

Femoral Vessel Access for Potential ECMO Sheath Cannulation in Three Patients with Cardiopulmonary Disease

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INTRODUCTION

Extracorporeal membrane oxygenation (ECMO) is a highly specialized and resource-intensive therapy that requires a multidisciplinary team of experts in critical care, cardiac surgery, perfusion, and nursing.

The decision to initiate ECMO should be based on careful patient selection and evaluation of the risks and benefits of the therapy.

In the obstetric population, initiating ECMO can be challenging because of complex physiology and unique considerations related to pregnancy and delivery.

Pre-operative evaluation and planning are paramount to for prompt and effective ECMO support.

We will describe three parturients who underwent CD and were evaluated for potential ECMO support pre-operatively. The decision to place ECMO sheaths was based on the patients' underlying cardiac or pulmonary pathology and the anticipated risk of acute decompensation during or after delivery.

Our goal:

- Highlight the importance of careful patient selection and evaluation of the risks and benefits of ECMO support in the obstetric population.
- Emphasize the need for prompt activation of the ECMO team and timely initiation of therapy

CASE 1: Repaired Tetralogy of Fallot

History of Present Illness:

- 31 year-old G1P0 scheduled for CD
- PMH: repaired TOF with moderate pulmonary hypertension; bilateral pulmonary atresia (left lung approximately 15% perfusion compared to her right lung).
- Patient suffered a cardiac arrest approximately one year prior to her CD
- Right heart catheterization demonstrated low-normal cardiac index, absent left pulmonary artery flow and mild stenosis in her right pulmonary artery stent; underwent balloon angioplasty to right stents. MPAP ~55mmHG. AICD was placed.
- TTE: Normal biventricular function with mild stenosis and mild regurgitation of her pulmonic valve.

Periopeartive Course:

- Line placement: modified CSE, large-bore PIVs and arterial line; ECMO team cannulated left femoral artery and vein with 20g angiocath.
- Epidural ineffective after delivery of fetus → conversion to GA: etomidate, high-dose opioid, and succinylcholine → patient remained stable.
- Surgery proceeded with complication, patient remained stable, and was safely extubated in the operating room.
- Transferred to the ICU for management of her cardiopulmonary status and femoral artery and vein cannulations.
- The patient remained stable in the ICU overnight, her femoral cannulations were removed, and she was transferred to the post-partum ward where she remained stable until discharge on post-operative day 3.

CASE 2: HFrEF and Ventricular Tachycardia

History of Present Illness:

- 27 year-old G2P1001 scheduled for her second CD
- PMH: HTN, HFrEF 30-35% (developed after first pregnancy)
- Holter monitor → ST, polymorphic ventricular tachycardia, PVC burden of 5% → placed on external defibrillator → 37 beats of ventricular tachycardia when the patient was sleeping without shock from vest (3rd trimester)
- TTE Significant findings:
 - Mild LV dilation, reduced LVEF 30-35%.
 - Mild-mod global hypokinesis of the left ventricle; inferolateral wall being severely hypokinetic.
 - Mild-mod MR.

Periooperative Course:

- Line placement: CSE, 9Fr introducer CVP in RIJ, Swan-Ganz catheter, arterial line, two 20g angiocatheters into the right femoral artery and vein.
- After delivery, patient's central venous rose from 15mmHg to 35mmHg without resulting hypotension.
 - 10mcg epinephrine IV x3 to improve cardiac inotropy and promote forward flow; the patient's central venous pressure improved back to baseline.
- The rest of the patient's intraoperative course was uneventful and she was safely transported to the cardiac intensive care unit.
- We followed up with the patient the following day and her cardiopulmonary status remained stable. She was safely transferred to the post-partum recovery ward on post-operative day 2.

