

ECMO-related Complications

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Patient-related

- Bleeding/thrombosis
- Limb ischemia
- Neurologic complications
- AKI/ infection

Circuit-related

- Hemolysis
- Oxygenator dysfunction
- Pump/circuit failure
- Air embolism

Physiology-related

- LV distension/pulmonary edema
- Differential hypoxemia
- Inadequate drainage/ECMO flow
- Recirculation

Common Complications

common complications

Bleeding & Thrombosis

GI bleeding
Intracranial hemorrhage
Cannulation site
Surgical bleeding
Psoas muscle, ...

Circuit / oxygenator
Intracardiac thrombosis
Systemic embolism
Stroke



Bleeding



Thrombosis

Bleeding & Thrombosis

Management of bleeding

- Minor → Local hemostasis; assess anticoagulation intensity and consider dose reduction
- Major → Temporarily hold UFH, control the bleeding source, and correct coagulopathy

Spontaneous muscle bleeding



Embolization preferred ;surgery reserved for refractory bleeding or compressive complications

Stroke & ICH

Neurologic monitoring & early detection

Daily sedation review — lighten when safe
Neuro checks every 1–4 h, based on risk
GCS · pupils · motor symmetry

New neurological change → urgent brain CT

Confirmed ICH

hold anticoagulation & control BP

Urgent neurology / neurosurgery consultation

Repeat brain CT; reassess anticoagulation restart

New focal deficit

activate stroke team; **CTA**

Large-vessel occlusion → assess for thrombectomy

Optimize cerebral perfusion; individualize anticoagulation

Stroke & ICH



Confirmed

hold anticoagulation & control BP

Urgent neurology / neurosurgery consult

Repeat brain CT; reassess anticoagulation

Awake ECMO

→ assess for thrombectomy
perfusion; individualize anticoagulation

Limb ischemia

Incidence and Risk Factors of Limb Ischaemia in Adult Patients Receiving Veno-Arterial Extracorporeal Membrane Oxygenation: A Systematic Review and Meta-Analysis

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Meta-analysis, 17 studies

N= 2,812

DPC: mixed

Limb ischemia: 16.9%

RESEARCH

Open Access

Fluoroscopy-guided simultaneous distal perfusion as a preventive strategy of limb ischemia in patients undergoing extracorporeal membrane oxygenation



Woo Jin Jang¹, Yang Hyun Cho², Taek Kyu Park³, Young Bin Song³, Jin-Oh Choi³, Joo-Yong Hahn³, Seung-Hyuk Choi³, Hyeon-Cheol Gwon³, Eun-Seok Jeon³, Woo Jung Chun¹, Ju Hyeon Oh¹ and Jeong Hoon Yang^{3*}

