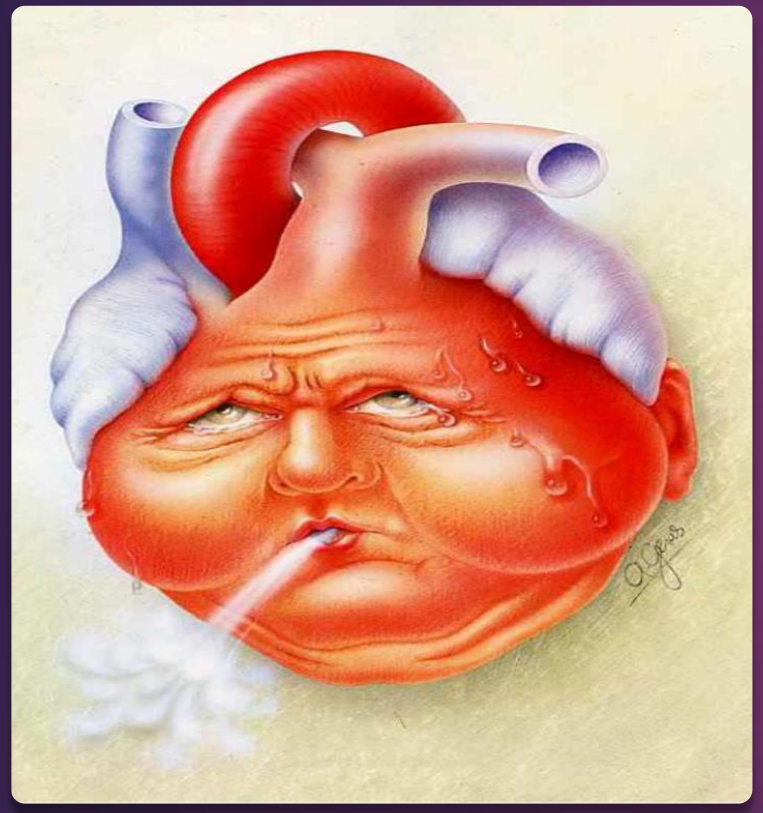

Pulmonary Hypertension in Anaesthesia and Critical Care

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Disclaimers…

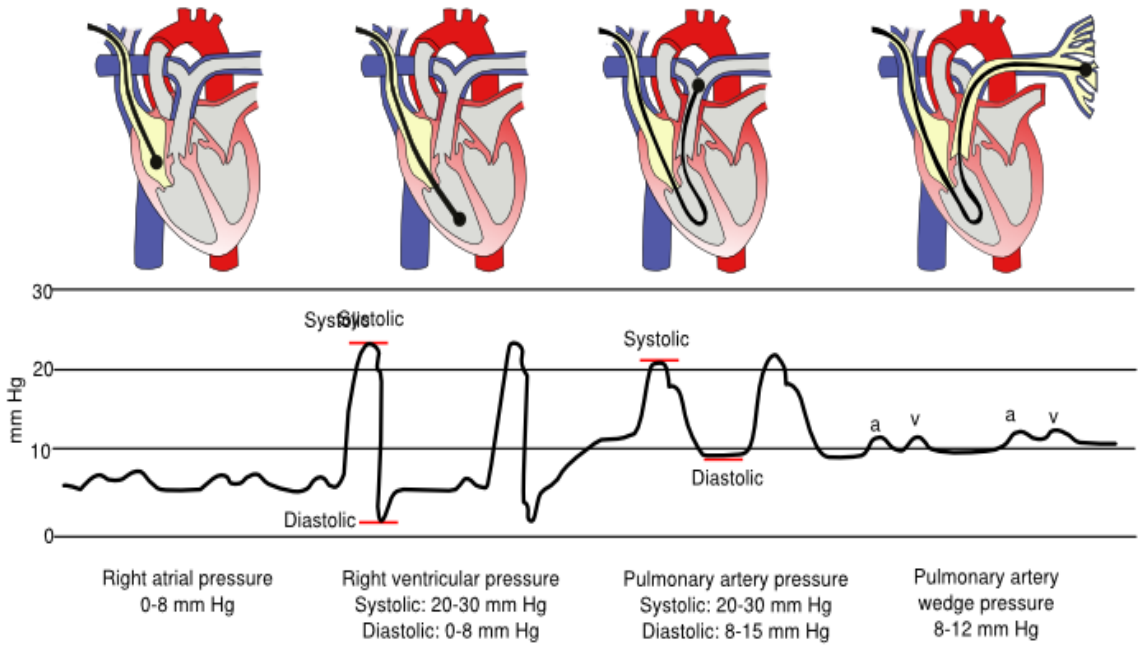
- I am not a cardiac anaesthetist
- I am definitely not a specialist in pulmonary hypertension or right heart failure
- My heart sinks when I hear / read the words “severe pulmonary hypertension” or “dilated poorly functioning right ventricle”

