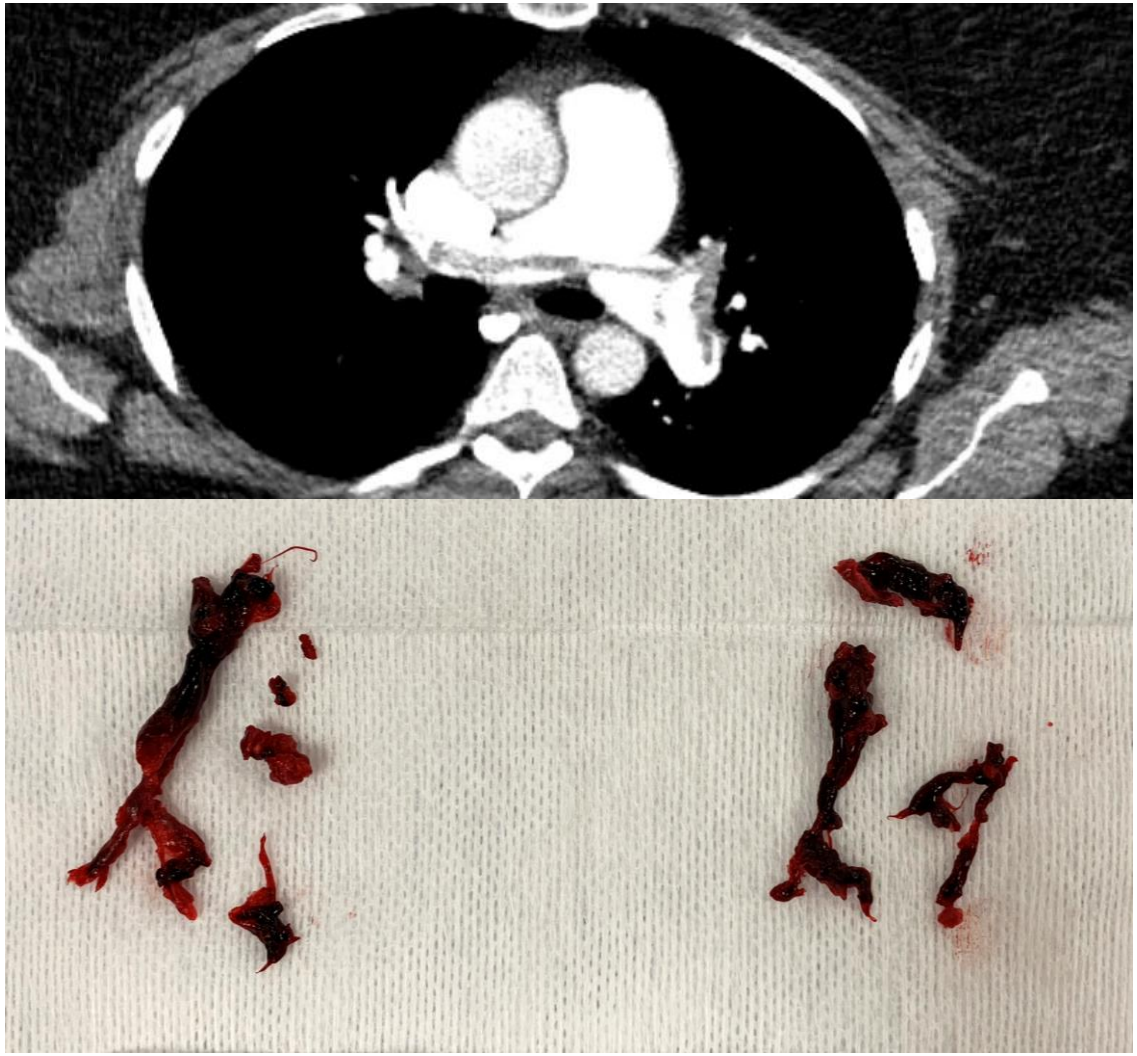


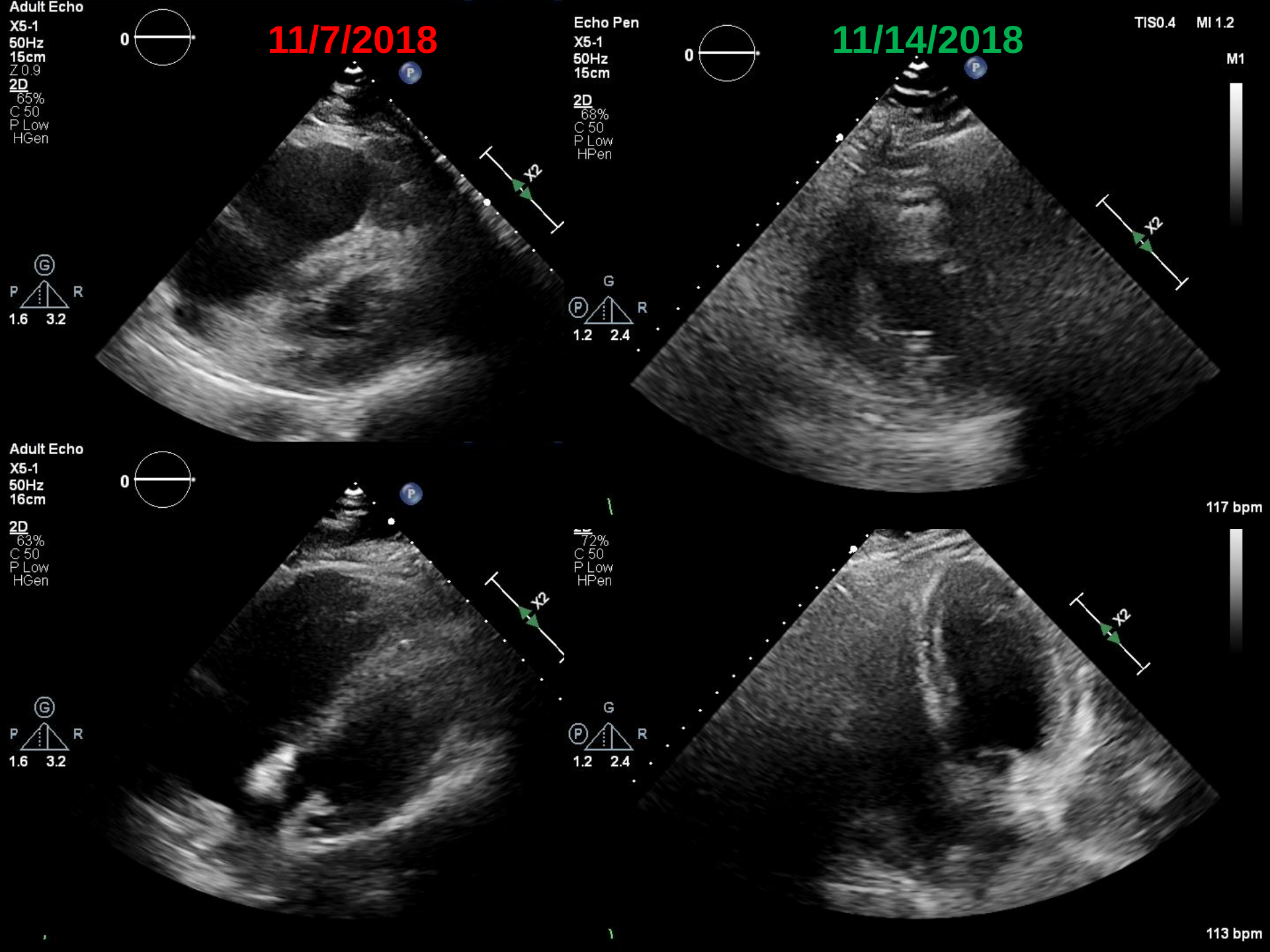
LPA Embolectomy

Before **Embolectomy** **After**



Case Presentation



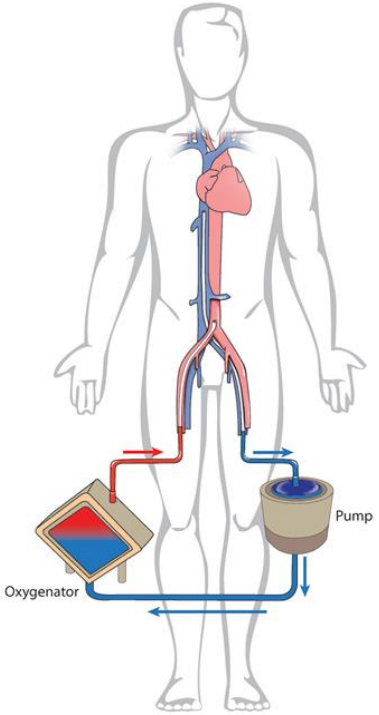

11/7/2018
11/14/2018
Adult Echo
X5-1
50Hz
15cm
Z 0.9
2D
65%
C 50
P Low
HGen
1.6 3.2
Echo Pen
X5-1
50Hz