Ann. Intensive Care (2018) 8:101

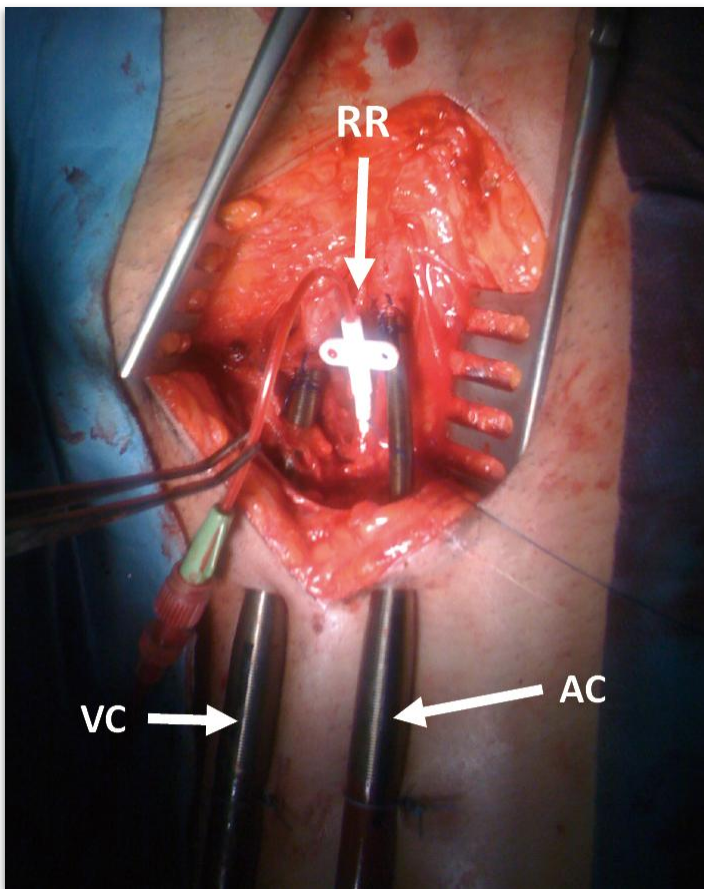
Multicenter, retrospective study

N= 230

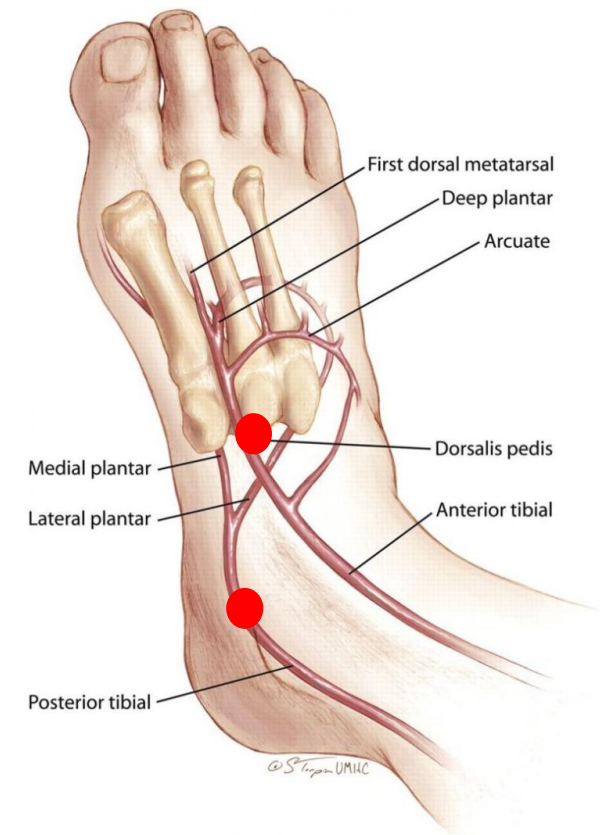
DPC: simultaneous vs provisional

Limb ischemia: 2.1% vs 8.2%

Distal perfusion



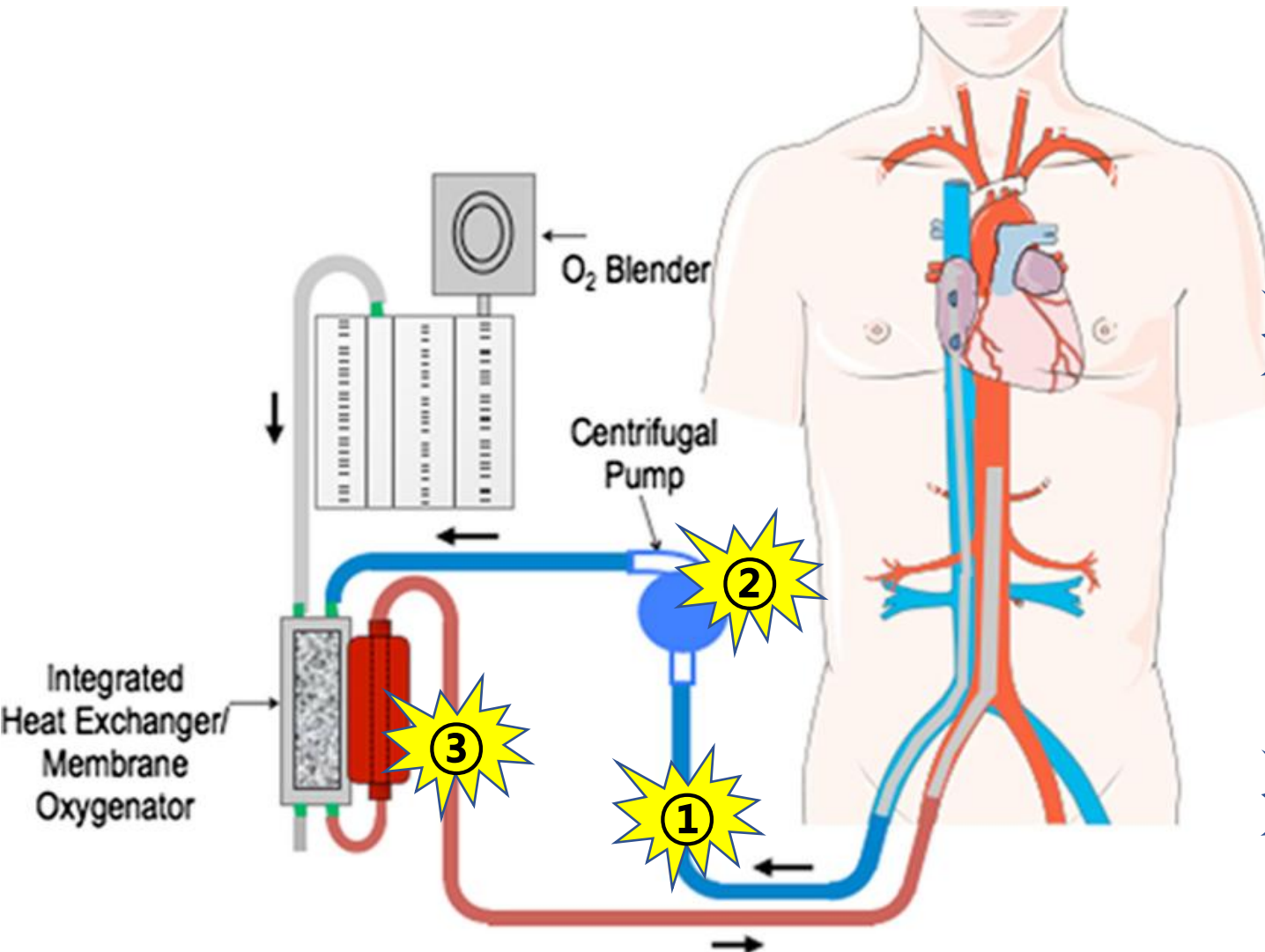
Limb perfusion assessed
→ color, temperature,
stiffness, NIRS, doppler



Circuit Problems

Circuit Problems

ECMO flow suddenly low?



①

Drainage insufficiency

- Hypovolemia / bleeding
- Tamponade
- Cannula malposition / obstruction
- Tubing kinking

②

pump dysfunction / failure

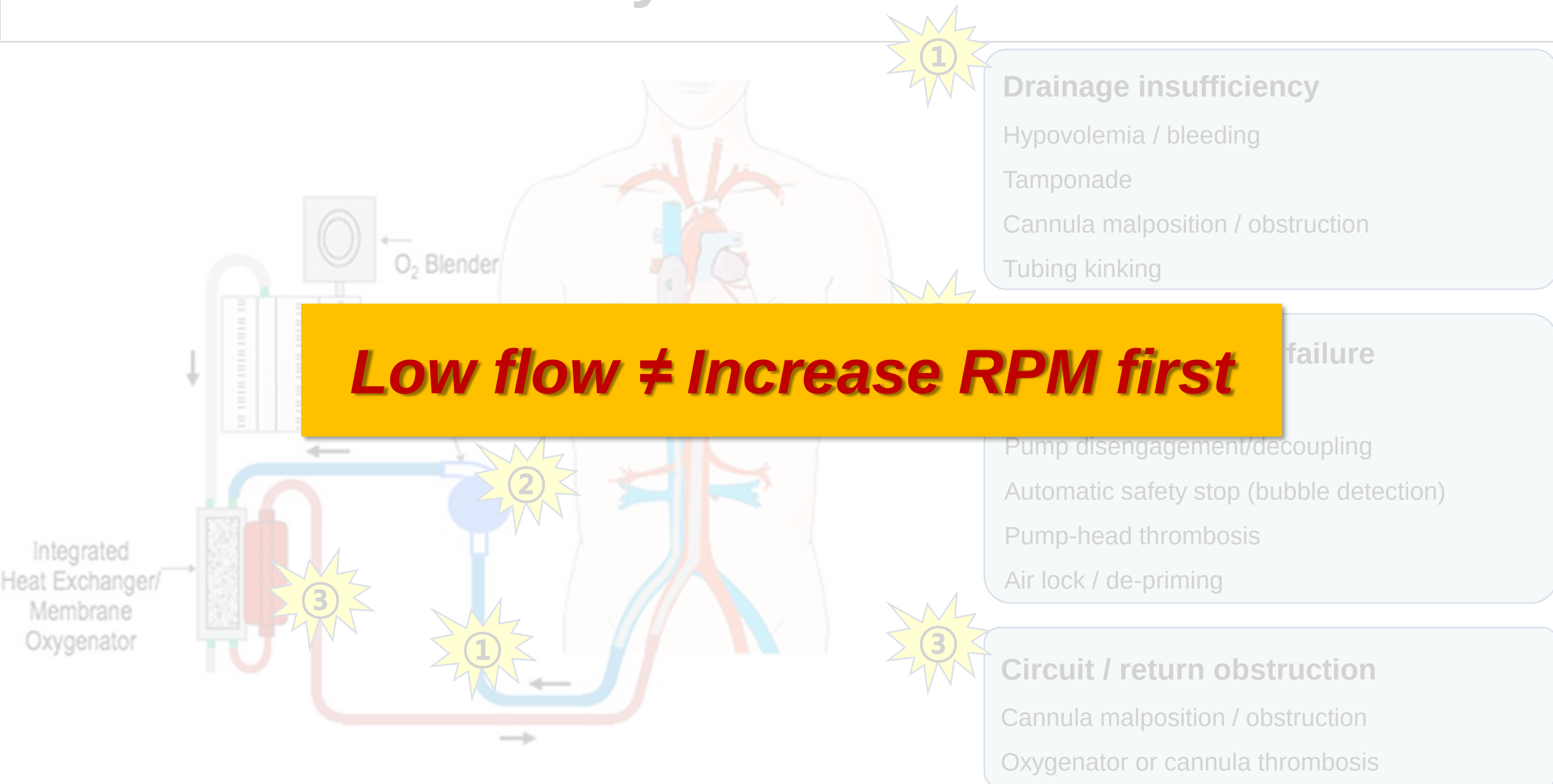
- Motor/drive failure
- Pump disengagement/decoupling
- Automatic safety stop (bubble detection)
- Pump-head thrombosis
- Air lock / de-priming

③

Circuit / return obstruction

- Cannula malposition / obstruction
- Oxygenator or cannula thrombosis

ECMO flow suddenly low?



