

Reduction in thrombotic and bleeding complications in pediatric ECMO patients

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Introduction:

Extracorporeal membrane oxygenation (ECMO) is a life-sustaining technology utilized in pediatric patients with cardiopulmonary compromise. Although general ECMO outcomes are favorable, these can be negatively impacted by thromboembolic and bleeding complications driven by inadvertent activation of the contact system and coagulation cascade. A delicate balance of anticoagulation is necessary to attenuate technology-related adverse events. In our institution, 62% of pediatric patients requiring ECMO had some degree of clotting complications between 2017 and 2021, therefore, we aimed to reduce clotting complications by 20% (to 40%) within two years.

Methods:

This is an observational time series in an academic urban tertiary children's hospital involving pediatric ECMO patients between July 2017 and April 2024. A multidisciplinary team including intensivists, hematologists, ECMO physicians, and ECMO coordinators was assembled in July 2021. ECMO anticoagulation protocol was revised and implemented in January 2022 including provider shift review of anticoagulation goals, education and placing of bedside signage. Focused review of erratic anticoagulation parameters during ECMO runs was done in real time starting November 2023. Outcome measures included the percent of clotting complications and ECMO runs requiring a circuit component change. Process measures included the percent of activated clotting time (ACT) within range and time to goal ACT. Balancing measure was the percent of ECMO runs with bleeding complications. Statistical process control charts were utilized to track process measures.

Results:

Eighteen patients were included in this initiative, 8 pre-intervention and 10 post-intervention. The percent of clotting complications decreased from 62% to 30% post intervention, with similar circuit component changes (12% vs 10%, Table 1). There was special cause variation in the percent of ACTs within goal per ECMO day with improvement from 52% to 85% (Figure 1). The time from cannulation to goal ACTs also improved from 9.9hrs to 2.6hrs (Figure 2). One patient required conversion to Anti-Xa protocol due to erratic ACTs. There was a modest improvement in bleeding complications from 62% to 50% post interventions (Table 2). Notably, compared to pre-intervention, there were no major bleeding episodes (intracranial or pulmonary) post-intervention, and bleeding complications were limited to cannula site bleeding.

Discussion: A multidisciplinary team approach focused on optimal anticoagulation strategies with a standardized protocol, formalized anticoagulation orders and real time case reviews reduced thrombotic and bleeding complications in our pediatric ECMO center. Cannula site related bleeding episodes remain an area for improvement, further work is required to mitigate this.

Table 1: Thrombotic complications

	Pre-intervention N=8	Post-intervention N=10
Thrombus, n (%)	5 (62)	3 (30)
Oxygenator	4	3
Bladder	3	1
Pump	0	1
Component change, n (%)	1 (12.5)	1 (10)
Oxygenator	1	0
Circuit	1	1

Table 2: Bleeding complications

	Pre-intervention N=8	Post-intervention N=10
Bleeding	5 (62)	5 (50)
Intracranial	3	0
Pulmonary hemorrhage	1	0
Cannula site	1	5
Arterial line	0	0

Figure 1: Percent of ACTs in range per ECMO day-p Chart

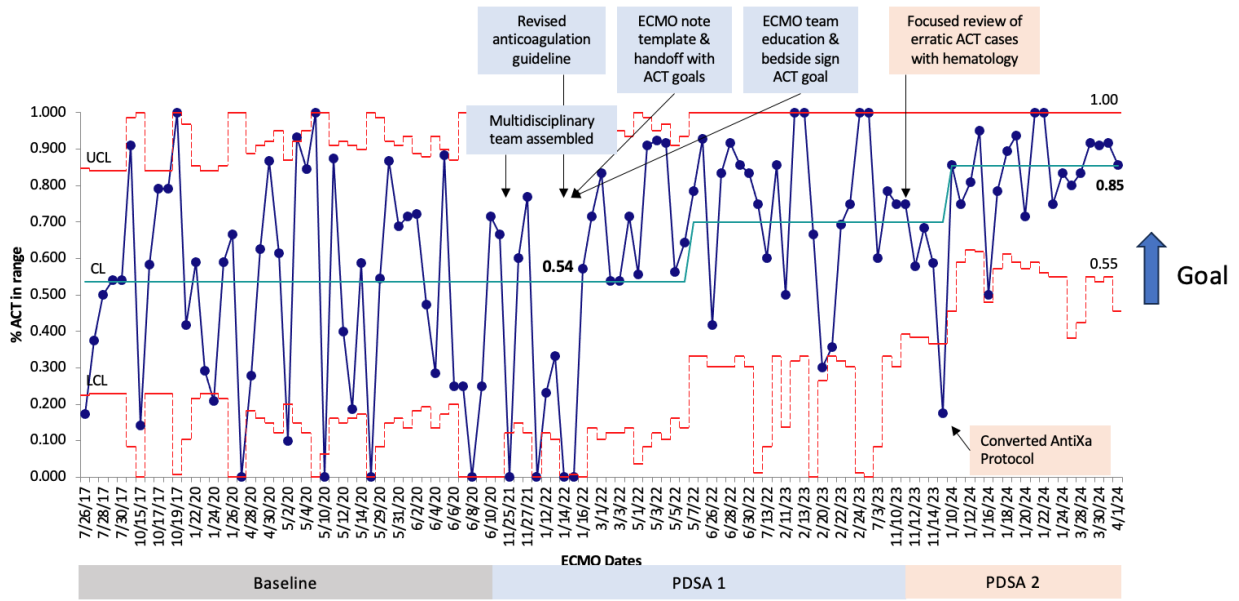


Figure 2: Time from Cannulation to goal ACTs - X Chart

