



Evaluation & Management of a Patient Requiring Extracorporeal Life Support (ECLS)

Description of the Activity	Extracorporeal life support (ECLS) is necessary in reversible conditions when additional pulmonary or cardiac support is required. A pediatric surgeon is expected to have expertise in indications and contraindications for ECLS; techniques for cannulation; strategies for anticoagulation, especially during procedures; prevention and management of complications; and readiness for decannulation.
Functions	❖ Nonoperative/Preoperative ➤ Define indications and contraindications for ECLS in neonates, children, and adolescents. ➤ Discuss the ethical dilemmas involved with the risks associated with ECLS versus ongoing medical management. ➤ Obtain informed consent for cannulation and decannulation of ECLS. ➤ Communicate to families the risks of ECLS, including neurologic injury, vascular injury, and inability to come off ECLS. ➤ Identify the equipment needed (eg, cannulas of different sizes, use of fluoroscopy or ultrasound). ➤ Determine the systems needed for safe cannulation (bedside vs operating room, personnel). ➤ Optimize the placement of cannulas by positioning the patient correctly and having medications and equipment readily available. ➤ Demonstrate understanding of the need for emergency cannulation without consent in special circumstances. ➤ Obtain informed consent for ECLS, including discussions regarding procedure, type of access, procedure risks, complications and outcomes ❖ Intraoperative ➤ Determine the ideal approach to cannulation for ECLS for a given condition. ➤ Implement management strategies for anticoagulation at cannulation, during an ECLS run, and decannulation. ➤ Avoid procedures when a patient is on ECLS, and manage anticoagulation when a procedure is needed. ➤ Address bleeding during an ECLS run (superficial vs organ space). ➤ Interpret a rotational thromboelastometry (ROTEM) or thromboelastography (TEG) to determine the appropriate response to anticoagulation. ➤ Identify when vessels are of an inappropriate size or when a strategy for cannulation needs to be modified. ➤ Troubleshoot elevated pressures when a patient is on ECLS, including dealing with "cutting out" and air or clots in cannula components. ➤ Manage the ventilator during ECLS (rest settings vs recruitment). ➤ Evaluate a patient for "awake" ECLS, including placement of a tracheostomy when needed and initiation of physical therapy. ➤ Interpret cannula placement using imaging guidance at placement and management during an ECLS run. ❖ Postoperative



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	➤ Communicate potential complications on ECLS. ➤ Discuss the readiness for decannulation. ➤ Implement a strategy when a patient is unable to be weaned off ECLS, and refer the patient to the transplant team when appropriate. ➤ Recognize the need for central cannulation when flows are inadequate. ➤ Assess the need for potential reconstruction of vessels and recannulation for repeat ECLS.
Scope	❖ In scope ❖ Diagnoses ➤ All diagnoses that require ECLS support (sepsis, congenital diaphragmatic hernia, meconium aspiration, burns, acute respiratory distress syndrome/respiratory failure) ❖ Procedures ➤ Distal perfusion cannula ➤ Ultrasound/fluoroscopic guidance ➤ Veno-venous and veno-arterial (neck, femoral) ❖ Special populations ○ Neonates ○ Adolescents ○ Extracorporeal cardiopulmonary resuscitation (ECPR) ❖ Out of scope • Diagnoses/procedures ○ Central cannulation ○ Congenital cardiac disease



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1 Framework: The attending will show and tell or the learner acts as first assistant. Entrustment: The learner demonstrates understanding of information and has basic skills. What a new pediatric surgery fellow should know.	• With active assistance, relates the indications and contraindications for ECLS in an uncomplicated patient • With active assistance, identifies patient-specific factors that predict the need for ECLS (eg, oxygen index, blood gas values, imaging findings, need for vasopressors) and begins resuscitation • With active assistance, recognizes aspects of care that may require ethical decisions concerning ECLS • Recognizes the need to coordinate intensivist, OR, surgical, and, occasionally, cardiology or radiology teams for ECLS cannulation	• With active assistance, performs cannulation for ECLS in an uncomplicated presentation • With active assistance, identifies evidence-based guidelines/recommendations for various aspects of ECLS care, including anticoagulation management, cannulation strategies, and the need for imaging to confirm cannula placement • Demonstrates awareness about administration of anticoagulation and the need for sedation, additional resuscitation, and imaging when necessary and during connection to the circuit	• With active guidance, demonstrates awareness of patient-specific factors that show readiness for decannulation from ECLS • With active assistance, demonstrates knowledge of ethical principles of ECLS complexities regarding tracheostomy, futility of care, and major complications • With direct supervision, communicates with all team members about ECLS circuit performance, including clot burden, inlet and outlet pressures, potential for hemolysis, and readiness for pulmonary recruitment and decannulation
2 Framework: The learner demonstrates understanding of the steps of the operation but requires direction through principles and does not know the nuances of a basic case.	• With passive assistance, relates the indications and contraindications for ECLS in an uncomplicated patient • With passive assistance, identifies patient-specific factors that predict the need for ECLS (eg, oxygen index, blood gas values, imaging findings, need for vasopressors) and begins resuscitation and initial management	• With passive assistance, performs cannulation for ECLS in an uncomplicated patient • With passive assistance, articulates evidence-based guidelines/recommendations for various aspects of ECLS care, including anticoagulation management, cannulation	• With passive guidance, articulates patient-specific factors of a straight-forward patient that show readiness for decannulation from ECLS • With passive assistance, fosters discussion of ethical dilemmas on ECLS regarding tracheostomy, futility of care, and major complications



