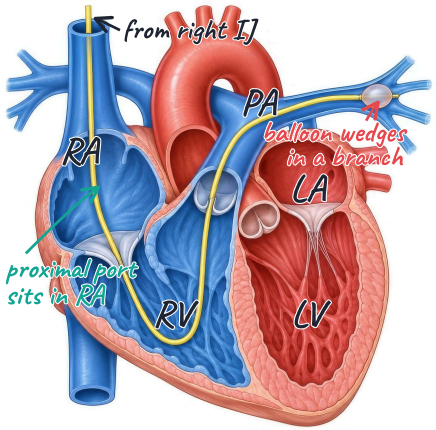
ER BASICS · ONE-PAGER

Hemodynamic Normals

Normal adult values, key formulas and how to read the waveforms behind them

21 sources + more detail
erbasics.com/sheets/hemodynamic-normals.html
checked Nov 2026

PATH Through the heart, and the ports



1 Pressure normals

Typical adult ranges.

PARAMETER	NORMAL	UNITS
HR	60–100	beats/min
MAP	70–105	mmHg
CVP / RAP	2–6	mmHg
RV	15–25 / 0–8	mmHg
PA	15–25 / 8–15	mmHg
PA mean	10–20	mmHg
PAOP (wedge)	6–12	mmHg

Preload: CVP (right), PAOP (left). Afterload: PVR (right), SVR (left). Pulmonary hypertension: mean PA above 20 mmHg since WSPH 2018; older texts use 25 or more.

2 Flow, resistance and oxygen

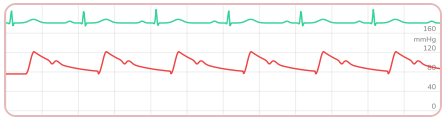
1 WU = 80 dyn·s/cm⁵; PH guidelines call PVR above 2 WU (160) high.

PARAMETER	NORMAL	UNITS
CO	4–8	L/min
CI	2.5–4.0	L/min/m²
SV	60–100	mL/beat
SVI	33–47	mL/m²/beat
SVR	800–1200	dyn·s/cm⁵
SVRI	1970–2390	dyn·s/cm⁵·m²
PVR	100–250	dyn·s/cm⁵
SvO2	60–80	%
ScvO2	About 70	%
DO2	950–1150	mL/min

- MAP = (SBP + 2 × DBP) ÷ 3
- CO = HR × SV ÷ 1000 (L/min); CI = CO ÷ BSA
- SVR = (MAP − CVP) × 80 ÷ CO
- PVR = (mean PA − PAOP) × 80 ÷ CO
- CaO2 = 1.34 × Hb × SaO2 (decimal) + 0.003 × PaO2 (17–20 mL/dL)
- DO2 = CO × CaO2 × 10
- Coronary perfusion = DBP − PAOP (60–80 mmHg)

EXAM TIP Low SvO2 or ScvO2: delivery is not meeting demand; check CO, hemoglobin, SaO2 and oxygen consumption. ScvO2 runs slightly below SvO2 in health, about 7% above it in unstable patients.

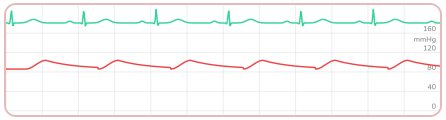
3 Arterial line and square-wave test



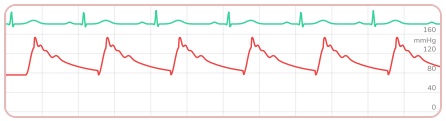
Normal: brisk upstroke, systolic peak, dicrotic notch (aortic valve closure).

Square-wave test: snap the fast flush and count oscillations before the tracing returns.

RESULT	OSCILLATIONS	ERROR
Optimal	1.5–2	None
Overdamped	Fewer than 1.5	False low SBP, high DBP
Underdamped	More than 2	False high SBP, low DBP



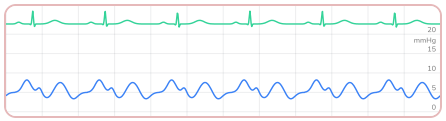
Overdamped: slurred upstroke, no notch, narrow pulse pressure. Look for air, clots, kinks or a soft flush bag (keep 300 mmHg).



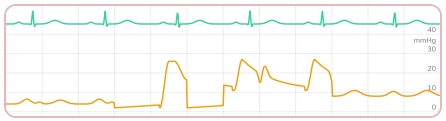
Underdamped: overshoot spike with ringing; systolic reads falsely high. Check for long or added tubing.

EXAM TIP MAP stays the most reliable number on a damped line; confirm with a cuff while you fix it.

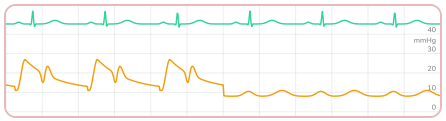
4 CVP and PA catheter waveforms



CVP: a wave after P (atrial kick), c after QRS (tricuspid closure), v just after T (atrial filling).



Insertion: RA, RV (diastolic near 0), PA (diastolic step-up, dicrotic notch), then wedge.



Balloon up: PA trace drops to wedge, mean below PA diastolic.

- PAOP estimates LA pressure and LVEDP; it reads high with mitral disease or high PEEP, low with a stiff LV.
- PAOP sits a few mmHg below PAD; a wide gap suggests high PVR. Small gap, stable patient: trend PAD and wedge less.
- Cannon a waves: AV dissociation. No a waves: atrial fibrillation.
- Giant v waves: tricuspid (CVP) or mitral (wedge) regurgitation.

SAFETY Check the PA trace before inflating; if damped, don't. Inflate slowly and stop at wedge, never past the 1.5 mL marked; wedge at under 1.25 mL suggests distal migration. Wedge 2 breaths or less (10–15 s), deflate passively, never flush while wedged. Wedge or RV trace with balloon down: catheter has moved (wedge risks infarction). Act per protocol.

5 Reading the numbers

- Level the air-fluid interface to the phlebostatic axis (4th intercostal space, midway front to back); re-level when position changes.
- Zero to air. Head of bed 0–60° is fine once leveled.
- Read at end-expiration on a frozen or printed trace, not the digital number: just before the inspiratory dip (spontaneous) or rise (ventilator).
- Read CVP and PAOP at the mean of the a wave.

SAFETY A transducer below the phlebostatic axis reads falsely high; above it reads falsely low, about 2 mmHg per inch.

6 Fluid responsiveness

- Responder: SV or CO rises more than 10% with a fluid challenge or passive leg raise (PLR).
- PLR: from 45° semi-recumbent, tilt the bed to trunk flat, legs up. Judge by SV or CO within 1–2 minutes, not BP.
- PPV above 13% or SVV above about 12% predicts response.
- PPV and SVV need controlled ventilation, no spontaneous breaths, regular rhythm, tidal volume about 8 mL/kg IBW, closed chest, normal abdominal pressure.
- SSC 2026: dynamic measures over physical exam or static values alone. Septic shock: initial MAP 65 mmHg (60–65 if 65 or older).

EXAM TIP CVP and PAOP are static and poorly predict fluid response; exams favor PLR, SVV and PPV. For shock profiles, see Shock Types. Study values only; follow your institution's protocols.

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