Hemolysis & Oxygenator failure

Hemolysis

- Excessive negative drainage pressure, pump / circuit thrombosis
- Plasma-free Hb, LDH ↑
- Hemoglobinuria, hematuria

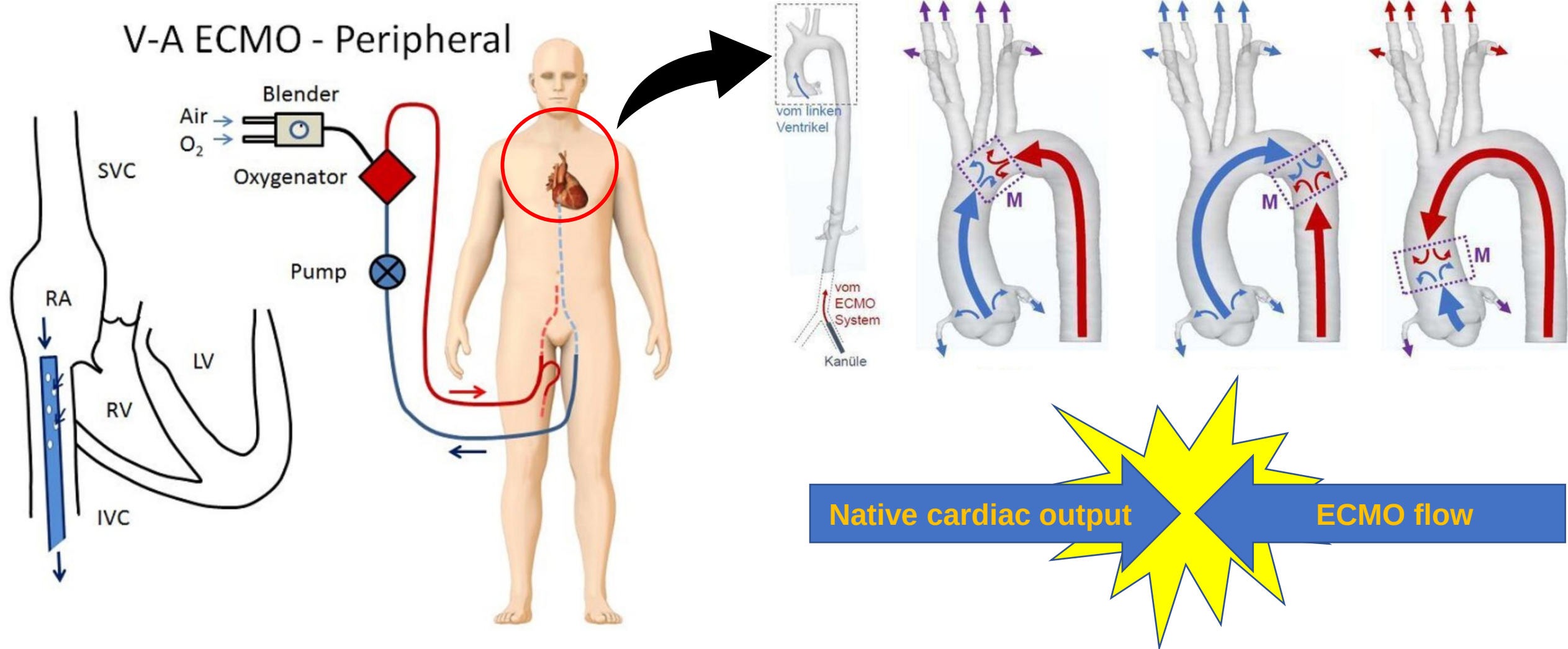
Oxygenator dysfunction

- Thrombus / fibrin deposition
- r/o gas supply failure
- Post-oxygenator PaO₂ ↓

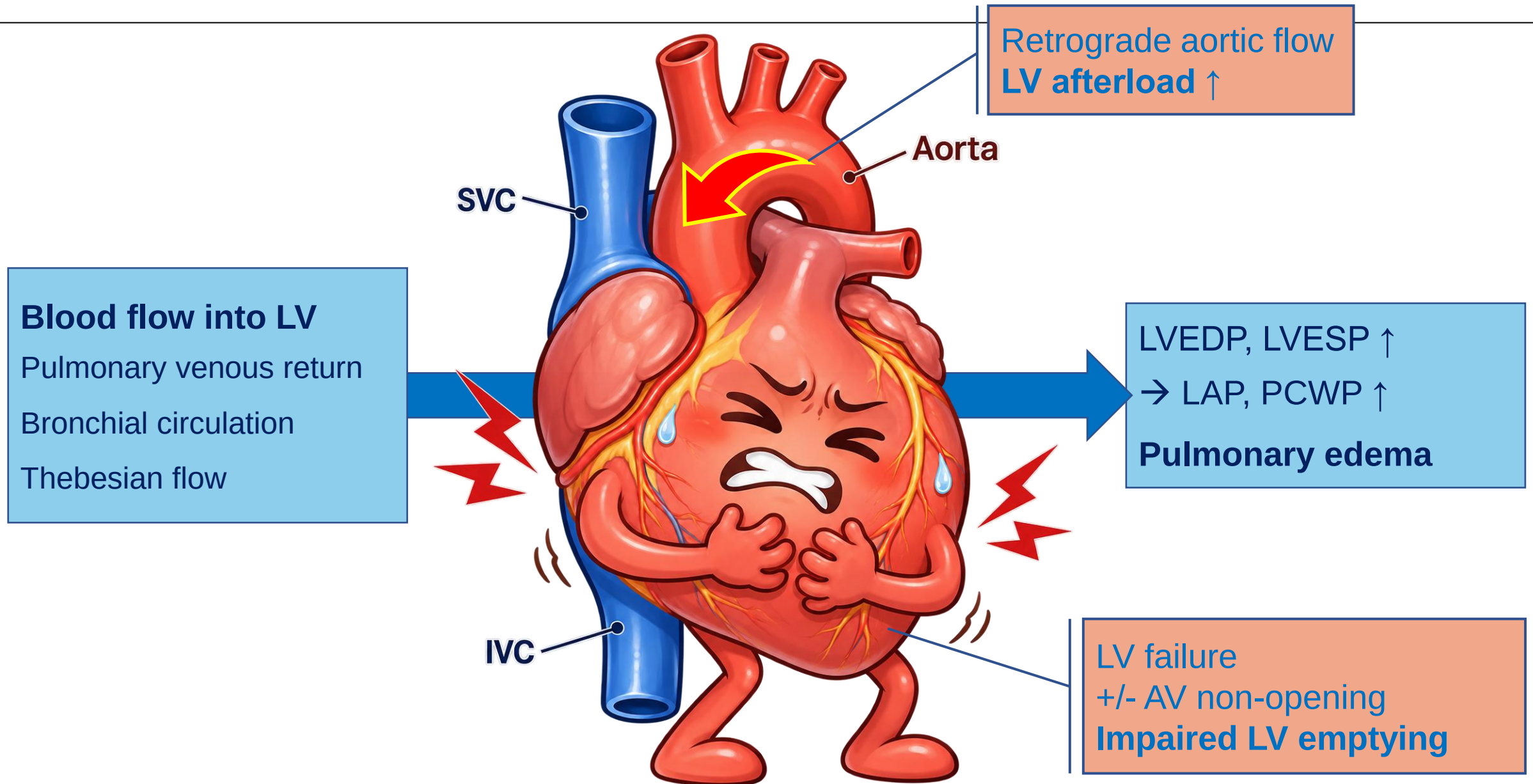
