

VTE Pathways



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BAY REGION

DISCLOSURE

In the past 12 months, received a speaker
honorarium from Eliquis

VTE

Deep Vein Thrombosis (DVT)

or

Pulmonary Embolism (PE)

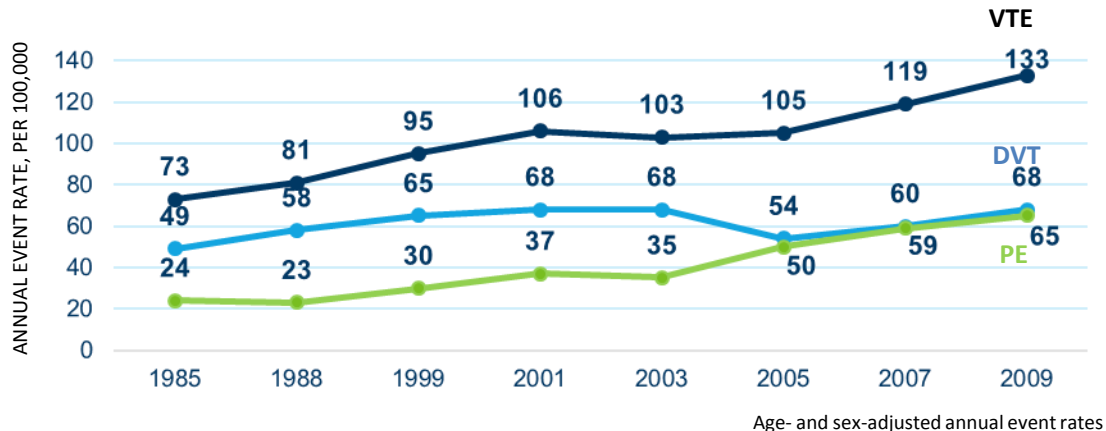
VTE (PE + DVT) IS MORE PREVALENT THAN MANY REALIZE

- Up to 900,000 cases of DVT/PE per year in the US^{1,2,3}
- More than 500,000 US patients hospitalized annually with VTE⁴
- VTE is a leading cause of death in industrial countries
 - Responsible for more deaths each year than breast cancer, AIDS, and road traffic accidents combined.⁵

1. Beckman MG, Hooper WC, Critchley SE, Ortel TL. Venous thromboembolism: a public health concern. Am J Prev Med. 2010;38(4 Suppl):S495-501.
2. Yusuf HR et al. Venous Thromboembolism in Adult Hospitalizations – US, 2007-2009. Morbidity and Mortality Weekly Report 2012; 61(22): 401-404.
3. "Deep Vein Thrombosis: Advancing Awareness to Protect Patient Lives" Public Health Leadership Conf. Feb 2003, American Public Health Association."

VTE INCIDENCE IS INCREASING, PRIMARILY DUE TO AN INCREASE IN PE

First-time occurrence



Between 1985 and 2009, the annual event rates of first-time venous thromboembolism nearly doubled and first-time pulmonary embolism nearly tripled

Huang W et al. Secular Trends in Occurrence of Acute Venous Thromboembolism: the Worcester VTE Study (1985-2009). Amer J Med 2014; 127: 829-839.

VTE

Often mis- or un-diagnosed

- Signs and symptoms often diffuse and difficult to recognize¹
- PE can accompany as well as mimic other cardiopulmonary illnesses^{1,3}
- As many as 50% of cases of DVT are “silent”²
- Tragic consequences from overlooked diagnosis
- First symptom of DVT is often a fatal PE²
- Approx. 10–30% of VTE patients die within 30 days⁴
 - Those that survive remain at increased risk (30%) for a possible VTE episode within the next ten years⁵

1. Goldhaber SZ. Pulmonary Embolism. N Engl J Med 1998;p 339:93-104.

2. The Surgeon General's Call to Action to Prevent Deep Vein Thrombosis and Pulmonary Embolism. US Department of Health and Human Services report, 2008.

3. Goldhaber SZ. PE risk factors and clinical characteristics: Why is PE so difficult to detect...are we missing important signs? Pulmonary Embolism Symposium , Boston, MA, May 22, 2015.

4. Beckman MG et al. Venous Thromboembolism: a public health concern. Am J Prev Med 2010; 38(4S)S495-S501.

5. Heit JA et al. Predictors of recurrence after deep vein thrombosis and pulmonary embolism: a population-based cohort study; Arch Intern Med 2000; 160(6):761-8.

LONG-TERM ECONOMIC COST OF VTE

Based on a review of seven years of adjudicated claims data (ICD-9-CM codes) among nearly 27,000 DVT/PE patients included in the study¹

	Annualized direct medical costs (median)		
	DVT	PE	DVT+PE
Pre-initial event	\$7,227	\$6,381	\$6,771
Post-initial event	\$17,512	\$18,901	\$25,554
Increase in cost (Δ)	\$10,285	\$12,520	\$18,783

Annualized healthcare cost increases several-fold following the initial episode of DVT²

1. MacDougall DA et al. Economic burden of deep-vein thrombosis, pulmonary embolism, and post-thrombotic syndrome. Am J Health-Syst Pharm 2006; 63, Suppl 6:S5-S15.

2. Marti C et al. "Systemic thrombolytic therapy for acute pulmonary embolism: a systematic review and meta-analysis." Eur Heart J 2014; 36: 605-614.

Pulmonary Embolism

Annual incidence

- United States: 69 per 100,000/year¹
 - Over 600,000 cases annually²
 - 1-2 PE episodes per 1000 people, up to 10 per 1000 in the elderly population³⁻⁶

Venous thromboembolism³

- PE commonly originates from lower limb deep vein thrombosis (DVT)
- 79% of patients presenting with PE have evidence of DVT
- PE occurs in up to 50% of patients with proximal DVT

1. Silverstein et al. *Arch intern Med* 1998;158:585-93.

2. Wood et al. *Chest* 2002;121:877-905.

3. Tapson. *N Engl J Med* 2008;358(10):1037-1052.

4. Geering et al. *CMAJ* 2012; 184(3):305-310

5. Chunilal et al. *JAMA* 2003;290:2849-58

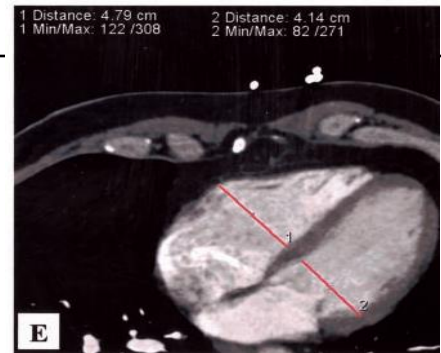
6. Siccamo et al. *Ageing Res Rev* 2011;10:304-13

