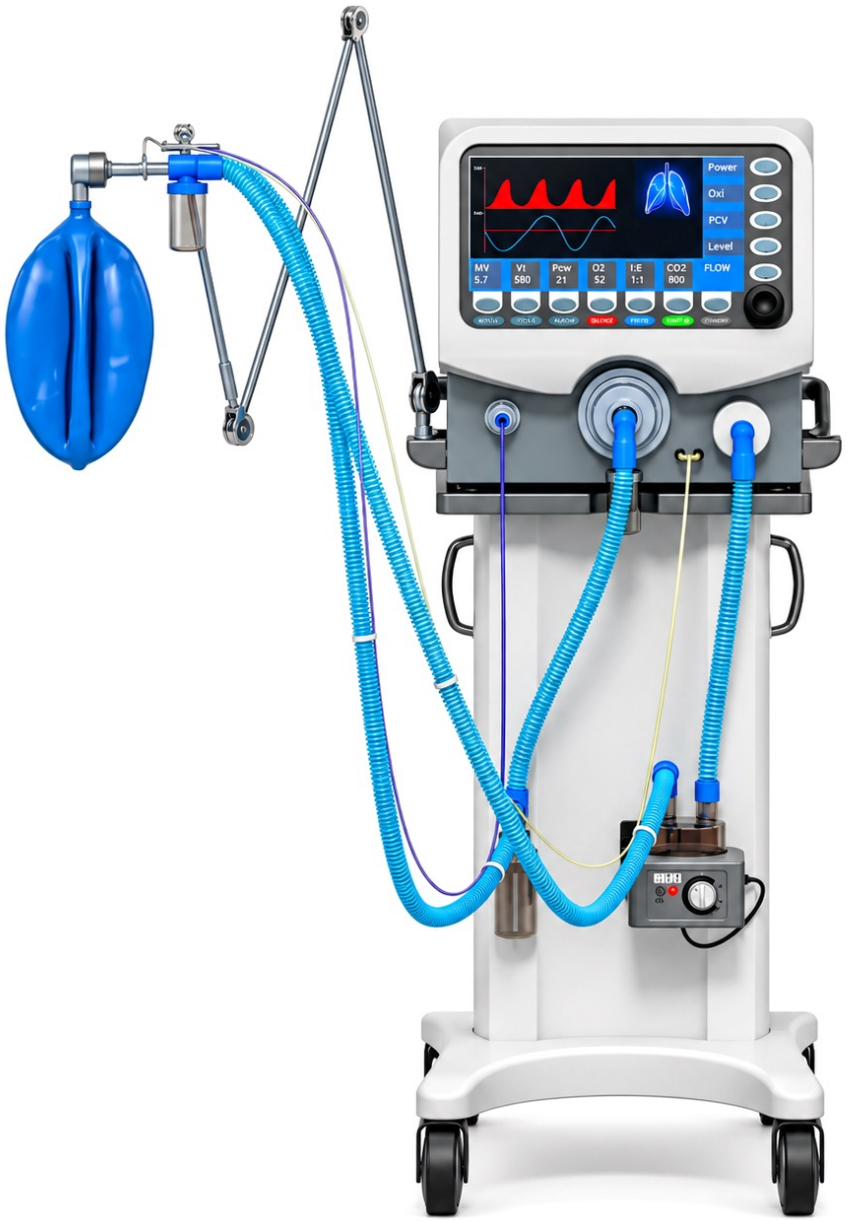
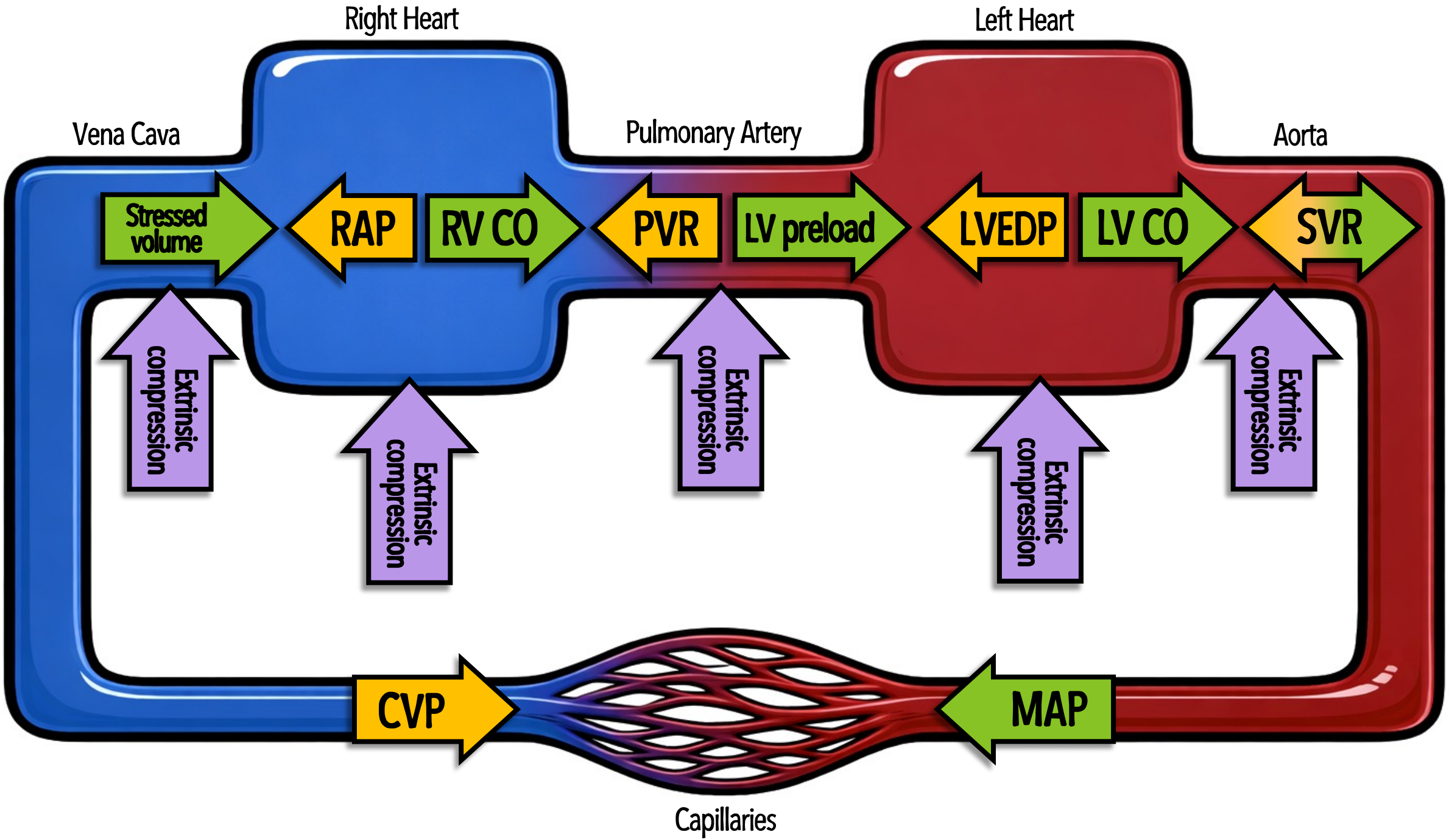
HEMODYNAMICS OF POSITIVE PRESSURE VENTILATION



HEMODYNAMIC CONSEQUENCES OF POSITIVE PRESSURE VENTILATION

- ⬇ RV preload
- ⬇ LV preload
- ⬆ RV afterload
- ⬇ LV afterload


Right Heart
Left Heart
Vena Cava
Pulmonary Artery
Aorta
Stressed volume
RAP
RV CO
PVR
LV preload
LVEDP
LV CO
SVR
Extrinsic compression
Extrinsic compression
Extrinsic compression
Extrinsic compression
Extrinsic compression
CVP
MAP
Capillaries