Physiology-related Complications

Physiology-related complications

VA-ECMO changes normal physiology



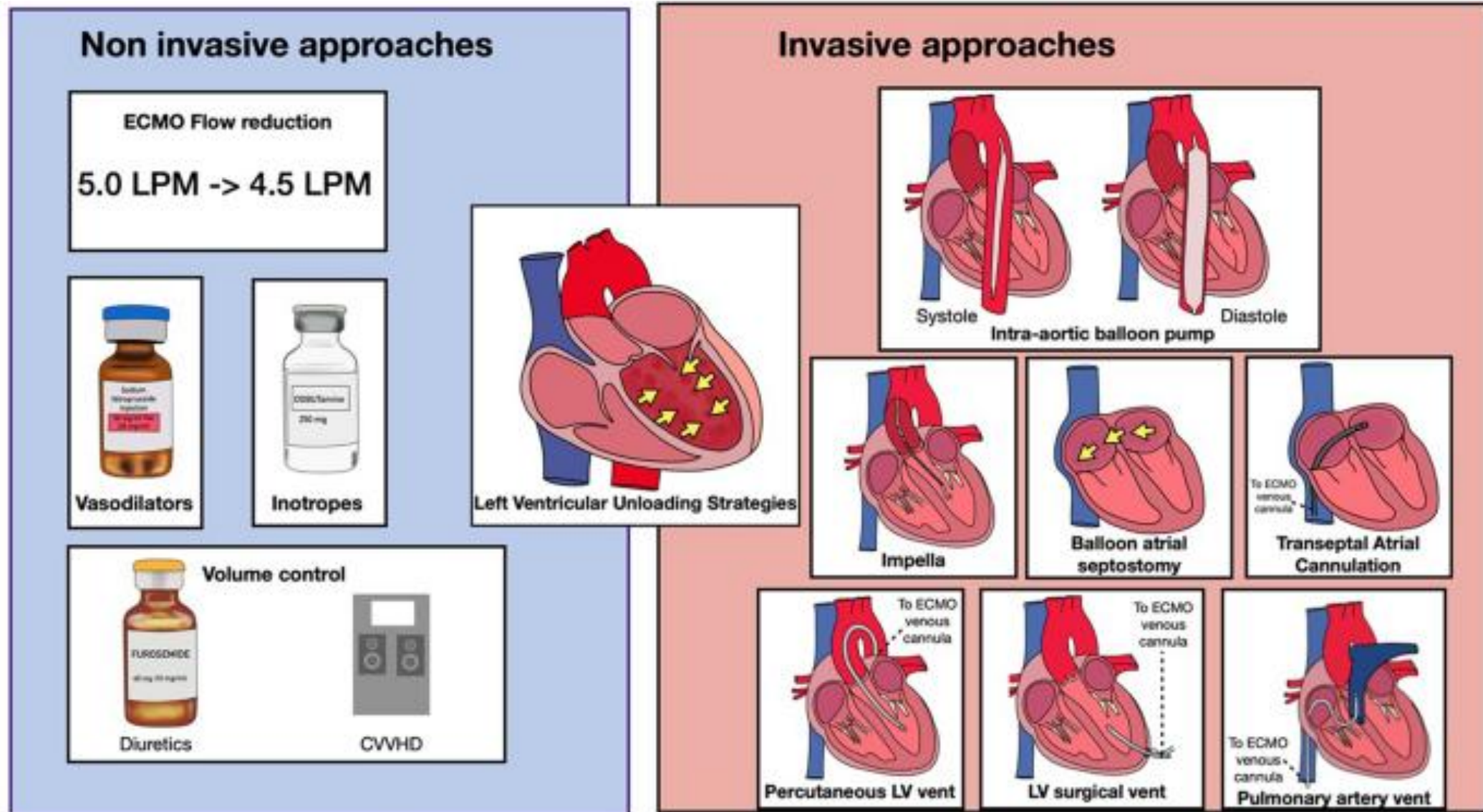
LV distension



Warning signs of LV distension



LV decompression



The legs are pink, but the brain is blue

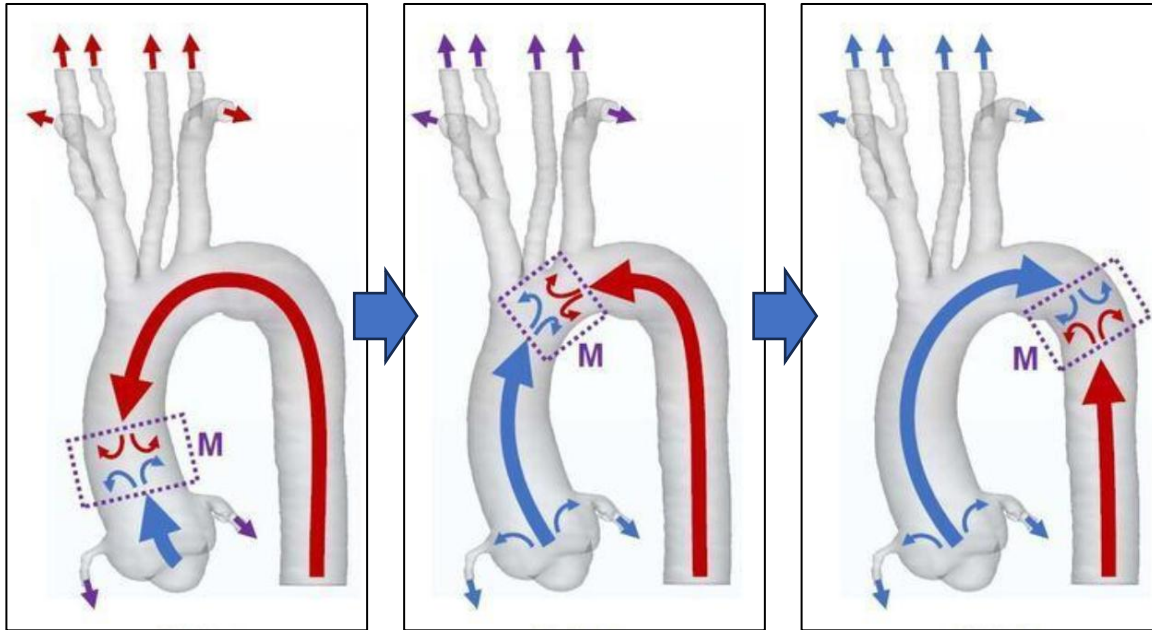
75세 남자, STEMI에 의한 cardiogenic shock으로 ECPR 시행하였으며, PCI 후 ICU 로 전원