Aims

- Definitions and Classification
- Operative risks and consent
- Pre-op
- "Spiral of death"
- Intra-op
- Plan for deterioration

Definitions

- Right ventricular failure = inability of the right ventricle to provide adequate blood flow through the pulmonary circulation at a normal CVP
- Pulmonary hypertension = **mean PAP ≥ 25mmHg** at rest by right heart catherisation
  - Mild: 25-40mmHg
  - Moderate: 41-55mmHg
  - Severe: >55mmHg
- *(mPAP = 0.61 x PASP + 2)*



PULMONARY HYPERTENSION

ELEVATED MEAN ARTERIAL PRESSURE ≥ 25 mmHg AT REST ASSESSED BY RIGHT HEART CATHETERIZATION

CATEGORIZED INTO FIVE GROUPS BY THE WORLD HEALTH ORGANIZATION (WHO)

GROUP 1: PULMONARY ARTERIAL HYPERTENSION (PAH)

MEOW?

PAH EXAMPLES: IDIOPATHIC, INHERITED, DRUG AND TOXIN INDUCED, CAUSED BY CONNECTIVE TISSUE DISEASE, HIV, SCHISTOSOMIASIS

HEART CAT(H)

ONLY GROUP 1 IS CALLED PULMONARY "ARTERIAL" HYPERTENSION, BUT ALL 5 GROUPS MAY BE REFERRED TO AS PULMONARY HYPERTENSION (PH)

GROUP 3: PH DUE TO LUNG DISEASE AND/OR HYPOXEMIA

GROUP 4: PH DUE CHRONIC THROMBOEMBOLISM

GROUP 2: PH DUE TO LEFT HEART DISEASE (MOST COMMON)

GROUP 5: PH WITH UNCLEAR MULTIFACTORIAL MECHANISMS

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	Ramakrishna et al. (2005) (n = 145)	Minai et al. (2006) (n = 21)	Lai et al. (2007) (n = 62)	Price et al. (2010) (n = 28)	Memtsoudis et al. (2010) (n = 3543)	Kaw (2011) (n = 96)
Country	USA	USA	Taiwan	France	USA	USA
PH due to left heart disease	No	No	Yes	No	No	Yes
General anaesthesia	100%	79%	58%	50%	Data unavailable	100%
Major surgery	79%	86%	58%	57%	THR/TKR	100%
Mortality	7%	18%	9.7%	7%	2.4/0.9%	1%
Morbidity	42%	14%	24%	29%	_	28%
Study type/ limitations	Retrospective No control ECHO criteria to define PH	Retrospective No control Severe PH	Retrospective Contolled Doppler ECHO criteria	Retrospective No control RHC criteria Mild-to-moderate disease	NIS database Matched samples. Immediate postoperative period only	Retrospective Controlled RHC criteria

ECHO, echocardiography; RHC, right heart catheterisation; THR/TKR, total hip/knee replacement; NIS, National Inpatient Sample.

Does it matter?