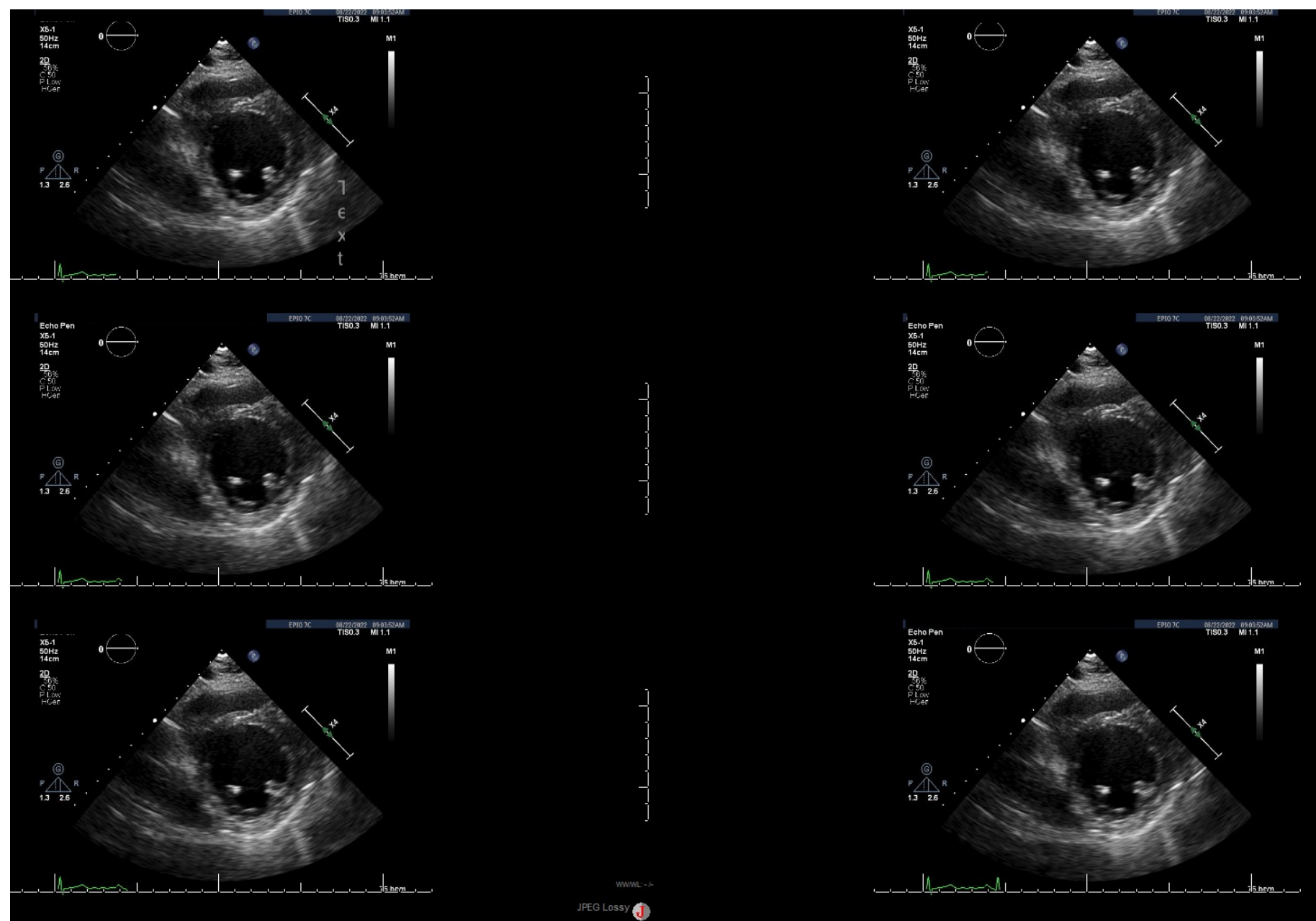