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Entrustment: The learner can use the tools but may not know exactly what, where, or how to do it. The attending gives active help throughout the case to maintain forward progression or may need to take over the case at a certain point.	- With passive assistance, analyzes straightforward situations using ethical principles for discussion of informed consent with a patient's family - Communicates clearly with the care team for ECLS cannulation, recognizing the need to coordinate intensivist, OR, surgical, and, occasionally, cardiology or radiology teams	- strategies, and the need for imaging to confirm cannula placement - Solicits feedback and communicates clearly with care team members about administration of anticoagulation and the need for sedation, additional resuscitation, and imaging when necessary and during connection to the circuit	With indirect supervision, communicates with all team members about ECLS circuit performance, including clot burden, inlet and outlet pressures, potential for hemolysis, and readiness for pulmonary recruitment and decannulation
3 Framework: The learner has a good understanding of surgical options and techniques but does not recognize abnormalities and does not understand the nuances of a complicated case. Entrustment: The learner can perform the operation/task independently in the uncomplicated patient. or The attending provides passive/indirect	- With passive assistance, relates the indications and contraindications for ECLS in a complicated patient - With passive assistance, individualizes ongoing critical care of a patient requiring ECLS and assesses their response to therapy - Analyzes a complex situation (previous ECLS, neurologic injury) using ethical principles and recognizes the need to seek help in managing or resolving a complex ethical situation for ECLS cannulation or withholding care - Communicates concerns and provides feedback to ensure mutual understanding among team members, including the intensivist, OR, surgical, and, occasionally, cardiology or radiology teams	- With passive assistance, performs ECLS cannulation in a complicated patient (eg, additional venous drainage, reperfusion cannula, ECPR) - Independently articulates evidence-based knowledge for various aspects of ECLS care, including anticoagulation management, cannulation strategies, and the need for imaging to confirm cannula placement, integrated with the patient's and family's preferences - Communicates concerns and provides feedback to peers and learners about administration of anticoagulation and the need for sedation, additional resuscitation, and imaging when necessary and during connection to the circuit	- With passive guidance, identifies patient-specific factors of a complicated patient that show readiness for decannulation from ECLS - Analyzes complex situations, seeking help as needed for ethical dilemmas on ECLS regarding tracheostomy, futility of care, and major complications - Independently communicates with all team members about ECLS circuit performance, including clot burden, inlet and outlet pressures, potential for hemolysis, and readiness for pulmonary recruitment and decannulation



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supervision/suggestions in the complicated patient but still allows the learner to perform the operation/task themselves.			
4 Framework: The learner has a strong and in-depth understanding of surgical options and techniques Entrustment: Can perform the operation/task independently in complicated cases <u>or</u> The attending may need to provide indirect supervision or suggestions in the context of extremely rare or severely complicated cases	- Independently relates the indications and contraindications for ECLS in a complicated patient - Independently individualizes ongoing critical care management of a patient requiring ECLS and assesses their response to therapy - Leads the team in formulating ethical decisions around the futility of ECLS, including discussions with the care team and family - Leads the team for ECLS cannulation, independently coordinating intensivist, OR, surgical, and, occasionally, cardiology or radiology teams	- Independently performs ECLS cannulation in a complicated patient (eg, additional venous drainage, reperfusion cannula, ECPR) - Critically appraises and applies evidence-based knowledge for various aspects of ECLS care, including anticoagulation management, cannulation strategies, and the need for imaging to confirm cannula placement, even in the face of uncertain or conflicting evidence to guide care, tailored to the patient and family - Communicates recommendations to team members, including constructive criticism to peers/superiors, about administration of anticoagulation and the need for sedation, additional resuscitation, and imaging when necessary and during connection to the circuit	- Independently identifies patient-specific factors that show readiness for decannulation from ECLS in a complicated patient - Leads complex discussions about ethical dilemmas on ECLS regarding tracheostomy, futility of care, and major complications - Leads team members on ECLS circuit performance, including clot burden, inlet and outlet pressures, potential for hemolysis, and readiness for pulmonary recruitment and decannulation