Intubation & mechanical ventilator support, peripheral VA ECMO state (LPM 4.0)

입원 당일 I/O 약 5000 positive, pulse pressure 10mmHg 미만, CXR 상 pulmonary edema 있고 AV opening 확인되지 않아 femoral vein 통한 LA venting 시행함

다음날, pulse pressure 20mmHg 이상 확인, 그러나 Rt. Radial artery 통해 시행한 ABGA 상 PaO₂ 55mmHg 확인되고 post-oxygenator ABGA 상 PaO₂ 300mmHg이었음

Differential hypoxemia



Harlequin syndrome / North–South syndrome

Heart recovers **BEFORE** lungs recover

Native cardiac output $\uparrow$



Poorly oxygenated LV blood travels farther into ascending aorta



Mixing point moves distally



Brain & coronary arteries receive hypoxemic blood

But,

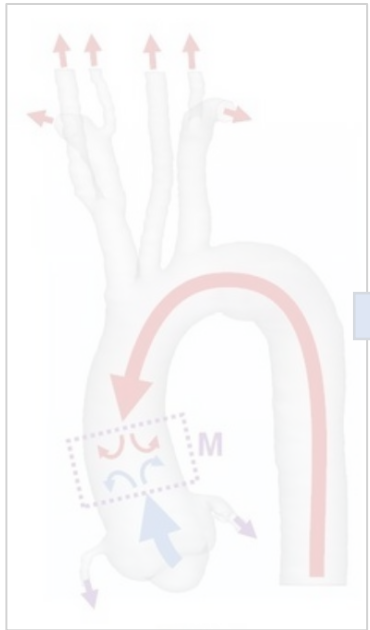
Lower body receives highly oxygenated ECMO blood

