Swan-Ganz (PA Catheter): Waveforms, Wedge and Normal Values

Normal pressures and flows, insertion waveforms RA to wedge, safe wedging, end-expiration reads, complications and shock profiles

ICU Basics
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PA CATHETER NORMAL VALUES

A Swan-Ganz (pulmonary artery) catheter floats through the right heart into the pulmonary artery to measure right-sided pressures, wedge pressure, cardiac output and mixed venous oxygen saturation. Normal adult values: CVP 2–6, PA 15–30/8–15, wedge (PAOP) 6–12 mm Hg, cardiac index 2.5–4.0 L/min/m², SvO_2 60–80%.

PRESSURE	NORMAL (MM HG)	REFLECTS
CVP / RA	2–6	Right-sided filling
RV	15–30 / 2–8	RV systolic = PA systolic
PA	15–30 / 8–15	Pulmonary vascular load
PA mean	About 10–22	Pulmonary hypertension if high
Wedge (PAOP, PCWP)	6–12	Left atrial and LV filling

Adult ranges from Bootsma 2021 (Edwards-based). Ranges differ a little between references.

FLOW AND RESISTANCE	NORMAL	HOW IT IS FIGURED
Cardiac output	4–8 L/min	Thermodilution or continuous
Cardiac index	2.5–4.0 L/min/m²	CO ÷ BSA
Stroke volume	60–100 mL	CO ÷ HR × 1000
SVR	800–1200 dyn·s/cm⁵	(MAP – CVP) × 80 ÷ CO
PVR	Under 250 dyn·s/cm⁵	(mean PA – PAOP) × 80 ÷ CO
SvO_2	60–80%	Distal port sample or fiberoptic

EXAM TIP PCWP vs CVP: CVP is right-sided filling; wedge (PCWP, PAOP, PAWP: same number) estimates left atrial pressure. High wedge with low output points to the left heart; high CVP with a normal or low wedge points to the right heart or the lungs.

SWAN-GANZ WAVEFORMS DURING INSERTION



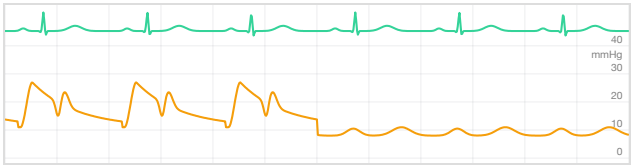
Insertion: RA, RV (diastolic near 0), PA (diastolic step-up, dicrotic notch), then wedge.

Add about 5 cm from the left internal jugular. Depths vary with body size and a dilated RV.

CHAMBER	DEPTH (RIGHT IJ)	WAVEFORM
RA	About 20 cm	Low pressure, a and v waves
RV	30–35 cm	Tall systolic, diastolic near 0 and flat or rising
PA	40–45 cm	Diastolic steps up and falls; dicrotic notch after the T wave
Wedge	About 50 cm	Low, damped trace with a and v waves

- The balloon goes up once the catheter is past the sheath (at least 20 cm in) and stays up while advancing; deflate it before pulling back.
- No RV trace by 40–45 cm, or no PA trace by 50–55 cm: deflate, pull back to about 20 cm and try again (likely coiling).
- Ectopy is common as the tip crosses the RV and settles once it reaches the PA. The catheter can cause right bundle branch block, and in a patient with left bundle branch block insertion may cause complete heart block: have pacing ready.

WEDGE PRESSURE: TECHNIQUE AND SAFETY



Balloon up: the PA trace drops to the wedge, which sits below PA diastolic.

1. Confirm a clean PA waveform first. If it is damped or already looks wedged, do not inflate.
2. Inflate with the catheter syringe only until the trace changes to wedge; never past the 1.5 mL the balloon holds.
3. Read at end-expiration on a frozen or printed trace, at the end of the a wave (just before the QRS).
4. Deflate as soon as the reading is taken, following your unit's technique, and confirm the PA trace returns. If it does not, the catheter may need pulling back about 2 cm.
5. Never flush the distal port while wedged.

SAFETY Wedge at well under 1.5 mL, a wedge trace with the balloon down, or a pressure that keeps climbing: the catheter has migrated. Do not inflate; pull back per policy or call. New hemoptysis after wedging suggests PA rupture, an emergency.

READING AT END-EXPIRATION

- At end-expiration, pleural pressure is closest to atmospheric, so CVP, PA and wedge are read there in every patient.
- Breathing on their own: just before the pressure dips with inspiration. On the ventilator: just before it rises with the breath.
- The digital number averages the whole breath and can be wrong; use the graphic trace, ideally next to the airway pressure or capnography waveform.
- Level the transducer to the phlebostatic axis and zero it, the same as an arterial line.
- PEEP of 10 cmH_2O or more makes CVP and wedge overread true filling; note the PEEP with every reading.

CARDIAC PROFILES BY SHOCK TYPE

After Bootsma 2021; SVR follows from SVR = (MAP – CVP) × 80 ÷ CO. Mixed and late shock blur these patterns.

SHOCK	CI	CVP	WEDGE	SVR	SvO_2
Hypovolemic	↓	↓	↓	↑	↓
Cardiogenic (LV)	↓	↑ or normal	↑	↑	↓
Obstructive (PE, tamponade)	↓	↑	↑ in tamponade, normal or low in PE	↑	↓
Distributive (septic, early)	↑ or normal	↓ or normal	↓ or normal	↓	↑ or normal

EXAM TIP On exams, find the CI first (pump), then the wedge and CVP (which side is full), then SVR (squeeze). A high SvO_2 fits distributive shock; a low SvO_2 means delivery is not meeting demand.

PA CATHETER COMPLICATIONS

WHEN	COMPLICATION
Insertion	Arrhythmias (usually brief), RBBB or complete heart block, pneumothorax, arterial puncture, air embolism
While in place	Line infection (mostly at the sheath), thrombosis, migration
Balloon	Pulmonary infarction from a persistent wedge; PA rupture (0.1–0.8%, often fatal); balloon rupture

PA rupture is more likely with older age, female sex, pulmonary hypertension, anticoagulation, hypothermia (a stiffer catheter) or a catheter advanced too far. Remove the catheter when its numbers no longer change care.

Sources (4) are listed with links at icubasics.com/sheets/pa-catheter.html. For education and exam preparation only. Not medical advice; follow current guidelines and your institution's protocols. ICU Basics is an independent study aid not affiliated with any certifying body.