Pulmonary Embolism Response Team (PERT)

Concept, Inception, & Development

Pavan K. Kavali, MD Assistant Professor of Radiology and Surgery Mallinckrodt Institute of Radiology Washington University School of Medicine

November 21, 2021

Washington University School of Medicine in St. Louis

Disclosures

□ I have no disclosures

Washington University School of Medicine in St. Louis

Case Presentation

- 65 year old male with no significant PMH presenting with shortness of breath
 - Cough, congestion, dyspnea x 1 week
 - COVID-19 negative (no vax)
- VS: 124/72, HR 105, sp02 90%, 98.3F
- proBNP >11K, trop I hs 83
- Admitted to the hospital for CHF workup
- Echo revealed large, mobile echogenic mass

Case Presentation – CT PE



Washington University School of Medicine in St. Louis

Case Presentation – CT PE



Washington University School of Medicine in St. Louis

Acute Pulmonary Embolism

- □ Life-threatening condition
- □ Third leading cause of cardiovascular mortality in the US
 - □ Most commonly from lower extremity DVT
 - \Box Evidence of DVT in > 50%

□ Three Categories

- □ Low-Risk
- □ Sub-massive (intermediate risk)
- □ Massive (high risk)

Acute PE Classification

Massive PE	Submassive PE	Minor/Nonmassive PE	
High risk	Moderate/intermediate risk	Low risk	
 Sustained hypotension (systolic BP <90 mmHg for ≥15 min) 	 Systemically normotensive (systolic BP ≥90 mmHg) 	 Systemically normotensive (systolic BP ≥90 mmHg) 	
Inotropic support	RV dysfunction	No RV dysfunction	
Pulseless	Myocardial necrosis	No myocardial necrosis	
 Persistent profound bradycardia (HR <40 bpm with signs or symptoms of shock) 			
RV/LV ratio > 0.9 or RV systolic dysfunction on ex RV/LV ratio > 0.9 or CT Elevation of BNP (>90 pg/mL) Elevation of NTpro-BNP (>500 pg/mL) ECG changes: new complete or incomplete RBBB anteroseptal ST elevation or depression anteroseptal T-wave inversion	cho	ance: 4.79 cm Max: 122 /308 2 Distance: 4.14 cm 2 Min/Max: 82 /271	

Jaff et al. Circulation 2011;123(16):1788-1830.

Washington University School of Medicine in St. Louis

Spiral of Death



Konstantinides et al, ESC Guidelines, E Heart Journal 2014

Washington University School of Medicine in St. Louis

Risk Stratification

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

ESC Guidelines for Acute PE Eur Heart J 2014

Washington University School of Medicine in St. Louis



Pulmonary Embolism Response Team

Washington University School of Medicine in St. Louis

PERT History

□ First PERT created at MGH in 2012

- National PERT consortium established in 2015 30 institutions from across the country at the inaugural meeting
- □ International in its scope now

PERT Introduction

□ Treatment paradigm little changed in the last 50 years

- most patients are treated with anticoagulation alone and few undergo systemic thrombolysis or surgical pulmonary thrombectomy
- New tools
 - catheter-directed thrombolysis (EKOS, infusion catheters)
 - percutaneous thromboaspiration (Inari FlowTriever, CAT12/Lightning, Angiovac)
 - extracorporeal membrane oxygenation (ECMO)

PERT Concept

- Goal Multidisciplinary expert panel to avoid inconsistency and variability in treatment
- Despite new therapeutic options, mortality high in massive PE patients
- Develop thoughtful, coordinated, comprehensive treatment plan for each patient¹

1. Rosovosky et al; Res Pract Thromb Haemost. 2019;3:315–330.

Washington University School of Medicine in St. Louis

PERT Protocol



Washington University School of Medicine in St. Louis

PERT @ MGH



Figure 2 Activation flow chart of MGH's PERT.

Note: Courtesy of MGH.

Abbreviations: MGH, Massachusetts General Hospital; PERT, pulmonary embolism response team; PE, pulmonary embolus; HIPAA, Health Insurance Portability and Accountability Act.