CLEAN KILL

UNHELPFUL

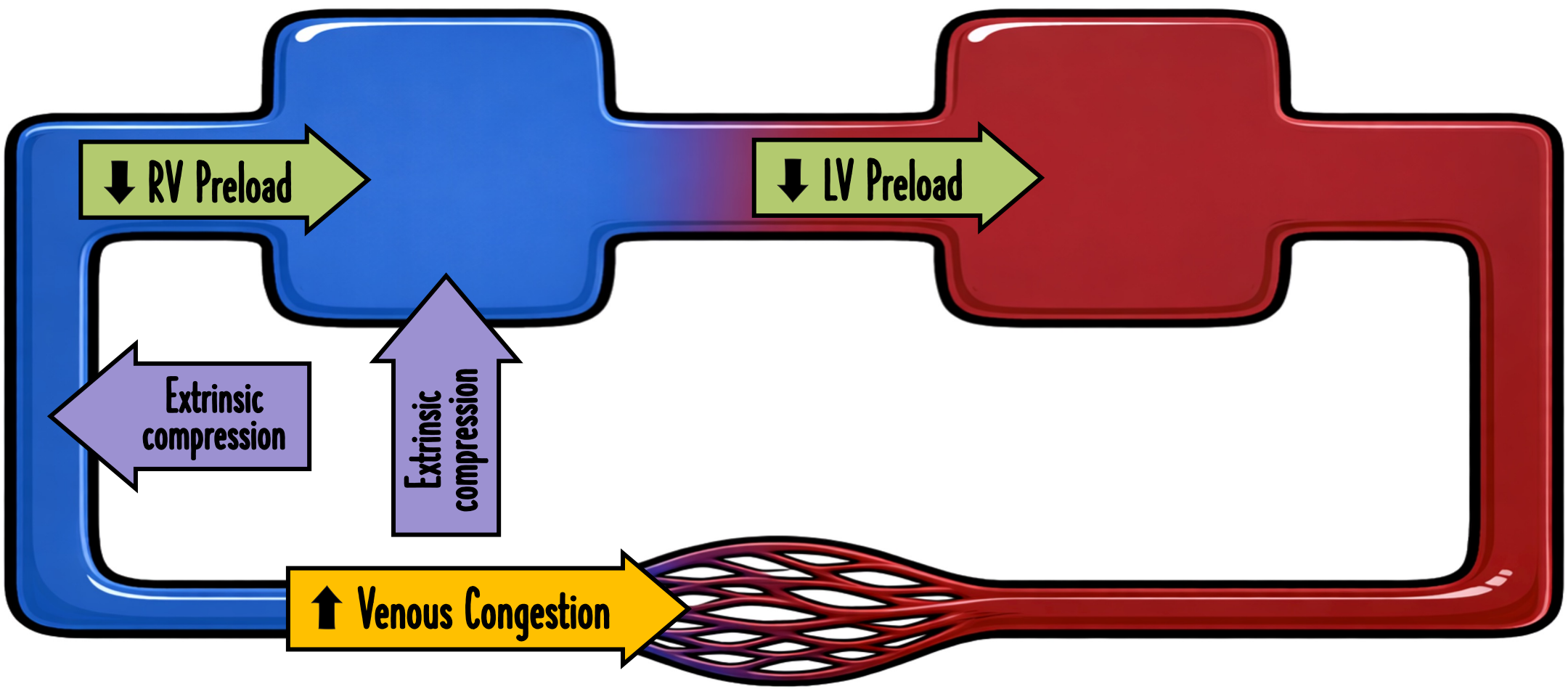
IT'S COMPLICATED

HELPFUL

Cardiac tamponade

Tension pneumothorax

CARDIAC TAMPONADE & TENSION PNEUMOTHORAX



Potential for precipitous cardiovascular collapse

Stick a needle in it

before starting positive pressure ventilation!

RAPID RESPIRATORY DETERIORATION

Precipitous and refractory hypoxemia in patients with an intracardiac right-to-left shunt

Vasodilation

Hypovolemia

Abdominal compartment syndrome

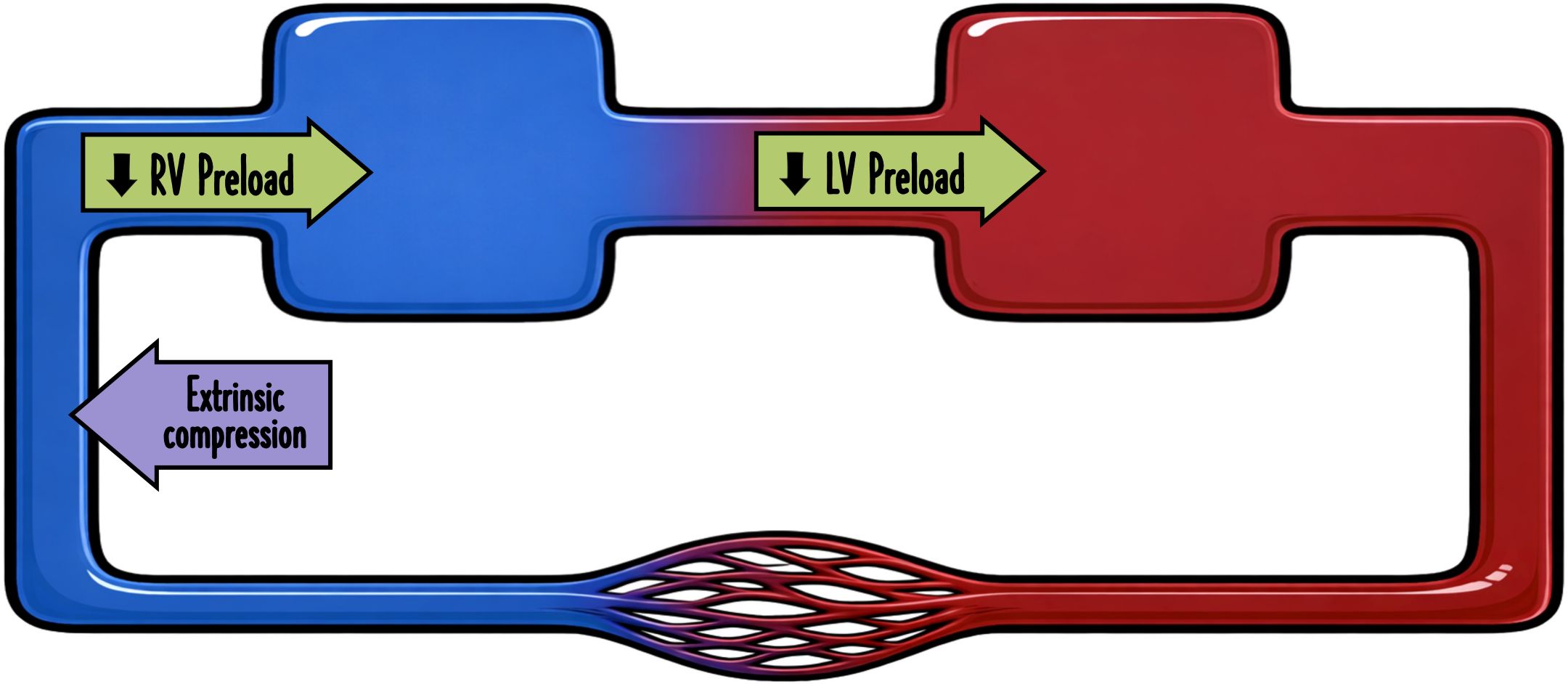
Tricuspid regurgitation

COMPETING PRIORITIES

You can't have everything
you want at the same time...