15cm
2D
68%
C 50
P Low
HPen
1.2 2.4
TIS0.4 MI 1.2
M1
Adult Echo
X5-1
50Hz
16cm
2D
63%
C 50
P Low
HGen
1.6 3.2
72%
C 50
P Low
HPen
1.2 2.4
117 bpm
113 bpm

Case Presentation

- 11/2/2018: Bifrontal craniotomy.
- 11/7/2018: PE, PEA arrest, VA ECMO, thrombectomy.
- 11/12/2018: ECMO decannulated.
  - HIT confirmed by PF4 and SRA, switched to bivalirudin, and eventually to warfarin.
- 11/17/2018: Extubated.
- 11/20/2018: Transferred to floor.
- 12/5/2018: Discharged home.
- 1/30/2019: Seen in clinic, doing well, on RA.

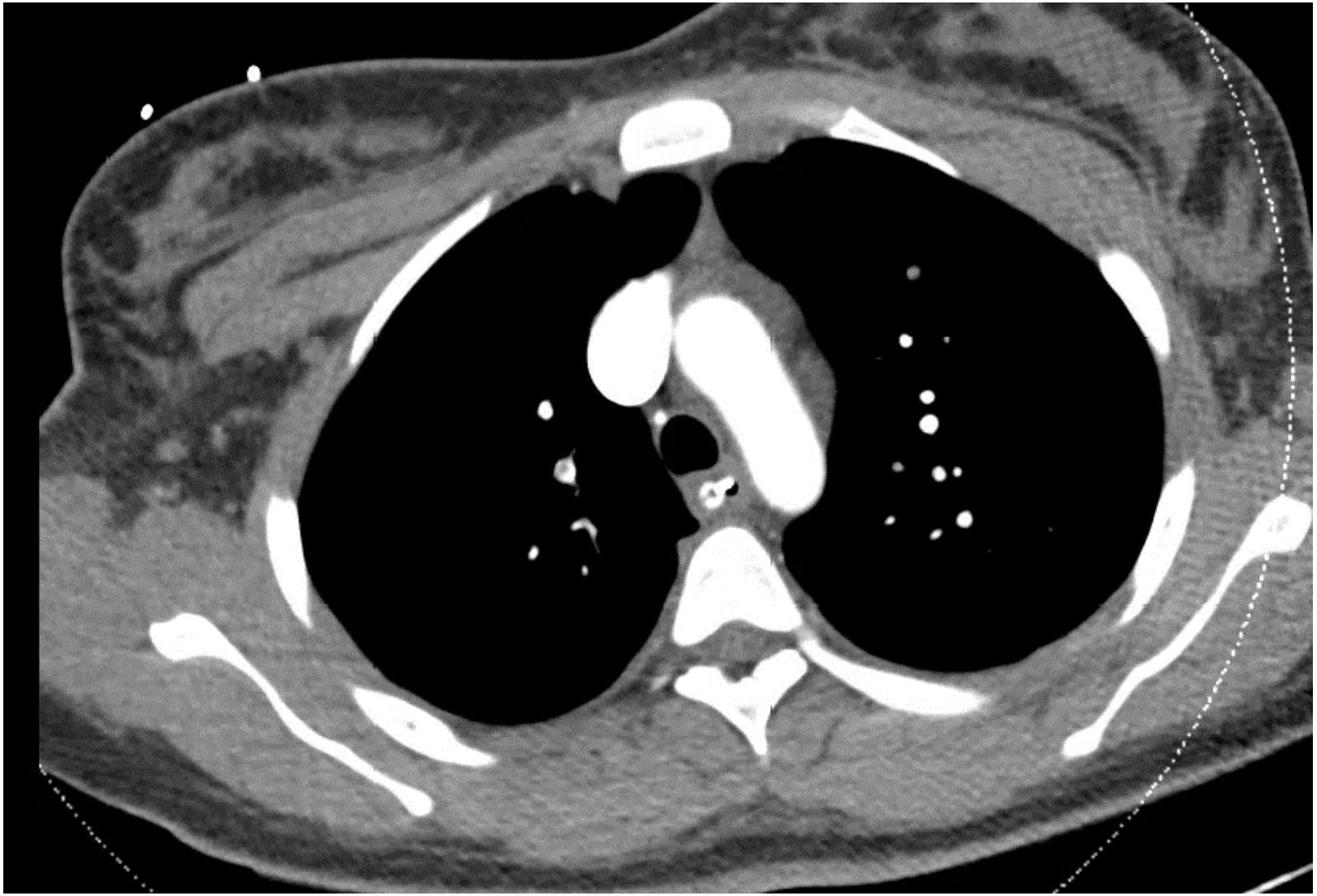
Submassive PEs: Always Plan for the Worst