PE Risk Stratification

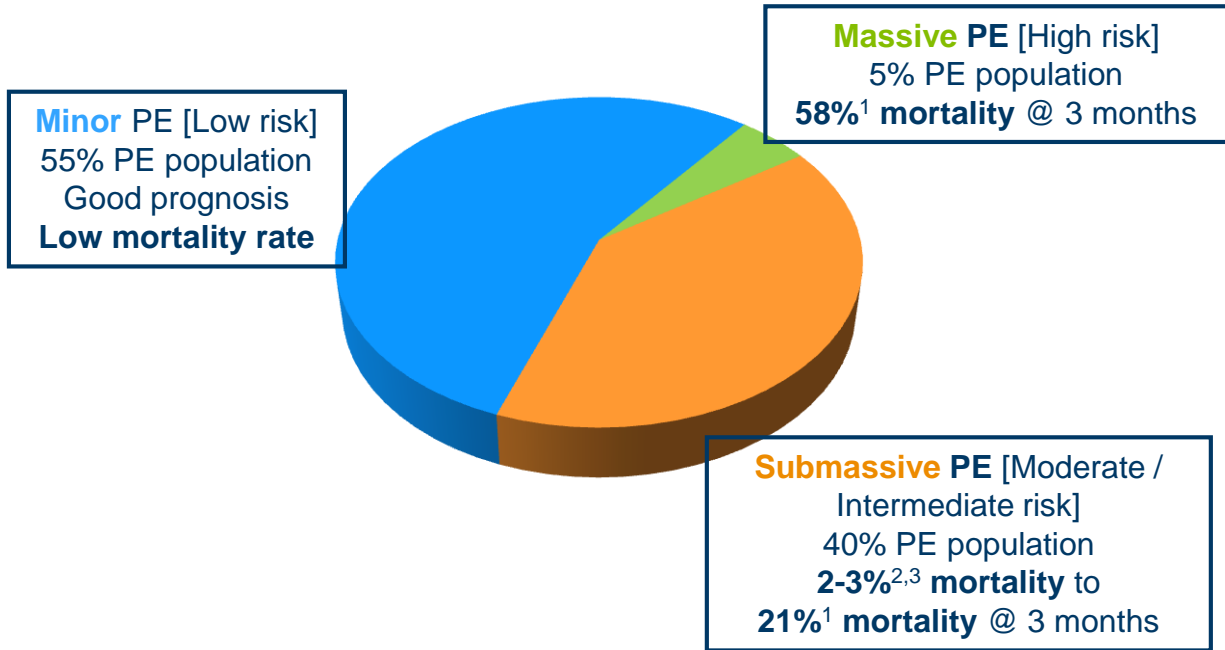
Patient risk stratification (per AHA Scientific Statement 2011 ¹)		
Massive PE	Submassive PE	Minor/Nonmassive PE
High risk	Moderate/intermediate risk	Low risk
<ul style="list-style-type: none"> - Sustained hypotension (systolic BP <90 mmHg for ≥15 min) - Inotropic support - Pulselessness - Persistent profound bradycardia (HR <40 bpm with signs or symptoms of shock) 	<ul style="list-style-type: none"> - Systemically normotensive (systolic BP ≥90 mmHg) - RV dysfunction - Myocardial necrosis 	<ul style="list-style-type: none"> - Systemically normotensive (systolic BP ≥90 mmHg) - No RV dysfunction - No myocardial necrosis

RV dysfunction

- RV/LV ratio > 0.9 or RV systolic dysfunction on echo
- RV/LV ratio > 0.9 on 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



PE Population Subgroups

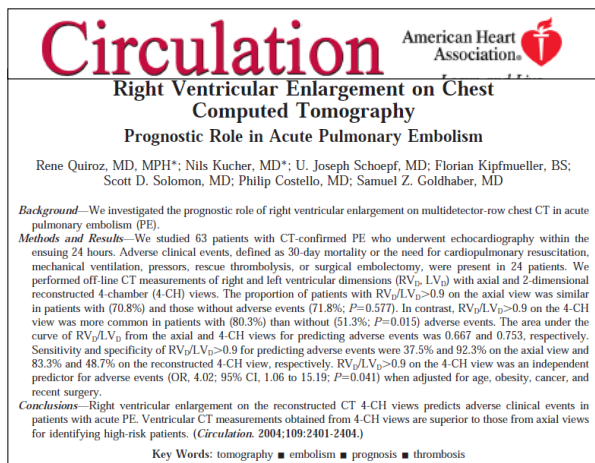


1. Goldhaber et al. Lancet 1999;353:1386-1389
2. Meyer et al. New Engl J Med 2014; 370: 1402-11
3. Casazza et al. Thrombosis Research 2012; 130:847-852

Why treat?

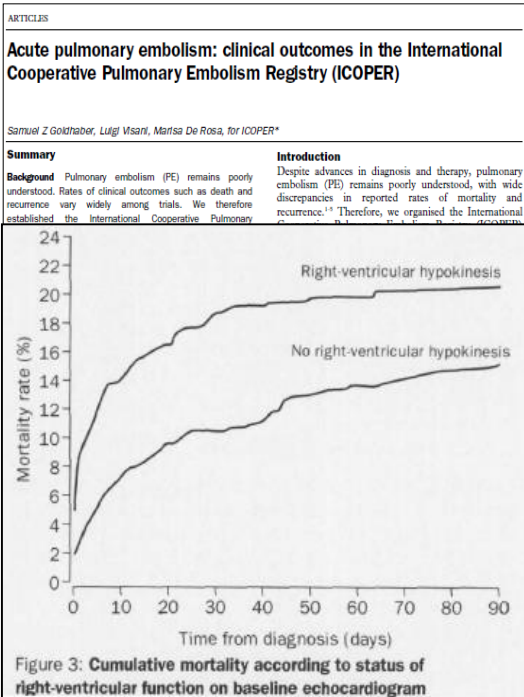
- The presence of right ventricular dysfunction (RVD) is a predictor of poor patient outcomes
 - Mortality
 - Adverse events
 - VTE recurrence

Patients with RVD defined as $RV/LV >0.9$ have a greater chance of adverse events within 30 days



- Retrospective analysis of 63 patients with chest CT
- Adverse event rate at 30 days:
 - **80.3%** if RV/LV ratio > 0.9
 - **51.3%** if RV/LV ratio ≤ 0.9

Presence of RV hypokinesia associated with 57% increase in mortality rate at 3 months



— Prospective study of 2,454 consecutive PE patients at 52 hospitals in 7 countries

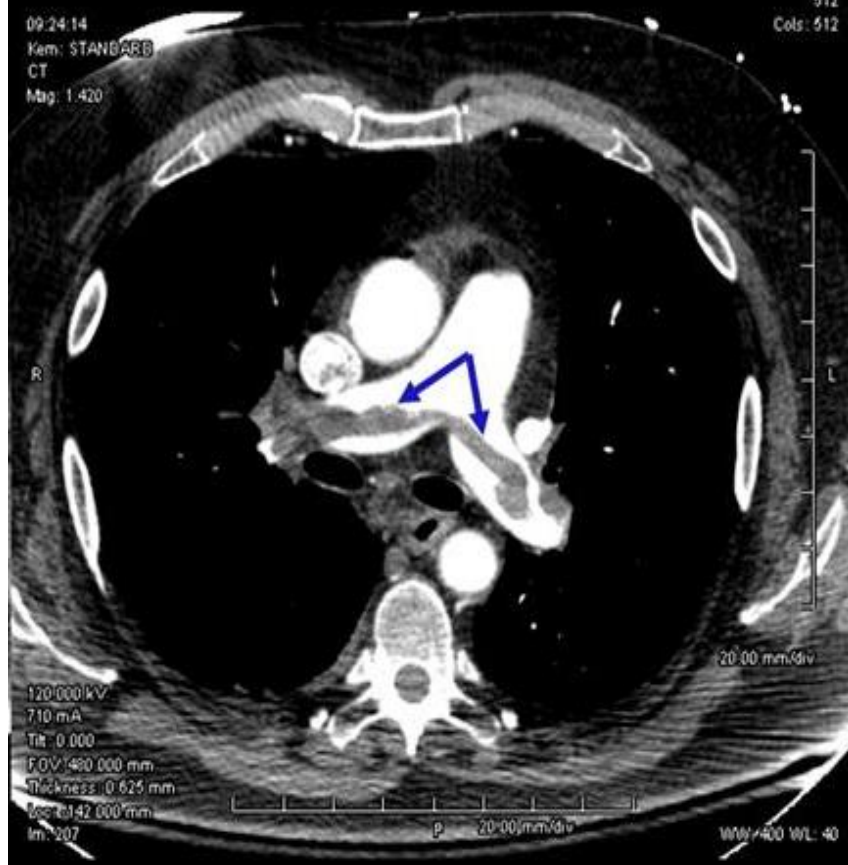
Mortality rate at 3 months:

- 21% with hypokinesia
- 15% with no hypokinesia

Goldhaber, S et al, Acute pulmonary embolism: clinical outcomes in the International Cooperative Pulmonary Embolism Registry (ICOPER), Lancet 1999; 353: 1386-89.