What to prioritize and what
to sacrifice is a moving target

VASODILATION & HYPOVOLEMIA

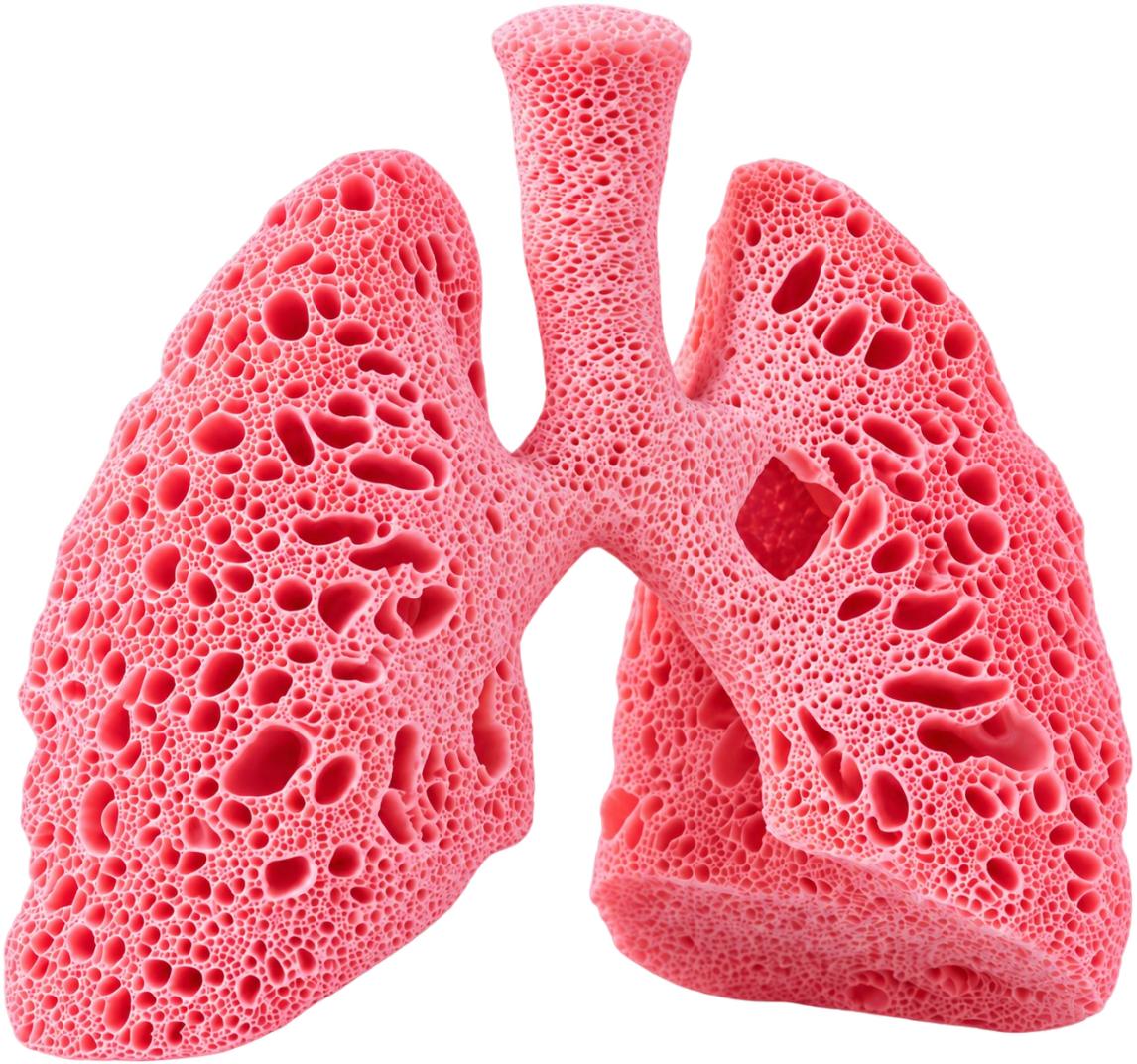


NEED TO AUGMENT STRESSED VOLUME

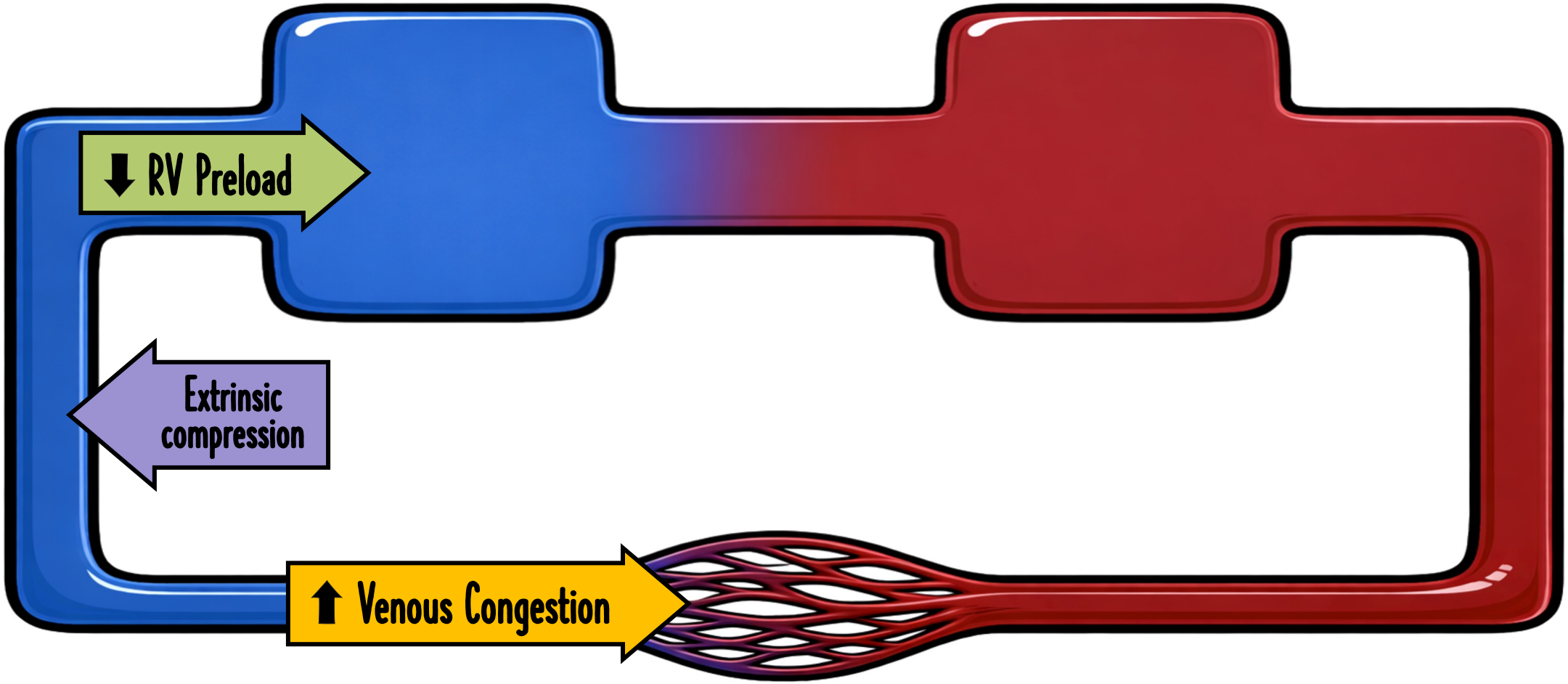
Add more volume versus pressurize the current volume