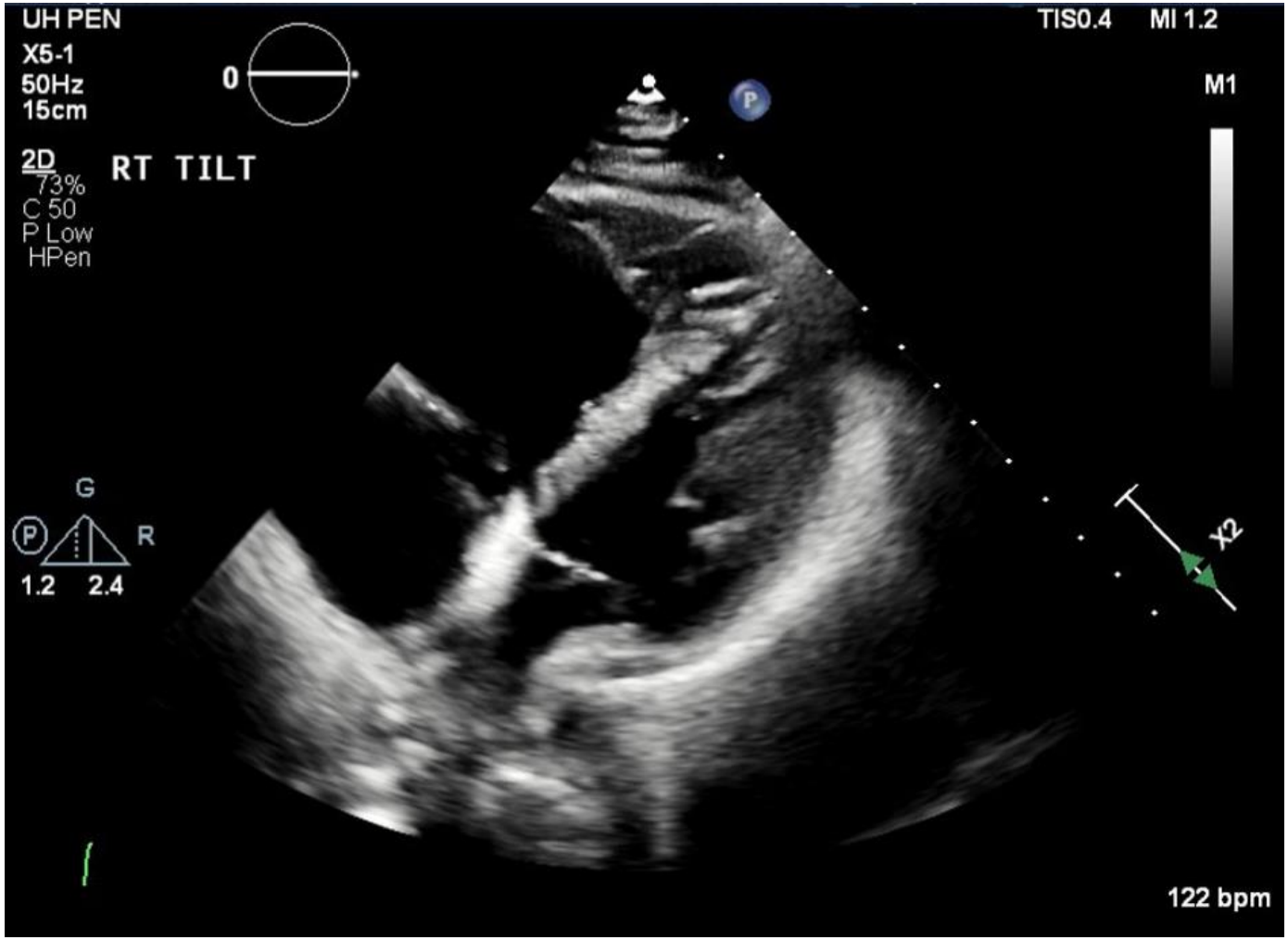
- Availability of Cardiohelp for percutaneous ECMO 24/7
  - Placed in cath lab
  - Decreases wait time for establishing full cardiopulmonary support



