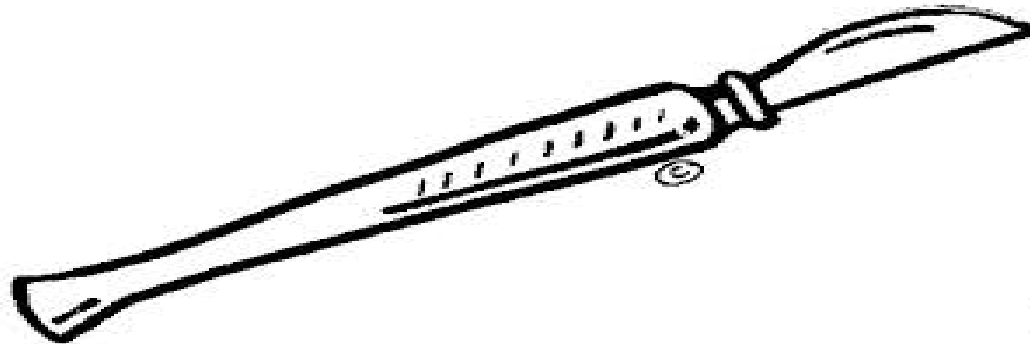


Pulmonary Emboli and Thrombolytic Management

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Pulmonary Embolism (PE)

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

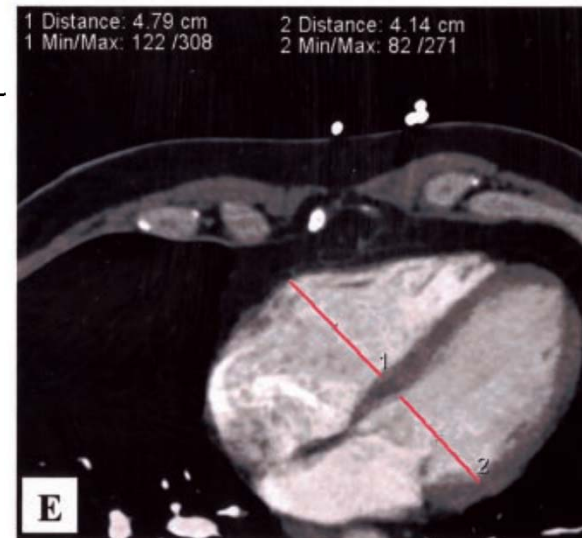
5. Chunilal et al. *JAMA* 2003;290:2849-58
6. Siccama et al. *Ageing Res Rev* 2011;10:304-13