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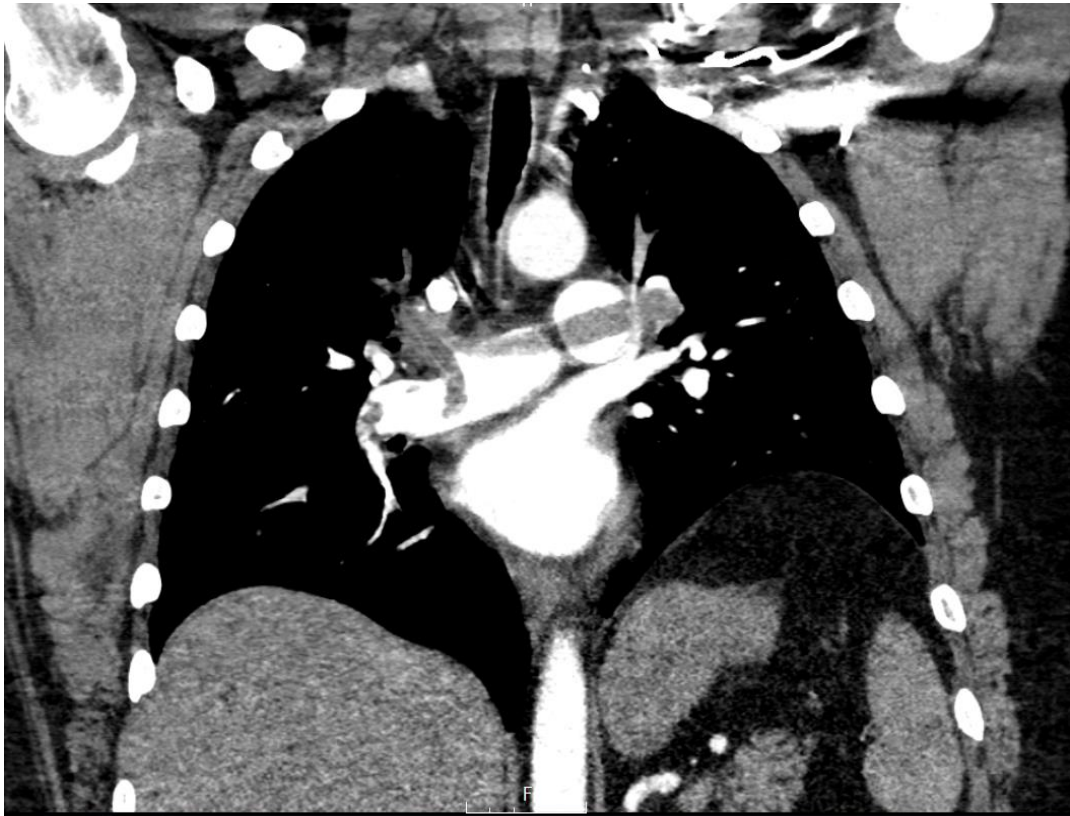
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Standard Therapies

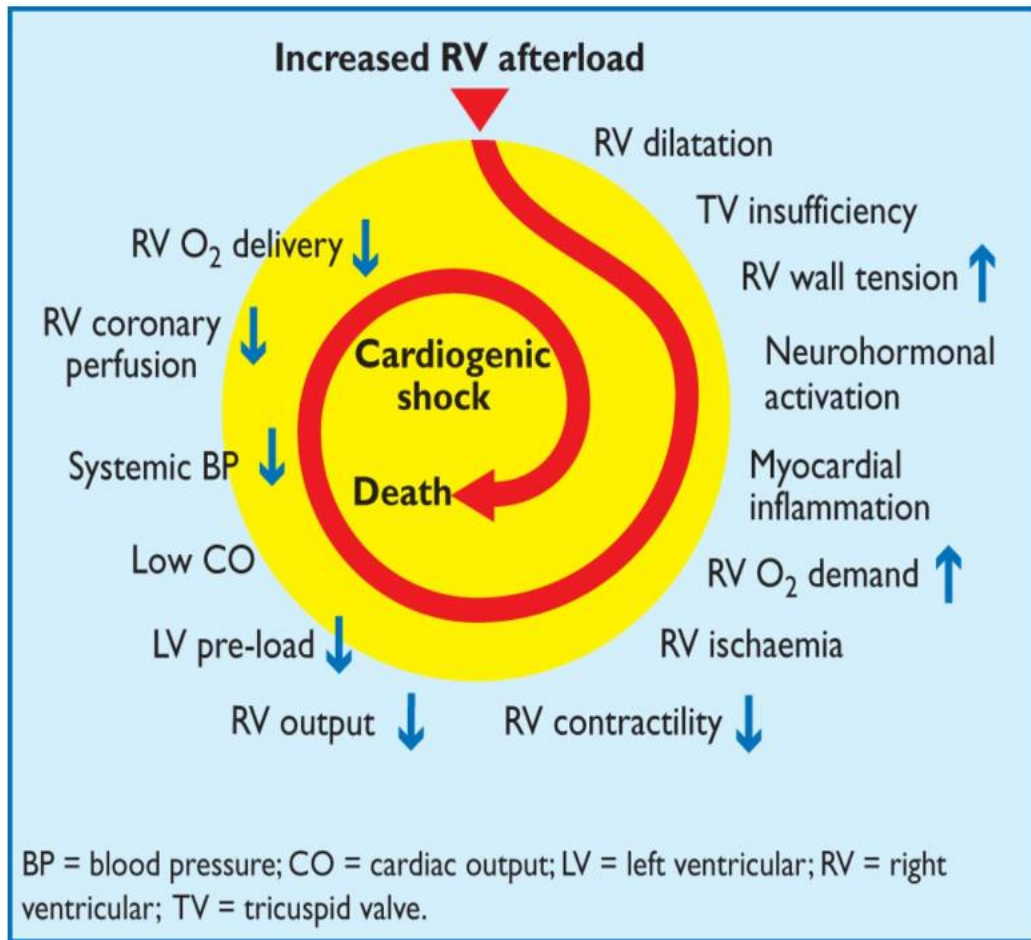
- Anticoagulation
 - Unfractionated heparin
 - Enoxaparin (LMWH)
 - Sodium Warfarin

Goal is to help prevent thrombus propagation

Rationale for Thrombolysis

REDUCE THROMBUS BURDEN (not achievable by anticoagulation alone)

- Reverse RV afterload / failure toward prevention of hemodynamic collapse
- Improve pulmonary reperfusion/capillary blood flow / gas exchange
- Restore systemic arterial perfusion pressure
- Decrease the risk of developing chronic pulmonary hypertension



Thrombolytic Therapy

- Systemic thrombolysis
- Catheter-directed thrombolysis (CDT)
- Acoustic pulse thrombolysis

More data..

