Is heparin enough?
Building a coalition of the willing for intervention in PE

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Disclosures

- Boston Scientific – Consultant

Outline

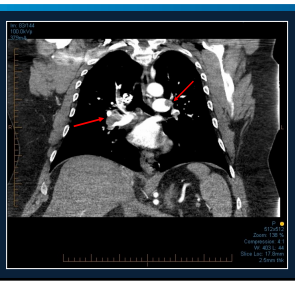
- Case presentation
- Pulmonary embolism risk stratification and beyond

Case Presentation

70 yo obese male (BMI 31) with prior history of OSA (non-compliant w CPAP) and HTN presented with 2 weeks of progressive CP and SOB after a shoulder dislocation led to a period of bed rest.

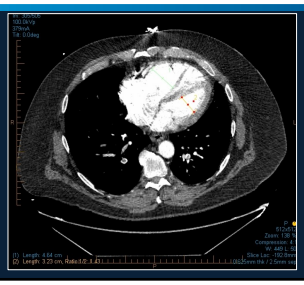
- Non-smoker. No prior VTE.
- ER: Afebrile, 140 (sinus), 22/min, 112/76 mHg, 98% on 4L . Mild resp distress, obese male.
- Pro- BNP: 2615 pg/mL (Ref < 125 pg/mL)
- Lactic acid: 2.7 mmol/L (Ref < 2.2 mmol/L)
- Troponin I: < 0.3 (Ref < 0.3 ng/mL)

Case Presentation



Coronal 2.5 mm Section: Saddle PE

Case Presentation

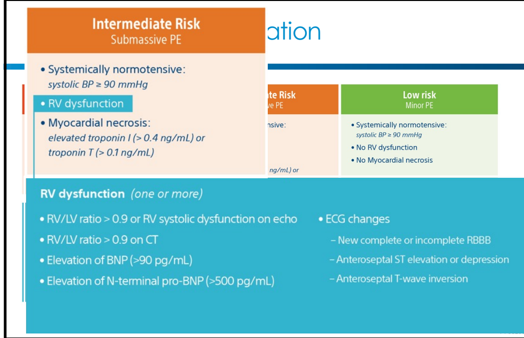


Axial 2.5 mm Cut: RV/LV >1

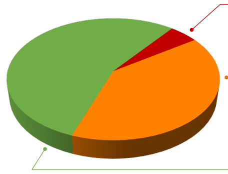
Case Presentation

- Received 1 L IVF. BP improved to 110/82 mmHg
- LMWH. US demonstrates + bilateral femoral acute DVT.
- Arrived to SDU. 6 hours later: progressive chest pain.
  BP dropped to 86/63 mmHg, 150/min, 6L O2 NC.
  1 L IVF received with blood pressure 105/74 mmHg (remained stable).
- Repeat labs drawn at that time:
  Pro- BNP: 5230 pg/mL (Ref < 125 pg/mL). Previous: 2615 pg/mL .
  Troponin I: 0.56 (Ref < 0.3 ng/mL). Previous: < 0.3 ng/m
- Lactic acid: 4.3 mmol/L (Ref < 2.2 mmol/L)
- STAT echocardiogram: akinetic RV, with interventricular septal bowing. Hyperdynamic LV.

...ation



PE Patient Population Profile



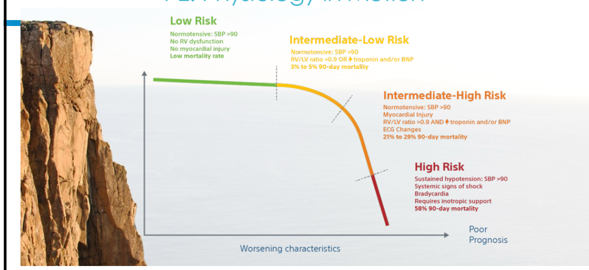
MASSIVE PE
(High risk)
5% PE population
58%[1] mortality @ 3 months

SUBMASSIVE PE
(Moderate/intermediate risk)
40% PE population
2-3%[2,3] mortality to
21%[1] mortality @ 3 months

MINOR PE
(Low risk)
55% PE population
Good prognosis
Low mortality rate

1. Goldhaber SZ et al. Acute pulmonary embolism: clinical outcomes in the International Cooperative Pulmonary Embolism Registry (ICOPER). Lancet 1999;353:1386-1389 2. Meyer G et al. Fibrinolysis for Patients with Intermediate Risk Pulmonary Embolism. New Engl J Med 2014; 370:. 3 Casazza F et al. Clinical features and short term outcomes of patients with acute pulmonary embolism. The Italian Pulmonary Embolism Registry (IPER). Thrombosis Research 2012; 130:847-852

PE: Physiology in Motion



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

Cardiac Biomarkers and Intermediate PE Risk Stratification

- **Recent retrospective data suggests elevated NT-proBNP and imaging signs of RVD are associated with all cause and PE related mortality.**
- There appears to be cumulative risk with 2 biomarkers conferring more risk than 1 biomarker for mortality.
- More prospective data is needed to further risk stratify intermediate risk PE.

