Reducing Blood Utilization by Implementation of a Type-and-Screen Transfusion Policy

A Single-Institution Experience

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ABSTRACT

Objectives: The Blood Utilization Committee implemented a standardized protocol for the preoperative blood order for cardiac patients. The aim of our study was to assess the improvement in blood utilization using the crossmatch to transfusion ratio (C:T).

Methods: Four months of retrospective data were collected, which included all RBC crossmatch requests and all RBC units transfused. Similar data were gathered for the period of the intervention. The difference in C:T was calculated.

Results: The retrospective group had 166 patients for whom blood products were ordered. There were 560 crossmatch requests and 237 transfused RBC units with a C:T of 2.36. The prospective group had 127 patients with 297 crossmatch requests, 190 transfused units, and a C:T of 1.56. There was a statistically significant difference in the C:T. The cost difference was $12,244.00.

Conclusions: Implementing exact guidelines, with the introduction of a type-and-screen concept, allowed more efficient blood usage.

Blood utilization reports reveal that approximately 60% of all blood transfusions are given intraoperatively. In postoperative surgical patients and medical patients, RBCs are crossmatched in response to a demonstrated anemia and are, for the most part, transfused. By comparison, 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.1 Overordering 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 experienced surgeons have realized that this is a counterintuitive practice for multiple reasons. Since blood is a limited resource, routine overordering shrinks the blood inventory available for emergent cases. Excessive crossmatching is costly because of the unnecessary use of materials and workforce. Most important, blood units that are
crossmatched but not transfused are pulled out of the inventory and kept as “standby” for a period and, therefore, are more likely to reach their expiration date and subsequently be discarded. Although RBCs may be stored for 35 to 42 days depending on the preservatives used, evidence suggests that the oxygen delivery capacity of these units decreases with time and that patients respond better with blood that is not near its expiration date.

In the 1970s, Friedman et al proposed the use of a Maximum Surgical Blood Order Schedule (MSBOS) as a way to limit the number of units removed from the general inventory and thus limit outstanding. These guidelines are widely accepted, and a maximum crossmatch to transfusion ratio (C:T) of 2:1 is recommended. Driven by the growing concerns over safety, cost, and adequacy of the national blood supply, as well as increased efficiency of the transfusion services, the Blood Utilization Committee at Mount Sinai Medical Center was created in November 2012 to study the trend of blood usage by the cardiac surgery department and to modify the guidelines and policies accordingly.

The aim of our study was to assess the improvement (change) in blood utilization with the implementation of updated guidelines using the C:T as a measure of efficiency. It is widely accepted that a C:T of less than 2 is a marker for optimal blood utilization. The committee also added cost savings as another measure of success.

Materials and Methods

The committee, led by the institutional chief medical officer, consisted of a cardiac surgeon, anesthesiologist, transfusion service manager, pathologist, pathology resident, perfusionist, and a representative of the Center for Clinical Excellence. The meeting involved an educational discussion of the difference between type and screen vs type and crossmatch. The transfusion services department performs ABO and Rh typing (type) and a screen for atypical antibodies (screen) 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 crossmatch is required. Because an immediate spin crossmatch is a fairly simple test, taking approximately 10 minutes, blood is available rather quickly if the need should arise. Since blood is not unnecessarily crossmatched and on reserve for a patient who might not be transfused, performing a type and screen is both a safe and cost-effective strategy.

The agenda of the meeting consisted of reviewing and analyzing the compiled data of blood utilization in 2010, 2011, and 2012 (which showed an increasing trend of blood products usage in 2012 compared with the previous 2 years). The current practice was to crossmatch 2 to 4 units of RBCs for each minimally invasive valve replacement and coronary artery bypass grafting (CABG) and 4 to 6 units for a redo of the CABG. The meeting also involved a thorough discussion of how, in the case of unexpected antibodies, the blood bank automatically crossmatches 4 units (or more, depending on the patient and/or the antibody screen result) of RBCs even if the surgeon’s initial order was type and screen. This ensures patient safety.

