

Undiagnosed Right Heart Failure Leading to Cardiac Arrest Upon Anesthesia Induction

Ultrasound Scholarly Concentration
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Kyle H. McKnight, MS3



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- I. Case
- II. Clinical Question
- III. Literature Review and Education
- IV. Key Points

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- 73 y.o. M (Mr. FM) with a history of DMII, hypertension, hyperlipidemia, and diverticulosis
 - Initially presented with hematochezia presumed to be secondary to diffuse diverticulosis
-



Hospital Course



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- 6/22 nuc med bleeding scan (+) but no target for embolization on angiogram
 - 6/24 colonoscopy with pan-diverticulosis without active bleeding & benign rectal polyp s/p polypectomy
 - 6/25 nuc med bleeding scan (+) but no target for embolization on angiogram
 - 6/26 CT angiogram abdomen (-)
 - 6/29 nuc med bleeding scan (-)
 - 6/30 CT angiogram abdomen (-), EGD unremarkable
 - 7/2 therapeutic enema with initial improvement in bleeding
 - 7/5 recurrence of bleeding
 - 7/6 Right open colectomy for uncontrolled diverticular bleed - intraoperative complication of distal ileum serosal injury s/p sutures
-



Acute Blood Loss Anemia

- s/p 16 units pRBCs, 1 unit platelets and 1 unit cryoprecipitate.
- H&H relatively stable following 7/6 colectomy

Post-op Ileus

- Extended period of ileus after colectomy
 - Improved and tube feeds were being advanced
-



- On 7/18 patient became unresponsive and found to have dehiscence to the fascial level (complication from 7/6 colectomy)
 - Emergent exploratory laparotomy with **cardiac arrest during anesthesia induction - propofol**. ROSC after 2 min ACLS
-

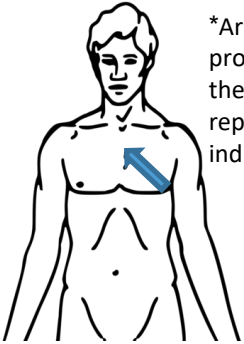


- Why did cardiac arrest occur upon anesthesia introduction?
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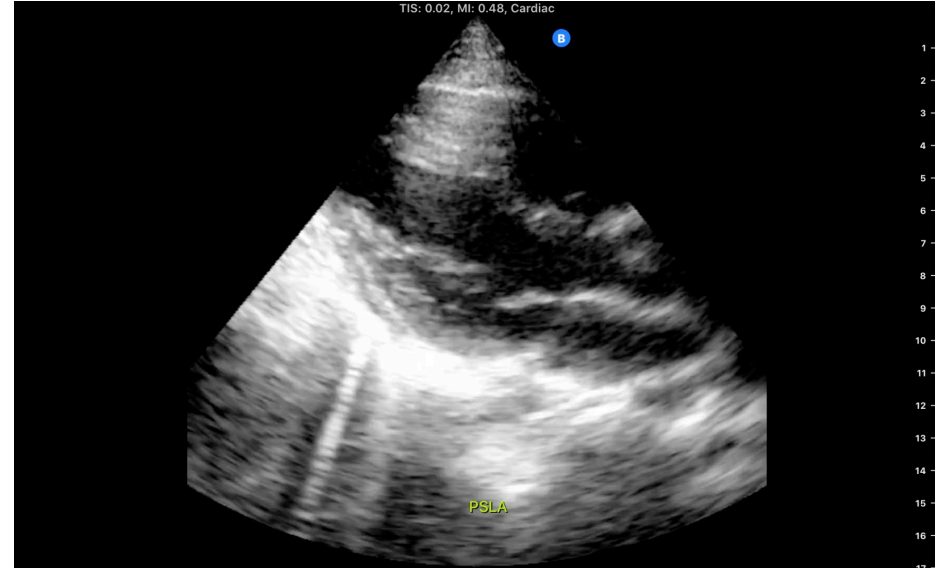
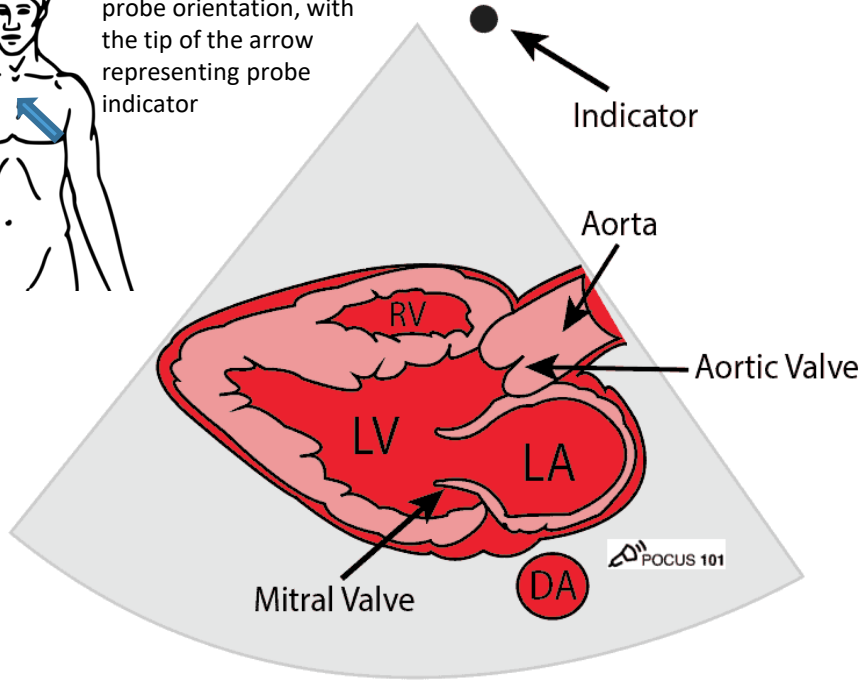


