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Effectiveness of Blood Request and Use During Surgery in Elective Patients of RSUD Dr. Soetomo's Gedung Bedah Pusat Terpadu

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ABSTRACT

Background: Data from developing countries show that only forty to seventy percent of the total blood cells ordered for patients are transfused. In the Global Database on Blood Safety (GDBS) report published in 148 countries in 2011, the World Health Organization (WHO) estimated that of the total 96.4 million WB donations worldwide, approximately 5 million (5.2%) were wasted. In 2023, the Blood Transfusion Installation (ITD) of Dr. Soetomo Hospital received 34,047 units of blood (various blood types) from the Surgical Unit; 14,249 units of blood were handed over to clinicians to be given to patients. Methods: This retrospective descriptive study recorded preoperative blood filling data, both on-hand supplies and GSH for all elective surgeries performed at the Integrated Central Surgery Building (GBPT) of Dr. Soetomo Hospital. Soetomo from January to December 2023. Results: Of the 5411 study subjects, the C/T ratio was reported to be 0.92 ± 0.31, TI 0.59 ± 0.19, and %T 12.47 ± 7.24. The analysis showed that the C/T ratio and blood demand during surgery had a statistically significant relationship, with a P value of 0.043 and a Pearson correlation of 0.770, indicating a strong positive relationship. The P value of TI and %T against blood demand is 0.903 and 0.193, far above the limit of 0.05 which shows that the two indicators have no correlation with the amount of blood demand. Conclusion: Overall, the C/T ratio is a useful indicator for blood demand planning, while TI and %T showed a less clear relationship.

KEYWORDS: C/T Ratio, Transfusion Index, Transfusion Percentage

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INTRODUCTION

Blood is a very valuable and expensive resource that is highly dependent on public donations; blood should be used logically and accurately. The continuously increasing demand for blood and the large amount of wasted blood products are a global challenge. In developing countries, blood is ordered by doctors where blood banks do not have the authority to replace or override these requests, resulting in unnecessary blood orders. Unnecessary blood requests, whether for whole blood (WB) or red cell concentrate (packed red cell / PRC), where these requests have gone through the crossmatching process which can lead to reagent usage, and wasted time where these resources should be able to be used for appropriate requests for other patients [1]. In elective surgery, bleeding related to surgical procedures should be anticipated so that the need for red blood cells can be calculated [1]. Data from developing countries shows that only 40-70% of the total ordered blood cells for patients are transfused [2–4].

A survey conducted by the World Health Organization (WHO) in the Global Database on Blood Safety (GDBS) report in 148 countries in 2011 estimated that out of a total of 96.4 million WB donations worldwide, approximately 5 million (5.2%) were wasted. Based on GDBS 2001-2002, WHO also reported an estimated cost wastage of at least US$ 214 million per year, this figure is calculated based on the cost of collecting and processing 2.5 million units of WB worldwide (World Health Organization, 2021) [5]. In the 2023 Blood Transfusion Installation (ITD) report of RSUD Dr. Soetomo, there was data on blood requests of 34,047 blood units (various blood types) from the Surgical Inpatient Unit, and 14,249 blood units were delivered to clinicians to be given to patients. The total blood units delivered was only 41.85% of the total blood ordered. However, this data represents overall requests, there has been no separation of orders based on needs, for example for surgical preparation needs, preoperative transfusion, postoperative transfusion. The Surgical Inpatient Unit includes Aster HCU, Bedah Bougenville, Bedah Cempaka, Bedah Dahlia, Bedah Edelweiss, Bedah Flamboyan, Bedah Gladiol, Bedah Herbra, Bedah Melati, Bedah Teratai, Sukardja. For the Integrated Central Surgery Building (GBPT) which includes Burn Unit, Intensive Care Unit and Operating Rooms Floors 4,5,6 GBPT, there was a total request of 5,750 blood units and 2,563 blood units were delivered. GBPT blood unit usage was 52.06% in 2023. For ROI, total orders were 4,068 units and 1,690 units were delivered, 41.54% total usage from orders. In 2020, data on blood component

distribution in the ROI room showed that PRC was the most widely used component, followed by WB, TC (Thrombocyte Concentrate) then FFP (Fresh Frozen Plasma). Anemia occupied the first position as a transfusion indication, followed by bleeding, thrombocytopenia, coagulation disorders, therapy, burns and surgical preparation. For the RES Room, total orders were 1,326 units and 451 units were delivered, 34.01% usage from total blood orders (Instalasi Transfusi Darah RSUD Dr. Soetomo, 2023) [6].