Pre-op assessment I

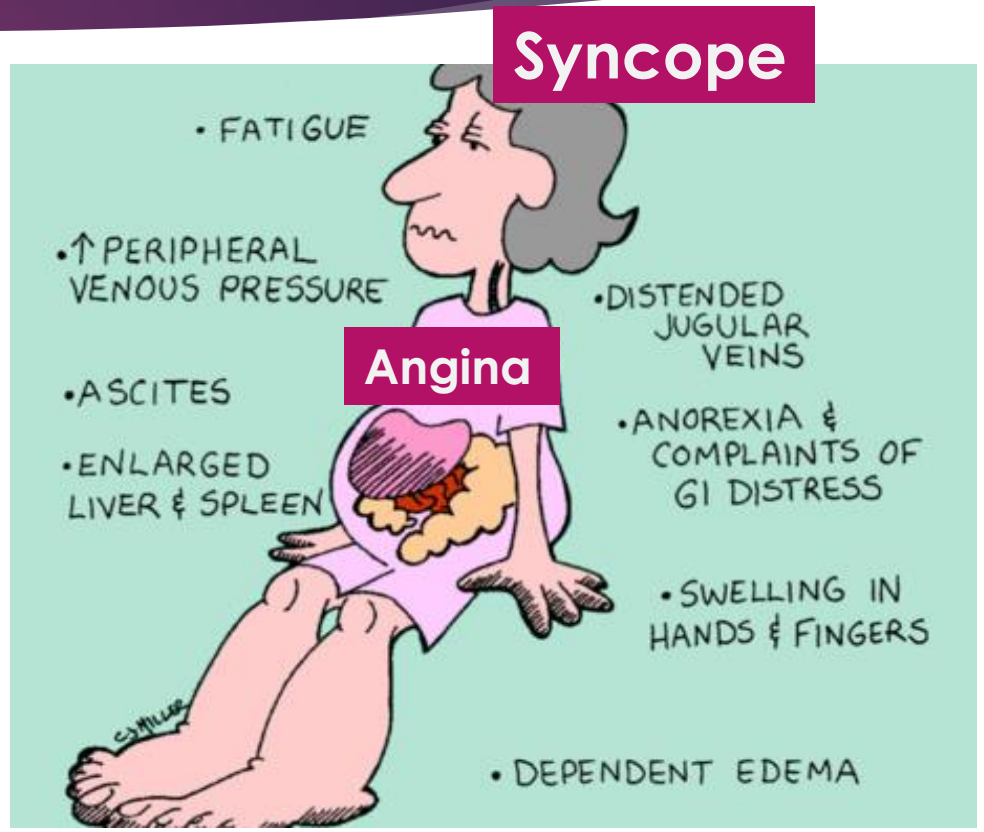
- Identify and stratify
- Appropriate consent – patient and surgeon
- Pre-optimise
- Consider optimal:-
  - Location: local hospital vs local cardiac centre vs specialised PH centre
  - Team: senior surgeon, senior (?cardiac) anaesthetist
  - Equipment: ?TOE ?PAC ?iNO ?inotropes
  - Post-op destination: ?HDU ?ICU
- Phone a friend