- Patient to ICU for close monitoring
 - STAT echo ordered; results returned the following morning while on surgery rounds, prompting **bedside POCUS** for further edification and education
-

Friendly reminder..... (PSLA in cardiac mode)

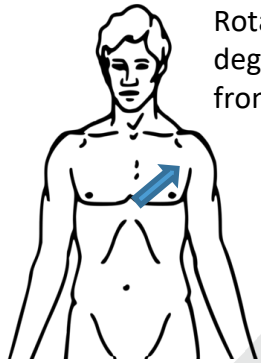


*Arrow demonstrates probe orientation, with the tip of the arrow representing probe indicator

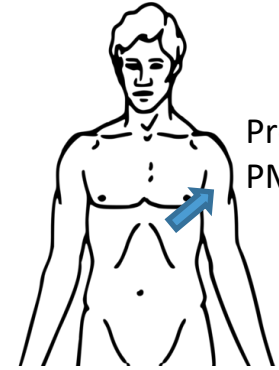
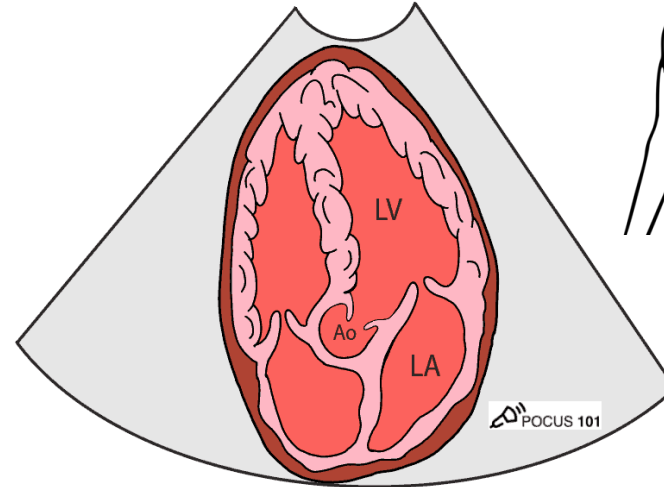
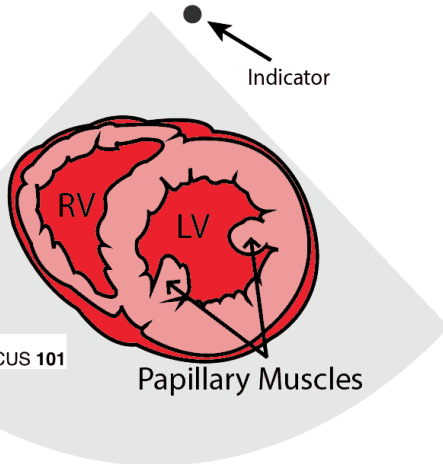