EARLY PRESSORS

Patients with acute lung injury often not very volume tolerant



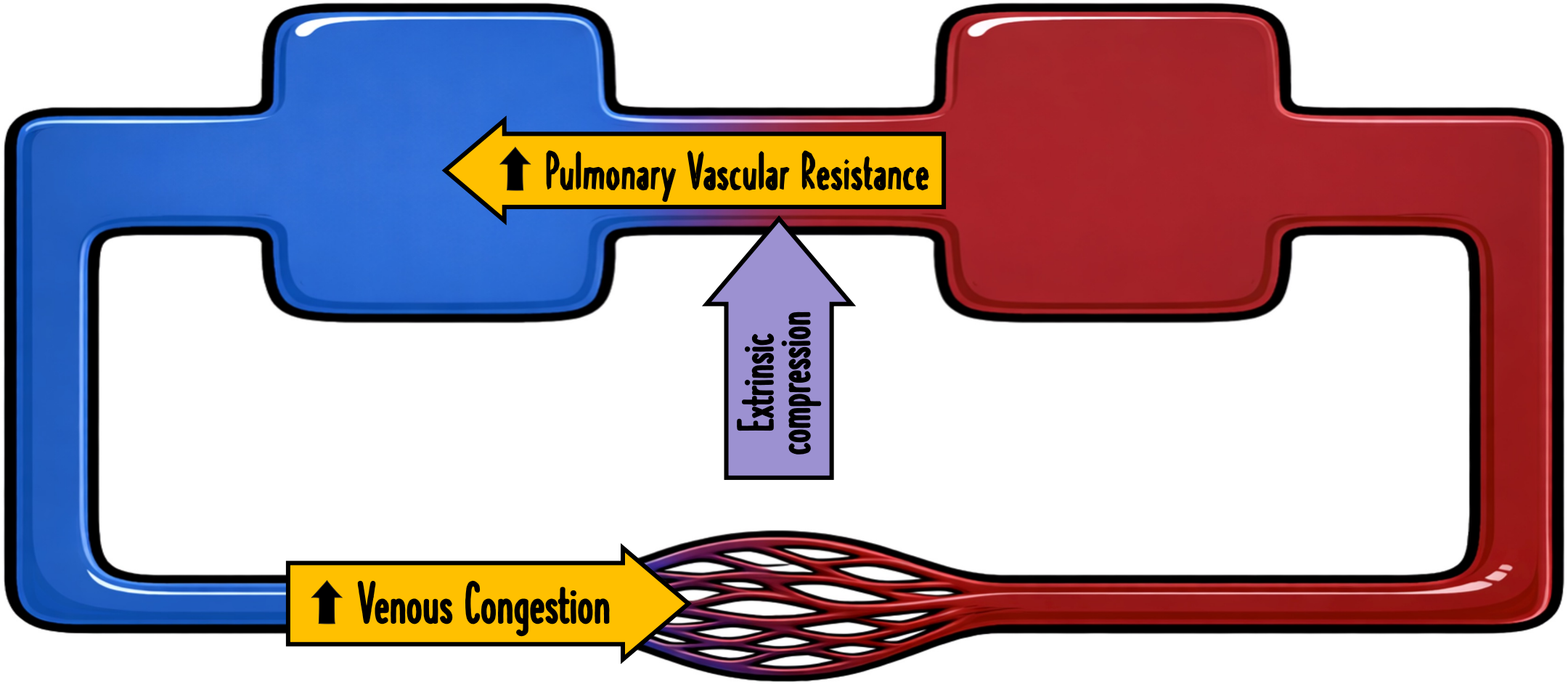
ABDOMINAL COMPARTMENT SYNDROME



VICIOUS CYCLE

Abdominal compartment syndrome causes a vicious cycle of hemodynamic and respiratory deterioration

TRICUSPID REGURGITATION



TRICUSPID REGURGITATION

Forward flow becomes heavily dependent on pressure gradients

TRICUSPID REGURGITATION

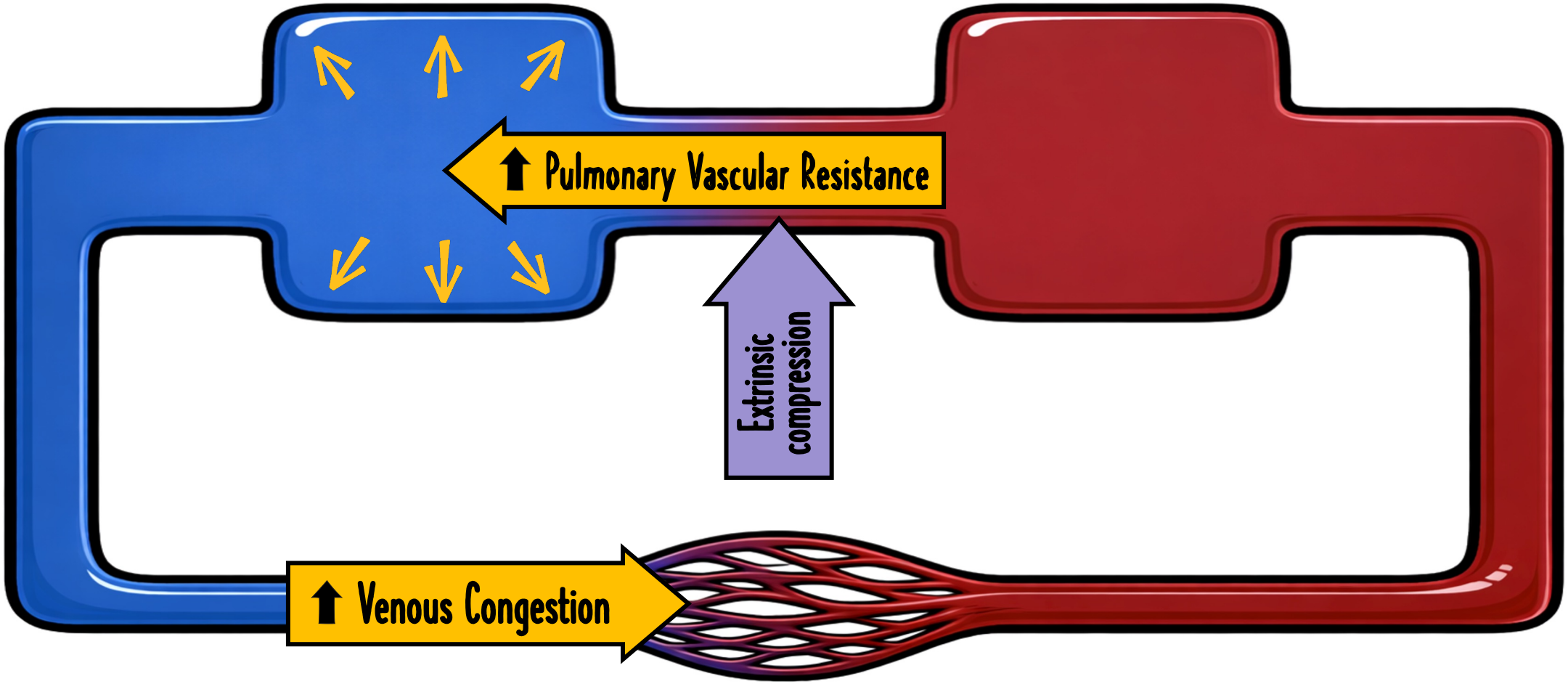
The goal is to optimize the pressure gradient by increasing upstream pressure and lowering downstream pressure