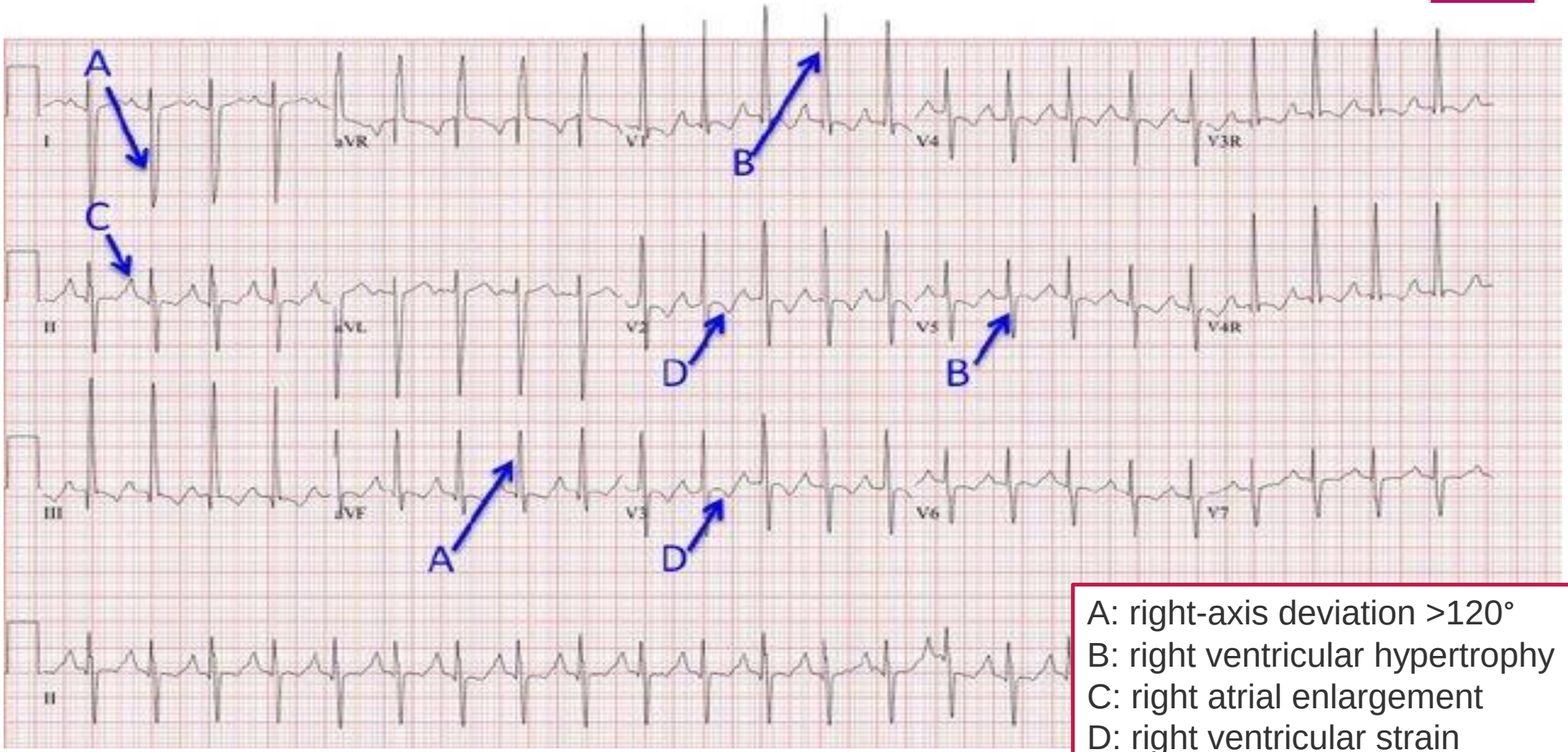
At risk groups

- **Group 1** – PAH: idiopathic, heritable, CTD (SLE, scleroderma), HIV, sickle cell, portal hypertension, congenital heart disease drugs (including methamphetamine, anorexogens, St John's Wort)
- **Group 2** – 2° LVF – systolic / diastolic (HFpEF) LV failure, valvular disease: mitral > aortic
- **Group 3** – 2° lung disease – COPD, OSA, ILD, obesity hypoventilation syn
- **Group 4** – CTEPH (chronic embolic / thrombotic)
- **Group 5** – Miscellaneous – metabolic disorders, chronic haemolytic anaemias, sarcoidosis, thyroid disease, CKD, neurofibromatosis, vasculitides, splenectomy

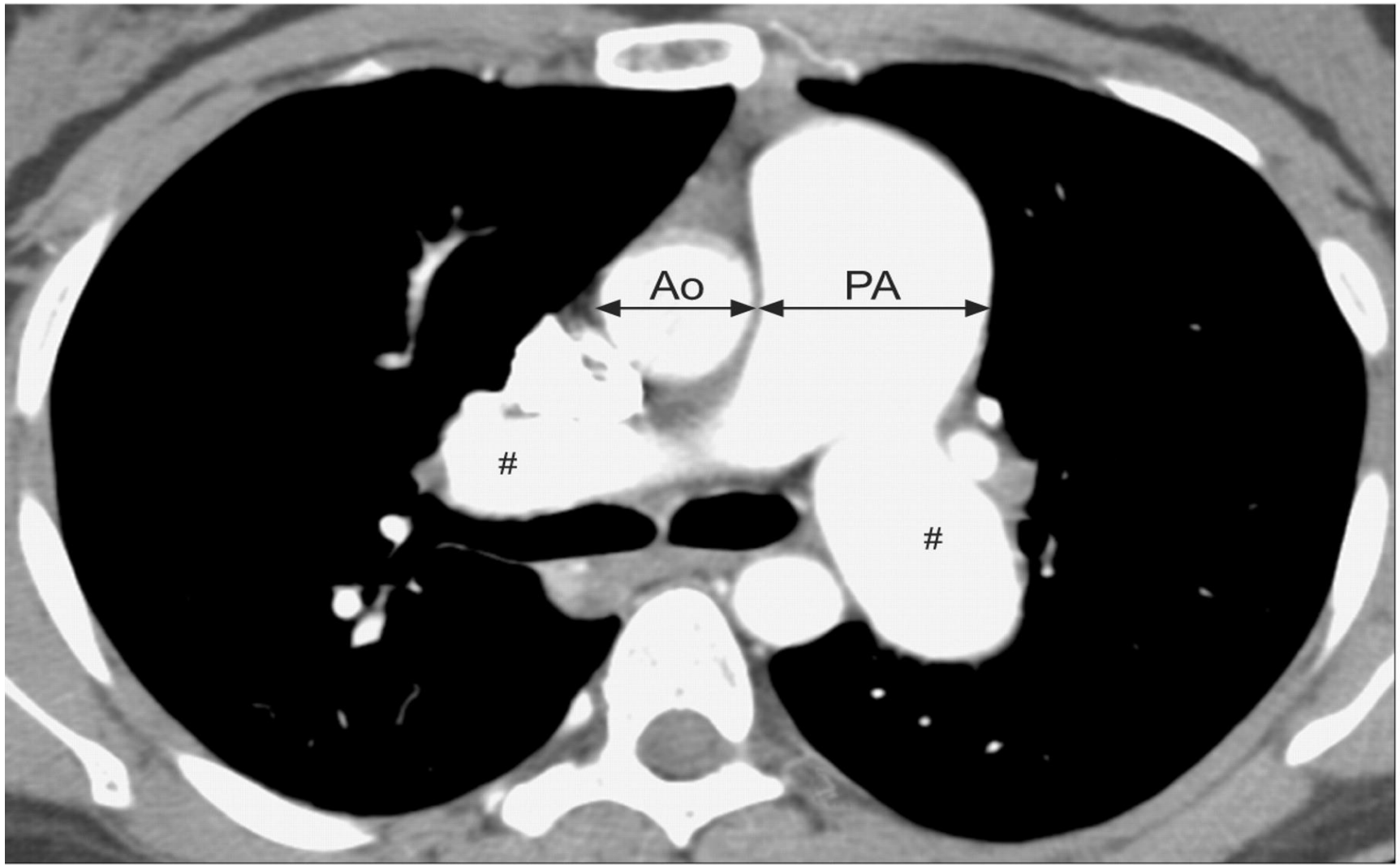
Pre-op assessment II – not known to have PH