Case Presentation

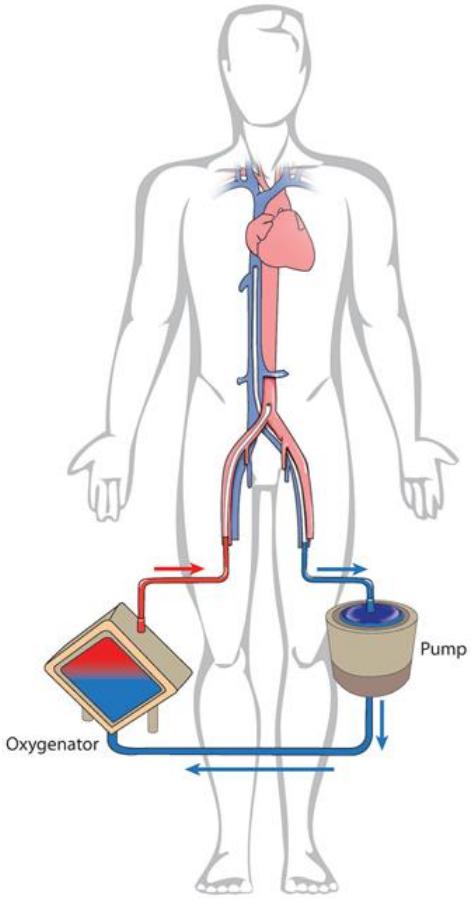
- 28 year old woman with IJ thrombus from enlarged tonsils 5 months prior, s/p anticoagulation treated at OSH.
- Presents with angioedema (c/f peritonsillar abscess) s/p nasotracheal intubation. Ongoing hypoxia/hypotension – proceeded with PE CT.
- HR 114 bpm, BP 66/42, 100% on ventilator (FiO2 30%)
  - On norepinephrine and epinephrine, invasive SBP remains 80-100s mmHg