Washington University School of Medicine in St. Louis

PERT MGH Initial Experience

□ 30 months – 394 unique PERT activations

 Each successive 5 month period with 16% increase in number of activations

CHEST 2016 150384-393DOI: (10.1016/j.chest.2016.03.011)

Washington University School of Medicine in St. Louis



CHEST 2016 150384-393DOI: (10.1016/j.chest.2016.03.011)

Washington University School of Medicine in St. Louis



CHEST 2016 150384-393DOI: (10.1016/j.chest.2016.03.011)

Washington University School of Medicine in St. Louis

PERT MGH Initial Experience - Treatment

- Most common treatment anticoagulation alone
 215/310 (69%) patients
- □ Catheter-directed thrombolysis in 28 (9%) patients
- □ systemic IV thrombolysis in 14 (5%)
- □ surgical thrombectomy in 8 (3%) patients
- □ suction thrombectomy in 1 (0.3%) patient
- Three patients had both systemic and catheter-directed thrombolysis,
 - 35 (11%) patients underwent thrombolysis after PERT activation

PERT Early Evidence at UH Cleveland

Received: 16 October 2020

Revised: 15 February 2021 Acc

Accepted: 14 March 2021

DOI: 10.1002/ccd.29697

ORIGINAL STUDIES

WILEY

EDITORIAL COMMENT: Expert Article Analysis for: Time for pulmonary embolism alert

Predictors and potential advantages of PERT and advanced therapy use in acute pulmonary embolism

Melanie Parikh MD¹ | Nicole M. Chahine MD² | Tarek A. Hammad MD¹ | Leben Tefera MD² | Jun Li MD¹ | Teresa Carman MD¹ | Robert Schilz DO³ | Mehdi H. Shishehbor DO, MPH, PhD¹ |

PERT Early Evidence at UH Cleveland

Prospective study of 307 patients with CT confirmed PE

- □ PERT activated in 22.5% patients
 - Activation associated with abnormal VS and RV strain
- Advanced therapy (systemic lytics, EKOS, thrombectomy devices etc) – significantly higher in the PERT cohort (35% vs 2%)
- PERT cohort with advanced therapy use, when compared to the no-PERT patients who could have qualified (PESI score of 2)
 - significantly lower 30- and 90-day mortality and 30-day readmission without difference in major bleed

PERT Early Evidence at UH Cleveland



Washington University School of Medicine in St. Louis

PERT @ Barnes Jewish Hospital

Washington University School of Medicine in St. Louis

PERT Members @ BJH

- Emergency Department
- Pulmonary/Critical Care
- Cardio-Thoracic Surgery/ECMO
- □ Interventional Radiology
- □ Vascular Surgery
- Hematology
- Cardiology

PERT Collaboration

- 24/7 Consult service
- Specialists
 - Decide on a treatment plan and proceed along that pathway
 - Survey published in JVIR in 2017 endovascular physicians are more likely to use CDT than their medical colleagues (*Taslakian B, Chawala D, Sista AK J Vasc Interv Radiol. 2017 Dec; 28(12):1693-1699.e2*)
- MGH data only 9% with CDT; 4% underwent surgical embolectomy
- Sometimes, consensus may differ from a particular physician's opinion but change can occur over time



Washington University School of Medicine in St. Louis



Washington University School of Medicine in St. Louis

PERT Development @ BJH

Pulmonary Embolism Response Team (PERT) Activation – 9/1/2021



Washington University School of Medicine in St. Louis

PERT Process @ BJH

< >		Q Search		··· Washington University in St. Louis PK —	
Q. Activity	< All teams	🦄 Ge	neral Posts Files +	₿ 🗍 Meet 🗸	(i)
5	The second		Meeting in "General" ended: 12s	X	
chat			← Reply		
Teams	PERT		Meeting in "General" started		
Assignments			2 replies from you and Daniel		
_	General		← Reply		
Calendar			Thursday, November 4, 2021		
G		D	Meeting in "General" ended: 30h	CR DP MC JX	
			\leftarrow Reply		
Files			Friday, November 5, 2021		
		D	Meeting in "General" started		
			2 replies from Jimmy		
			← Reply		
			Sunday, November 7, 2021		
		D1	Meeting in General ended: 24m 23s	SV MC JM PK WM +1	
			\leftarrow Reply		
			Friday, November 12, 2021		
		D1	Meeting in "General" ended: 16m 45s	ZW MC 🚯 MK K8	
			\leftarrow Reply		I
			Sunday, November 14, 2021		
			Meeting in "General" ended: 20m 4s	RM MC NR BB KB	
			\leftarrow Reply		
Apps			C New conversation		
? Help					

Washington University School of Medicine in St. Louis

Case Presentation – Pulmonary Angiography



Washington University School of Medicine in St. Louis

Case Presentation – Pulmonary Angiography



Washington University School of Medicine in St. Louis

Case Presentation – Intra-cardiac Echo



Washington University School of Medicine in St. Louis

Case Presentation – Intra-cardiac Echo



Washington University School of Medicine in St. Louis

Case Presentation – Intra-cardiac Echo



Washington University School of Medicine in St. Louis

PERT Long Term Vision

Evaluate PE patients in a clinic

- Collect data on demographics, diagnostics, treatments, and outcomes in an effort to address the gap in clinical experience in modern PE therapeutics
- Create an institutional registry (Redcap database) clinical research and quality improvement efforts can be made

Thanks



Washington University School of Medicine in St. Louis