ECMO was originally developed to treat neonatal respiratory insufficiency. It was quickly applied to infants with myocardial dysfunction following cardiac surgery. Indication for ECMO includes acute life-threatening low cardiac output due to any number of causes that have failed medical therapy including; myocardial dysfunction, arrhythmias and systemic to pulmonary artery shunt occlusion. In addition, ECMO support can be applied to patients with acute pulmonary insufficiency due to meconium aspiration, congenital diaphragmatic hernia and other causes. ECMO supports end-organ function until pulmonary and/or myocardial function improves. Among the advantages of ECMO are its ability to conform to atypical anatomy and the presence of specialized care teams that are familiar with the ECMO circuit who are able to provide standardized care. The disadvantages of ECMO include the need for anticoagulation with the associated risks of bleeding and thromboembolism and short duration of support. Although there are notable exceptions, the duration of support possible with ECMO is typically about 2 weeks.

ECMO is a closed cardiopulmonary bypass system. Venous drainage is accomplished with a cannula placed in a large vein, such as the jugular or femoral vein or directly in the right atrium. The blood is then pumped through a membrane oxygenator with heat exchanger to permit temperature regulation. Blood returns to the patient via a cannula placed in a large artery, such as carotid or femoral or directly into the aorta. In the patient with myocardial dysfunction in the immediate postoperative period, cardiac cannulation is typical; venous drainage is via a cannula in the right atrium and arterial inflow via a cannula in the aorta. In other patients undergoing ECMO support, peripheral cannulation is commonly used.

For neonates and infants this is typically accomplished using the common carotid artery and internal jugular vein. For older patients the femoral vessels are more commonly used. Unlike conventional cardiopulmonary bypass there is no venous reservoir and the patient acts as the reservoir. Excessive negative venous pressure could result in air entrainment into the circuit. In order to prevent air embolism, a safety mechanism called a “bladder box” is included which temporarily suspends pump function if the inlet pressure becomes dangerously low. ECMO increases afterload to the left (systemic) ventricle. In the face of severe myocardial impairment, the systemic ventricle can become distended which impairs myocardial blood flow and will prevent myocardial recovery. In cases of cardiac cannulation, as is typically used in the postoperative period, a vent or drainage cannula can be placed into the systemic ventricle. This cannula can be connected to the venous limb of the ECMO circuit. In cases of peripheral cannulation, left sided decompression can be accomplished via an atrial septal defect (ASD) created in the cath lab. Should left atrial drainage via the ASD prove inadequate, a vent can be introduced via peripheral venous cannulation and directed into the left (systemic ventricle). This cannula is then connected to the venous limb of the ECMO circuit.

ECMO has more recently been applied in a rescue modality where cannulation is accomplished while the patient is being resuscitated. A smaller simplified circuit that has low priming volume is used. It is fully assembled and ready to prime or is pre-primed with crystalloid solution. This modality is used to allow for transition from CPR resuscitation to ECMO as quickly as possible. A traditional ECMO setup requires 30 to 45 minutes to assemble while the simplified circuit is ready for immediate use.