Normal POCUS PSLA

Friendly reminder (PSSA, apical 5 chamber)

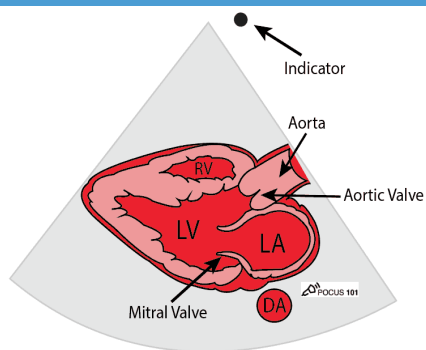


Rotate probe 90
degrees clockwise
from PSLA

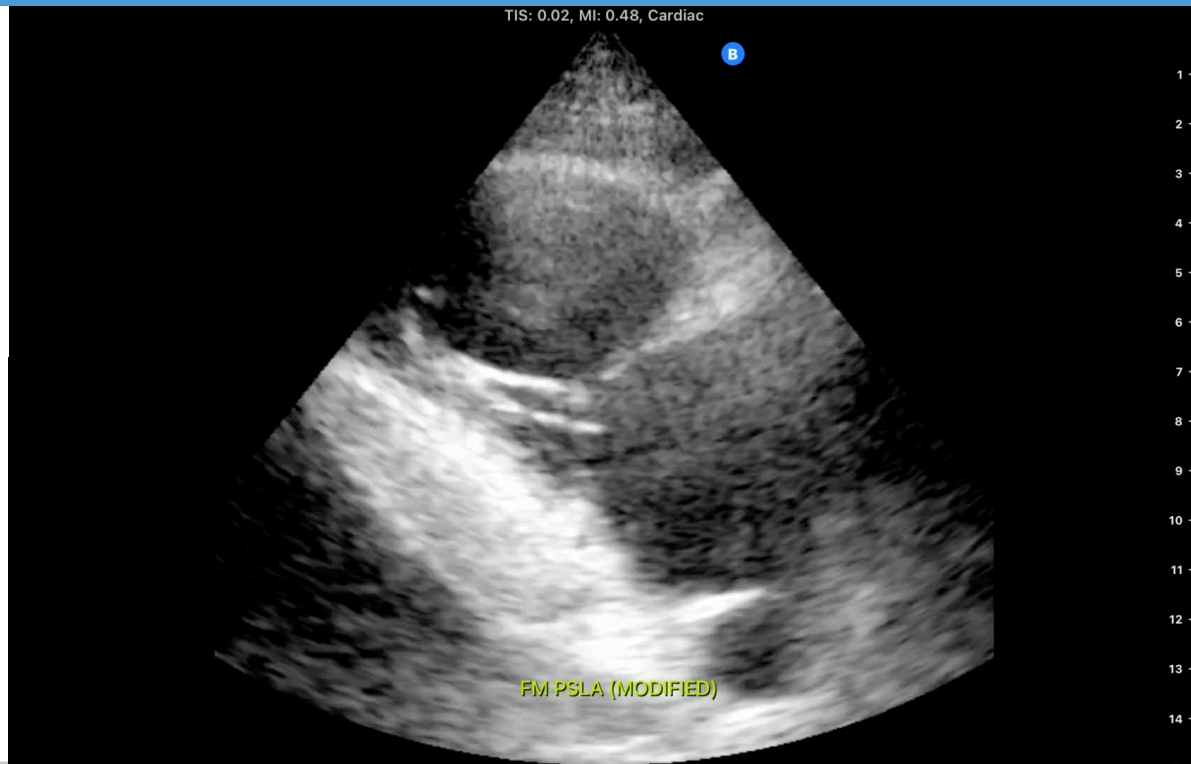


Probe at
PMI

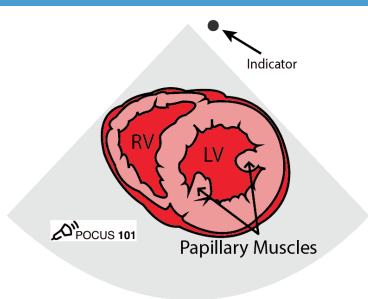
Mid-Papillary Level



Normal PSLA

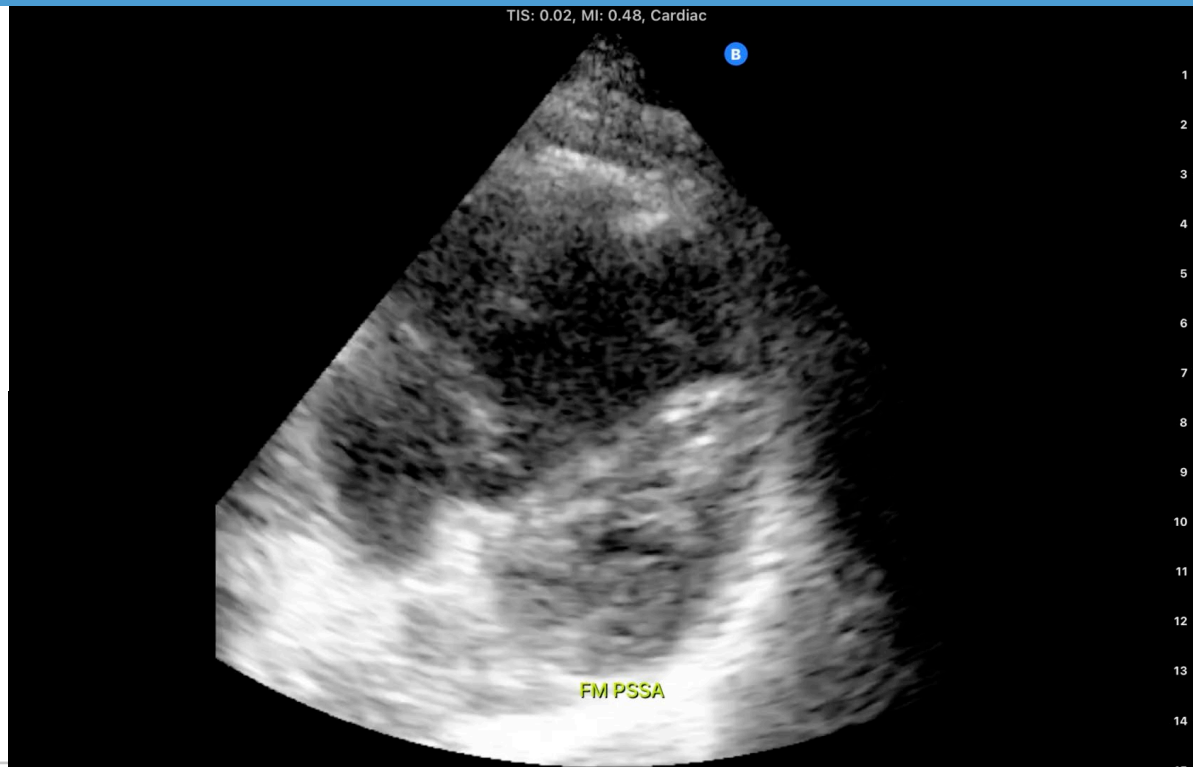


Mr. FM PSLA



