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An Introduction to Extracorporeal Membrane Oxygen

Background:

Extracorporeal membrane oxygenation (ECMO) is a circuit that provides **support for respiratory and/or cardiac function**. It was first used successfully in the early 1970s. Various case reports and RCTs have evaluated ECMO throughout that time with **mixed results**. In 2009, placing patients on ECMO led to increased survival during the H1N1 pandemic. Currently, ECMO has regained popularity with its use during cardiac arrest known as extracorporeal CPR (**ECPR**). A recent prospective, observational trial in Japan by the SAVE-J Study Group, Sakamoto T, et al., demonstrated significant 1 and 6 month positive neurological outcomes following the use of ECPR during cardiac arrest (VF/pulseless VT) compared to conventional resuscitation. Typically, the use of ECPR should be considered **10-15 minutes into the cardiac arrest**. Many ECPR centers consider patients to be eligible for ECPR after 10 minutes with failure of standard cardiac arrest care.

Indications:

Patient selection for the initiation of ECMO in acute cardiac or pulmonary failure is based on one these disease processes having a **potentially reversible cause**. For example, it is used for: a bridge to cardiac transplantation, LVAD, Pa02/Fi02 <100, hypercapnic respiratory failure with an ABG pH less than 7.2, refractory cardiogenic shock, cardiac arrest, and failure to wean from bypass.

Contraindications:

ECMO **shouldn't be initiated in patients where anticoagulation is contraindicated (intracranial injury, recent surgery) and the cause of respiratory or cardiac failure is irreversible**. Relative contraindications include patients mechanically ventilated for greater than 7 days or there is a contraindication to cardiac transplant or LVAD initiation.

Circuits:

The two main types of ECMO are venovenous (VV) ECMO and venoarterial (VA) ECMO. VV ECMO is indicated in patients with **hypoxemic or hypercapnic respiratory failure with PRESERVED cardiac function**. In VV ECMO, deoxygenated blood is extracted **from the vena cava which is then oxygenated and returned to the right atrium**. Typically multisite areas of venous cannulation are used: the **IJ and Femoral veins**. In contrast, VA ECMO is indicated in **severe cardiac failure unresponsive to conventional therapy, combined respiratory and cardiac failure and ECPR**. **Femoral vein combined with femoral arterial** cannulation are the most commonly accessed sites. VA ECMO uses the **vena cava to remove deoxygenated blood which is then oxygenated and returned via retrograde infusion into the femoral artery**. MAP and perfusion in VA ECMO are both determined by the flow rate, intrinsic cardiac output and vascular resistance. In the image below, A demonstrates VV ECMO and B represents VA ECMO.

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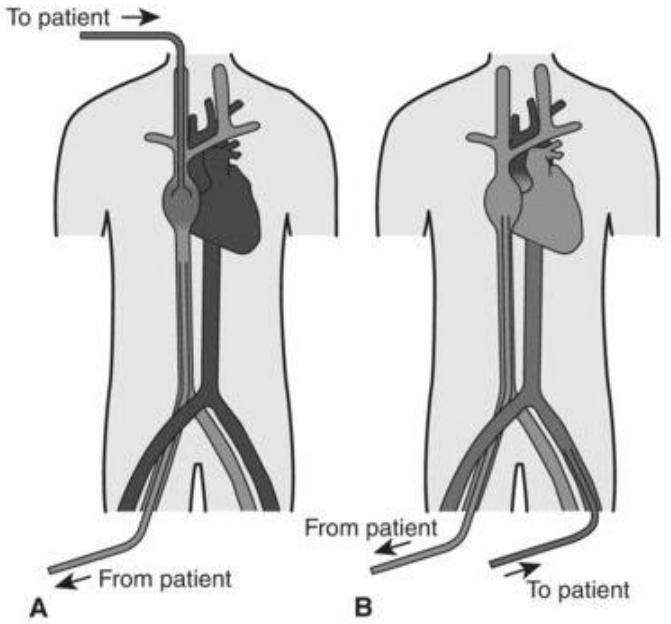

Complications:

Thromboembolism, bleeding, arterial dissection, ischemia, HIT, cardiac thrombosis, pulmonary hemorrhage, decreased ventricular output in VA ECMO.

Management:

After cannulation, blood flow is increased to attain certain hemodynamic goals: Sa02 >90 % for VA ECMO or >75% for VV ECMO, venous Saturation 70-80% on VA ECMO, adequate arterial blood pressure and blood lactate level. Oxygen Saturations should be monitored in both upper and lower extremities during VA ECMO due to blood infusion into femoral artery via the circuit. Venous oxyhemoglobin saturation can be improved by increasing flow rate, volume, and hemoglobin concentration.

ECMO cannulae are easily coagulable. Because of this, anticoagulation with the use of **heparin** requiring monitoring of activated clotting time (ACT) of aPTT should be followed. Direct thrombin inhibitors can also be used. Platelets should be monitored with transfusion recommendations between **20,000-100,000** as they are actively consumed during ECMO. Ventilator settings include goals of plateau pressures <20 and Fi02 <0.5.

Further Work:

An RCT comparing conventional therapy in cardiac arrest to ECPR could have a profound impact on the use of this modality in the sickest patients seen in the both the ED and ICU.

Works Cited:

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