Downstream pressure is the pulmonary pressure

Pulmonary hypertension

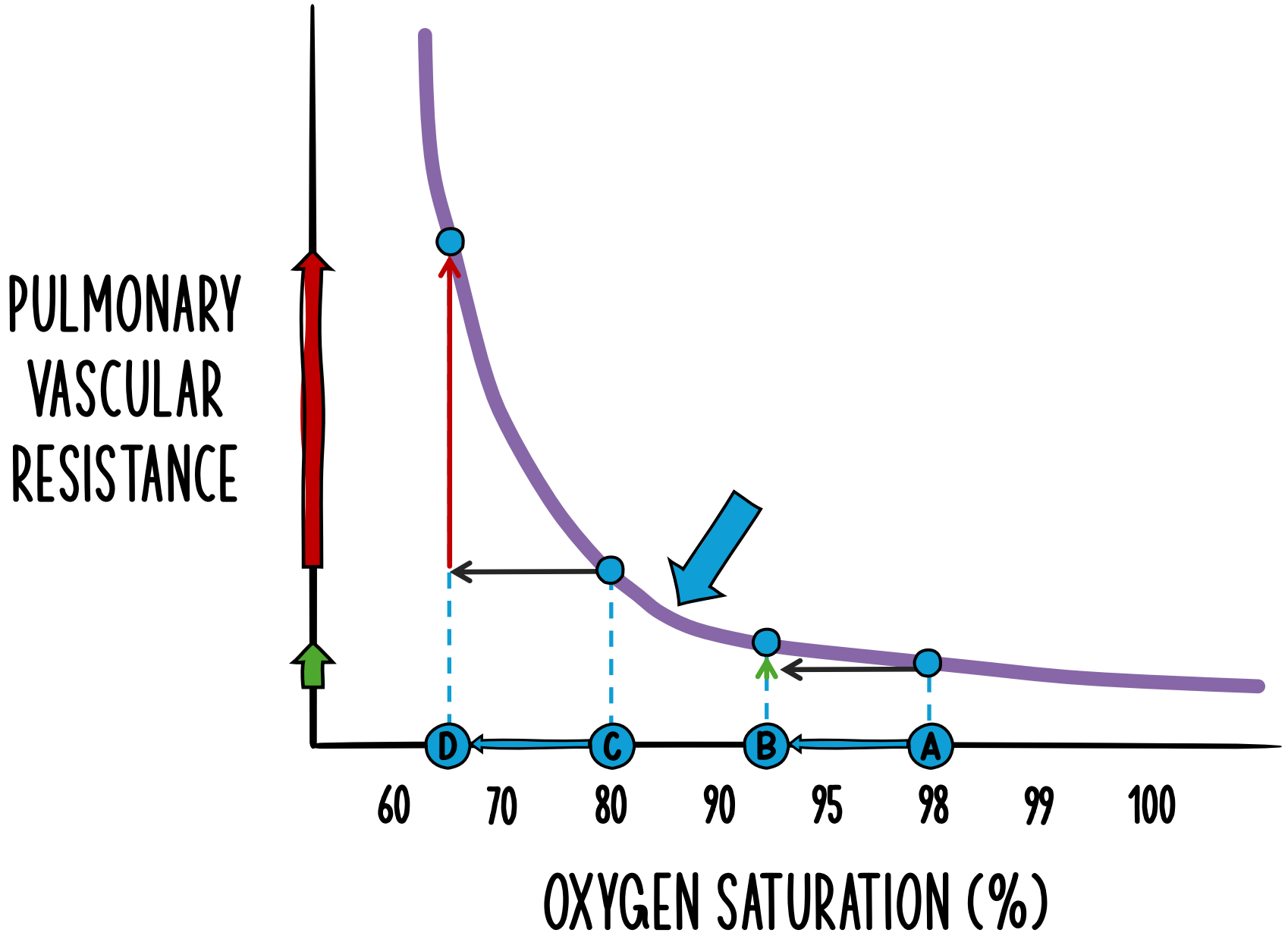
Right ventricular failure

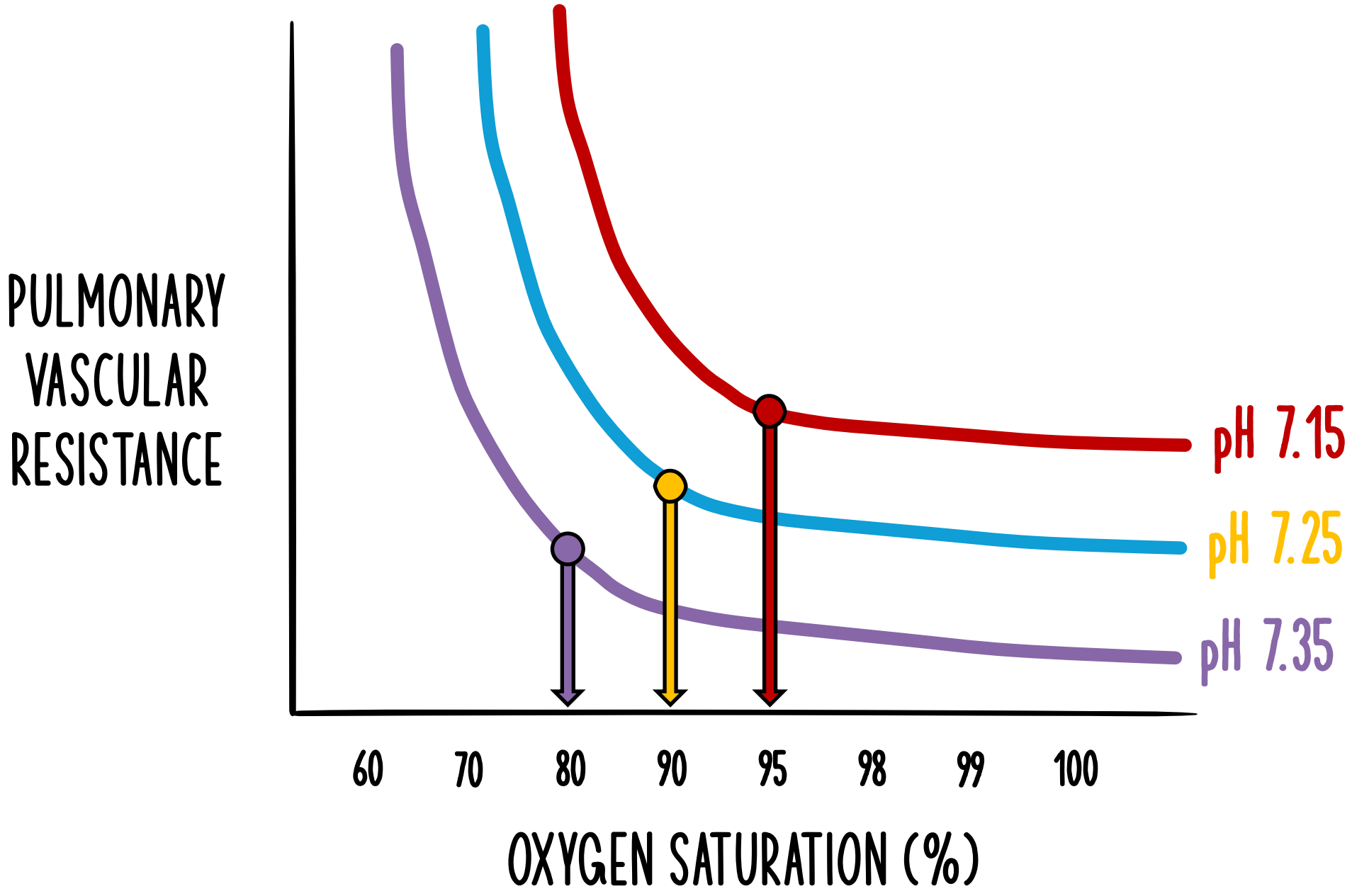
PULMONARY HYPERTENSION



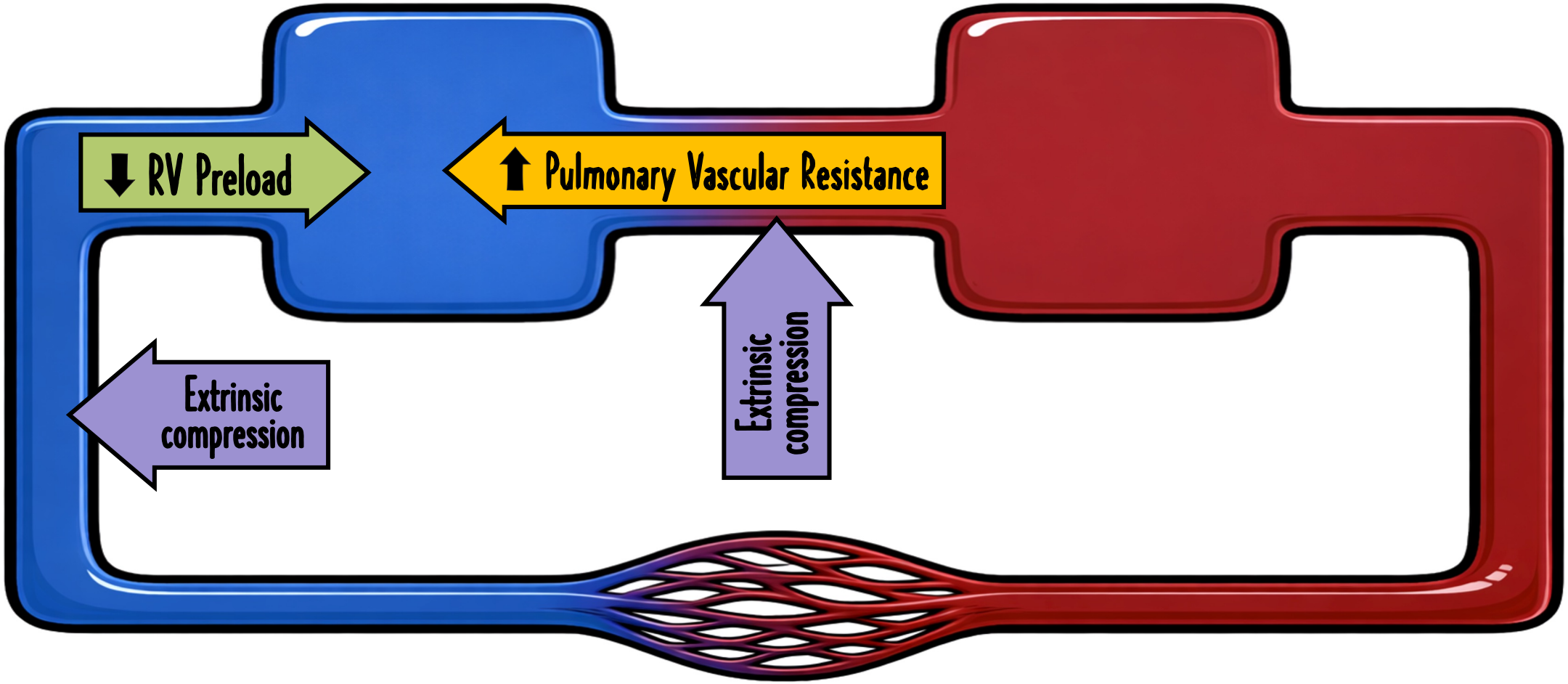
LUNG PATHOLOGY?

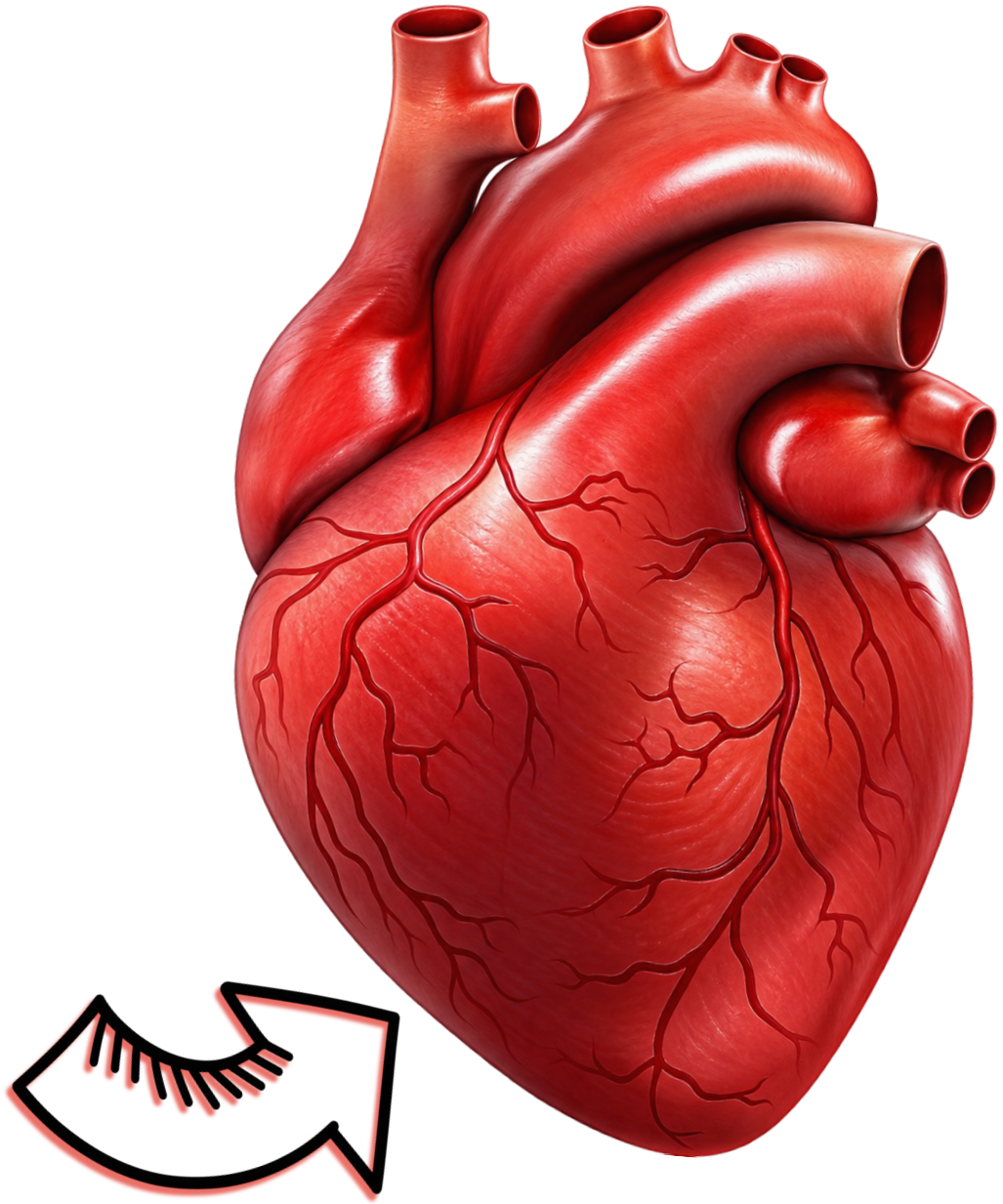
Improving lung mechanics hypoxemia, acidemia can more than offset the direct effects of positive pressure ventilation


PULMONARY
VASCULAR
RESISTANCE
D
C
B
A
60
70
80
90
95
98
99
100
OXYGEN SATURATION (%)


PULMONARY VASCULAR RESISTANCE
pH 7.15
pH 7.25
pH 7.35
60
70
80
90
95
98
99
100
OXYGEN SATURATION (%)

RIGHT-SIDED HEART FAILURE





WHY IS THE RIGHT VENTRICLE FAILING?