The Clinical Respiratory Journal

jth journal of
thrombosis and haemostasis™

Journal of Thrombosis and Haemostasis, 12: 1086–1095

DOI: 10.1111/jth.12608

ORIGINAL ARTICLE

Impact of the efficacy of thrombolytic therapy on the mortality of patients with acute submassive pulmonary embolism: a meta-analysis

S. NAKAMURA, H. TAKANO, Y. KUBOTA, K. ASAI and W. SHIMIZU

Department of Cardiovascular Medicine, Nippon Medical School, Tokyo, Japan

Chronic Thromboembolic Pulmonary Hypertension: the End Result of Pulmonary Embolism

Alison S. Witkin¹ · Richard N. Channick¹

Published online: 23 June 2015

Abstract Chronic thromboembolic pulmonary hypertension (CTEPH) occurs when a pulmonary embolism fails to undergo complete thrombolysis leading to vascular occlusion and pulmonary hypertension. Despite the fact that CTEPH is a potential

Aggressive Approach

CLINICAL FOCUS: HOSPITAL ADMISSIONS, LATEST PROTOCOLS,
PREOPERATIVE MEDICINE, AND TRANSITIONS OF CARE

The Massachusetts General Hospital Pulmonary Embolism Response Team (MGH PERT): Creation of a Multidisciplinary Program to Improve Care of Patients With Massive and Submassive Pulmonary Embolism

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PERT

- **Pulmonary Embolus Response Team**
- Multi-disciplinary approach



PERT Team

Co-Directors McLaren PERT

Kalil Masri, DO FACC FACOI FCCP
Cardiology

Nicolas J. Mouawad, MD MPH MBA RPVI
Vascular Surgery



Protocol


- Identification of patients with **massive** or **submassive** PE
- PERT team notified
 - McLaren Bay Region Transfer Center
 - ER
- Cath lab / hybrid team mobilized

Available 24 hours per day

Hospital Algorithm for Pulmonary Embolism

Massive PE

- Sustained Hypotension (Systolic BP <90 mmHG



Available 24 hours per day

- bleeding diathesis
- Uncontrolled Severe HTN (S>200 or D> 100)
- Surgery Previous 10 days
- Thrombocytopenia

> Surgical
Embolectomy

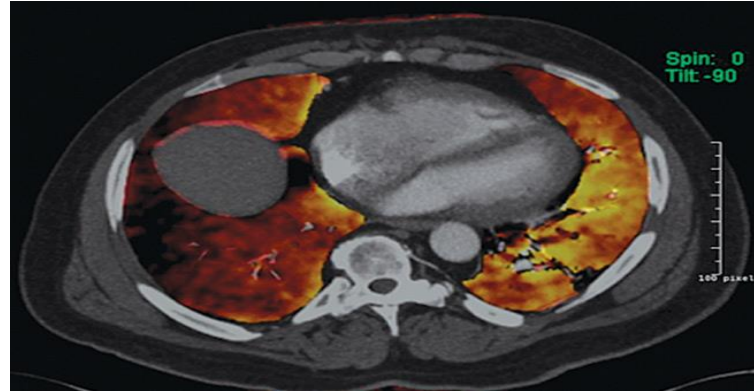
Thrombolytic Therapy
> Catheter based lytics
If relative systemic is
contraindicated

Thrombolysis

version 7

- Acoustic pulse thrombolysis initiated
- Patients maintained in ICU for close hemodynamic monitoring
- Discharged on anticoagulation with follow up ECHO/CTA in 6-8 weeks

Goal....



All in an effort to decrease the complications of chronic thromboembolic pulmonary hypertension

Our Experience

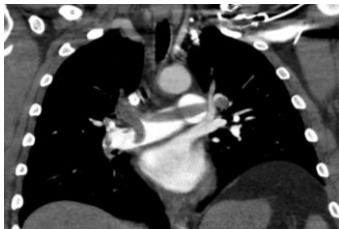
- 86 patients (over 28 months)
- 6-8 week follow up with imaging
- 2 year V/Q scan

Acoustic Pulse Thrombolytic Therapy for Acute Submassive Pulmonary Embolism Decreases the Risk of Developing Chronic Thromboembolic Pulmonary Hypertension

Nicolas J. Mouawad MD MPH MBA FACS RPVI, Jenna Lee, Matthew Lee, Kalie Taylor RN, Kalil Masri DO

Introduction

- Chronic Thromboembolic Pulmonary Hypertension (CTEPH) is a disabling condition affecting 0.4 – 9.1% of patients suffering from PE
- It is estimated at approximately 3.8% at 2 years following initial insult
- Standard treatment for VTE includes systemic anticoagulation



Hypothesis

As part of our aggressive multi-disciplinary Pulmonary Embolism Response Team (PERT), we hypothesized that patients undergoing aggressive therapy with catheter-directed, ultrasound-assisted thrombolysis (CDUAT) will have a decreased incidence of CTEPH at 2 years follow-up

Methods

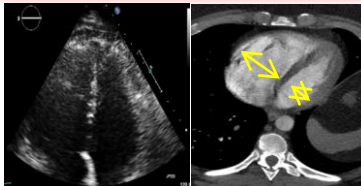
- Retrospective review of prospective data
- PERT activation for submassive PE using EKOS device (12mg tPA)
- Biomarkers, ECHO and CTA independently reviewed at presentation and at 2 years

Massive PE

- Sustained Hypotension (Systolic BP <90 mmHG for \geq 15 minutes)
- Inotropic Support
- Pulselessness
- Persistent profound bradycardia (HR < 40 bpm or symptoms of shock)

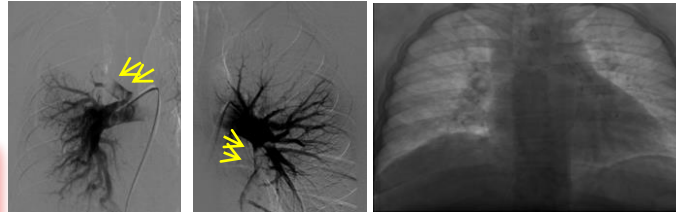
Submassive PE:

- Absence of above findings; plus 2 of below:
- RV Dysfunction. RV/LV Ratio > 0.9
- Echo –RSVP Dilatation, Hypokinesis, Elevated Pressures
- (+) Troponins
- (+) EKG Acute Changes



ECHO

CTA RV:LV



Results

- 31 patients underwent CDUAT
- 55% male
- Average age 55 (26-85)
- 12.9% had negative cardiac markers
- Saddle PE in 44.8%
- Pre-CDUAT RV pressure 52.99mmHg (16.4-99.6)

- 9 patients at 28 months follow up – RVP 34.2mmHg (30.3-42.3)

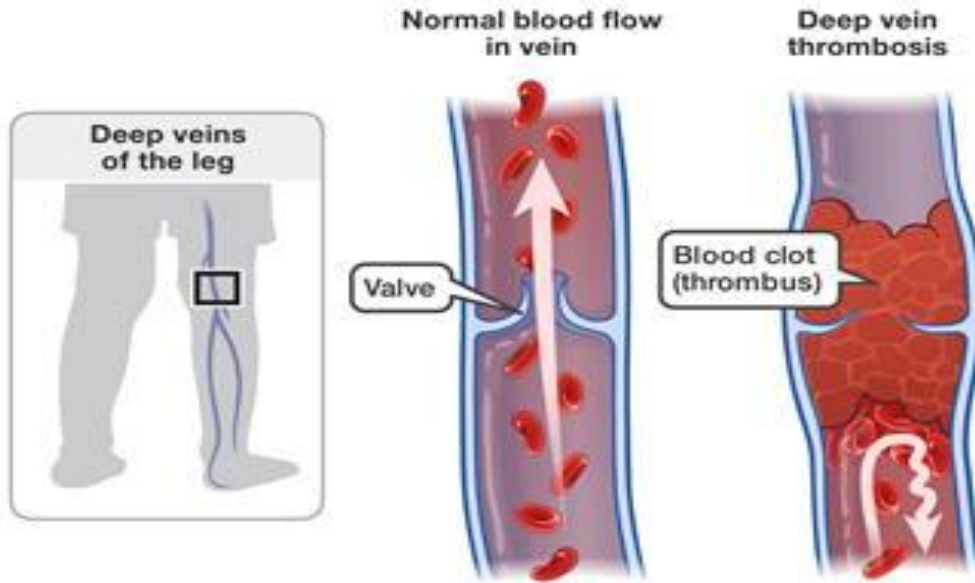
- No clinical signs of CTEPH or elevated RV pressures



Conclusions

- No signs of CTEPH at 2 year follow up when aggressive and early CDUAT for submassive PE
- Benefit of multi-disciplinary approach
- More long term follow up needed

Deep Vein Thrombosis (DVT)