- Could this patient have undiagnosed PH?
  - At risk groups
- Signs / symptoms: vague and non-specific
  - SOB / Fatigue / Exercise intolerance
  - ?Signs of right ventricular failure
  - **Onset/worsening of angina**
  - **Syncope**
- Ix – ECG, CT, TTE, ?refer for RHC



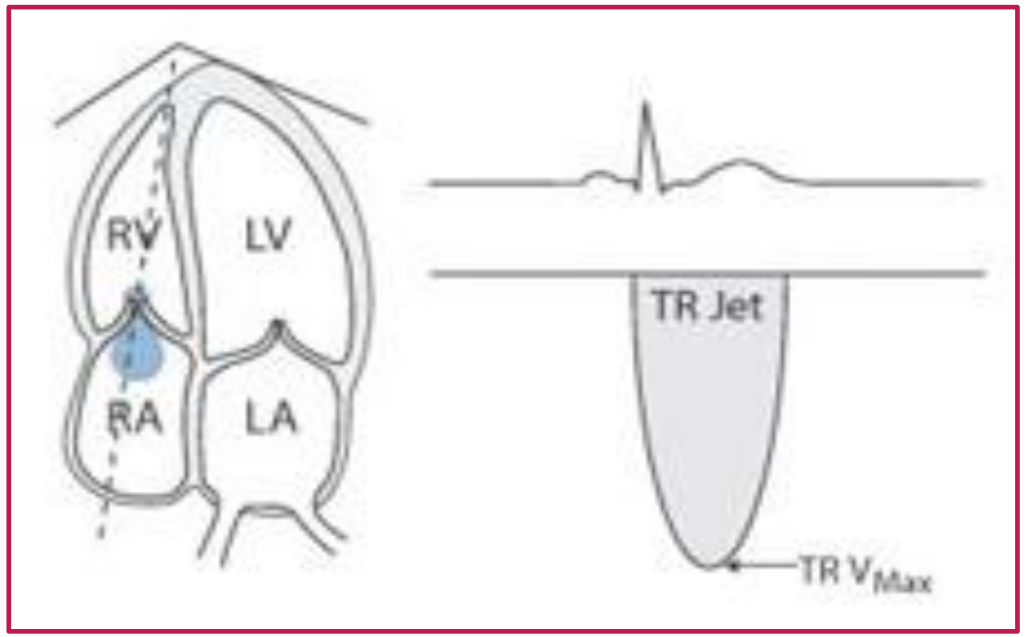


A: right-axis deviation >120°
B: right ventricular hypertrophy
C: right atrial enlargement
D: right ventricular strain


Ao
PA
#
#

Echo

- PASP – estimated from doppler signal through TR
  - PASP > 40mmHg ≈ mPAP > 25mmHg
  - mPAP = (PASP x 0.61) + 2
- Worrying features
  - TAPSE ≤ 15mm or FAC < 35%
  - Pericardial effusion
  - R ventricular hypertrophy: RV wall thickness > 5mm (diastole)
  - Dilated RV and severe TR
- Also check – LV and valvular function, intra-cardiac shunts



