Laboratory QA

Analysis of Turnaround Time for Intraoperative Red Blood Cell Issues: A Single-Center Study

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ABSTRACT

Background: When unpredicted surgical blood loss occurs, it is essential that blood arrive from the blood bank in a timely manner.

Objective: To evaluate the turnaround time (TAT) for red blood cells (RBCs) from the blood bank to the operating suite. Cases with delayed TATs were further analyzed to determine potential causes for the delays.

Methods: During a 6-month period, intraoperative RBC requests were included among the blood component request lists at a single tertiary care hospital.

Results: A total of 387 RBC-product requests were received from the operating room, of which 220 (56.8%) cases were intraoperative requests. The overall mean (SD) TAT was 19.4 (9.8) minutes. Mean (SD) preparation-to-issuance time (14.9 [7.8] minutes) contributed more to the overall TAT than did mean (SD) request-to-preparation time (4.5 [7.4] minutes). The 31 cases (14.1%) exceeded the internally mandated TAT threshold ($>$ 30 minutes). Prolonged compatibility testing and delayed courier arrival contributed to TAT delay.

Conclusions: TAT standards for issuing RBCs from the blood bank to the operating suite should be established and carefully monitored for quality improvement of transfusion services.

Keywords: turnaround time, intraoperative, monitoring, blood banking/ transfusion medicine, compatibility test

Turnaround time (TAT) is an important quality indicator in clinical laboratories. The timeliness of blood issuances is very important for efficient and satisfactory laboratory services, especially during surgical urgency or emergency. Although TAT for delivery of blood is an important quality indicator, most studies have focused on the standardization of blood component processing and prevention of blood transfusion–transmitted diseases to enhance the quality of blood-transfusion services.[1-5]

Surgical blood loss usually is unexpected. Red blood cell (RBC) transfusion is a common perioperative intervention: intraoperative RBC transfusion accounts for approximately 40% of total RBC transfusions administered.[6] When unpredicted surgical blood loss occurs, timely receipt of blood supply from the blood bank is essential to support physicians in the operating suite. The blood ordering process starts with an electronic request for RBC units to be cross-matched. After RBC requests and cross-match orders are received by the blood bank, compatibility tests are performed by laboratory personnel. Then, blood products are issued to the operating suite.

The checklist TRM.30866 from the College of American Pathologists provides guidance regarding the urgency of transfusion requirements. It states that it would be helpful to establish an agreement or understanding between the blood bank and the clinical areas regarding expectations for TAT, notifications of delays in obtaining suitable products, and transportation of components and products on a timely basis. However, most blood banks do not monitor TAT for blood-product issuance.[7] Further, there is no established benchmark for TAT of blood-product issuance within the field of transfusion medicine.

The aims of this study were to investigate the overall TAT of issuing RBCs to the operating suite from the blood bank

Abbreviations

TAT, turnaround time; RBC, red blood cell; EMR, electronic medical record; ANOVA, analysis of variance

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and to evaluate the contribution toward TAT of the request-to-preparation phases and preparation-to-issue phase of processing. Cases with delayed TATs were further analyzed to determine potential causes for the delay.

Materials and Methods

Study Subjects

Between January 2016 and June 2016, intraoperative RBC requests were included among the blood component request lists at a single tertiary care hospital. Daegu Catholic University Hospital in South Korea has approximately 850 beds. *Intraoperative blood transfusions* were defined as those initiated during the operation or in the recovery suite. The inclusion criteria were adult elective surgical cases with negative antibody screening results and ABO/Rh type results.

Blood Ordering Process and TAT

We evaluated the TAT for intraoperative RBC orders according to the blood ordering process, including blood product ordering, preparation, and issuance. In Daegu Catholic University Hospital, the blood products are ordered using an electronic medical record (EMR) system that transmits the order to the blood bank. The start time was identified as the time of request. A pop-up window in the EMR alerts laboratory personnel to blood product requests. Laboratory personnel then conduct compatibility tests. The preparation time, or the time until all cross-match tests are completed, is recorded in the EMR system. A pop-up window notifies nurses and other healthcare professionals when the blood products are ready for issue. Then, a courier collects the blood products from the blood bank and delivers them to the operating suite. The *end time* was defined as the time at which the product left the blood bank via courier; this issuance time was captured by the EMR system. We analyzed the total TAT, comprising request-to-preparation time and preparation-to-issuance time. TAT data were further categorized into the number of units ordered (ie, 1-2 units, 3-4 units, or $>$ 4 units) and into the time of day the order took place (day [9:00 AM–6:00 PM] or night [6:00 PM–9:00 AM]).

TAT Delays

Prolonged TATs were defined as TATs longer than the 30-minute internal quality standard for intraoperative product issuance. Cases with extended TATs were further evaluated to determine factors that potentially contributed to such delays.