The committee suggested the use of type and screen instead of a crossmatch when the following criteria are met: elective isolated valve, minimally invasive surgery, no antibodies identified in the screening process, clopidogrel (Plavix) dose of less than 150 mg, hematocrit above 30% (or hemoglobin above 10 g/dL), aspartateaminotransferase less than 50 U/L, and creatinine less than 1.5 mg/dL. Redo CABG cases were excluded. The agreement was to modify the current transfusion guidelines and to develop and implement a standardized protocol for the preoperative management of cardiac patients with the introduction of the type and screen as a safe, effective, and financially responsible method to prevent preoperative overordering of blood products.

Table I

<table>
<thead>
<tr>
<th>Type of Surgery</th>
<th>Previous</th>
<th>New</th>
<th>Previous</th>
<th>New</th>
</tr>
</thead>
<tbody>
<tr>
<td>Minimally invasive valve</td>
<td>X</td>
<td>X</td>
<td>2-4</td>
<td>0</td>
</tr>
<tr>
<td>CABG</td>
<td>X</td>
<td>X</td>
<td>2-4</td>
<td>0</td>
</tr>
<tr>
<td>Redo CABG</td>
<td>X</td>
<td>X</td>
<td>4-6</td>
<td>2</td>
</tr>
<tr>
<td>CABG with (any of the following)</td>
<td>Clopidogrel &gt;150 mg</td>
<td>X</td>
<td>X</td>
<td>4-6</td>
</tr>
<tr>
<td>AST &gt;50 U/L</td>
<td>X</td>
<td>X</td>
<td>4-6</td>
<td>2</td>
</tr>
<tr>
<td>Creatinine &gt;1.5 mg/dL</td>
<td>X</td>
<td>X</td>
<td>4-6</td>
<td>2</td>
</tr>
<tr>
<td>Hematocrit &lt;30%</td>
<td>X</td>
<td>X</td>
<td>4-6</td>
<td>2</td>
</tr>
</tbody>
</table>

AST, aspartate aminotransferase; CABG, coronary artery bypass grafting; PRBC, packed RBC.

After obtaining approval by the institutional review board, 4 months of retrospective data were collected from December 2011 through March 2012. The data included all RBC crossmatch requests during this period as well as the number of RBC units transfused. Similar data were gathered from December 2012 through March 2013, after intervention. A paired sample t test was performed on the C:T using the SPSS statistical package, version 20 (SPSS, Chicago, IL). All tests were two sided and the type I error was .05. The cost of a crossmatch was roughly estimated by adding the costs of laboratory tubes, reagents, and technologist time that it takes.
to perform a crossmatch of a unit of packed RBCs. Using these data, cost difference was obtained for the two periods.

Results

The retrospective data of cardiothoracic patients from December 2011 through March 2012 showed a total of 166 patients for whom blood products were ordered. There were 560 crossmatch requests and a total of 237 transfused packed RBC units with a C:T of 2.36. Per patient, there was a mean of 3.37 crossmatch requests and 1.43 units transfused. After implementing the new cardiac surgery blood ordering guidelines, data gathered from December 2012 through March 2013 showed that the total number of patients was 127, with 297 crossmatch requests and 190 transfused units, giving a C:T of 1.56. Per patient, there was a mean of 2.34 crossmatch requests and 1.50 transfusions. There was a statistically significant difference in the C:T from before and after the intervention (P = .0001).

Using hospital-provided data Table 2, we calculated the cost difference of the intervention. Prior to implementing the new guidelines, the total cost for crossmatch and transfusing for a period of 4 months was $55,560 compared with $43,316 in the later time frame and an overall cost difference of $12,244.00 in 4 months for the cardiac surgery department.

