Should We Implement Type and Screen Transfusion Policy in Pediatric Cardiac Surgery to Improve Patient Blood Management?

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J Card Crit Care 2022;6:228–229.

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Bleeding during or after cardiac surgery is common in adults and associated with significant utilization of blood products.[1] There is very little evidence available on patient blood management in pediatric cardiac surgery. Children typically receive transfusions perioperatively for many reasons, including developmental alterations of their hemostatic system, hemodilution, and hypothermia with cardiopulmonary bypass, systemic anticoagulation, etc. The complexity of their surgical procedures, complex cardiopulmonary interactions, and risk for inadequate oxygen delivery and postoperative bleeding further contribute to blood product utilization in this vulnerable population. Till date, most of the blood centers in India follow blood typing and crossmatch policy as a part of pretransfusion testing to select the right blood for these patients. In this policy, patients are typed for their ABO/RhD and received red cell transfusions based on the antihuman globulin crossmatch results. However, in type and screen policy, the transfusion services perform ABO/RhD typing and a screen for atypical antibodies of the patient's blood and plasma. A negative antibody screen signifies that the patient does not demonstrate any clinically significant antibodies and, therefore, only an immediate spin or abbreviated crossmatch is required. Because an immediate spin crossmatch is a fairly simple test, taking approximately 10 minutes in comparison to full crossmatch that takes around 45 minutes, blood is available rather quickly if the need should arise. Since blood is not unnecessarily crossmatched and reserved for a patient who might not require transfusion, performing a type and screen is both a safe and time-saving strategy without attributing to an inventory crisis of blood products.[2] Recently, a study from India has concluded that in adult cardiac surgery that screen is a better tool than type and crossmatch especially in patients having the previous history of transfusion and pregnancy, as they are at a risk of red cell alloimmunization.[3] However, alloimmune response is rarely seen in pediatric nontransfusion group of population; to manage the inventory with the improvement in crossmatch-to-transfusion (C/T) ratio and decrease in turnaround time (TAT) for the issue of blood units, the pretransfusion testing protocol was modified at the authors' center from type and crossmatch policy to type and screen in 2016. The C/T correlates with actual blood usage and a C/T greater than 2.5 is an indicator of poor blood utilization, and hospitals should aim to keep a C/T of 2 or less.[4]

With an aim to determine the effects of change in policy over the next 3 year's period on C/T ratio and TAT in pediatric patients undergoing cardiac surgeries, a prospective transfusion audit was conducted where data were compared with the retrospective group of similar population between 2013 and 2015, before intervention. The secondary objective was to determine the prevalence and spectrum of naturally occurring atypical antibodies present in pediatric patients who were suffering from congenital cardiac diseases without any history of blood transfusion after birth.

After obtaining approval by the institutional review board, 36 months of retrospective data were collected from February 2013 to January 2016. The data included all red blood cell (RBC) crossmatch requests during this period as well as the number of RBC units transfused to the patients

DOI https://doi.org/10.1055/s-0042-1759830.
ISSN 2457-0206.

Thieme Medical and Scientific Publishers Pvt. Ltd., A-12, 2nd Floor, Sector 2, Noida-201301 UP, India

including details of TAT. Similar data were gathered from February 2016 through January 2019, after implementation of the new pretransfusion policy. Groups were matched for age, sex, baseline preoperative data, and type of cardiac surgeries. A paired sample *t*-test was performed on the C/T and TAT using the SPSS statistical package, version 20 (SPSS, Chicago, Illinois, United States). All tests were two sided and the type I error was 0.05.

Blood grouping was performed by column agglutination technology (CT) using DiaClon ABO/D+ Reverse Grouping cards (DiaClon ABO/D+ grouping, Bio-Rad, Switzerland). Antibody screening and identification were done using three cell panels (ID-Diacell I-II-III, Bio-Rad, Switzerland) and 11-cell panels (ID-DiaPanel, Bio-Rad, Switzerland) on CT with Low Ionic Strength Solution (LISS)/Coombs cards. Further immunohematology tests such as thermal amplitude test and red cell phenotyping were performed case wise, whenever indicated.

The retrospective data of children underwent cardiothoracic surgery from 2013 through 2016 showed a total of 3,712 patients for whom blood products were ordered. The mean age was 2.4 ± 1.7 years (range: 4 months to 12 years) with male-to-female ratio of 1.51. A total of 14,882 red cell units were crossmatched and 7,792 were transfused with a C/T of 1.91 (95% confidence interval: 1.71–2.03). After implementing the new cardiac surgery blood ordering guidelines from 2016 through 2019 showed that the total number of patients was 3,931, with 5,888 units crossmatched and 5,661 units transfused giving a C/T of 1.04 (95% confidence interval: 0.91–1.13). The mean age was 2.2 ± 1.5 years (range: 1 month to 12 years) with male-to-female ratio of 1.78. There was a statistically significant difference in the C/T from before and after the intervention ($p = 0.007$). Also, the average TAT was significantly reduced after implementation of the new policy from 47 to 22 minutes ($p = 0.001$). Out of 3,931 patients, 11 children (0.28%) were found to have positive antibody screens in spite of no history of blood transfusion after birth. The antibody was identified as anti-M in each of 11 cases. Blood group discrepancy was observed in six cases. Further workups were suggested presence of immunoglobulin G along with immunoglobulin M (IgM) type of anti-M naturally occurring antibody in nine cases where in the rest of two cases the antibody was only IgM in nature. These cases would have been missed otherwise if previous type and crossmatch policy were followed that could potentially lead to mismatched blood transfusions.

The previous institutional practice was to crossmatch and preserve two to four units of RBCs for each pediatric patient undergoing cardiac surgery. The prospective data showed that 41% of children did not require a single unit of transfusion. It is a well-known fact that preoperative crossmatching of RBCs is performed in anticipation of a potential need based on the physician's own transfusing experiences, and subsequently, many blood units that are crossmatched before surgery are never transfused.[5,6] Over ordering crossmatches is considered by some to be a safe policy to ensure that more rather than less blood is available should the need arise, but this practice is a counterintuitive for multiple reasons. Since blood is a limited resource, routine over ordering shrinks the blood inventory available for emergent cases. Also, excessive crossmatching has involved additional expenditures. Most importantly, blood units that are crossmatched but not transfused are pulled out of the stock and kept as "standby" for a period, leading to an inventory crisis. The introduction of the type-and-screen concept improved blood utilization in this study. It also provides enough time for blood centers to complete the workups, confirm the antibody present in serum, and also to arrange compatible units for safer transfusion. Blood audit is an important measure that needs to be performed regularly in all transfusion services and hospitals. These audits serve as a surveillance tool with which changes to current guidelines can be made. This study has few limitations as cost-analysis was not performed in this group as children with cardiac ailments are receiving free of cost treatment under a government scheme named "ShishuSathi" in the state of West Bengal, India, since 2013. Also, a "Hawthorne effect" cannot be completely ruled out during this study. While this intervention is not novel in concept, this report shows that perseverance and multidisciplinary recruitment are the necessary ingredients to implement changes in patient blood management that can minimize unnecessary transfusions and improve blood utilization.

Conflict of Interest
None declared.

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