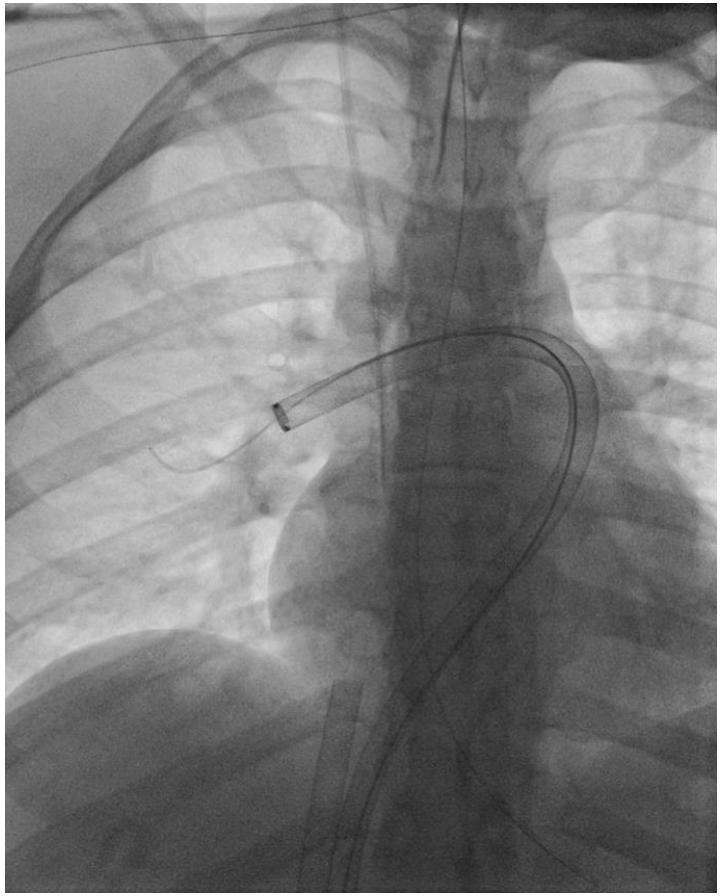


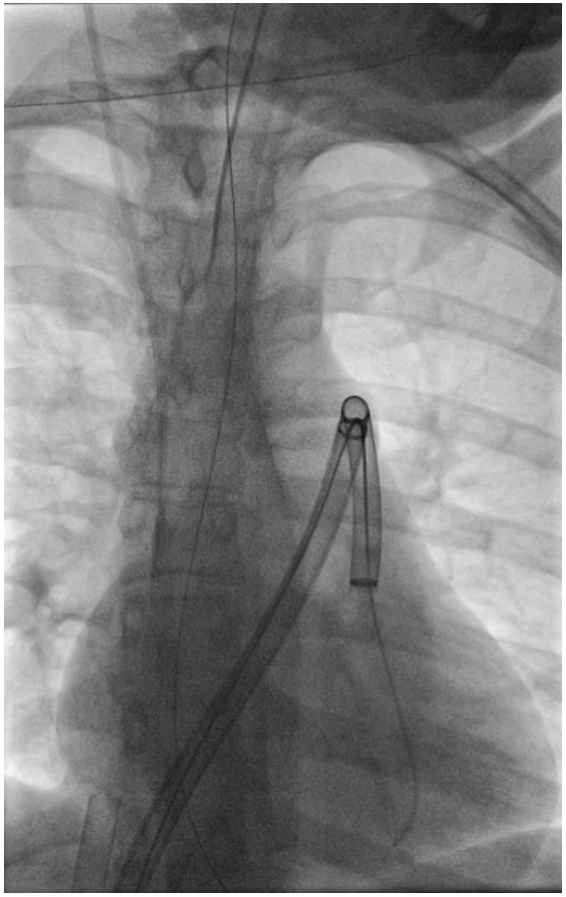

UH PEN
X5-1
50Hz
15cm
2D
73%
C 50
P Low
HPen
RT TILT
TIS0.4 MI 1.2
M1
G
R
1.2 2.4
X2
122 bpm

Options?