Mid-Papillary Level

Normal PSSA

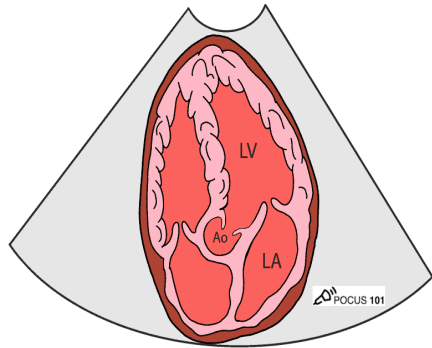


Mr. FM PSSA

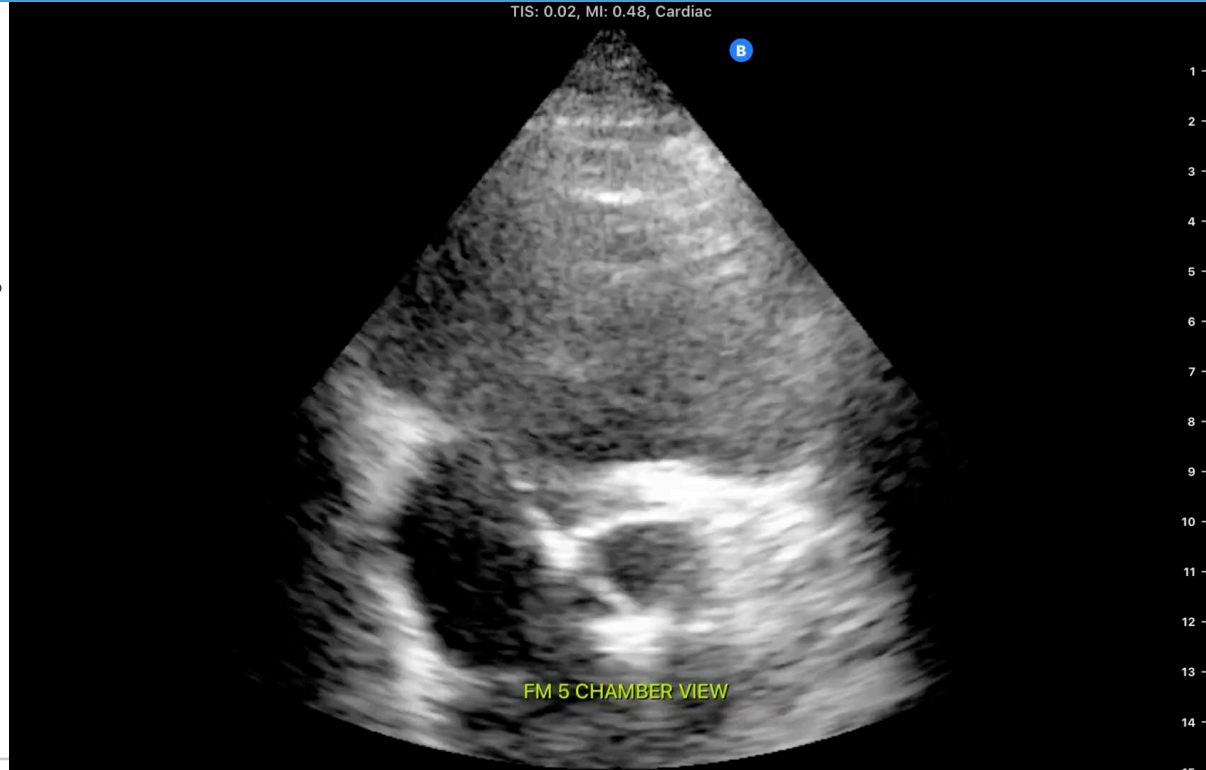
5 chamber



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Normal 5 chamber



Mr. FM 5 chamber



- The left ventricle is normal in size and function with no regional wall motion abnormalities appreciated.
 - The estimated left ventricular ejection fraction is 65% with severe paradoxical septal motion.
 - **There is severe right ventricular enlargement. There is impaired right ventricular function.**
 - Pulmonary artery systolic pressure estimated from the TR jet is 75 mmHg
 - **Consistent with severe pulmonary hypertension.**
-