PE Risk Stratification

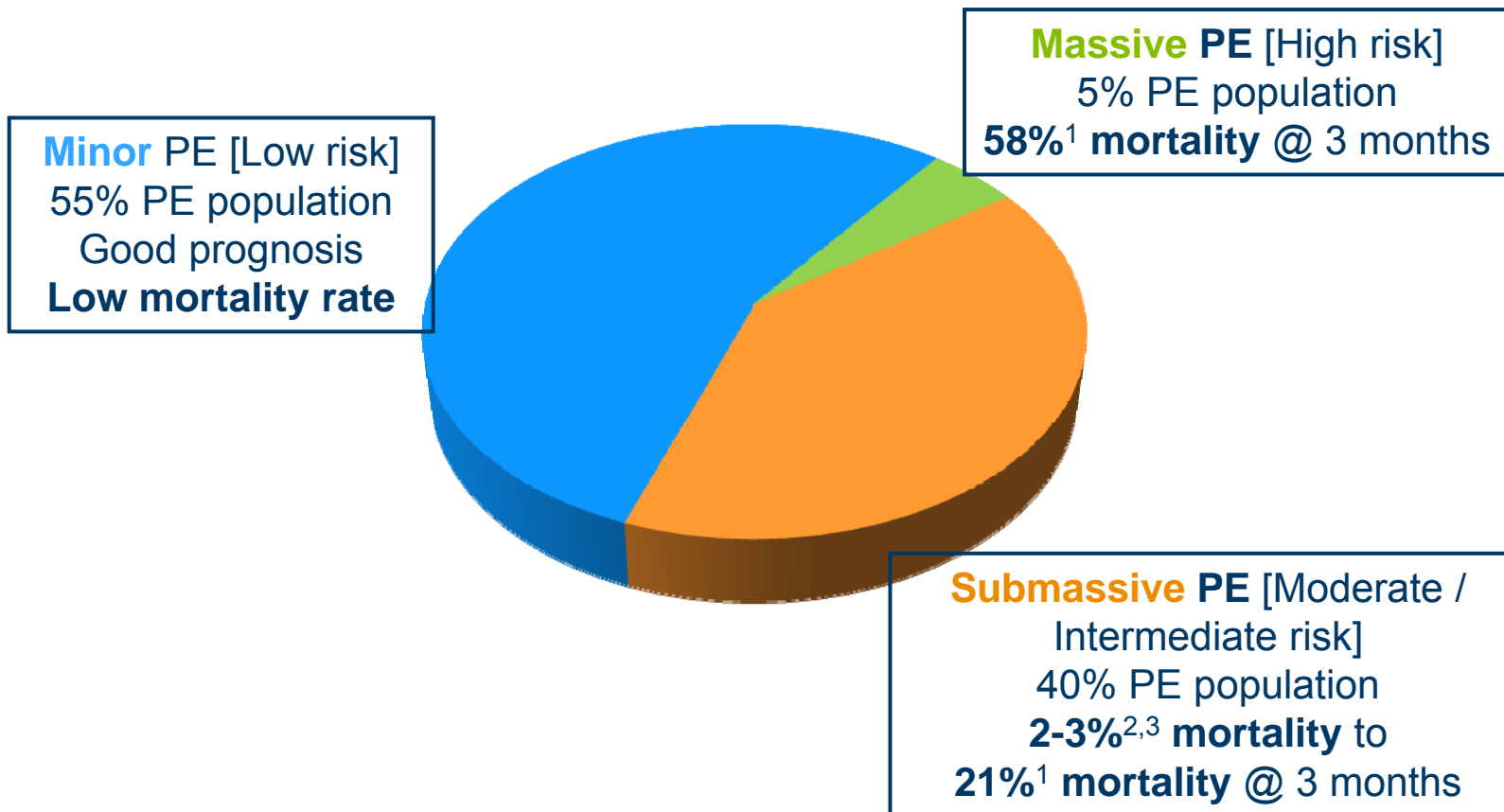
Patient risk stratification (per AHA Scientific Statement 2011 ¹)		
Massive PE	Submassive PE	Minor/Nonmassive PE
High risk	Moderate/intermediate risk	Low risk
<ul style="list-style-type: none"> – Sustained hypotension (systolic BP <90 mmHg for ≥15 min) – Inotropic support – Pulselessness – Persistent 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

Circulation American Heart Association 

Right Ventricular Enlargement on Chest Computed Tomography
Prognostic Role in Acute Pulmonary Embolism

Rene Quiroz, MD, MPH*; Nils Kucher, MD*; U. Joseph Schoepf, MD; Florian Kipfmueller, BS; Scott D. Solomon, MD; Philip Costello, MD; Samuel Z. Goldhaber, MD

Background—We investigated the prognostic role of right ventricular enlargement on multidetector-row chest CT in acute pulmonary embolism (PE).