- Systemic thrombolysis
- Catheter-directed thrombectomy
- Catheter-directed thrombolysis
- Hemodynamic support +/- catheter-based therapy

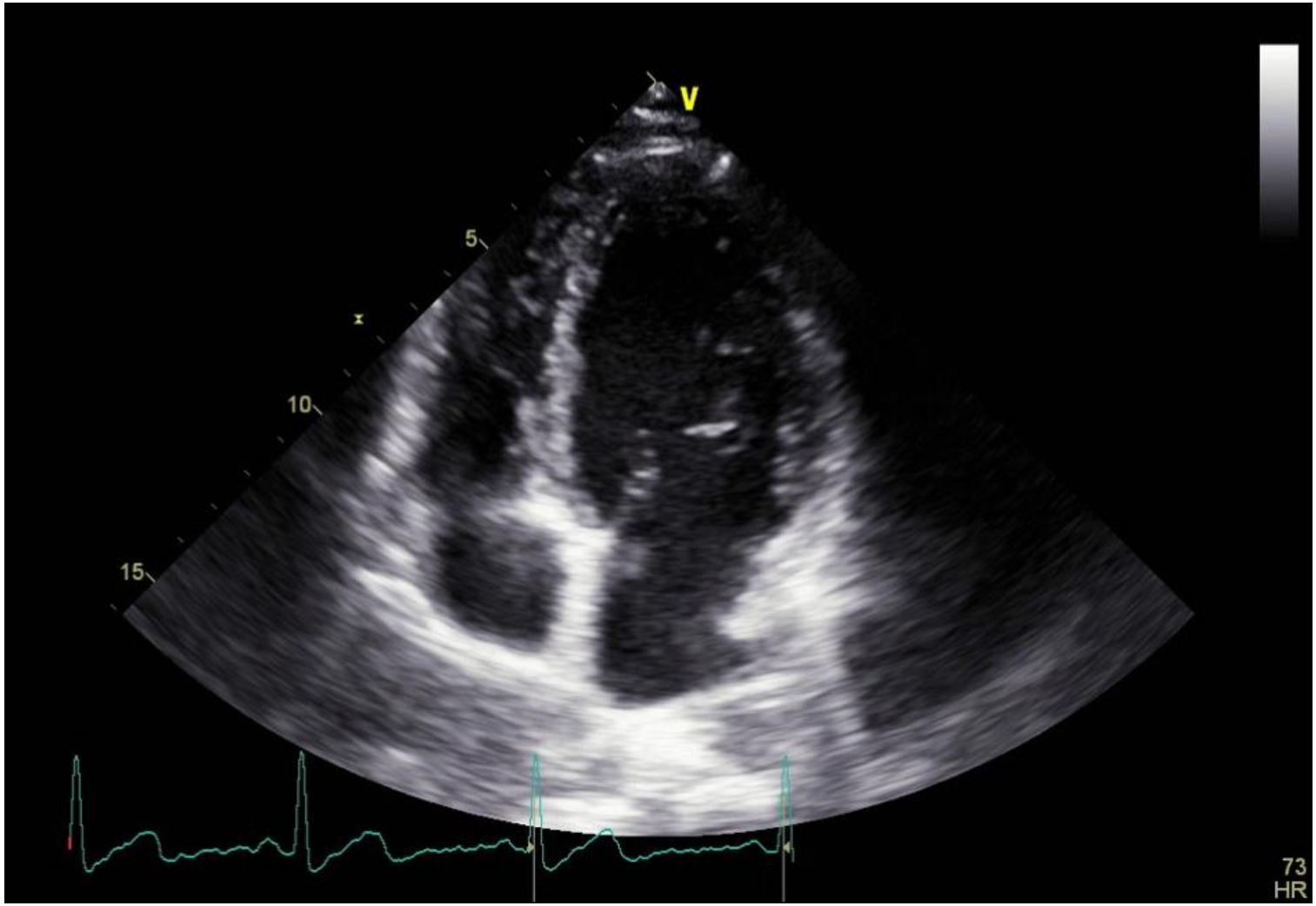

Pump
Oxygenator





Case Presentation

- Next day
  - BP 110-120s/60s (off pressors)
  - HR 70s
- Decannulated on post-procedure day 1
- Extubated on post-procedure day 2
- Discharged home on post-procedure day 6


V
5
10
15
73
HR

Conclusions

- Despite diagnosis, submassive PE patients remain undertreated
- PE treatment remains individualized
  - The multidisciplinary PERT approach is key to help identify those at highest risk of adverse outcomes and would benefit from CDI
- Much more to be learned about PE management in the coming years