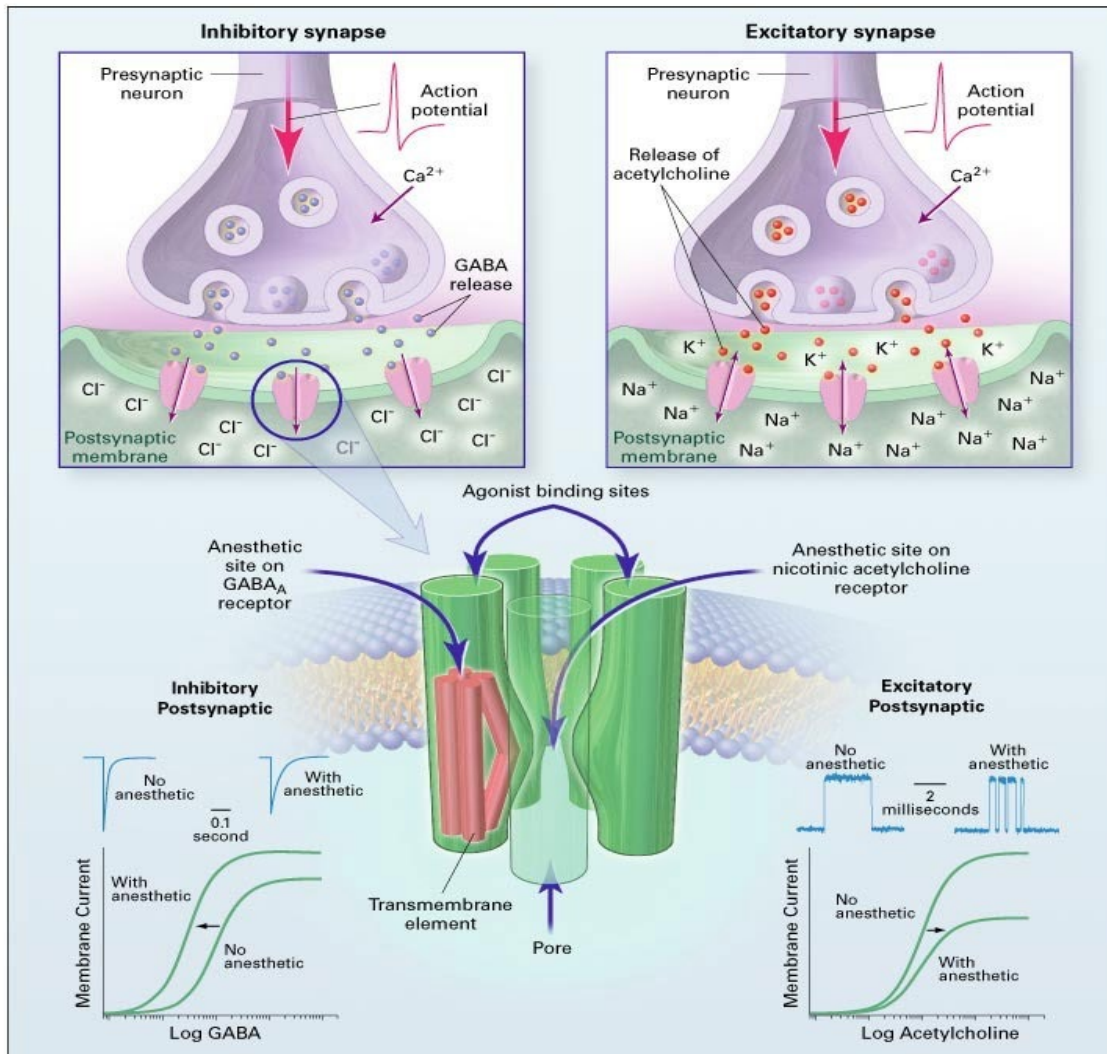
- Based on various measurements and calculations (i.e tricuspid regurgitation velocity, R ventricle dimensions, doppler velocity, myocardial performance index, etc..)
- Most relevant for us: R ventricle dimensions. All measured at end diastole
 - Measured at 3 different places
 - Max transverse diameter in basal 1/3 of ventricle
 - Max diameter at papillary muscles
 - RV length (tricuspid annulus to RV apex)

****If echo diagnosis is questionable or require confirmation → right heart cath (MAP \geq 25 mmHg)**



Propofol activates GABA channels (inhibitory), and inhibits presynaptic calcium and sodium channels

Mechanisms of actions of inhaled anesthetics: [letter]. (2003). *The New England Journal of Medicine*, 349(9), 909-910.