	All-cause mortality and/or rescue thrombolysis (n=58)		PE-related mortality and/or rescue thrombolysis (n=40)	
	HR (95% CI)	P value	HR (95% CI)	P value
Elevated troponin	1.7 (0.91-3.1)	0.097	1.7 (0.77-3.5)	0.200
Elevated NT-proBNP	3.6 (1.3-10.3)	0.015	4.7 (1.1-20)	0.037
Imaging signs of RVD	2.8 (1.5-5.2)	0.001	9.7 (3-31.7)	<0.001

Lankeit et al. "Predictive Value of High-Sensitivity Troponin T Assay and the Simplified Pulmonary Embolism Severity Index in Hemodynamically Stable Patients with Acute Pulmonary Embolism" Vascular Medicine Dec 13, 2011; 124:2716-2724
Santos, et al. "Risk stratification in normotensive acute pulmonary embolism patients: focus on the intermediate high risk group" European Heart Journal: Acute Cardiovascular Care Apr 2019 1-7

Is there a role for lactic acid in risk modeling?

- Association between elevated lactate (2.5mmol/L) and 30 day mortality independent of shock state, troponin, RV function or hypotension.
- Combining Int. high risk patients with lactate > 3.3 mmol/L had 27.5% risk of in-hospital adverse events vs 6.8% for lactate <3.3 mmol/L.
- Adding lactic acid to int high risk patients led to an increased risk of hemodynamic collapse by day 7 from 15.3% to 24.1% in a retrospective study.

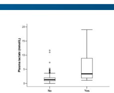


Figure 1. Box-and-whisker plots showing the correlation between plasma lactate levels and patients' survival during their in-hospital stay. Circles represent outliers.

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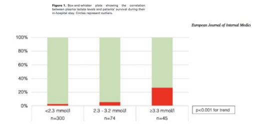
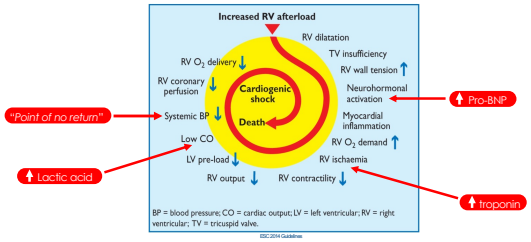


Fig. 1. Rate of an in-hospital adverse outcome stratified to venous lactate level at presentation.

Ebner, M et. al. Venous lactate improves the prediction on in hospital adverse outcomes in normotensive pulmonary embolism Eur. J Int Med 2021, 86, 25-31
Vani S Prognostic value of plasma lactate levels among patients with acute pulmonary embolism. Ann. Emerg Med 2013, 61, 330-338

Why Intermediate-Risk PE Patients Are in Clinical Peril:
Key Factors Contributing To Hemodynamic Collapse In PE



1. Konstantinides SV. 2014 ESC Guidelines on the diagnosis and management of acute pulmonary embolism. Eur Heart J 2014; 35: 3033–3073.

Case Outcome

- PERT Activated. Decision made to proceed with EKOS®.
  6 hr protocol with bilateral PA cath, 1 mg/hr/cath for a total infusion of 12 mg.
- During infusion run patient reported subjective improvement of chest pain.
  O2 weaned to 2L. Blood pressure increased to 127/78 mmHg (without additional fluids).
- 6 hrs later post-EKOS® removed. No complications.
- Discharged on NOAC.

Conclusions

- Pulmonary embolism exists on a spectrum that is in constant motion (towards better or worse clinical outcomes).
- Decisions made early in clinical treatment have substantial downstream effects on patient outcome.
- Check a lactate!!
- Opportunities exist to subtly shift the physiology of the patient to less morbidity and mortality through intervention.
- Failure to intervene may allow for natural progression and worsened clinical outcomes or therapies with a greater side effect potential (systemic lytics)
- Intervention with advanced therapies is best when chosen early as the physiology is more malleable to improvement.