Differential hypoxemia

Heart recovers **BEFORE** lungs recover

Native cardiac output ↑

farther into



Right Arm
Right radial arterial line
Right radial ABGA

Harlequin syndrome / North–South syndrome

Brain & coronary arteries receive hypoxemic blood

But,

Lower body receives highly oxygenated ECMO blood

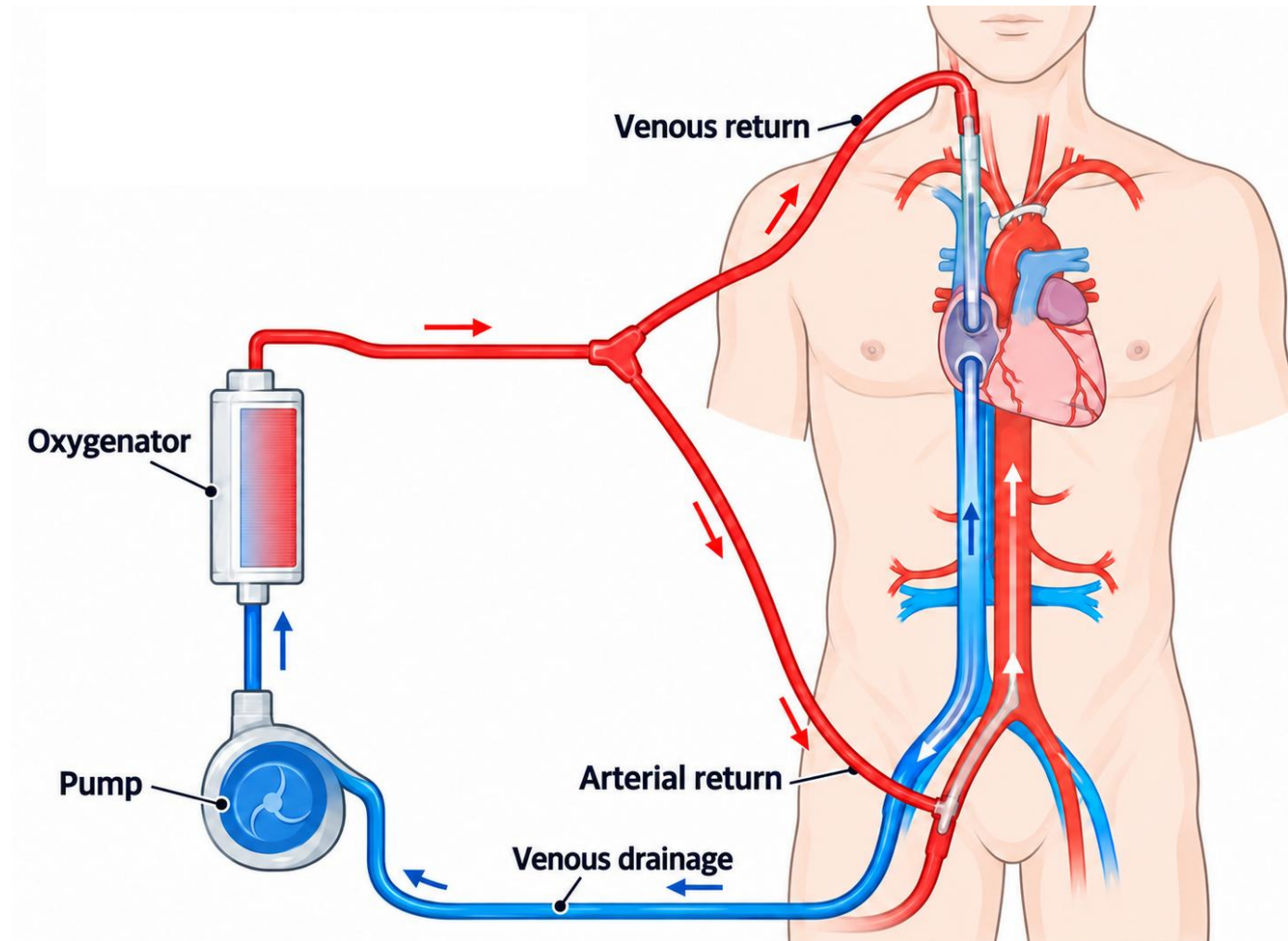
Differential hypoxemia

First: Improve the lung

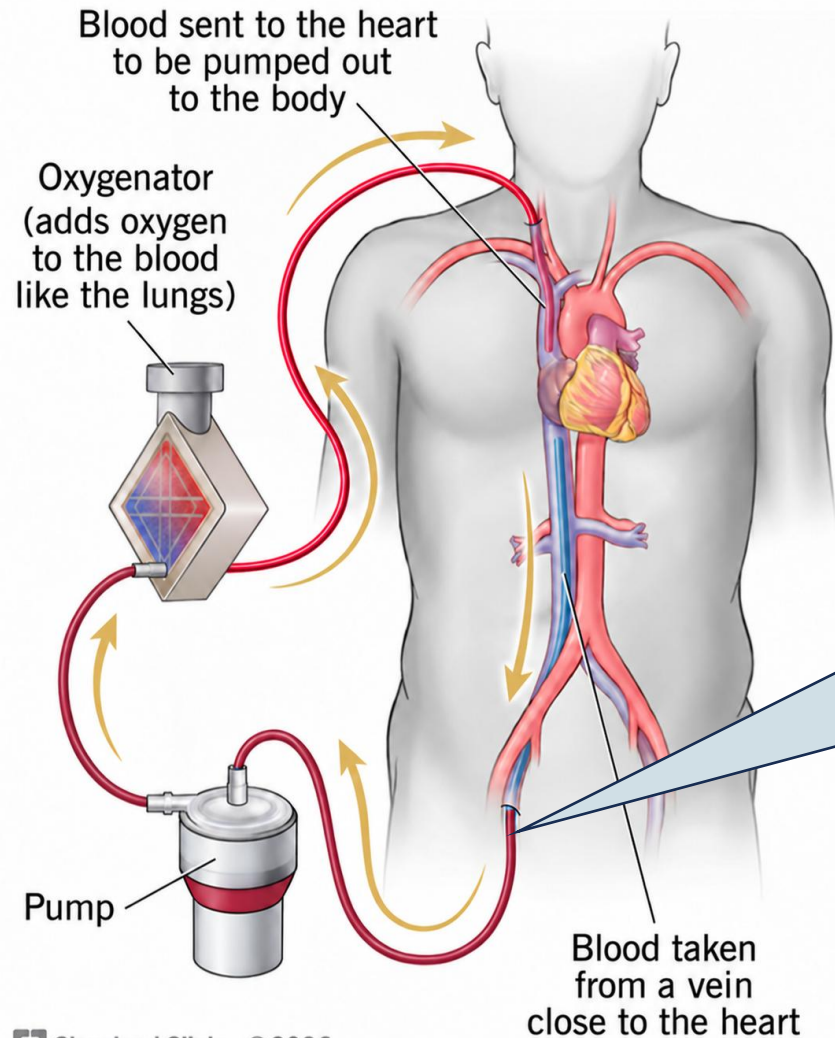
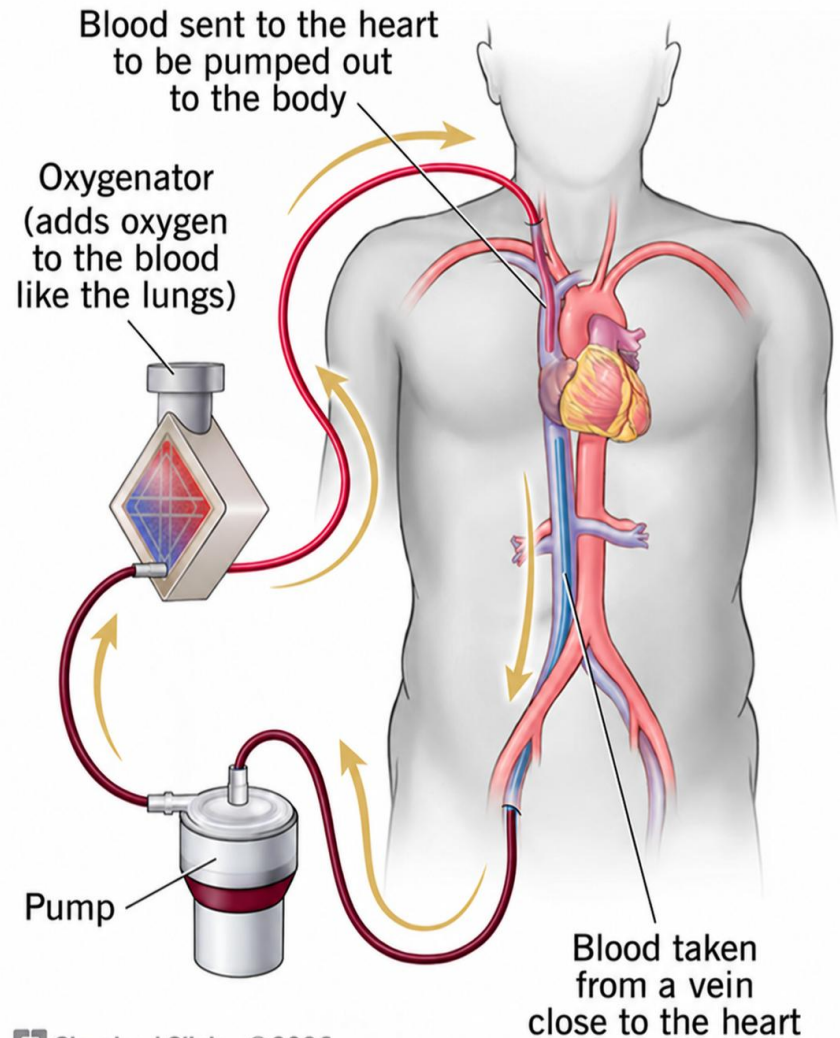
- Ventilator optimization
- Recruitment: position, PEEP
- Bronchoscopy if indicated
- Treat pulmonary edema

