ANTICOAGULATION GOALS ASSOCIATED WITH BLEEDING AND THROMBOTIC COMPLICATIONS IN PATIENTS ON ECMO; SINGLE CENTER ANALYSIS

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ABSTRACT

Background: Extracorporeal Life Support (ECLS) and one of its forms Extracorporeal Membrane Oxygenation (ECMO) is a supportive life sustaining critical care capability which carries bleeding and thrombotic complications. This single center study sought to evaluate the number of such complications occurring in patients on venovenous (VV) or venoarterial (VA) ECMO with heparin as their initial anticoagulation approach, and the impact of these events on the patient's course of care. We hypothesized that there was a higher rate of bleeding complications at our center, and therefore a higher rate of bleeding complications that required intervention.

Methods: A retrospective analysis was performed of ECMO patients admitted from 2012 to 2016 at Brooke Army Medical Center. Bleeding events were categorized by severity according to the Bleeding Academic Research Consortium (BARC) definition for bleeding. Per severity, the total amount and type of blood products used, average length of stay and survival were recorded. In addition, anticoagulation goals, and measurements of anticoagulation were recorded.

Results: 30 patients were reviewed for this initial analysis. Mean age (95% confidence interval): 33.6 (31.46-35.74). While on anticoagulation 159 bleeding events (75.5%) and 17 thrombotic events (82.4%) were observed overall. 57.2% of bleeding events were a BARC severity Grade IIIA. The longest average length of stay occurred in Grade II events and the greatest amount of blood products were used in Grade III events. ICU/hospital survival and ECMO survival were inversely correlated with severity of bleeding. There were no statistically significant differences in bleeding and thrombotic complications between average PTT, PT, and INR.

Conclusions: Bleeding and thrombosis are significant complications associated with morbidity and mortality during ECMO. Variability in monitoring and management of anticoagulation makes it challenging to determine the best strategy to reduce complications. We will continue to collect data form our patient registry to determine an appropriate anticoagulation goal protocol.

INTRODUCTION

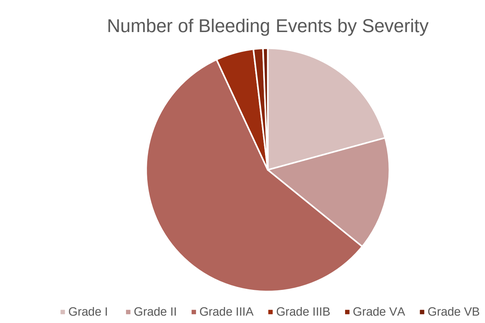
Extra corporeal membrane oxygenation (ECMO) is a supportive life-sustaining critical care modality than can be used for patients with acute respiratory distress syndrome (ARDS) and/or in patients needing circulatory support. However, this ability to support various aspects of a patient's cardiovascular system requires systemic anticoagulation and is not without risk to include the occurrence of bleeding and thrombotic complications[1,2,3,4,5]. There have been many studies with varying conclusions in the literature comparing activated clotting time (ACT) to activated partial thromboplastin time (PTT) for monitoring of anticoagulation during ECMO[6,7,8,9]. This single center study sought to evaluate the number of bleeding and thrombotic events that occurred in patients on venovenous (VV) and venoarterial (VA) ECMO. In addition, it sought to determine if there were anticoagulation goals that were more frequently associated with bleeding or thrombotic events. Finally, we looked for differences between anticoagulation measurements at the time of bleeding and thrombotic events.