Pressure overload

Volume overload

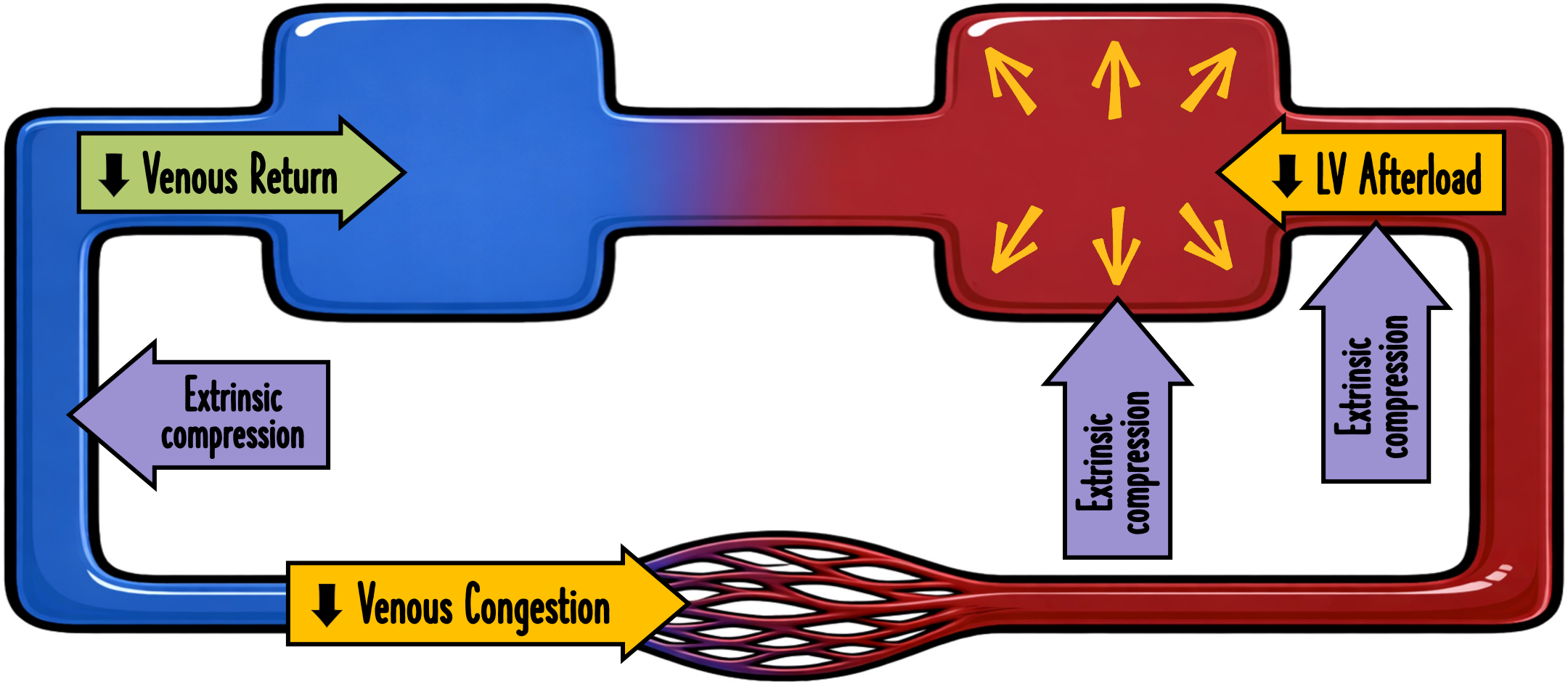
Decreased contractility

Left ventricular failure

Mitral regurgitation

Aortic regurgitation

LEFT-SIDED HEART FAILURE

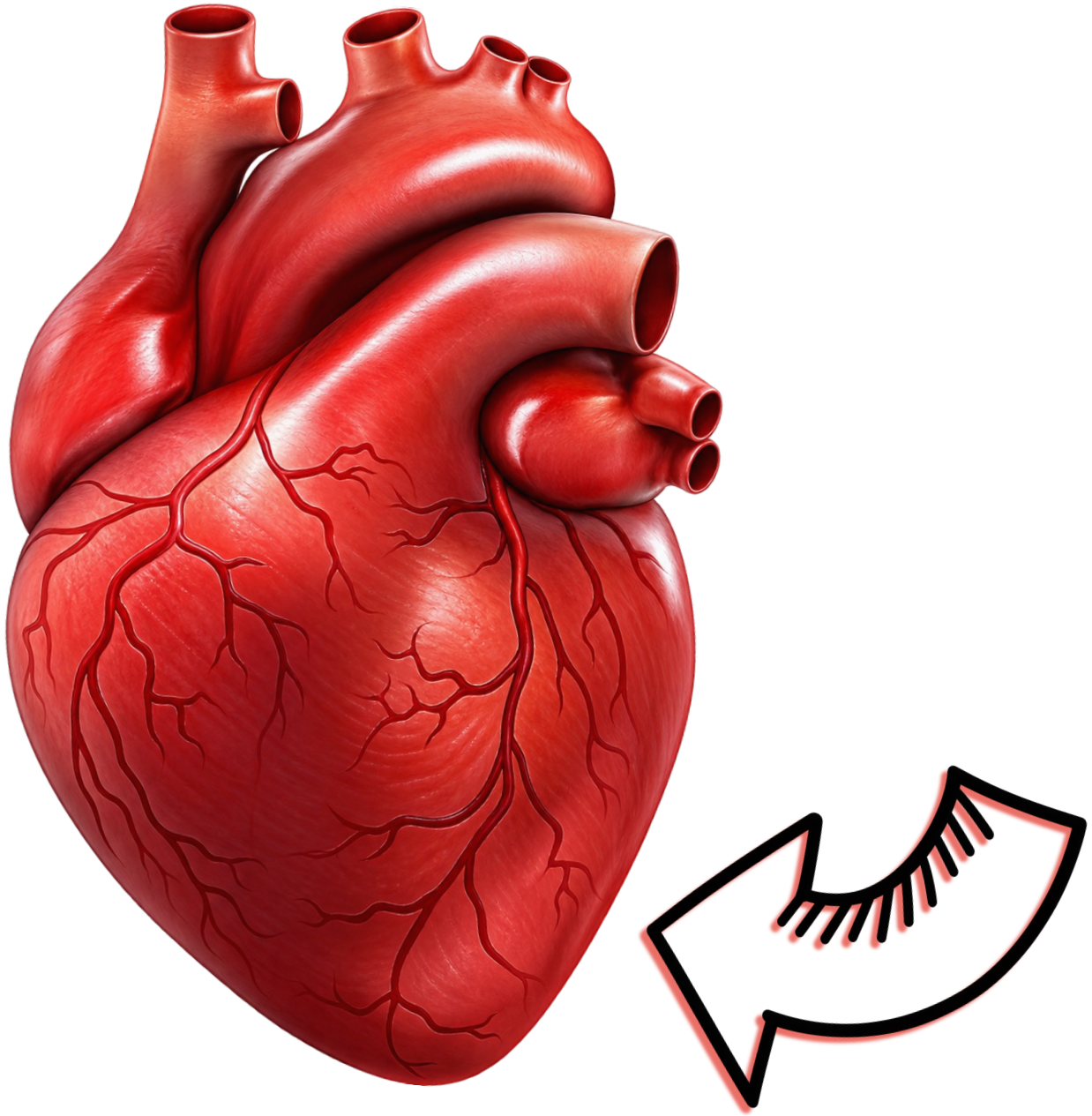


LEFT-SIDED HEART FAILURE

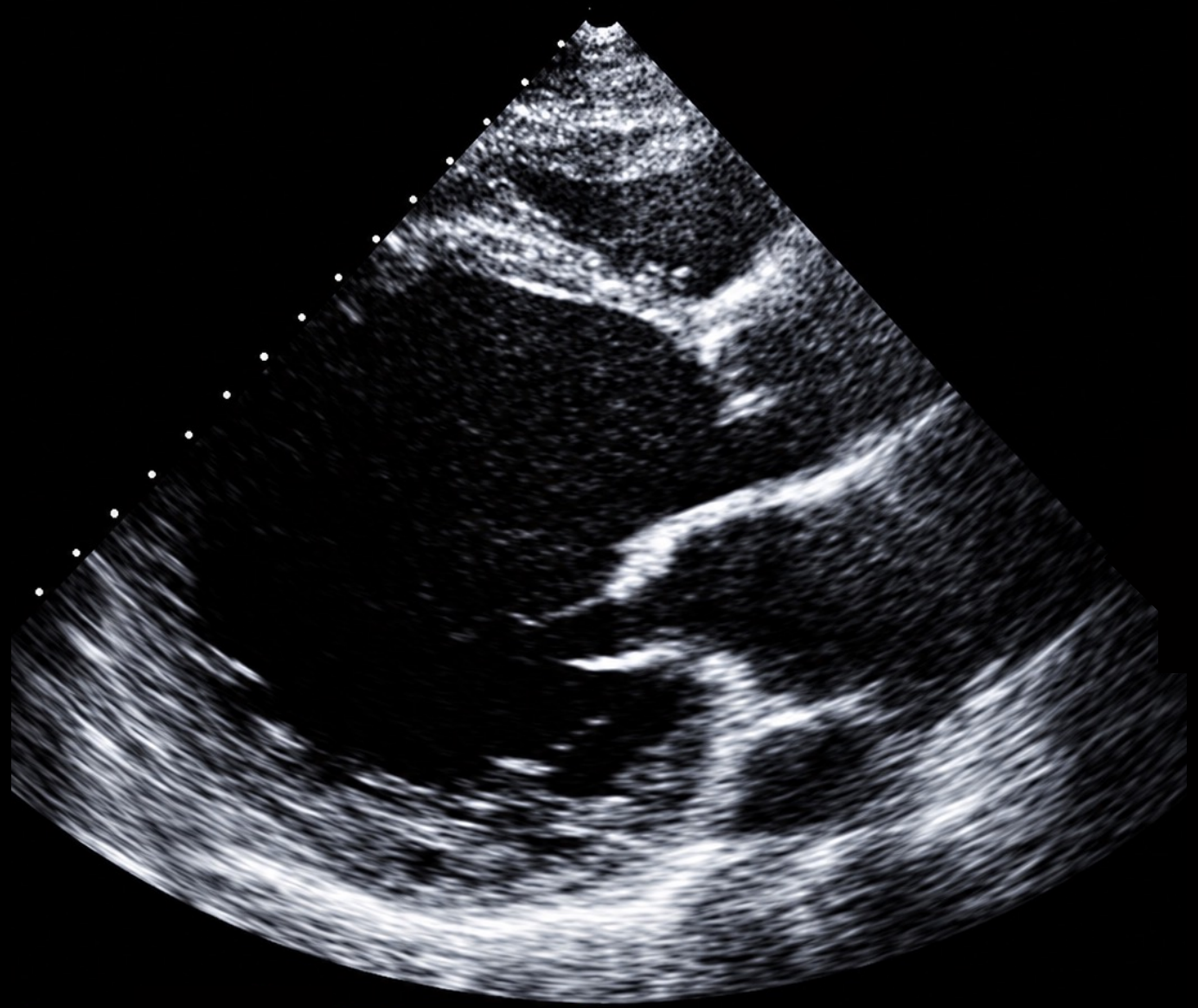
Offload LV volume

Reduce LV distention & transmural pressure

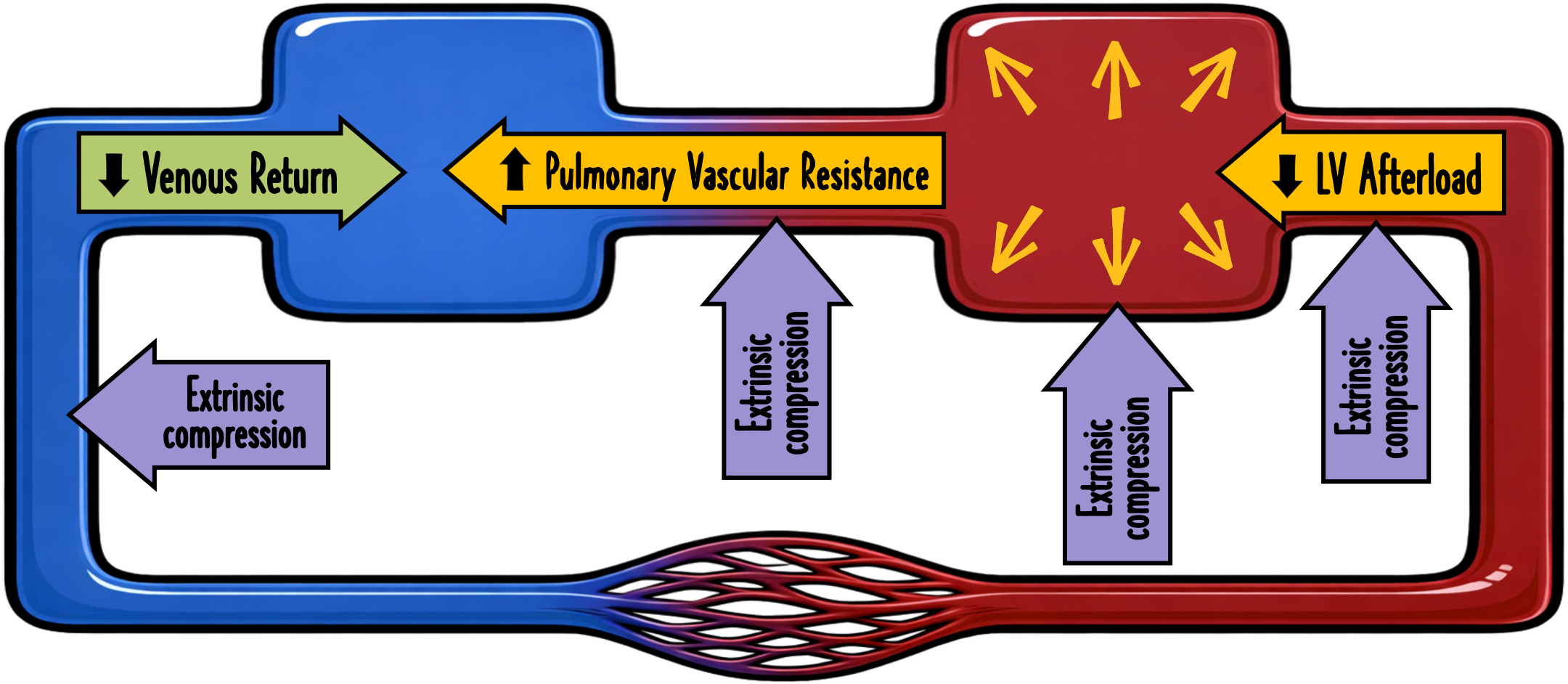
Decrease LV afterload



Needing to buy some time so we don't end up in a code situation



MITRAL & AORTIC REGURGITATION



MITRAL & AORTIC REGURGITATION

The goal is to optimize the pressure gradient by increasing upstream pressure and lowering downstream pressure

Upstream pressure is the pulmonary pressure

Downstream pressure is the LV afterload

Using positive pressure ventilation to improve the hemodynamics?

Don't forget to tell your team!

CLEAN KILL

UNHELPFUL

IT'S COMPLICATED

HELPFUL

Hemodynamic response to positive pressure ventilation can be a useful diagnostic data point

HEMODYNAMICS OF POSITIVE PRESSURE VENTILATION