NEW YORK HEART ASSOCIATION (NYHA) HEART FAILURE CLASSIFICATION

CLASS I

NO LIMITATION OF PHYSICAL ACTIVITY; ORDINARY PHYSICAL ACTIVITY DOES NOT CAUSE SYMPTOMS

CLASS II

SLIGHT LIMITATION OF PHYSICAL ACTIVITY; COMFORTABLE AT REST; ORDINARY PHYSICAL ACTIVITY CAUSES SYMPTOMS

CLASS III

MARKED LIMITATION OF PHYSICAL ACTIVITY; COMFORTABLE AT REST, BUT LESS THAN ORDINARY ACTIVITY CAUSES SYMPTOMS

CLASS IV

SEVERE LIMITATION AND DISCOMFORT WITH ANY PHYSICAL ACTIVITY; SYMPTOMS PRESENT EVEN AT REST

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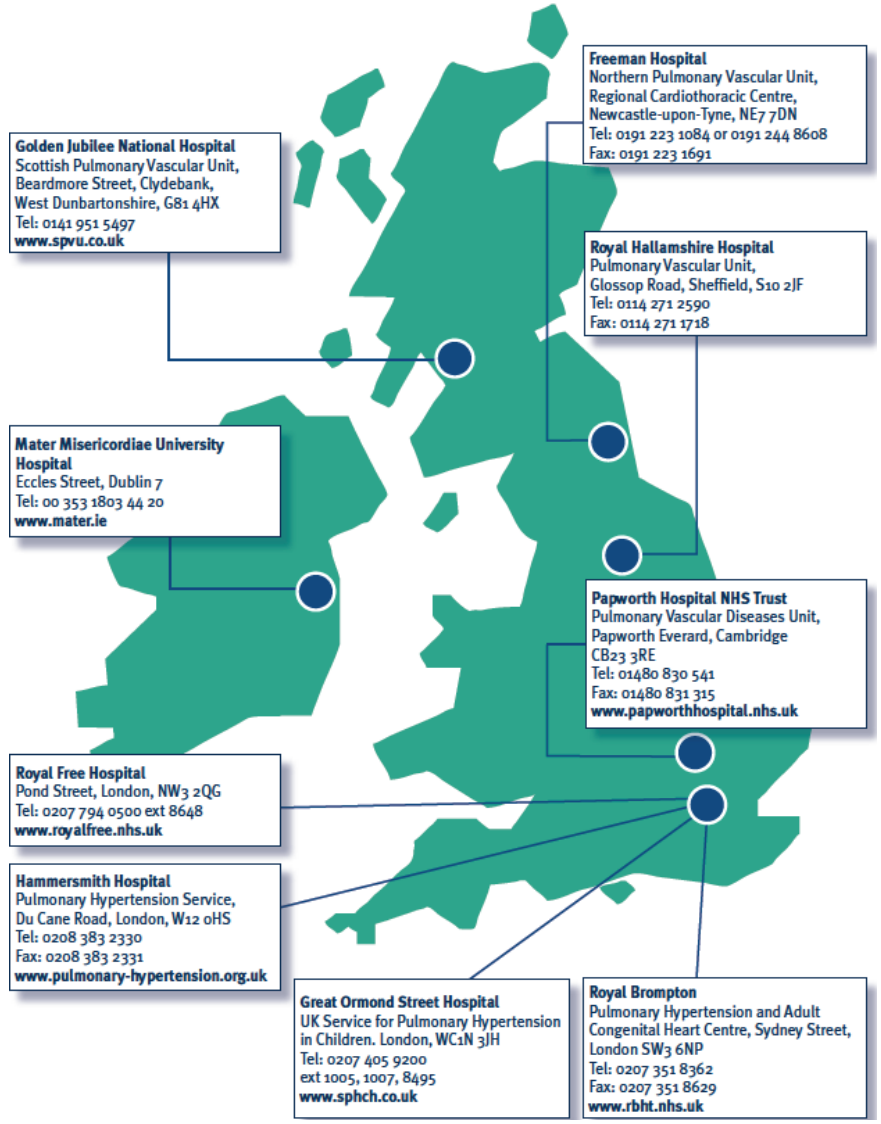
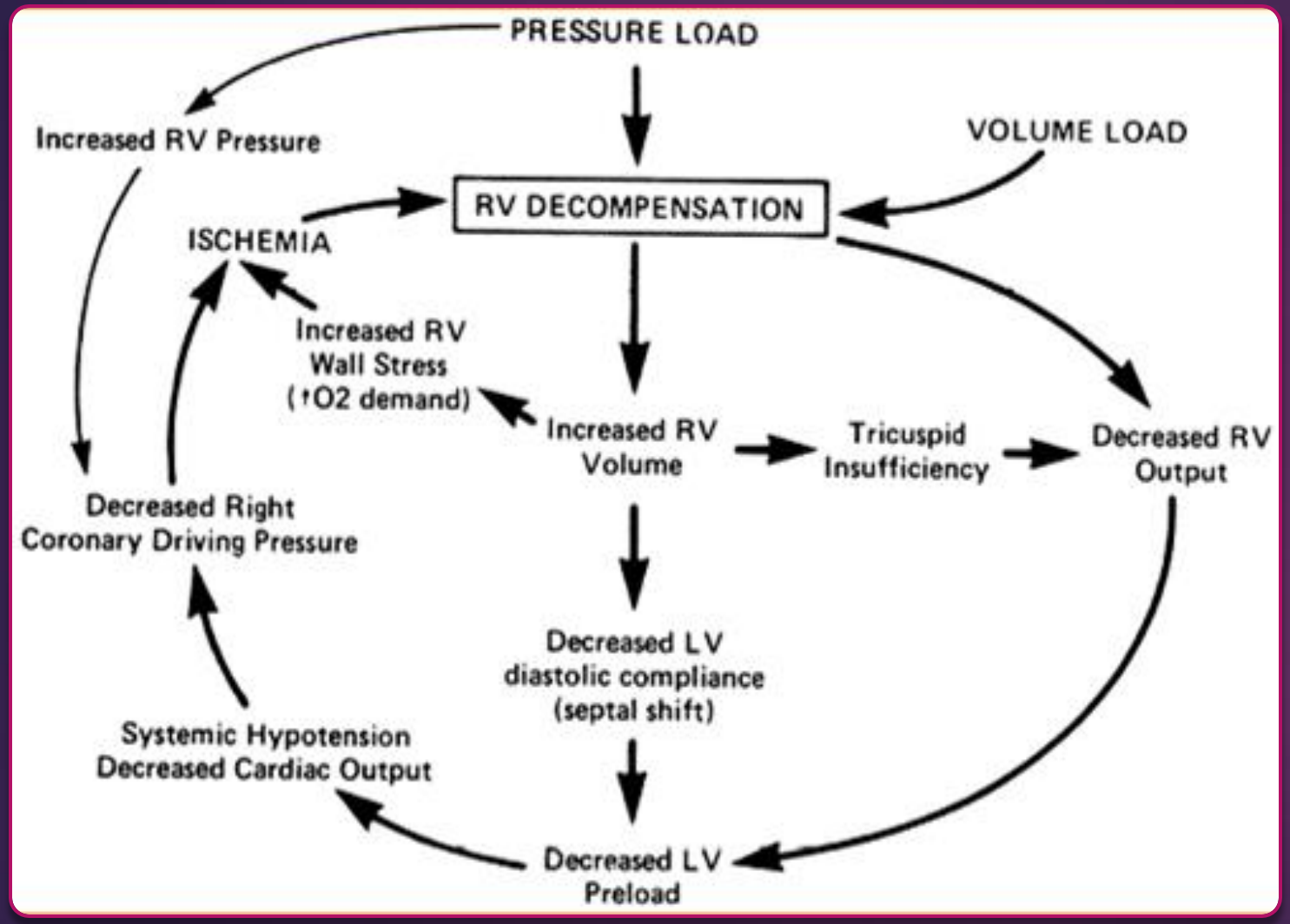
Pre-op assessment III - known to have PH