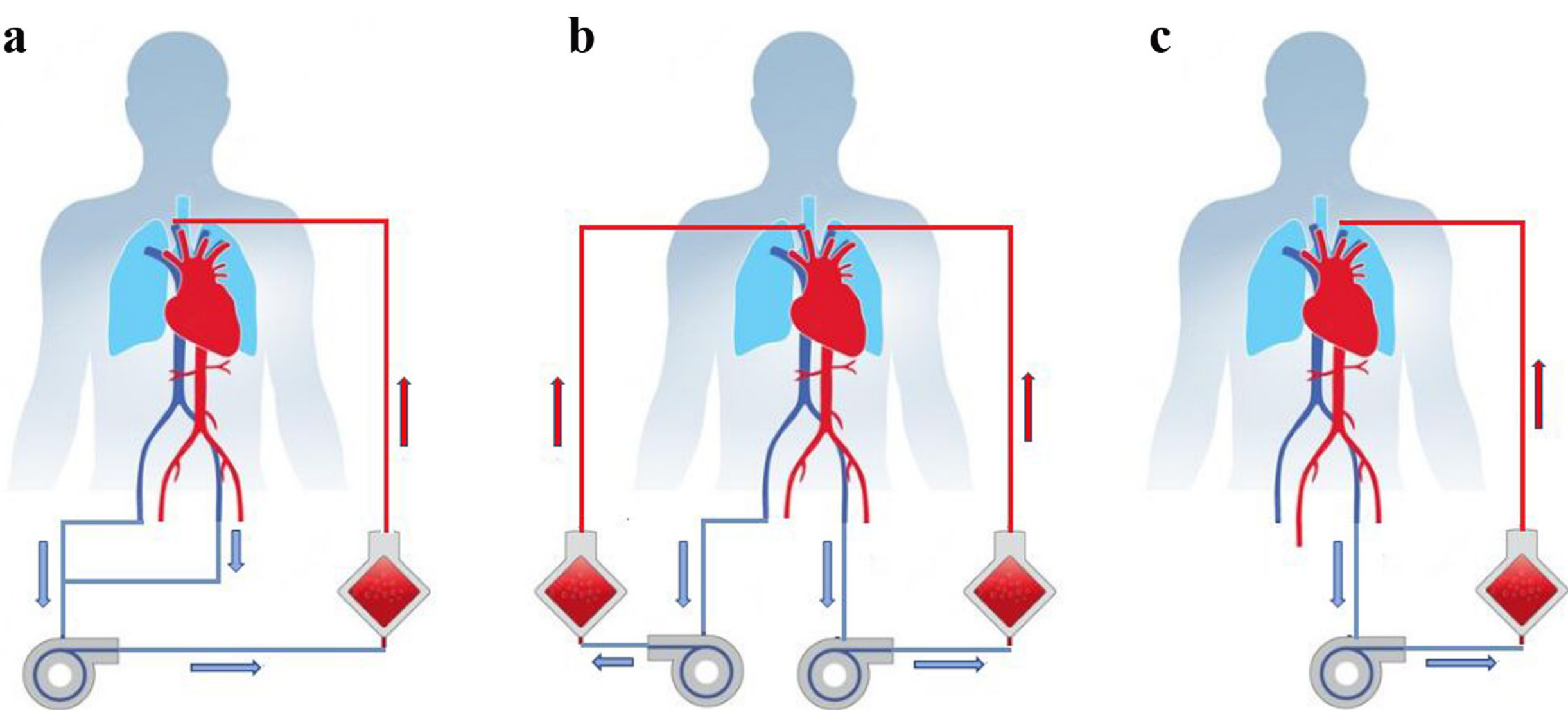
CASE 3: Cystic Fibrosis