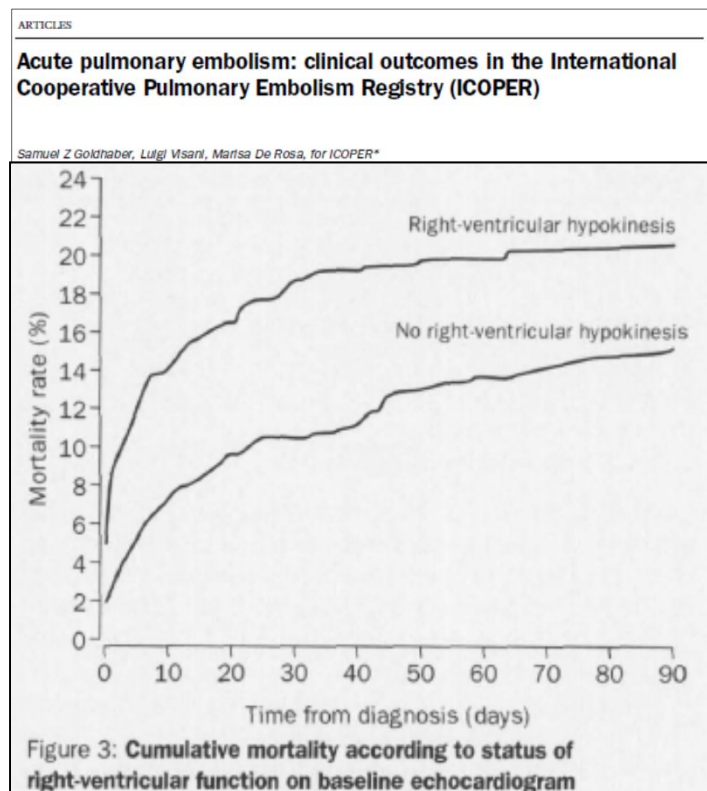
Methods and Results—We studied 63 patients with CT-confirmed PE who underwent echocardiography within the ensuing 24 hours. Adverse clinical events, defined as 30-day mortality or the need for cardiopulmonary resuscitation, mechanical ventilation, pressors, rescue thrombolysis, or surgical embolectomy, were present in 24 patients. We performed off-line CT measurements of right and left ventricular dimensions (RV_D , LV_D) with axial and 2-dimensional reconstructed 4-chamber (4-CH) views. The proportion of patients with $RV_D/LV_D > 0.9$ on the axial view was similar in patients with (70.8%) and those without adverse events (71.8%; $P=0.577$). In contrast, $RV_D/LV_D > 0.9$ on the 4-CH view was more common in patients with (80.3%) than without (51.3%; $P=0.015$) adverse events. The area under the curve of RV_D/LV_D from the axial and 4-CH views for predicting adverse events was 0.667 and 0.753, respectively. Sensitivity and specificity of $RV_D/LV_D > 0.9$ for predicting adverse events were 37.5% and 92.3% on the axial view and 83.3% and 48.7% on the reconstructed 4-CH view, respectively. $RV_D/LV_D > 0.9$ on the 4-CH view was an independent predictor for adverse events (OR, 4.02; 95% CI, 1.06 to 15.19; $P=0.041$) when adjusted for age, obesity, cancer, and recent surgery.

Conclusions—Right ventricular enlargement on the reconstructed CT 4-CH views predicts adverse clinical events in patients with acute PE. Ventricular CT measurements obtained from 4-CH views are superior to those from axial views for identifying high-risk patients. (*Circulation*. 2004;109:2401-2404.)