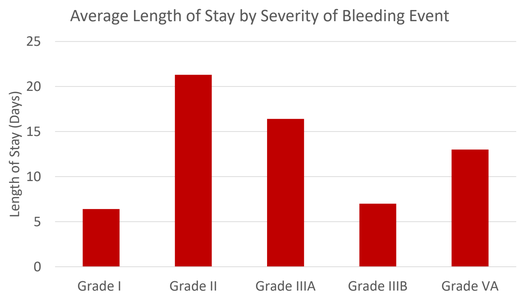
METHODS

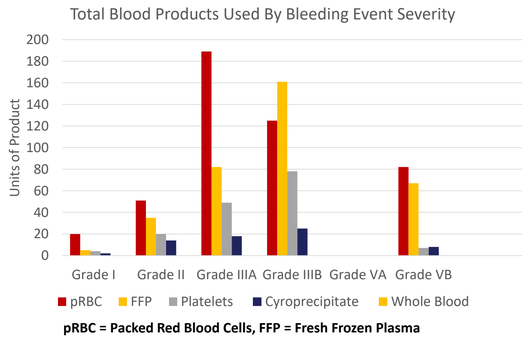
A retrospective analysis was performed of VV and VA ECMO patients admitted to Brooke Army Medical Center from 2012 to 2016. Bleeding and thrombotic events for patients on heparin as their initial anticoagulation were recorded, in addition to events that occurred when anti-coagulation was held. Bleeding events were categorized by severity according to the Bleeding Academic Research Consortium (BARC) definition. Average length of stay and total amount and type of blood products used per severity of bleeding event were recorded. Average ECMO and ICU and hospital survival in days was calculated by severity of bleeding event, and a linear regression analysis was performed for each. The anticoagulation goals which included a variety of protocols over the course of this review were recorded at the time the event occurred (goals were marked as "none" for events that occurred when was anticoagulation was held). PTT, prothrombin time (PT), international normalized ratio (INR), and anti-Factor Xa (anti-Xa) values at the time of the bleeding and thrombotic events were obtained from the patient record. A one sided t-test assuming unequal variances with a 95% confidence interval was performed, comparing the averages of these values in bleeding and thrombotic events.

RESULTS

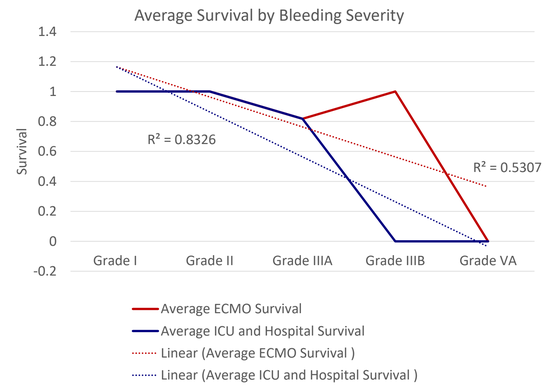
Bleeding severity by BARC Definition:
Grade I: Bleeding is not actionable
Grade II: Bleeding requires intervention by healthcare professional
Grade IIIA: Overt bleeding with hemoglobin drop of 3 to < 5 g/dL and/or any bleeding requiring transfusion
Grade IIIB: Overt bleeding plus hemoglobin drop ≥ 5 g/dL; cardiac tamponade; bleeding requiring surgical intervention for control; bleeding requiring intravenous vasoactive agents
Grade IIIC: Intracranial hemorrhage; intraocular bleed compromising vision
Grade IV: CABG-related bleeding
Grade VA: Probable fatal bleeding
Grade VB: Definite fatal bleeding

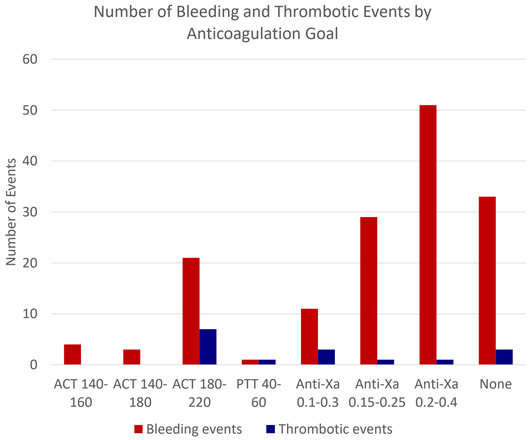






pRBC = Packed Red Blood Cells, FFP = Fresh Frozen Plasma





Average PTT, PT, INR, and Anti-Xa at time of Bleeding and Thrombotic Complication

	Bleeding Complications	(n)	Thrombotic Complications	(n)	(p)
PTT	53.6	127	51.06	12	0.390
PT	17.06	127	17.87	12	0.353
INR	1.34	126	1.45	13	0.333
Anti-Xa	0.24	65	N/A	N/A	N/A
Anti-Xa<0.10	N/A	39	N/A	6	N/A

DISCUSSION

There were more observed bleeding events than thrombotic events in this initial analysis. In general, more bleeding events occurred with higher anticoagulation goals across a variety of types of goals, which would be expected given the higher level of anticoagulation. Grade IIIA was the most frequent bleeding severity event observed which did require intervention as defined by the severity score. Grade III bleeding events were also associated with the highest usage of blood products. Finally, average ECMO and ICU and hospital survival were inversely correlated with severity of bleeding, as would be expected.

CONCLUSION

Our preliminary analysis suggests there is a higher rate of bleeding vs thrombotic complications at our center. This higher bleeding rate is accompanied by a high rate of bleeding severity that required intervention. We plan to continue to collect data on patients from our registry. This analysis categorically suggests the need to introduce tight anticoagulation goals with the aim to reduce the amount and severity of coagulation complications at our center.

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