Statistical Analysis

We performed statistical analysis using SPSS software, version 19.0 (SPSS Inc), with data expressed as mean (SD). The TATs between the different groups categorized according to the number of units ordered were compared using the Kruskal-Wallis test, analysis of variance (ANOVA), and subsequent post hoc range tests. We used the Mann-Whitney test to compare TATs between the 2 groups categorized by time of day and between the 2 groups categorized by TAT period.

Results

A total of 3640 blood product requests were received, and 19,316 units of blood products were issued during the 6-month study period. A total of 387 RBC product requests were received from the operating suite; 220 (56.8%) were intraoperative requests. A total of 1994 RBC units were issued from the blood bank to the operating suite and 996 (49.9%) RBC units were issued during operations. All 220 intraoperative RBC requests were eligible for inclusion in our analysis and were evaluated for TAT.

The distribution of TATs for all cases is displayed in **Figure 1**. The most frequent TATs were 11 minutes to 15 minutes. Regarding the overall and segmental TAT for intraoperative RBC orders, the overall mean (SD) TAT was 19.4 (9.8) minutes. The mean preparation-to-issuance time (14.9 [7.8] minutes) contributed more to the overall TAT than did request-to-preparation time (4.5 [7.4] minutes). TATs stratified by number of units and time of day are shown in **Table 1**. Most intraoperative RBC orders were for 1 or 2 units (152 [69.1%]), with 47 (21.4%) orders for 3 or 4 RBC units and 21 (9.5%) orders for 4 or more RBC units. There was no statistically significant difference ($P = .421$) among the number of units issued. The mean (SD) TAT for orders placed during the 9:00 AM to 6:00 PM and 6:00 PM to 9:00 AM time segments did not differ statistically ($P = .768$). The mean (SD) request-to-preparation TAT was longer during the

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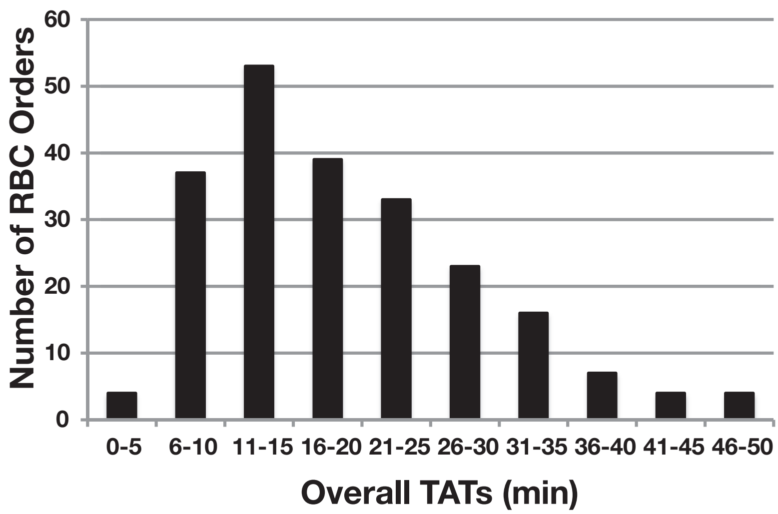

Figure 1

Distribution values for turnaround times for all cases in this study.

hours of 6:00 PM to 9:00 AM (5.4 [9.2] minutes) than during the hours of 9:00 AM to 6:00 PM (4.1 [6.5] minutes).

Overall, the TAT compliance rate was 85.9%. The 31 cases (14.1%) with TATs that exceeded the internal policy (>30 minutes) were further evaluated to determine which factors contributed to the delay. The mean (SD) TATs were 37.1 (5.7) minutes in delayed cases. TATs from request to preparation and TATs from preparation to issuance in delayed cases were longer than those TATs for cases issued within internal-policy time requirements (**Table 2**). Prolonged compatibility testing and delayed courier arrival contributed to TAT delay.

Discussion

In this study, overall TATs and segmental TATs for intraoperative RBC orders were evaluated. In addition, TATs were analyzed and stratified by the number of RBC units ordered and the time of day the order was placed. Potential causes for delay were evaluated in cases with extended TATs.

Intraoperative blood loss can occur unpredictably, and the need for blood transfusion might be necessary in an urgent situation. Timely issuance of blood products is essential and important for patient safety and for optimal intraoperative management. In the present study, the overall mean and median TAT for emergency operating suite RBC orders were 19.4 minutes and 18 minutes, respectively. The mean and median TATs were shorter than 22 minutes, which constitutes the 25th percentile of fastest-performing participants in the 2002 College of American Pathologists Q-probe–based study to benchmark operating-suite delivery TATs.[8] However, the overall TAT of 19.4 minutes was longer than the 15-minute TAT expected by anesthesiologists for urgent surgical cases.[7]

Although there was no statistically significant difference ($P = .768$), the mean (SD) TAT was longer during the hours of 6:00 PM to 9:00 AM than during the hours of 9:00 AM to 6:00 PM. The request-to-preparation period contributed to TAT delay. Prolonged compatibility testing might be due to *short staffing* (inadequate number of workers). In our blood bank, 4 full-time employees work. There are 2 full-time equivalent (FTE) on day shift and 1 FTE on night shift.