The decision to order blood T/S (type and screen) or T/C (type and crossmatching) before surgery can be very controversial, especially in surgical cases with a small or medium possibility of requiring transfusion. Several variables must be considered when making this decision, including the amount of bleeding for a particular procedure, perioperative hemoglobin concentration, and the relative risk of emergency transfusion of type O blood when T/S and T/C are not available [7].

Maximum Surgical Blood Order Schedule (MSBOS) recommendations for commonly performed surgical procedures were published more than 30 years ago by Friedman et al [8], which is a list of preoperative blood order recommendations for various types of surgical procedures. However, many new procedures have been introduced and surgical techniques have evolved so that bleeding is now not commonly occurring. Ideally, blood ordering protocols should be based on each institution's blood usage history, which is difficult to obtain [7]. The effectiveness of blood ordering and use in elective Central Surgery patients at RSUD Dr. Soetomo is evaluated in this study. It is expected that the findings of this study can be used as a consideration in establishing department-specific MSBOS at RSUD Dr. Soetomo.

METHOD

Research Design

This research is descriptive retrospective by recording blood order filling data before surgery both for on-hand stock and GSH for elective surgery at the Integrated Central Surgery Building of RSUD Dr. Soetomo.

Research Location and Time

The research location and time were at the Integrated Central Surgery Building of RSUD Dr. Soetomo Surabaya and the Blood Transfusion Installation, this research lasted for one month.

Research Population and Sample

The research population was all patients who underwent elective surgery at the Integrated Central Surgery Building of RSUD Dr. Soetomo from January 2023 to December 2023. All patients who underwent elective surgery at the Integrated Central Surgery Building of RSUD Dr. Soetomo from January 2023 to December 2023 who placed blood orders. Sampling was done by total sampling, for 12 months from January to December 2023. The sampling technique was consecutive sampling.

Inclusion Criteria

All patients who placed blood orders to undergo elective surgery at the Integrated Central Surgery Building of RSUD Dr. Soetomo.

Exclusion Criteria

1) Patients who did not require blood requests to undergo elective surgery.
2) Patients undergoing cardiac surgery.
3) Patients with Hb less than 8.
4) Patients aged under 18 years and over 65 years.
5) Blood requests made during ongoing surgery.

Research Variables

Independent Variables

1) Age
2) Type of Surgery
3) Initial Hb before surgery

Dependent Variables

1) Amount of blood requested
2) Amount of blood prepared
3) Amount of blood transfused
4) Amount of bleeding during surgery
5) Amount of unused blood
6) Crossmatch to Transfusion Ratio (C/T Ratio)
7) Transfusion Index (Ti)
8) Transfusion Probability (%T)

Research Data Collection Method
Recording from Anesthesia Medical Records and Blood Transfusion Installation Data of RSUD Dr. Soetomo.

Data Processing and Analysis Techniques
Recorded data will be collected, tabulated and analyzed descriptively.

RESULT
This research is a descriptive retrospective study by recording blood order filling data before surgery both for on-hand stock and GSH for elective surgery at the Integrated Central Surgery Building of RSUD Dr. Soetomo. The research sample was all patients who underwent elective surgery at the Integrated Central Surgery Building of RSUD Dr. Soetomo from January 2023 to December 2023 who placed blood orders. This research aims to assess the effectiveness of blood request and use during surgery in elective Central Surgery patients at RSUD Dr. Soetomo.
This study used 5411 blood order filling data before surgery with 2428 patients with blood requests. The data that had been obtained were extracted and analyzed to determine the effectiveness of blood request and use during surgery in elective Central Surgery patients at RSUD Dr. Soetomo.

Research Sample Characteristics
A descriptive test was conducted on the research data and the following overview was obtained:

Table 1: Research Sample Characteristics Based on Gender

Gender per Department	Number of Patients	Percentage	Department Percentage
BMU	**36**		1.48%
F	23	0.95%	
M	13	0.54%	
BU	**413**		17.01%
F	220	9.06%	
M	193	7.95%	
MTA	**40**		1.65%
F	17	0.70%	
M	23	0.95%	
NS	**239**		9.84%
F	133	5.48%	
M	106	4.37%	
OBG	**446**		18.37%
F	446	18.37%	
ORT	**550**		22.65%
F	227	9.35%	
M	323	13.30%	
PLS	**216**		8.90%
F	73	3.01%	
M	143	5.89%	
THT	**32**		1.32%
F	16	0.66%	
M	16	0.66%	
TKV	**167**		6.88%
F	64	2.64%	
M	103	4.24%	
URO	**289**		11.90%
F	139	5.72%	
M	150	6.18%	
Grand Total	**2428**	**100.00%**	**100.00%**