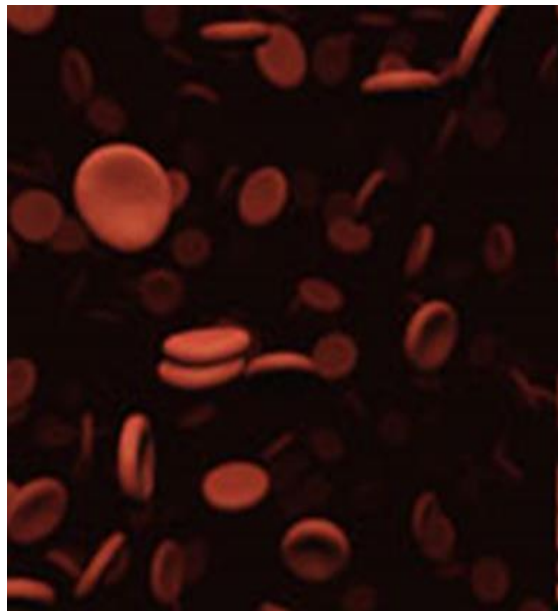


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MEDICAL MANAGEMENT IS INADEQUATE FOR MANY VTE PATIENTS

Anticoagulation therapy

- Does not reduce or eliminate the existing thrombus¹
- 50% of patients on oral therapy are at optimal levels²
- Venous obstruction often persists in patients with lower extremity DVT treated with anticoagulation alone, leading to PTS³
- AC only reduces the *risk* of Pulmonary Embolism⁴



1. Parikh S et al. Ultrasound-accelerated Thrombolysis for the Treatment of Deep Vein Thrombosis: Initial Clinical Expertise. J Vasc Interv Radiol. 2008 Apr;19(4):521-8.

2. Pirmohamed, M, Warfarin: almost 60 years old and still causing problems, Br J Clin Pharmacol 62(5): 509-511.

3. Enden T, et al. Catheter-directed thrombolysis vs. anticoagulant therapy alone in deep vein thrombosis: results of an open randomized, controlled trial reporting on short-term patency. J Thromb Haemost 2009;7:1268-75.

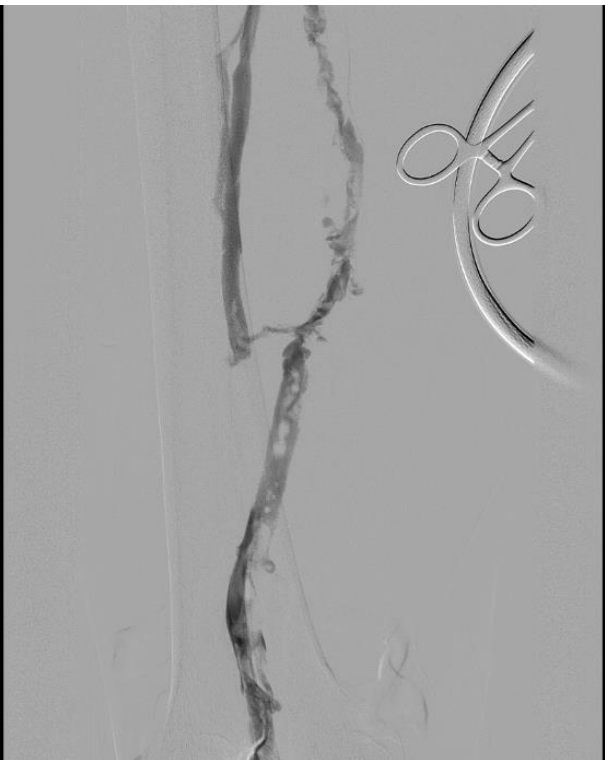
4. Kearon C et al. Antithrombotic Therapy for VTE Disease: Antithrombotic Therapy and Prevention of Thrombosis, 9th ed. CHEST 2012; 141(2)(Suppl):e419S-e494S.

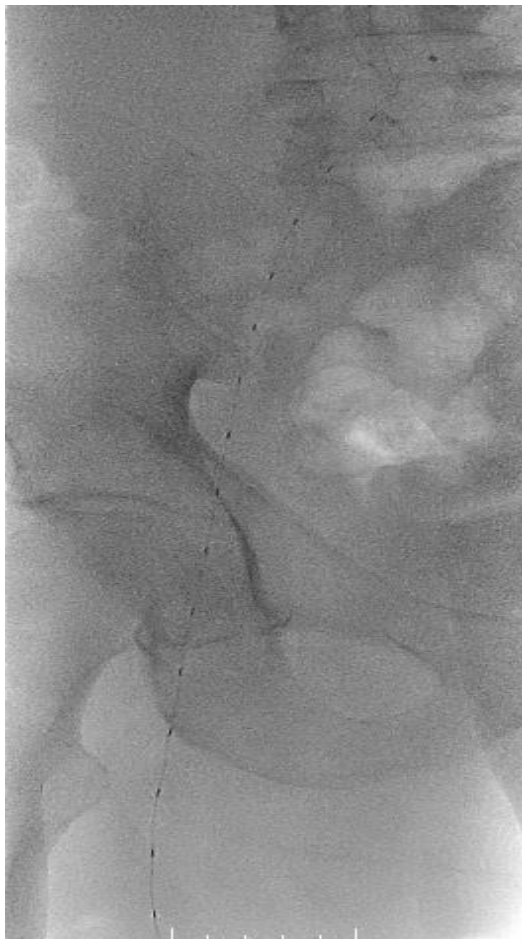
POST-THROMBOTIC SYNDROME (PTS)

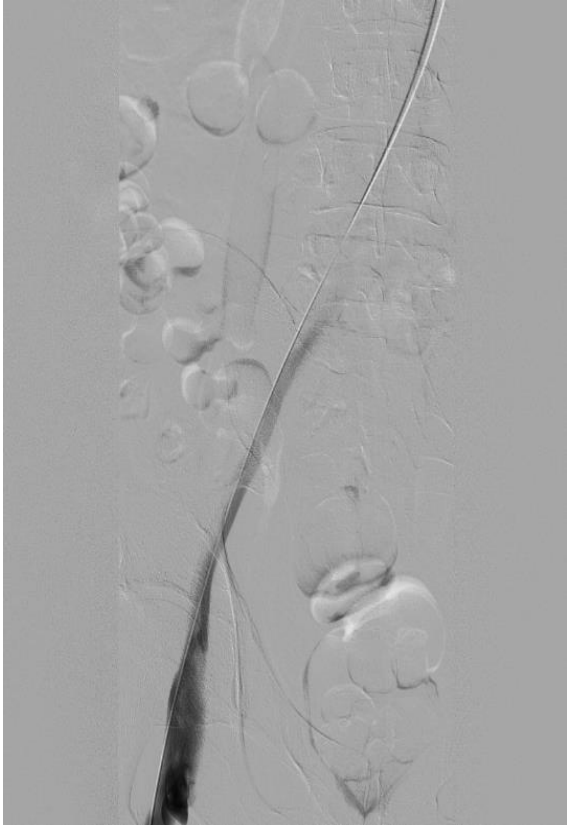
- A potential consequence of VTE
- Approximately 50% of patients with acute ilio-femoral DVT develop PTS.^{1,2,3,4}
- After adjustments for clinical and demographic factors, the mean difference in annualized total health care costs was 32% higher in the PTS group.⁵



1. Ashrani AA, Heit JA. "Incidence and cost burden of post-thrombotic syndrome." *J Thromb Thrombolysis*. 2009;28:465-476.
2. Kahn, S. et al., "Determinants and time course of the postthrombotic syndrome after acute deep venous thrombosis." *Annals of Internal Medicine*, 2008;149(10), 698-707.
3. Kahn SR et al., "Determinants of health-related quality of life during the 2 years following deep vein thrombosis." *J Thromb Haemost* 2008; 6: 1105-12.
4. Kahn SR et al., "Relationship Between Deep Venous Thrombosis and the Postthrombotic Syndrome." 2004 vol 164: 17-26
5. MacDougall DA et al. Economic burden of deep-vein thrombosis, pulmonary embolism, and post-thrombotic syndrome. *Am J Health-Syst Pharm* 2006; 63, Suppl 6:S5-S15.



