ECMO Essentials

VA vs VV, the circuit, monitoring, troubleshooting and ECPR for CCRN, CMC, CSC and transport exams

VA VS VV AT A GLANCE

FEATURE	VV	VA
Supports	Lungs only	Heart and lungs
Circuit vs heart	In series; native heart must pump	In parallel; bypasses heart and lungs
Typical use	ARDS P/F <80 despite proning; pH <7.25 + $PaCO_2$ ≥60	Refractory cardiogenic shock, ECPR, massive PE, poisoning
Cannulation	Fem + IJ, or dual-lumen RIJ	Fem-fem; axillary; central post-op
Usual SaO_2	Often 80–90%	Check right radial (femoral VA)
Contraindication	No exit plan (no recovery)	Severe AR; aortic dissection

EXAM TIP Exam favorite: VV supports only the lungs; a failing heart needs inotropes or conversion to VA.

THE CIRCUIT AND ITS CONTROLS

Drainage → pump → oxygenator (with heater) → return. Pre-pump tubing is under negative pressure: an open port pulls in air.

CONTROL	MAIN EFFECT
Blood flow (pump RPM)	Main oxygenation lever; on VA, also MAP
Sweep gas flow	CO_2 removal: more sweep, lower $PaCO_2$
FdO_2 (gas blender)	Post-oxygenator PO_2; lower on VA to avoid hyperoxia

EXAM TIP Exams pair blood flow with O_2 and sweep with CO_2. Lower a high $PaCO_2$ slowly: a drop over 50% near cannulation is linked to brain injury.

MONITORING AND ANTICOAGULATION

- Drainage pressure more negative at same RPM = poor drainage; pump hemolysis beyond –300 mm Hg
- Post-oxygenator PO_2 over 300 mm Hg on FdO_2 1.0 = working membrane
- VA: pulse pressure shows native ejection; drainage sat reflects SvO_2 (aim over 66%)
- Limb NIRS over 50% (ideally 60%), under 20% side-to-side gap
- VA wean signs: pulse pressure >10, MAP >65 at 2–2.5 L/min, minimal pressors

LAB	EXAM VALUE
Anti-Xa on UFH	0.3–0.7 IU/mL
aPTT	About 60–90 s (center-specific)
Plasma free Hb	Under 10 mg/dL; over 50, find the cause
Other hemolysis clues	↑LDH, ↑indirect bilirubin, ↓haptoglobin, pink urine

UFH is usual; bivalirudin or argatroban if HIT. High free Hb, bilirubin or lipids falsely lower anti-Xa. Follow your institution's protocols.

COMPLICATIONS

PROBLEM	CLUES	RESPONSE
Bleeding	Oozing, GI bleed, new neuro change	Pressure; hold or reduce heparin per protocol
Thrombosis	Circuit clots, ↑ΔP, ↑D-dimer	Flashlight checks; component change
Limb ischemia (VA)	Cool, pale leg; low NIRS	Distal perfusion cannula (6–8 Fr) at cannulation
North-South or Harlequin (femoral VA)	Low R-hand SpO_2, pink legs; heart better, lungs not	Optimize vent, then V-AV; VV once heart recovers
LV distension (VA)	Pulse pressure <10, closed aortic valve, lung edema	Inotrope, less flow; IABP, Impella or septostomy vent
Air embolism	Bubbles, detector alarm	Stop pump, clamp near patient

SAFETY Air or decannulation: stop the pump, clamp the lines near the patient, set emergency vent settings, call the ECMO team; press on bleeding sites. On VA, support stops and a stopped pump can flow backward: prepare for CPR and pressors.

TROUBLESHOOTING

FINDING	LIKELY CAUSE	FIRST MOVES (ECMO TEAM)
Chatter, falling flow	Hypovolemia, bleeding, tamponade, cannula position	Lower RPM, give volume, treat cause
Low post-oxygenator PO_2	Gas line off, blender error, failing membrane	Check gas connections; plan change-out
Rising ΔP (transmembrane pressure)	Clot if flow falls at same RPM; else check transducer	Trend flow; coags, free Hb
VV hypoxemia, good membrane	Recirculation, high CO, fever, agitation	Check pre-oxygenator sat; reposition; lower O_2 demand
Pink urine, ↑free Hb	Pump clot, high suction	Find and fix the source

EXAM TIP Recirculation: bright red drainage blood, high pre-oxygenator saturation, and SaO_2 that falls as flow rises.

NURSING CARE AND TRANSPORT

- Routine circuit checks: flows, pressures, sweep, FdO_2, flashlight; clamps at the bedside
- Cannulas secured in 2+ places; check sites; minimize punctures
- Neuro checks every 1–4 h with pupils; distal pulses (Doppler), color, NIRS
- Heater masks fever: watch WBC, hemodynamics and sites
- VV lung rest: plateau ≤25 cm H_2O, PEEP ≥10, low rate
- Transport: gas for the whole trip, backup power, hand crank, clamps
- Pump and oxygenator at patient level; trace lines before, during and after moves; plan heat

ECMO IN CPR (ECPR)

- AHA (2a, 2023, still current): reasonable for refractory arrest in select patients within a trained, equipped system
- AHA 2025: reasonable to set selection criteria, use experienced percutaneous cannulators, regionalize (2a); intra-arrest transport may be considered for highly selected OHCA (2b)
- Better outcomes: bystander CPR, shockable rhythm, intermittent ROSC or signs of life, short low-flow time
- Also 2a in 2025: pregnancy, PE, hypothermia, refractory poisoning, anaphylaxis, cath lab arrest
- ELSO: consider after 10–15 min of failed CPR, cannulate after 10–20 min, flow within 60 min; CPR continues until flow ≥3 L/min
- After ECPR: right-arm arterial line, SpO_2 92–97%, MAP ≥60 but <80; watch for LV distension

Sources (14) are listed with links at icubasics.com/sheets/ecmo.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.