Table 2: Research Sample Characteristics Based on Age

Patient Age	Number
Age group 18-25	**775**
F	360
M	415
Age group 26-35	**1010**
F	557
M	453
Age group 36-45	**1104**
F	678
M	426
Age group 46-55	**1377**
F	794
M	583
Age group 56-65	**1145**
F	595
M	550
Grand Total	**5411**

Table 3: Blood Utilization Indicators by Department

Department	Total Patients	TOTAL WB + PRC PREOP REQUEST	TOTAL WB + PRC TRANSFUSED DURING	C/T Ratio per department	Ti per department	%T
BMU	36	92	22	4.18	0.61	100.00%
BU	413	1216	170	7.15	0.41	100.00%
MTA	40	80	3	26.67	0.08	100.00%
NS	239	810	151	5.36	0.63	100.00%
OBG	446	1016	278	3.65	0.62	100.00%
ORT	550	1749	286	6.12	0.52	100.00%
PLS	216	467	62	7.53	0.29	100.00%
THT	32	84	7	12	0.22	100.00%
TKV	167	482	79	6.1	0.47	100.00%
URO	289	608	56	10.86	0.19	100.00%
Grand Total	2428	6604	1114	5.93	0.46	100.00%

Based on the data in Table 1, the total number of patients involved in this study was 2,428 people. Patient distribution by department shows that the highest proportion came from the Orthopedics Department (ORT) with 550 patients (22.65%), followed by the Obstetrics and Gynecology Department (OBG) with 446 patients (18.37%), and the General Surgery Department (BU) with 413 patients (17.01%). The lowest proportion came from the Ear Nose Throat Department (THT) with 32 patients (1.32%), and Oral and Maxillofacial Surgery (BMU) with 36 patients (1.48%).

Based on the data in Table 1 gender distribution, male and female patients showed relatively balanced proportions in most departments. The department where all patients were female was OBG, while departments with male patient dominance included Orthopedics (M 13.30%) and Plastic Reconstruction (M 5.89%). Overall, there was a tendency for the number of female patients to be slightly higher than males, especially in obstetric and gynecology cases.

Analysis based on age distribution showed a total of 5,411 patients categorized into five age groups. The 46-55 year age group was the most numerous, comprising 1,377 patients, while the 18-25 year age group was the least with 775 patients. Gender distribution in each age group showed that women dominated in the 26-35 year and 36-45 year groups, while relative balance was seen in older age groups.

Overall, the demographic characteristics of patients in this study described a heterogeneous population in terms of gender, age, and type of surgical procedure. This distribution variation reflects the variety of cases and types of anesthesia performed in various surgical departments at the research hospital.

Correlation of C/T Ratio with Blood Request Amount

A correlation test was conducted to determine the relationship between C/T Ratio and blood request amount and the following results were obtained:

Table 4: Correlation of C/T Ratio with Blood Request Amount

	Blood Request	C/T Ratio
P value		0.043
r		0.770

Based on statistical test results, the C/T ratio shows a significant relationship with blood requests. A P value of 0.043 indicates that this relationship is statistically significant, because the P value is less than 0.05. In addition, a Pearson correlation value of 0.770 shows a strong and positive relationship between C/T ratio and blood requests. In other words, the higher the C/T ratio, the higher the blood request, indicating a significant and strong correlation between the two variables.

Correlation of TI with Blood Request Amount

Table 5: Correlation of TI with Blood Request Amount

	Blood Request	TI
P value		0.903
r		-0.057

Based on statistical test results, the relationship between blood request and TI shows that the P value is 0.903. Because this P value is much greater than the 0.05 significance threshold, the relationship between blood request and TI is not statistically significant. In addition, the Pearson correlation value of -0.057 shows that there is a very weak and negative relationship between blood request and TI. Thus, it can be concluded that there is no significant relationship between blood request and TI.

Correlation of %T with Blood Request Amount

Table 6: Correlation of %T with Blood Request Amount

	Blood Request	%T
P value		0.192
r		0.559

Based on statistical test results, the relationship between blood request and %T shows a P value of 0.192. Because this P value is greater than the 0.05 significance threshold, the relationship between blood request and %T is not statistically significant. However, the Pearson correlation value of 0.559 shows a fairly strong positive relationship between blood request and %T. Although this relationship is not statistically significant, the strength of the correlation indicates that there is a positive tendency between the two variables.

DISCUSSION

Research Sample Characteristics

In this study, an evaluation was conducted on the effectiveness of blood request and use during surgery in elective patients at the Integrated Central Surgery Building of RSUD Dr. Soetomo. The analysis results include the relationship between several variables such as C/T ratio, TI, and %T with blood requests, to understand how these factors affect blood use during surgery.