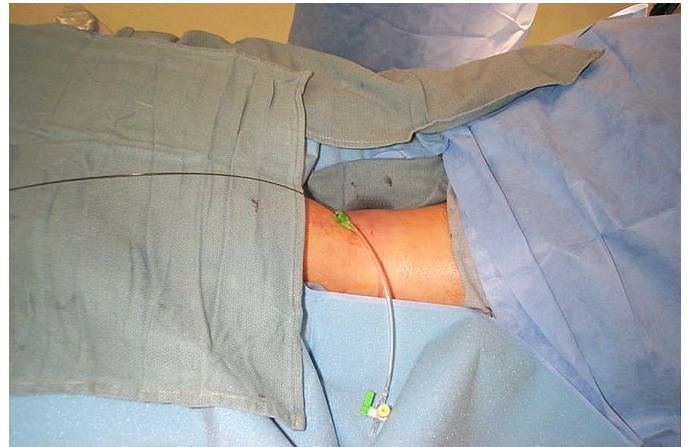
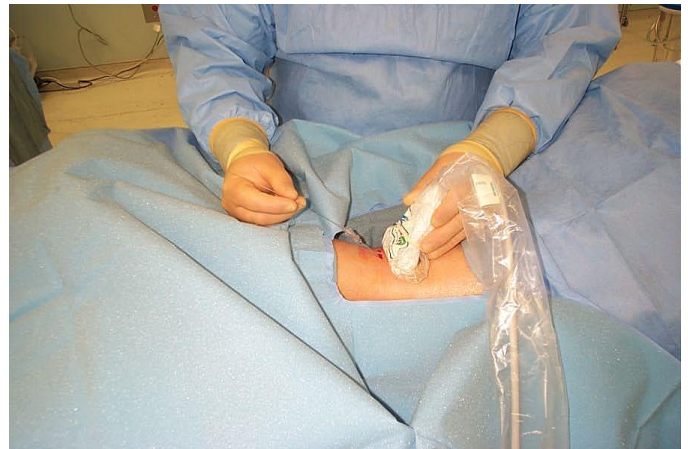






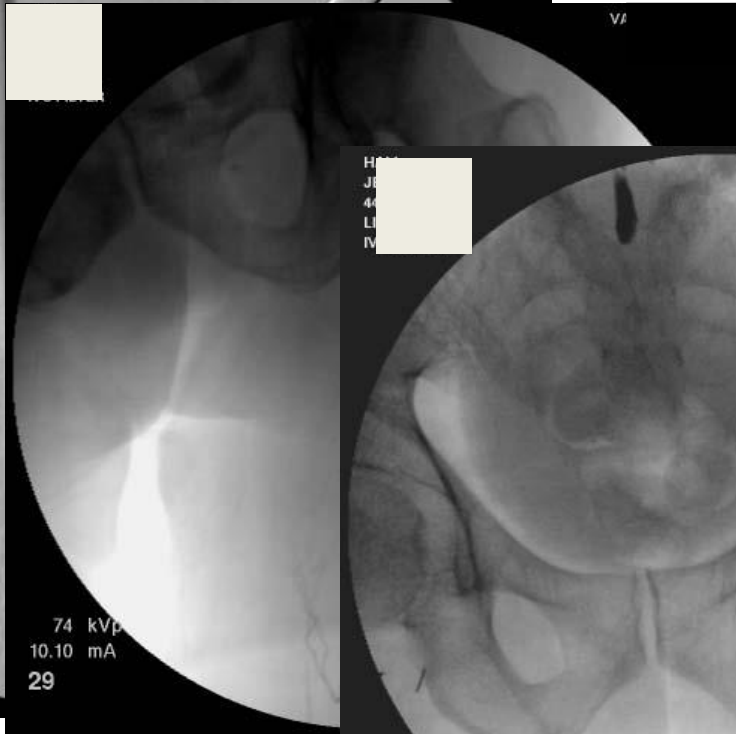
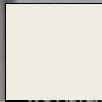
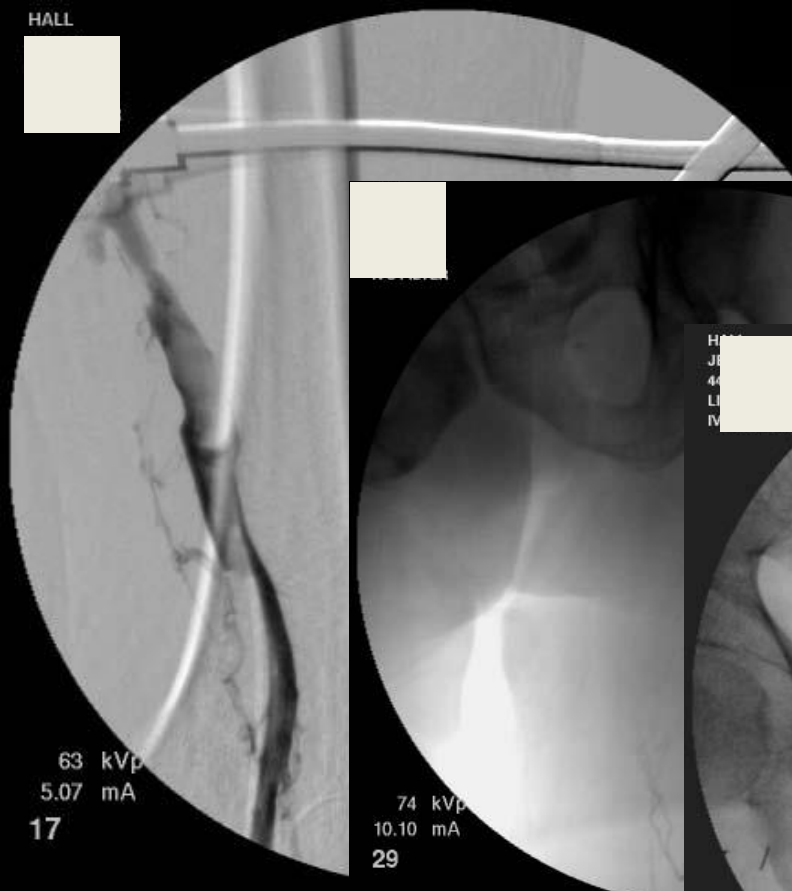