Modify ECMO configuration

- Convert to VAV-ECMO
- Consider alternative arterial return sites

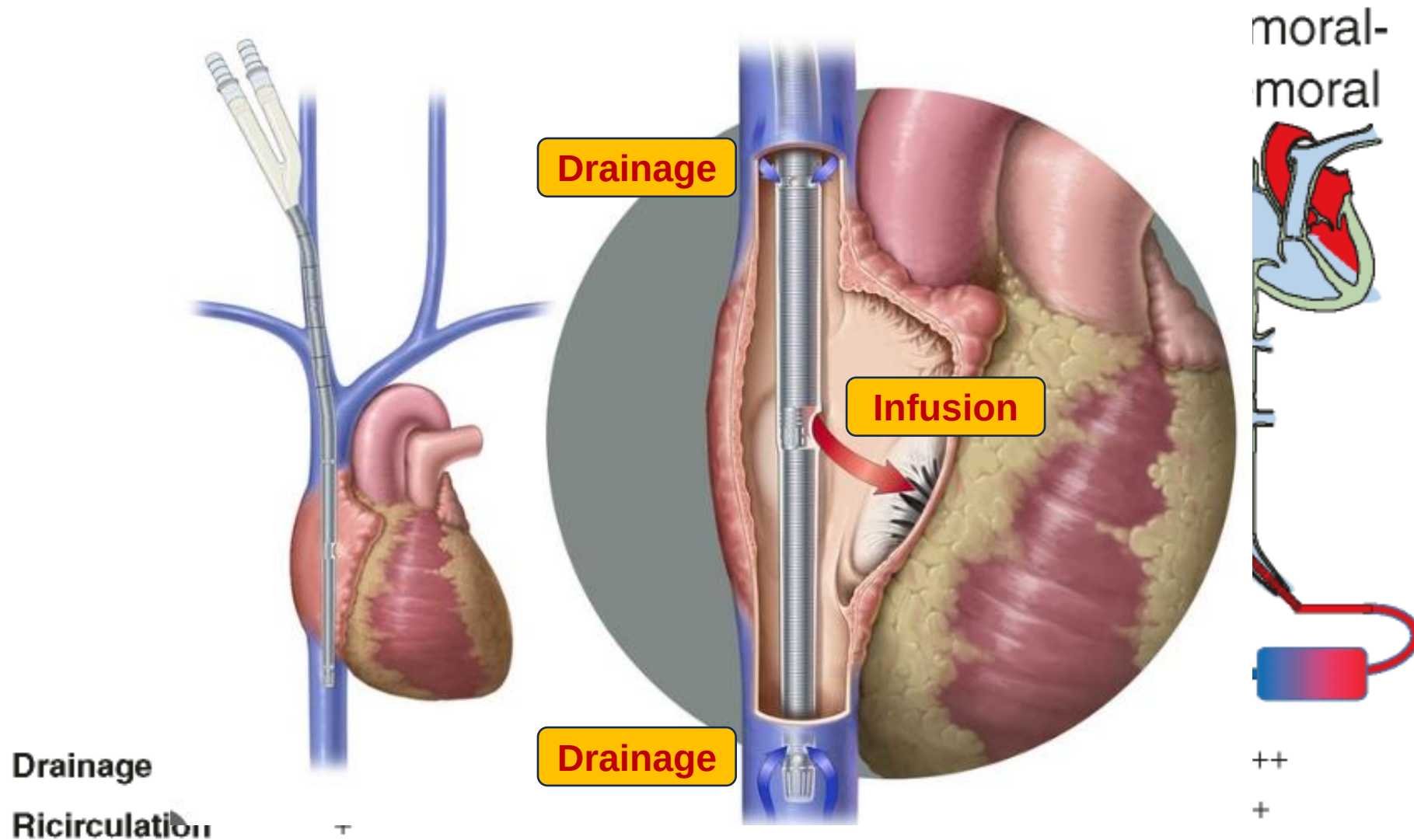


VV-ECMO: Recirculation

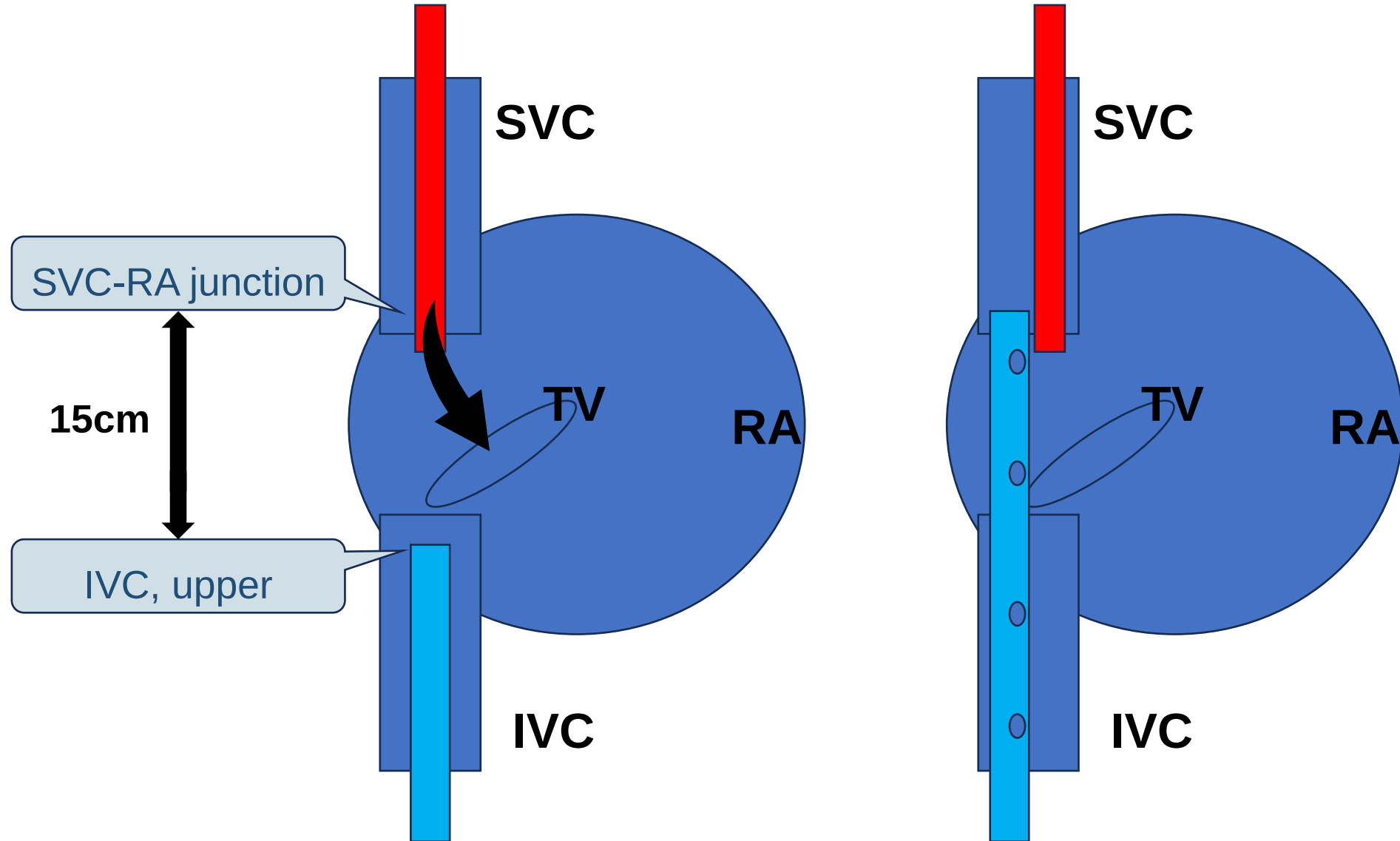


Cannula malposition / too close
High ECMO flow
Reduced or disturbed native
venous return