Out of a total of 5,411 respondents, there were 2,429 males (44.9%) and 2,982 females (55.1%). This distribution shows that the majority of respondents were female, with a significantly higher proportion compared to males. Differences in the number of males and females may need to be considered in result analysis, as gender can affect various medical aspects and blood needs during surgery.

Age distribution shows significant concentration in the 46-55 year age group (25.4%) and 36-45 year age group (20.4%). This indicates that elective patients undergoing surgery at the Integrated Central Surgery Building tend to be in older age groups. Age factors can affect blood needs and complication risks during surgery, which need to be considered in transfusion planning and management. Departments with the largest numbers were BU and ORT, each 17.1%, indicating that the types of surgery performed in these departments may more often require blood. Other departments, such as ANS and RAD, had very small respondent numbers, so they may not significantly represent the population. Varying blood request amounts indicate that blood requests during surgery can be very different. With the highest request number for 2 blood units (17.8%) and the lowest number for 9 blood units (0.1%), this reflects different blood needs depending on the type of surgery and patient condition. The distribution of transfused blood shows that most patients received 1 blood unit (7.2%) or 2 blood units (4.5%). Meanwhile, the distribution of delivered blood shows a

similar tendency, with 1 blood unit (10.5%) being the most common. This data provides insights into the amount of blood commonly used during surgery, and can help in more efficient blood needs planning.

Correlation of C/T Ratio with Blood Request Amount

Analysis results show that there is a significant relationship between C/T Ratio (Immediate Spin to Transfusion Ratio) and the amount of blood requested during surgery. The P value for this relationship is 0.043, which shows statistical significance because this value is less than the 0.05 significance threshold. In addition, a Pearson correlation value of 0.770 shows a strong positive relationship between C/T Ratio and blood request amount. A P value of 0.043 shows that the relationship between C/T Ratio and blood request amount is statistically significant. This means there is a very small possibility that this relationship occurred by chance, so these results can be relied upon in the research context. This significance indicates that C/T Ratio is an important indicator that can predict blood needs during surgery. A Pearson correlation value of 0.770 shows a strong and positive relationship between C/T Ratio and blood request amount. This positive correlation means that the higher the C/T Ratio value, the higher the amount of blood requested. This strong relationship shows that changes in C/T Ratio can significantly affect the amount of blood requested during surgery.

C/T Ratio can be used as an important indicator in planning blood needs during surgery. Because of the strong correlation, routine monitoring of C/T Ratio can help in predicting and preparing the required blood amount, reducing the risk of blood shortage during surgery, and improving patient safety. By understanding the relationship between C/T Ratio and blood requests, medical teams can develop better transfusion management strategies. For example, in cases where C/T Ratio shows high values, earlier preparation for the possibility of greater blood needs can be done.

C/T Ratio is defined as the number of blood units that go through the crossmatch process or cross-compatibility test compared to the number of blood units transfused or given to patients. Ideally this ratio should be 1.0 but the British Committee for Standards in Hematology establishes the Golden Standard for CT ratio as 2.5 or less, where this value is indicated as efficient blood use. The Hematology and Blood Bank Department cooperates with surgeons to design and implement MSBOS. MSBOS is formulated using Mead's Criterion, which according to the calculated number of red blood cell units, is 1.5 times the transfusion index for certain surgical procedures. Minister of Health Regulation No. 91 of 2015 states that T/S and MSBOS policies are made based on blood use data for previous surgical procedures, recommending T/S or the maximum amount of blood ordered for routine elective surgery. C/T Ratio of more than 2.5 indicates excessive cross-compatibility test requests [2,9].

Correlation of TI with Blood Request Amount

Analysis results show that the relationship between TI (Transfusion Index) and blood request amount is not statistically significant. The P value for this relationship is 0.903, which is much greater than the 0.05 significance threshold. In addition, a Pearson correlation value of -0.057 shows a very weak negative relationship between TI and blood request amount. A P value of 0.903 shows that there is no significant relationship between TI and blood request amount. Because this P value is much greater than 0.05, this result indicates that the relationship between TI and blood request amount may not be consistent or relevant in this research context. In other words, changes in TI do not significantly affect the blood request amount during surgery. A Pearson correlation value of -0.057 shows that the relationship between TI and blood request amount is very weak and negative. This negative correlation means that there is little or no clear relationship between TI and blood requests. The very small value indicates that TI may not be an important factor in predicting the required blood amount.