Introducer sheath placement in popliteal vein under ultrasound guidance  McLaren

HALL



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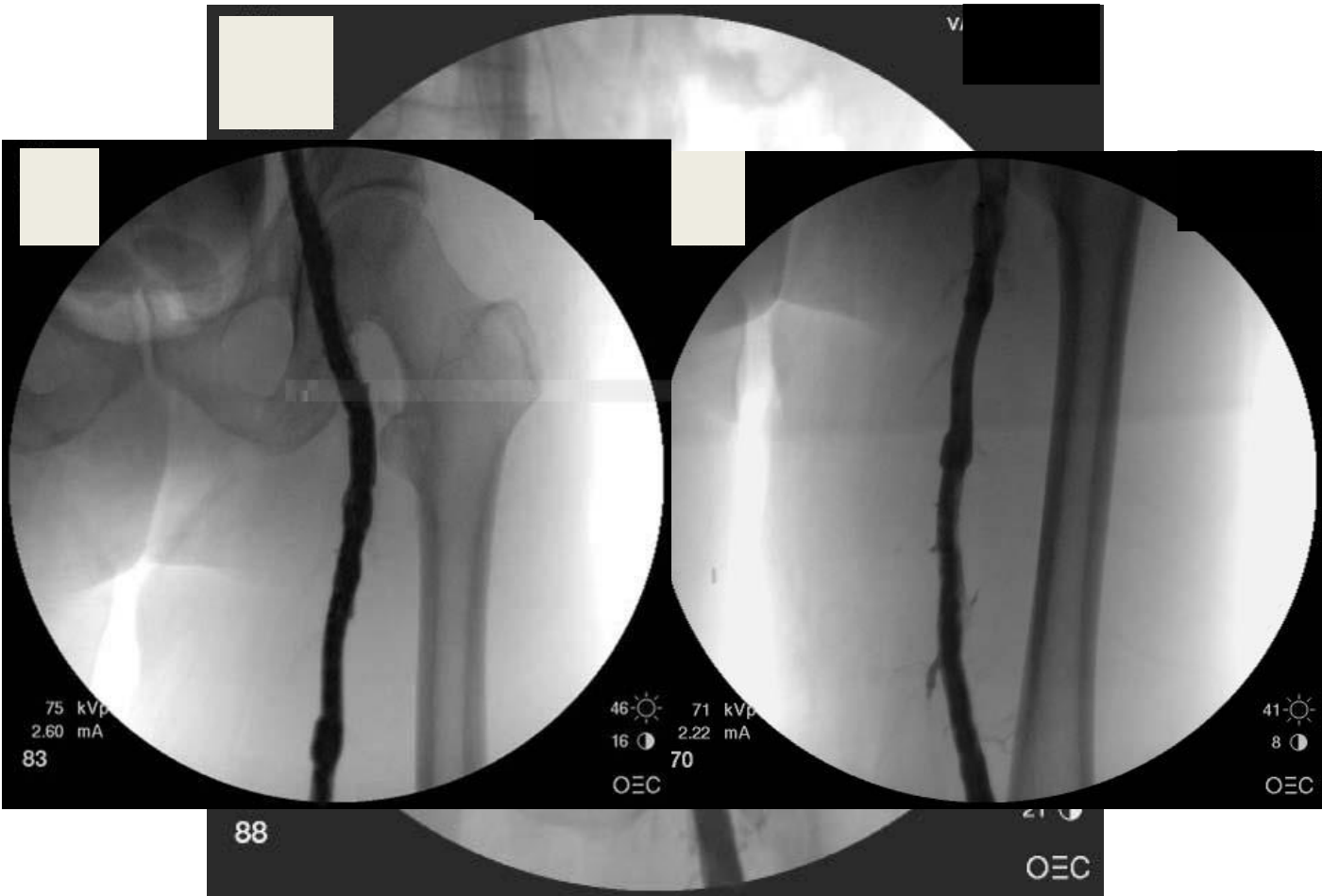
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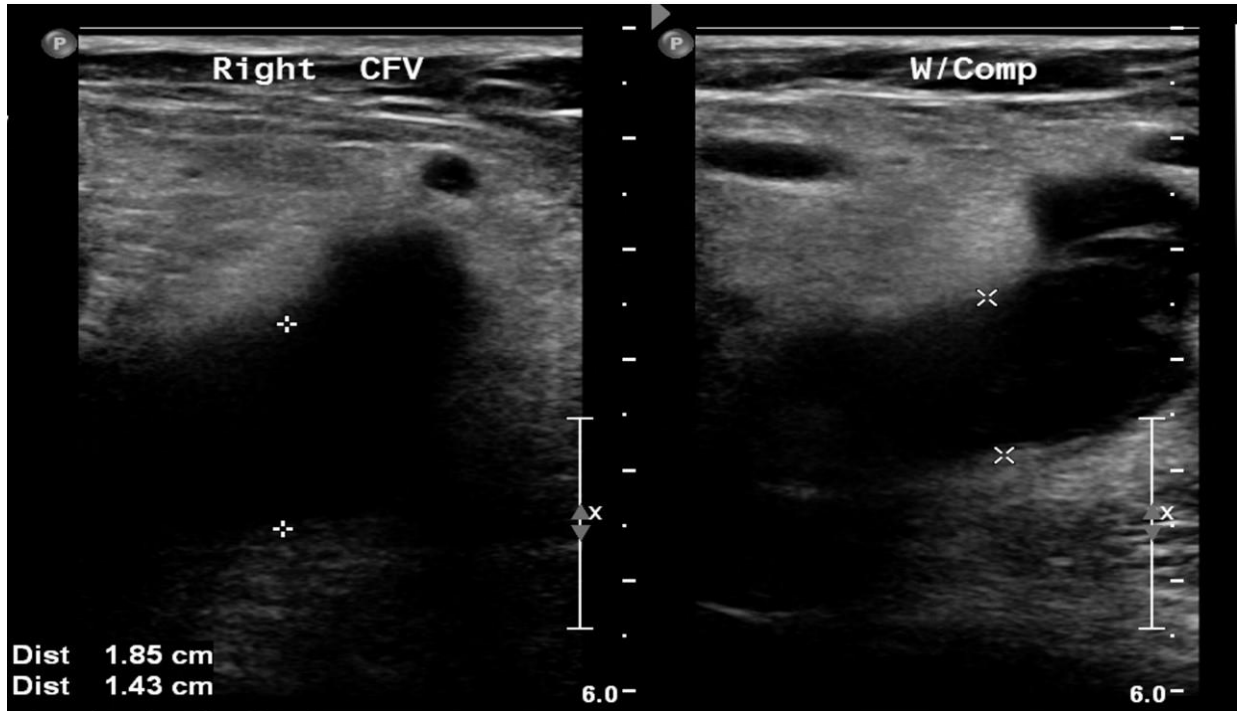
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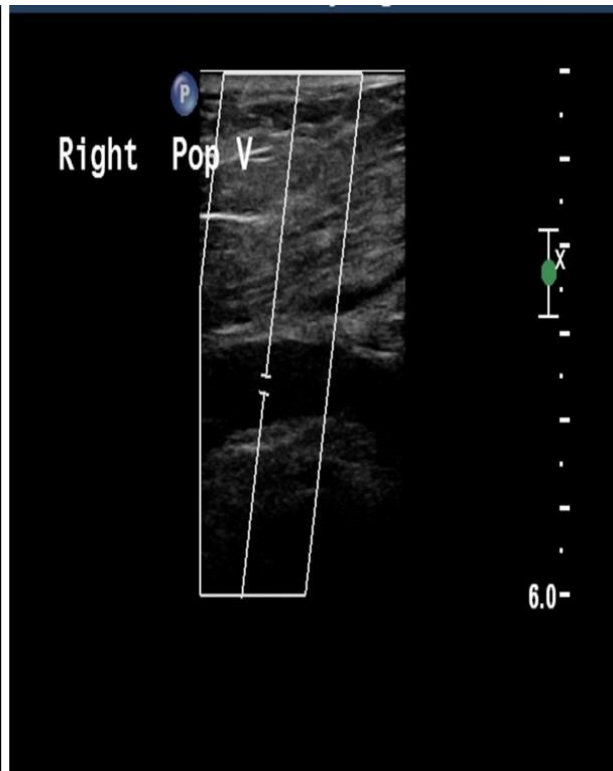
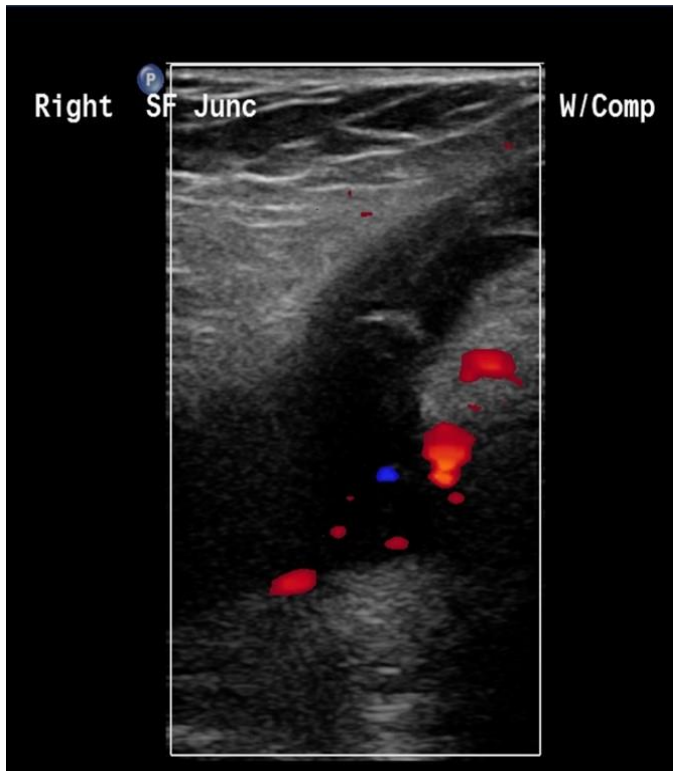
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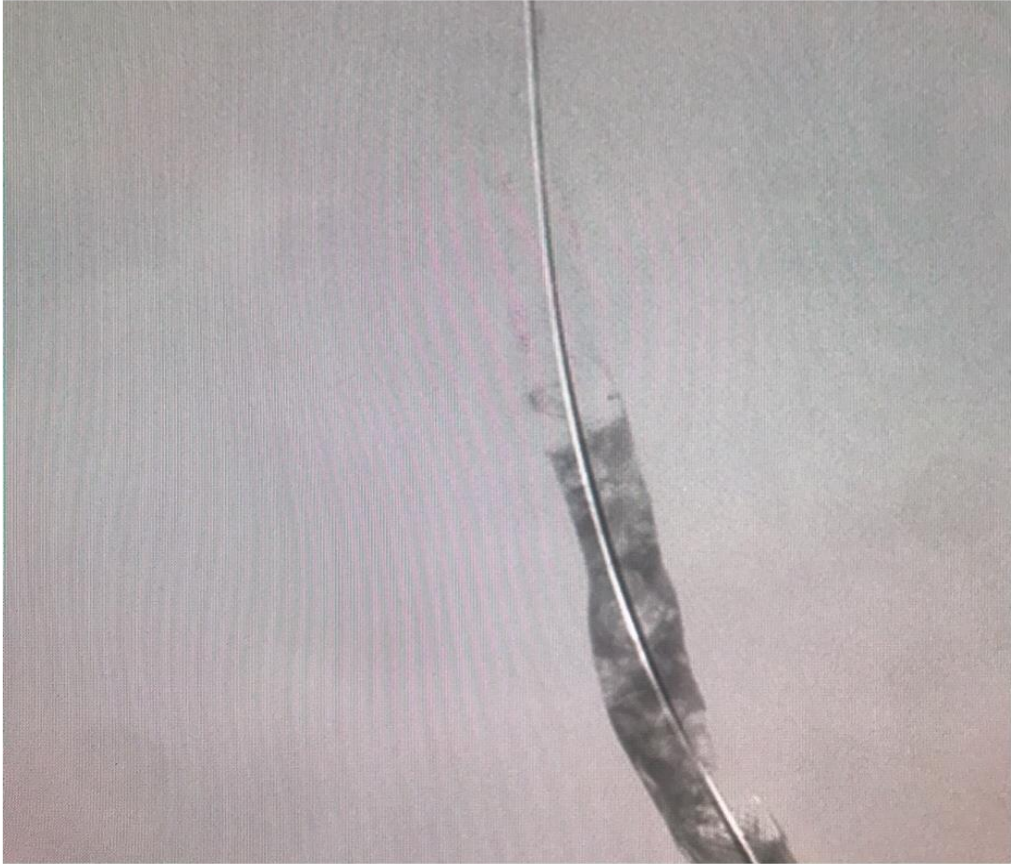