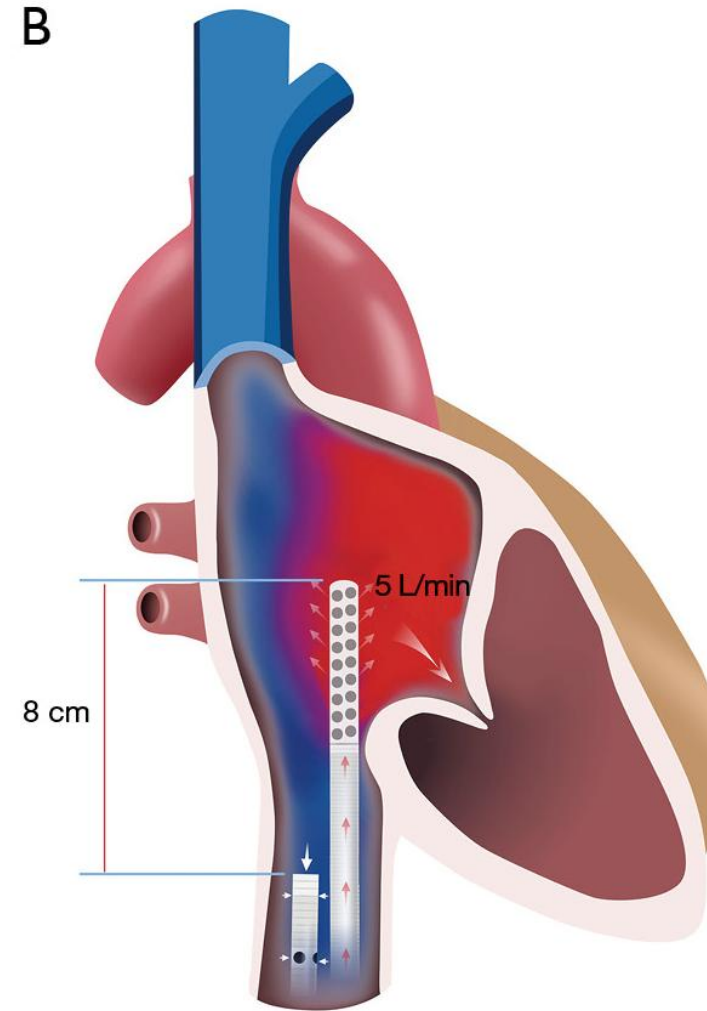
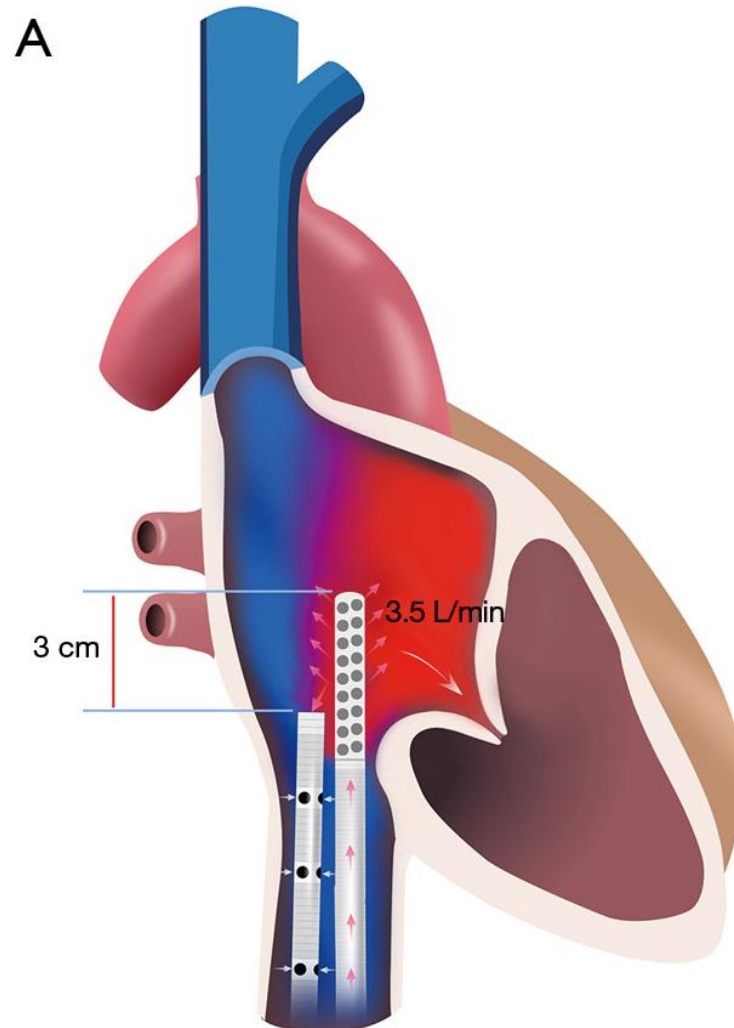
VV-ECMO: Recirculation



VV-ECMO: Recirculation



VV-ECMO: Recirculation



When the ECMO Patient Suddenly Deteriorates

When the ECMO Patient Suddenly Deteriorates

Troubleshooting checklists

Physiology

LV distension?
Differential
hypoxemia?
Recirculation?

Patients

Bleeding?
Tamponade?
Pneumothorax?
Sepsis?

Circuit

Pump?
Oxygenator?
Thrombus?
Hemolysis?

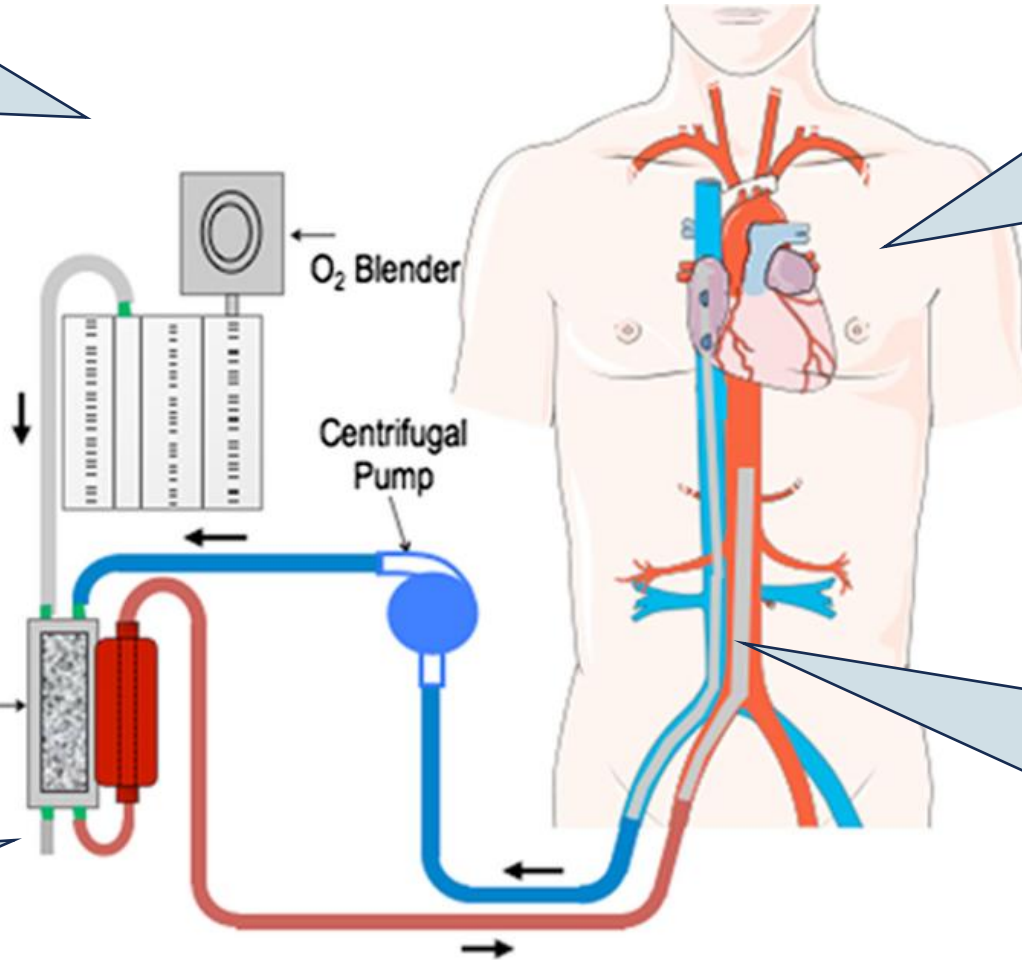
Integrated
Heat Exchanger/
Membrane
Oxygenator

O₂ Blender

Centrifugal
Pump

Cannula

Position?
Kinking?
Drainage?



Take-Home messages

Look beyond ECMO parameters.

Take a comprehensive approach.

Early recognition is the key to preventing catastrophic outcomes.

Before troubleshooting, UNCOVER the patient.

THANK YOU

THANK YOU

References

- Extracorporeal Life Support: The ELSO Red Book. 6th ed. Ann Arbor, MI: Extracorporeal Life Support Organization; 2022. Google Books
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