Given the insignificance of TI in predicting blood requests, the use of TI as a single indicator in blood needs management may not be effective. TI may not provide sufficient information to plan the blood amount needed during surgery. This research shows that other factors, such as C/T Ratio, may be more relevant and significant in predicting blood needs compared to TI. Therefore, attention should be focused on other factors that have stronger and more significant relationships with blood requests.

Ti is defined as the number of blood units transfused compared to the number of patients who underwent crossmatching. A value of 0.5 or more is considered significant blood use [9]. Mahar defines Ti as the average number of blood units transfused for each particular surgical procedure. In surgery with Ti less than 0.5, routine crossmatch procedures are not necessary, group and save is sufficient, where patients undergoing this procedure only need to have their blood type checked and antibody testing on blood serum. At the Blood Transfusion Installation of RSUD Dr Soetomo, if antibodies are not found in the blood or the antibody is said to be negative, then the blood sample is stored and if surgery requires blood then blood can be given after rapid immediate spin crossmatch or phase 1 crossmatch is performed. This allows blood to be available quickly in emergency cases and prevents unnecessary crossmatch procedures (Instalasi Transfusi Darah, 2023) [2].

Correlation of %T with Blood Request Amount

Analysis results show that the relationship between %T and blood request amount has a P value of 0.192 and Pearson correlation of 0.559. Although the correlation value shows a fairly strong positive relationship, the P value greater than 0.05 shows that this relationship is not statistically significant. A P value of 0.192 shows that the relationship between %T and blood request amount is not statistically significant. This means that although there is a positive tendency, the results are not strong enough to be considered significant in this statistical test context. Other factors may affect blood requests so that this relationship does not reach the

significance level.

A Pearson correlation value of 0.559 shows a moderate positive relationship between %T and blood request amount. This indicates that there is a tendency that an increase in %T may be related to an increase in blood request amount. Although this relationship is quite strong, the strength of this correlation is not sufficient to consider it statistically significant in this study. Although not statistically significant, the moderate relationship between %T and blood requests shows that %T could be a useful indicator in blood needs planning. Clinical practice may still consider %T as one factor in blood needs evaluation, especially in combination with other more significant factors. Because the relationship between %T and blood requests is not statistically significant, it is important to consider other factors that may be more influential in determining blood needs. Comprehensive evaluation of other factors such as C/T Ratio, patient clinical condition, and type of surgery may be needed to plan blood needs more accurately.

Analysis results show that although there is a moderate positive relationship between %T and blood request amount, this relationship is not statistically significant. This indicates that %T may not consistently affect blood requests in this research context. Therefore, in blood transfusion planning and management, it is advisable to combine %T information with other indicators that have stronger and more significant relationships to improve accuracy and effectiveness in meeting blood needs during surgery. %T is defined as the number of patients given transfusion compared to the number of patients who underwent crossmatching [9].

Research Results Analysis

Research results show that C/T Ratio has a significant relationship with blood request amount, with P value 0.043 and Pearson correlation 0.770, indicating a strong positive relationship. This shows that an increase in C/T Ratio is related to increased blood needs. Conversely, TI (Transfusion Index) does not show a significant relationship with P value 0.903 and Pearson correlation -0.057, showing TI is not relevant in predicting blood needs. %T (Percentage of Transfused Blood) has a moderate positive relationship with blood request amount, with P value 0.192 and Pearson correlation 0.559, but this relationship is not statistically significant. Overall, C/T Ratio is a useful indicator for blood needs planning, while TI and %T show less clear relationships.

Research Limitations

This research has several limitations observed during its implementation:

1) Sample Size: Sample size can only represent blood ordering effectiveness in 2023 at RSUD Dr. Soetomo.
2) Secondary Data: Inaccuracy or incompleteness of medical data can affect analysis results.
3) Result Generality: Findings may not be generalizable to other hospitals or types of surgery.
4) Parameter Measurement: Variability in parameter measurement methods can affect results.
5) Time Factor: Research may not consider long-term changes in practices or patient conditions.

CONCLUSION

The conclusions of this research, derived from the analysis and discussion, indicate that there is a significant relationship between the C/T Ratio and the amount of blood requested, while no significant relationship is found between Ti and the amount of blood requested, nor between %T and the amount of blood requested. Based on these findings, several recommendations can be proposed. The integration of the C/T Ratio into blood requirement planning strategies during surgery, as outlined in the MSBOS for each department, is encouraged to enhance prediction accuracy and transfusion management through comprehensive socialization. Further research with larger sample sizes and broader methodologies may be conducted to validate these results and investigate additional factors influencing blood demand. Consideration of other variables related to patient medical conditions and the type of surgery is also suggested to support more accurate and comprehensive planning and management of blood needs.

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