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Extended Abstract
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Perioperative Bleeding Management in Cardiac Surgery, the Multidisciplinary Approach

Konstantina Triantafillopoulou
Cardiothoracic Surgery Department St Luke's Hospital, Greece

Perioperative bleeding is common among patients in cardiac surgery. Major bleeding, transfusion and anemia have been characterized as the deadly triad of cardiac surgery (Ranucci et al. Ann Thorac Surg 2013, 96:478) Patient blood management (PBM) in cardiac surgery contributes to the maintenance of perioperative haemostasis and the minimization of bleeding, which reduce blood transfusion requirements. PBM in cardiac surgery comprises an interaction between the cardiothoracic surgeon, the anesthesiologist, the clinical perfusionist but furthermore the cardiologist and hematologist! (2017 EACTS/EACTA Guidelines on patient blood management for adult cardiac surgery European Journal of Cardio-Thoracic Surgery 0 (2017) 1–33 doi:10.1093/ejcts/ezx325).

This multidisciplinary approach following evidence-based guidelines can be the only accepted way to prevent any adverse outcomes. The methodology to identify and amend all factors related to increased risk of bleeding, transfusion and reoperation includes preoperative assessment, intraoperative techniques and postoperative management by all affiliated specialties. Advanced age, preoperative anemia, antiplatelet therapy and platelet dysfunction, use of NOACs, congenital and acquired coagulopathies, non-elective cardiac surgery, complex procedures and redo cardiac surgery, additional to individual comorbidities are only few of the risk factors. Risk scores, advanced surgical techniques, minimal procedures and PBM algorithms need to be addressed for patient's benefit.

The aim of the protocol was to decrease bleeding and blood product transfusion in the perioperative period via reduction of variability in anticoagulation and transfusion management and introduction of MUF into intraoperative practice. A total of 62 patients were evaluated after implementation of the protocol from February 2014 to May 2014. While awaiting design changes of CPB circuit for MUF, 17 consecutive patients were managed with the new protocol, but in lieu of MUF, were transfused with blood after single pass hemoconcentration (SPHC) upon termination of CPB (9). The subsequent 45 patients were managed with the protocol plus MUF as the source of hemoconcentration.

Specific focus of the protocol was standardization and decreased variability in multiple areas. The team agreed to precisely follow the Hepcon HMS (Medtronic, Minneapolis, MN) dosing recommendation for protamine and to administer protamine as an infusion over 5 minutes. When there was SPHC blood available post-CPB, it was administered prior to protamine and any other blood products. Laboratory results for clotting factors and thromboelastogram were obtained before the transfusion of hemostatic donor products (platelets, fresh frozen plasma [FFP], or cryoprecipitate). If blood products were needed, the clinicians treated laboratory values "per protocol" transfusion thresholds only. In addition, autologous cell saver blood was used before allogenic red blood cells.

Demographic, surgical, transfusion, bleeding, and laboratory data were prospectively collected by clinicians on the postprotocol cohorts in the same manner as preprotocol patients. Blood product administration was followed for the first 6 hours in the CVICU to evaluate the impact of the protocol on CVICU outcomes and transfusion practices. The first analysis of data was conducted at 3 months, which demonstrated clear improvements in blood product utilization and some bleeding outcomes. At this point, prospective data collection was stopped, and the perioperative bleeding management protocol was adopted into daily practice without modifications.

CPB circuit consisted of a Terumo System 1 (Ann Arbor, MI), Terumo FX Oxygenators, Terumo Hemoconcentration HC05, and a Sorin CSC-14 DelNido Cardioplegia Delivery Set (Arvada, CO). Packed red blood cells (PRBC; 100 mL) and FFP (100 mL) were utilized to prime the circuit for patients <5 kg, and the hemoconcentration was used to reduce the volume to the minimum operating level prior to CPB. In patients >5 kg, an estimated dilutional hematocrit (HCT) was determined and retrograde autologous priming was used. Once on CPB, blood products may

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be needed if the HCT goal set by surgeons for specific cardiac lesions were not met. All allogenic red blood cells used in the cardiovascular operating room (CVOR) were <7 days old and washed prior to use.

Conclusion: Perioperative Bleeding Management in cardiac surgery comprises a multidisciplinary and multifactorial approach and consists of a sequence of separate strategies and interventions. It is a constant interaction between cardiac surgeon, anesthesiologist, perfusionist, cardiologist, hematologist and intensivist, additional to evidence-based guidelines, recommendations, algorithms, multicentric trials and ongoing research.

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