At our institution, the standard TAT for intraoperative RBC orders was set at 30 minutes, consistent with the 50th percentile of TAT reported in the previous study.[8] The TAT target was achieved in 85.9% of cases, whereas the target rate is compliance of greater than 90%. Therefore, we analyzed the TAT according to the blood-ordering process and determined the reasons for the delays. The mean

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Table 1. TAT Categorized Per Number of Units Ordered and Time of Day the Units Were Ordered

Packed RBC Orders	Requests, No.	Mean (SD)		
		Overall TAT (min)	Segmental TAT (min)	
			Request-to-Preparation Time	Preparation-to-Issuance Time
1-2 units	152	18.9 (9.9)	4.9 (7.8)	14.0 (7.2)
3-4 units	47	20.4 (8.9)	3.9 (6.7)	16.5 (8.6)
> 4 units	21	20.4 (11.0)	2.6 (5.5)	17.8 (9.3)
P value		.42	.16	.06
Time of day				
09:00 AM–6:00 PM	155	19.1 (9.3)	4.1 (6.5)	15.1 (7.7)
6:00 PM–9:00 AM	65	20.0 (10.9)	5.4 (9.2)	14.6 (8.2)
P value		.77	.95	.58

TAT, turnaround time.

Table 2. Comparison of TAT Between Cases That Meet Internal-Policy Standards (≤30 min) and Cases Exceeding Those Standards (>30 min)

Time	Number of Requests, No.	Overall TAT (min)	Segmental TAT (min)	
			Request-to-Preparation Time	Preparation-to-Issuance Time
≤30 min	189	16.5 (6.8)	2.9 (4.5)	13.6 (6.2)
> 30 min	31	37.1 (5.7)	14.2 (12.6)	22.9 (11.4)
P value		<.001	<.001	<.001

TAT, turnaround time.

request-to-preparation TAT and mean preparation-to-issuance TAT were 4.5 minutes and 14.9 minutes, respectively. In delayed cases, the mean request-to-preparation TAT and the mean preparation-to-issuance TAT were 14.2 minutes and 22.9 minutes, respectively. The median request-to-preparation TAT was faster in the present study than those in previous studies: 1 study reported a median TAT of 26 minutes[8] and another reported a mean TAT of 33 minutes.[9] These differences could be due to the inclusion criteria and method of order entry. In the present study, the eligible cases already had type-and-screen results before requests were received by the blood bank, and orders were limited to intraoperative RBC requests.

Cases with the presence of unexpected antibodies in patient specimens were excluded because these conditions could cause delays. When type and screening tests were performed and unexpected antibody results were negative, manual immediate spin was performed. Our institution has an electronic laboratory information system, and blood requests are received using electronic order entry: manual call slips are not used. Most laboratories use an immediate spin method when no clinically significant antibodies have been detected by antibody screening test.[10] It is allowed to omit the immediate spin and antihuman globulin phases when cross-matching nonalloimmunized patients.[10] Electronic cross-matching can be performed in such situation. Electronic cross-matching can be an option to reduce TAT, even if assembling the computer system may be expensive. We identified significant delays from preparation to issuance. In the present study, the preparation-to-issuance TAT contributed most to the overall TAT. The TAT of this phase was longer than the median TAT of 8 minutes reported in a previous study.[8] After completing the compatibility test, the nurse checks the pop-up window and calls the courier to bring the blood product. Then, the courier departs from the operating suite to the blood bank and issues the RBCs. In a series of processes, time delay may be a variable. At our institution, prepared blood products are not transported by means of a pneumatic tube system but are retrieved via courier. Pneumatic tube systems are expensive; therefore, from a cost-accounting perspective, buying into such a system for blood product delivery may be implausible. If the courier receives an order and arrives at the blood bank faster, the TAT of this phase could be shortened, to achieve the optimal TAT.

Healthcare professionals frequently opine that that TATs for blood requests are too long. Physicians may tend to overorder blood component units, to assure availability of those units during surgical procedures that have the potential for significant blood loss.[11] It is essential to provide TAT data and education regarding blood-ordering processes and TAT standards to physicians. Understanding expected TATs for cross-matched RBCs enables physicians to consider whether they should delay transfusions until clinically significant surgical blood loss is confirmed. This practice would reduce unnecessary intraoperative cross-matching and, thus, the workload of blood bank personnel, allowing stronger work efficiency. Moreover, the rate of blood returns and blood wastage would be decreased. In addition to issuing RBCs, the TAT involved more steps, including delivery to the operating suite and retrieval for infusion for clinician perspectives. The delivery time to the operating suite and retrieval time for infusion should be investigated to measure the actual time period for transfusion.

In conclusion, TAT standards for issuing RBCs from the blood bank to the operating suite should be established and carefully monitored, for quality improvement of transfusion services and for greater customer satisfaction. Blood bank personnel should be trained to handle urgent requests by assigning them priority. Moreover, continued education of hospital staff is needed to improve TATs. **LM**

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