Discussion

Our results show a significant cost saving for the transfusion service department, which we attribute to decreased C:T as well as a more conservative transfusion practice after implementing the new guidelines. The C:T correlates with actual blood usage.1 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. Multiple interventions have been attempted with the aim of lowering the C:T, the most successful of which is the MSBOS.6,7 The MSBOS is a table of elective surgical procedures that lists the number of units of blood routinely crossmatched preoperatively for the different procedures, based on retrospective analysis of actual blood usage. In 1976, two groups were involved in the development of a preoperative crossmatch schedule to limit the number of units removed from the general RBC inventory.6,8 Friedman et al6 named the process MSBOS, in which the proposed number of RBC units would meet 90% of the transfusion requirements of a given surgical procedure. By comparing preoperative/intraoperative crossmatch orders with the intraoperative/immediate postoperative blood utilization, Mintz et al8 suggested that the average number of RBC units used over a period for a given surgical procedure was to be included in the preoperative guideline for transfusion therapy. The guideline by Mintz et al further incorporated the concept of type and screen for those surgical procedures rarely requiring blood transfusion. In 1977, Boral and Henry9 were able to prove mathematically the safety of the type and screen by examining the frequencies of those rare antigen-antibody combinations that were not detected by the screen for unexpected RBC antibodies. They demonstrated that type and screen is 99.99% effective in preventing incompatible blood transfusions and may be safely used instead of routine preoperative crossmatch in those procedures usually not requiring blood.

Our new guidelines, which serve as a hospital- and service-specific MSBOS, improved blood utilization in cardiac surgery. Palmer et al,10 in a study published in 2003, demonstrated that a patient-specific blood ordering system (PSBOS) was more accurate, compared with MSBOS, in predicting the number of blood transfusions. Patient and surgeon variables are both included in the PSBOS, which helped to reduce the number of patients who had blood crossmatched preoperatively. However, this might not be applicable in institutions where there are a large number of surgeons on staff.

Another aspect of crossmatch is needed only if the patient currently or by history has an unexpected RBC antibody. A type and screen is both a safe and cost-effective strategy for those patients who are not expected to use blood. In the event that such a patient needs blood urgently, blood can be transfused within a few minutes after an immediate spin or an electronic crossmatch is performed to verify the ABO compatibility between the patient and the RBC unit.11 The introduction of the type-and-screen concept improved blood utilization in our study. This has also been proven effective in other types of surgeries such as endovascular aneurysm repair and vascular neurosurgery.12,13 The C:T improvement in our case can also be attributed to the educational material presented at the initial blood utilization committee. Sayani14 illustrated that regular physician education and the role of a blood transfusion committee improved the C:T at the studied institution. Blood audit is an important measure that needs to be carried out regularly in all transfusion services and hospitals. These audits serve as a surveillance tool with which changes to
current guidelines can be made. This was demonstrated in the Clarke et al study, in which blood audits were used to implement evidence-based crossmatching protocols, which resulted in significant savings in time, manpower, and money.

The improved C:T in our study has led to better blood usage. We believe that this can be attributed to compliance with the new guidelines, but a Hawthorne effect cannot be ruled out. The Hawthorne effect is a consequence documented in an experiment conducted at the Hawthorne plant of the Western Electric Company, where the study group behaved positively when they were aware of being under special observation. The Hawthorne effect was thought to be the reason behind the reduction in transfusion orders noted in the Lam et al study published in 1997. Our study was limited to one specialty for a short period. However, we do demonstrate a cost saving for the transfusion service department.

With the implementation of the new type-and-screen protocol, there was a total cost savings over a 4-month period of approximately $12,224. Implementing exact guidelines in the cardiac surgery cases reduced the costs and allowed more efficient use of the blood supply. We are expecting similar results as other departments, such as orthopedic surgery and obstetrics, follow in the steps of the cardiac surgery team. We believe that reporting our experience of improving the C:T and blood utilization for patients undergoing cardiac surgery is helpful to other specialties and institutions. It serves as a guideline to which modification can be applied based on surgical and patient variation. The historical perspective, discussed in this report, of the preoperative crossmatch schedule and the concept of type and screen gives an insight to how cost-effective measures can be applied based on audit and institutional analysis of blood usage. While this intervention is not novel in concept, our report shows that perseverance and multidisciplinary recruitment are the necessary ingredients to implement changes. Each hospital should evaluate its transfusion requirements and modify its MSBOS to minimize unnecessary requests and thus improve its blood utilization.

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References