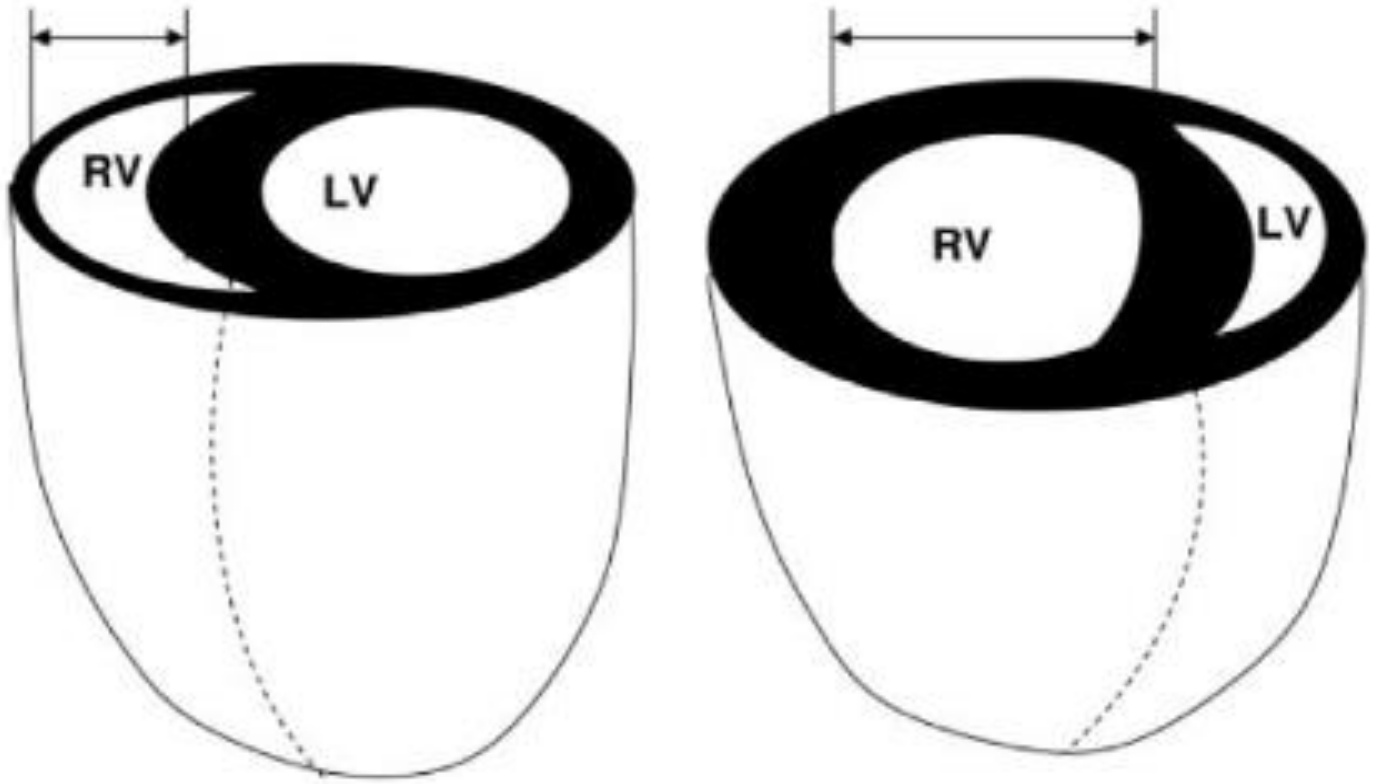
- Phone a friend – local PH centre – Royal Hallamshire (switchboard 0114 271 1900)
  - PH SpR (0900-1700 Mon – Fri bleep 2387)
  - PH Consultant (outside of office hours)
- Latest Right Heart Catheterisation & echo data
- Symptoms – NYHA class (esp syncope), any signs of decompensation
- DH: Ca-channel blockers, diuretics, bosentan, ambrisentan, sildenafil (regularly), tadalafil, riociguat, iloprost nebs, treprostinil, warfarin
  - Take on day of surgery, warfarin plan