Key Words: tomography ■ embolism ■ prognosis ■ thrombosis

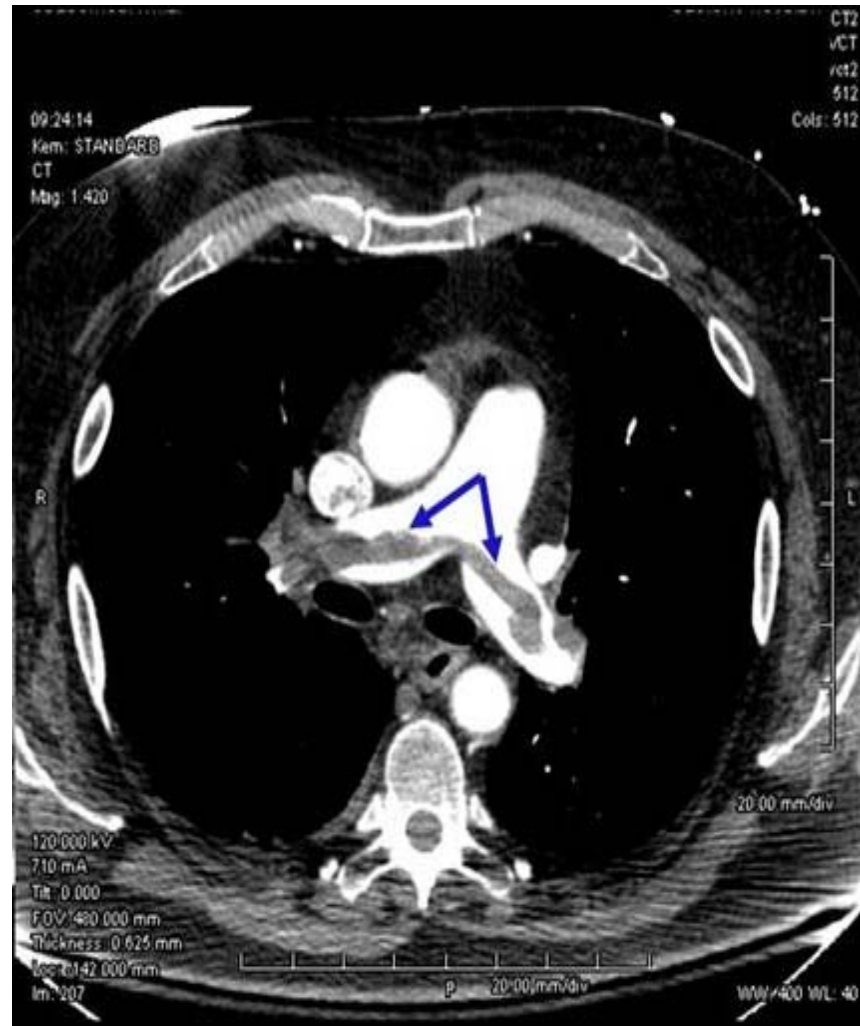
- Retrospective analysis of 63 patients with chest CT
- Adverse event rate at 30 days:
 - **80.3%** if RV/LV ratio > 0.9
 - **51.3%** if RV/LV ratio ≤ 0.9

Presence of RV hypokinesis 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 hypokinesis
 - **15%** with no hypokinesis

Treatment



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

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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

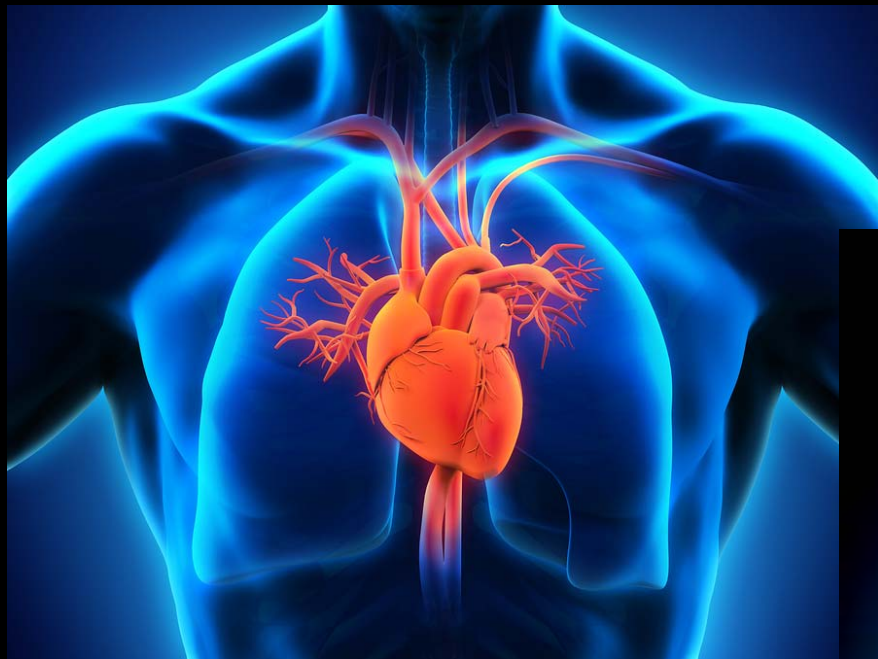
The Massachusetts General Hospital Pulmonary Embolism Response Team (MGH PERT): Creation of a Multidisciplinary Program to Improve Care of Patients With Massive and Submassive Pulmonary Embolism