History of Present Illness:

- 21 year-old G1P0 scheduled for primary CD
- PMH: CF homozygous with severe lung disease, chronic hypoxic respiratory failure and pancreatic insufficiency.
- Patient required oxygen 4L/min while sleeping → increased to 2-3L/min oxygen during day time in pregnancy.
 - Patient was not able to lay supine 2/2 shortness of breath; she would sleep with two pillows in the lateral decubitus position.
- Pre-partum spirometry: FEV1 of 21%-27% (baseline 33%)
- TTE: normal biventricular systolic and diastolic function; trace pulmonic valve and mitral valve regurgitation, and an elevated right ventricular systolic = 26mmHg.

Periooperative Course:

- Schedule for CD at 34 weeks gestation
- Line placement: CSE, large-bore PIVs, arterial line, femoral vessel cannulation via the ECMO team.
- The pulmonology team and respiratory therapists were present in the operating room to assist with chest physiotherapy or bronchoscopy, if needed.
- The delivery proceeded without complication and the patient remained stable throughout the surgery without the need for general anesthesia or ECMO.
- She was transferred the ICU post-operatively for further hemodynamic monitoring and management of ECMO cannulation.



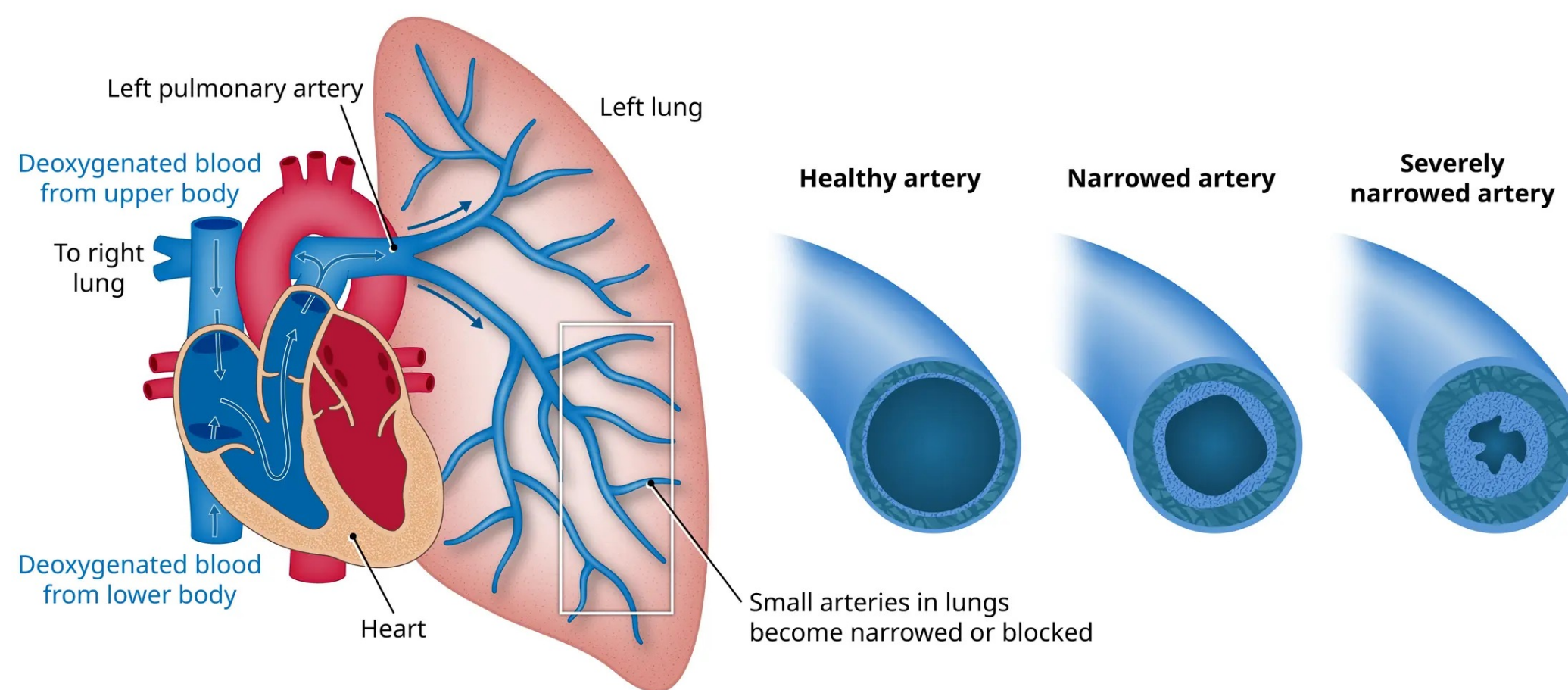
DISCUSSION

- ECMO has been effective in treating obstetric patients during ARDS, cardiogenic shock, and cardiac arrest¹.
 - Survival rate = 77.8% (35 of 45) for mothers and 65.1% (28 of 43) for fetuses.
- Venovenous (VV) and venoarterial (VA) ECMO are the two most employed therapeutic modes².
- ECMO for severe ARDS → lower morbidity and mortality compared to those not placed on ECMO³.
- The Extracorporeal Life Support Organization (ELSO) indicate the consideration of ECMO for acute severe cardiac or pulmonary failure when there is a 50% mortality risk; indicated in most clinical scenarios when there is an 80% mortality risk⁴.
- In the obstetric population, difficult to accurately predict who will require ECMO initiation intraoperatively
- CD and autotransfusion: 500cc - 750cc of blood delivered from uteroplacental capacitance vessels into maternal circulation⁵:
 - In the healthy parturient, CV system compensates for increase → maternal cardiac output 10-20% above pre-delivery levels for 24 to 48 hours.
 - In those with poor ventricular systolic / diastolic function, or pulmonary hypertension, increase in right-ventricular preload leads to acute HF.
- Activation of VA/VV ECMO may not be prompt enough to prevent maternal morbidity and mortality⁶:
 - Cannulation via US may prove to be difficult and cause iatrogenic injury, and cut down to vessels may delay ECMO initiation
 - Vascular complications major cause of mortality in ECMO patients: survival to discharge rates for patients on ECMO was 18% and 49% in patients with and without vascular complications, respectively.
 - Limb ischemia is the most common acute and late vascular complication: 10% to 70% of patients undergoing VA ECMO.
 - Other vascular complications include dissection, pseudoaneurysm formation, groin infection and retroperitoneal bleeding.
- Our cases prove to allow for an effective access point for ECMO sheath placement and aim to decrease vascular complications leading to increased maternal morbidity and mortality.

ACKNOWLEDGEMENTS & REFERENCES

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Pulmonary Arterial Hypertension



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Cystic Fibrosis