Ultrasonic Images











Clinical Result & Post Procedure Follow-up



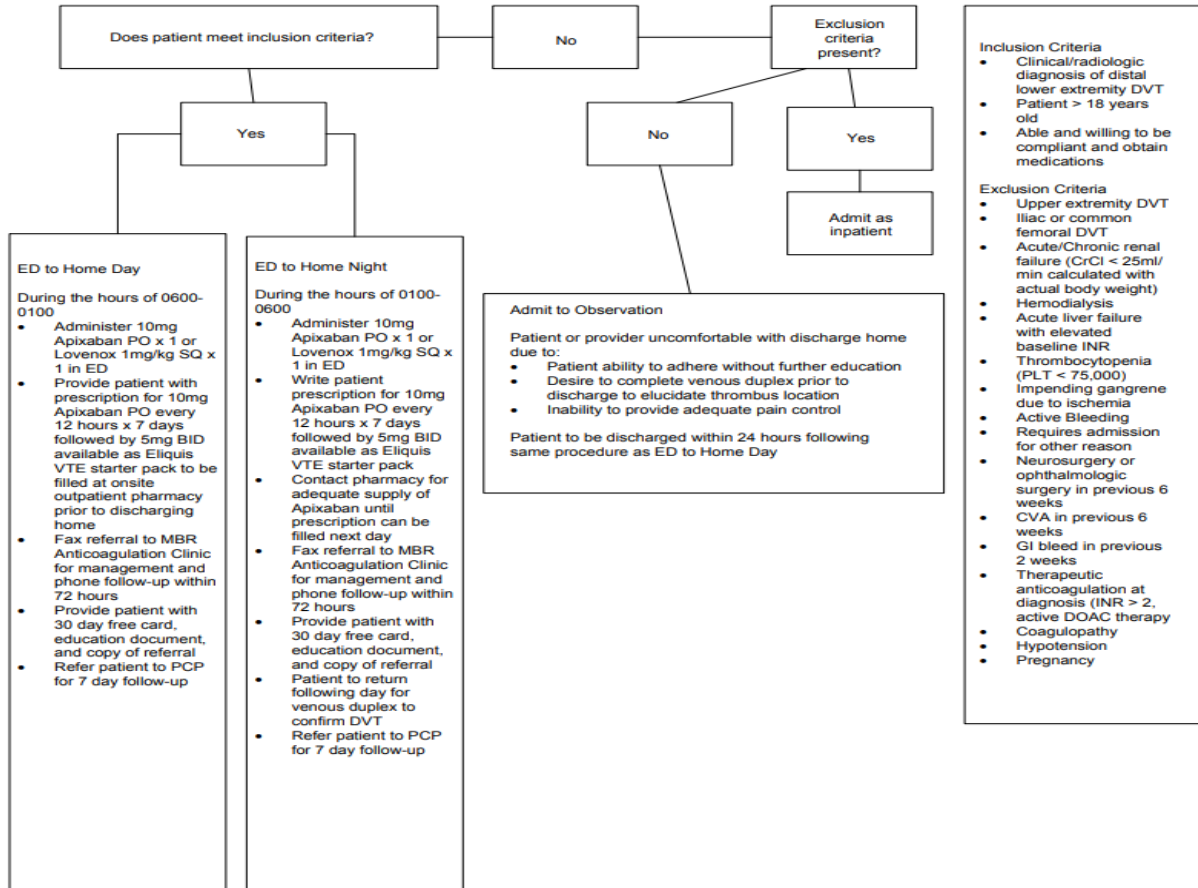


But these are major DVTs

- Phlegmasia
- Venous gangrene

- Most patients with DVTs do not need admission
- Oral anticoagulants may be administered directly from PCP or ER
- Early ambulation
- If in doubt, consult vascular surgery!

DEEP VEIN THROMBOSIS EMERGENCY DEPARTMENT TO HOME CLINICAL ALGORITHM







The McLaren logo, featuring a stylized blue and red 'M' icon followed by the word 'McLaren' in a blue sans-serif font.

PATIENT ENTRANCE



McLaren Bay Heart & Vascular

McLaren Bay Region Transfer Center

989 – 894- 3930



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Nicolas Mouawad



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