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PERT

- Pulmonary Embolus Response Team
- Multi-disciplinary approach



Cardiology



Vascular Surgery

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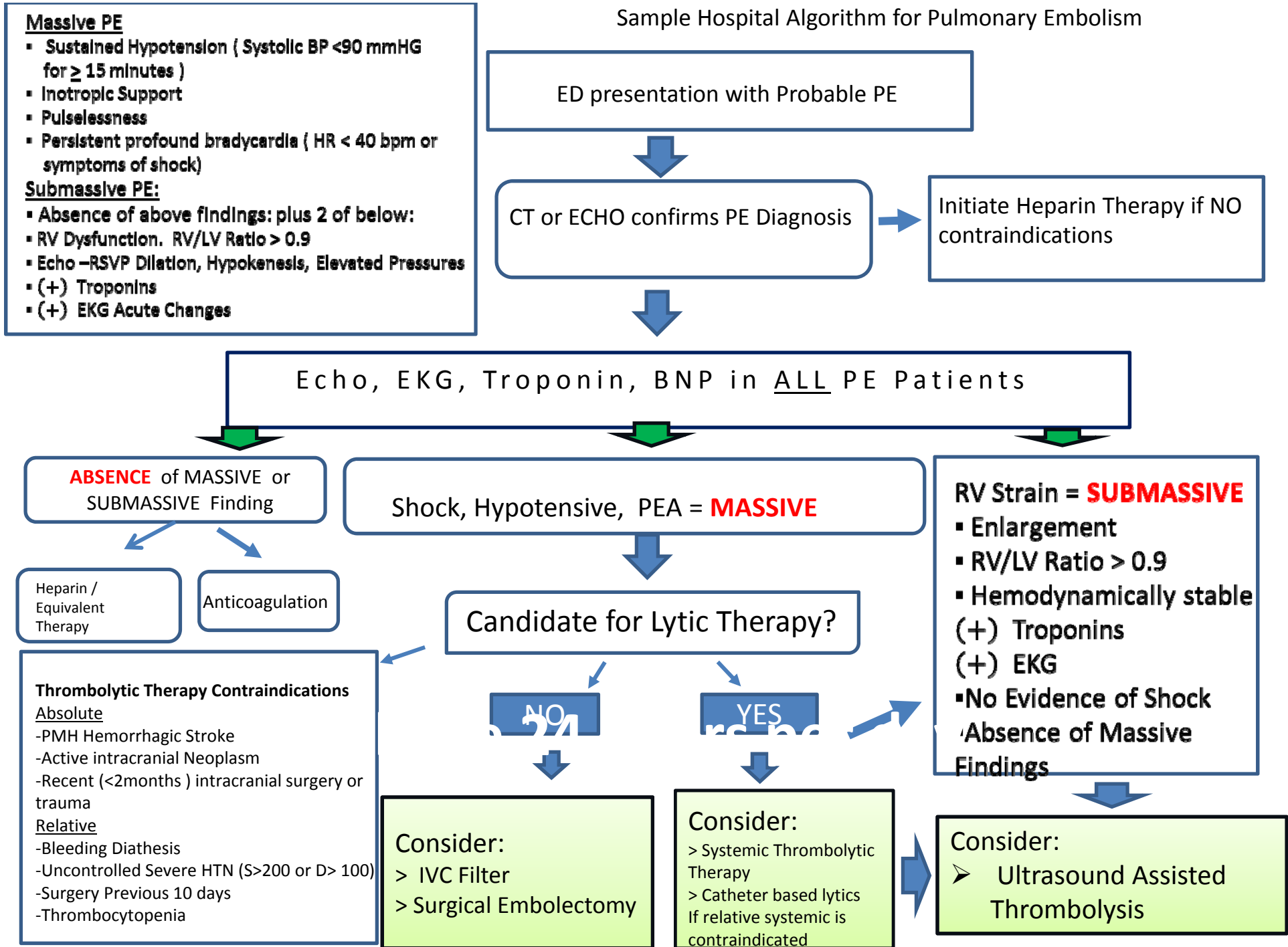



Protocol

- 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

Sample Hospital Algorithm for Pulmonary Embolism



- 
- 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

McLaren Bay Heart & Vascular

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PERT



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PATIENT ENTRANCE