"The spiral of death"

Ventricular interdependence

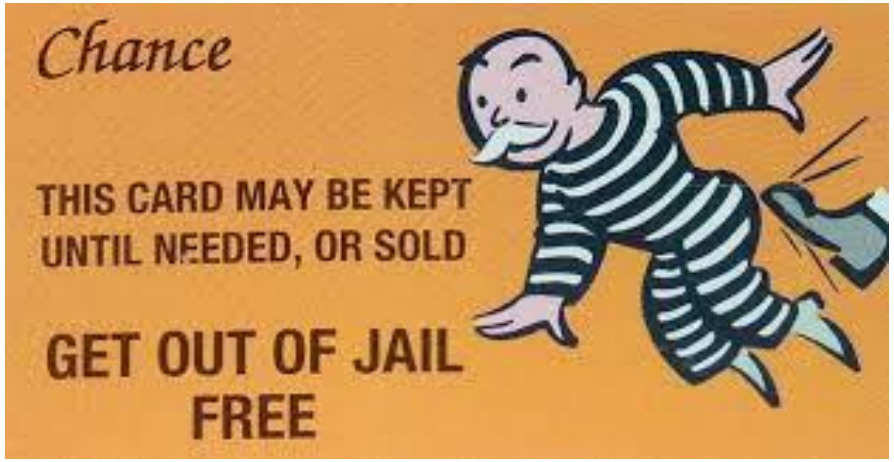


Intra-operative management

- Communicate concerns with team + **plan for deterioration**
- Local vs regional vs GA
- Surgeon and surgical plan
- Monitoring
- "**Physiological difficult airway**"
- Drugs to use and avoid
- Ventilation strategy
- Warm everything
- Post-op plan

Plan for deterioration

- **Rising CVP / falling BP / falling SpO2 / signs of end organ hypoperfusion**
- Echo confirmation
- Small fluid bolus vs bolus diuretic?
  - Passive leg raise
- Optimise ventilation – gentle recruitment, increase FiO2, mild hyperventilation,
- Arrythmias - Amiodarone + DCCV
- Vasopressors – NA +/- vasopressin
- Inotropes / inodilators – milrinone, dobutamine (adrenaline)
- Pulmonary vasodilators – iNO, iloprost neb (ultrasonic), epoprostenol infusion



Conclusions

Definitions and Classification

Operative risks and consent

Pre-op

"Spiral of death"

Intra-op

Plan for deterioration

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