“The major finding of this study was that doubling the maintenance dose of propofol, sevoflurane, and desflurane caused **dose-dependent depression of myocardial contractility (for propofol and desflurane but not sevoflurane), decrease in MAP, and peripheral vasodilation.....**

these results show dose-dependent **hypotension caused by a simultaneous depression of contractility and vasodilation.**”

“Acute right ventricular (RV) failure has until recently received relatively little attention in the cardiology, critical care or anaesthesia literature. However, it is frequently encountered in cardiac surgical cases and is a **significant cause of mortality in patients with severe pulmonary hypertension who undergo non-cardiac surgery.**”

Colin Forbes Royse, David F. L. Liew, Christine E. Wright, Alistair G. Royse, James A. Angus;
Persistent Depression of Contractility and Vasodilation with Propofol but Not with Sevoflurane or
Desflurane in Rabbits. *Anesthesiology* 2008; 108:87–93
doi: <https://doi.org/10.1097/01.anes.0000296077.32685.26>

Forrest P. Anaesthesia and right ventricular failure. *Anaesth Intensive Care*.
2009 May;37(3):370-85. doi: 10.1177/0310057X0903700314. PMID:
19499856.

Literature Review – Pre-surgical evaluation

Patient-Related Predictors for Risk of Perioperative Cardiac Complications

Major clinical predictors

Myocardial infarction ≤ 6 weeks previously

Unstable angina

Decompensated congestive heart failure

Significant arrhythmias (e.g., causing hemodynamic instability)

Severe valvular disease (e.g., aortic or mitral stenosis with valve area < 1.0 cm²)

Intermediate clinical predictors

Mild angina pectoris

Myocardial infarction > 6 weeks previously

Compensated congestive heart failure

Diabetes mellitus

Minor clinical predictors

Advanced age

Abnormal electrocardiogram

Cardiac rhythm other than sinus

Low functional capacity, history of stroke, uncontrolled hypertension

Patient with major clinical predictors

Postpone surgery, obtain cardiology consultation and consider coronary angiography.

Institute therapy and measures for modifying risk factors.

Reevaluate cardiac status.

Patient with intermediate clinical predictors

Poor functional capacity

(< 4 METs)

or

High-risk procedure

Noninvasive testing

Moderate or excellent

functional capacity

(> 4 METs)

and

Low- or intermediate-risk procedure

Proceed to surgery

Patient with minor clinical predictors

Poor functional capacity

(< 4 METs)

and

High-risk procedure

Noninvasive testing

Moderate or excellent

functional capacity

(> 4 METs)

or

Low- or intermediate-risk procedure

Proceed to surgery



Examples of a Functional Capacity of More Than 4 METs

Climbing one flight of stairs

Mowing the lawn

Gardening

Golfing without a cart

Doubles tennis

Swimming

Riding a bike

Square dancing

Jogging

**METs = metabolic equivalents of oxygen consumption (>4 METs indicates good functional status)



- Exercise caution when picking anesthesia for patients with pulmonary HTN and RHF.....Propofol dilates arteries and veins = no blood return to heart = no blood to body = cardiac arrest (similar to giving nitrates in patient with inferior MI)
 - Morbidity and mortality
 - Pre-surgery cardiac evaluation
 - Remember > 4 METs!
 - Patient didn't get echo until 7/19 (day after surgery and cardiac arrest)
 - Exam documented as normal – closer exam detail needed?
 - Could signs of RHF been seen earlier?
 - i.e. elevated JVP, ascites, dependent edema, etc...
-



- Did well after ex-lap for fascial dehiscence
 - Extubated following day
 - 7/21 asphyxiation event, patient passed away after attempts at revival
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