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A retrospective analysis of intraoperative blood transfusion practices in patients undergoing thoracotomy and major lung surgery in an Indian tertiary care hospital and formulation of a maximum surgical blood ordering Schedule (MSBOS)

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Abstract

Background and Aims: The risk of blood loss in lung surgeries is significant and depends on the nature of surgery. The literature on the pattern of intraoperative requirement of blood transfusion in various types of lung surgeries is scarce. In the absence of clear evidence, often inappropriate amount of blood is cross matched, ordered and transfused. Excessive cross matching of blood can increase the burden on the blood bank. The aim of the study was to analyze the blood transfusion practice in patients undergoing major lung surgery at our center and propose a maximum blood ordering schedule (MSBOS) for optimizing blood ordering.

Methods: Retrospective review of electronic database of medical records and anesthesia charts was done for patients who underwent thoracotomy and major lung surgery between July 2014 and June 2016. All the patients were studied under 5 surgical categories. Upper lobectomy, lower lobectomy, pneumonectomy, decortication and others (Hydatid cyst excision/lung abscess drainage/ Bullectomy/wedge resection). Under each category amount of blood cross matched and transfused intraoperatively were noted. Cross match to transfusion ratio(C: T ratio), Transfusion probability (T%), and Transfusion Index(TI) were calculated and Maximum surgical blood ordering schedule (MSBOS) was proposed in each surgical category.

Results: A total of 229 patients with mean age of 40 years were studied. Four hundred seventy eight units of blood were cross matched and 162 units were transfused in 90 patients. C:T ratio, TI and T% were 2.95, 0.7 and 39% respectively in the total cohort. All the three indices showed significant usage of blood in upper lobectomy and pneumonectomy group whereas all the indices showed low requirement of blood in patients undergoing decortication, Bullectomy, hydatid cyst excision, lung abscess drainage and wedge resection. MSBOS suggested crossmatch and reserve of 2 blood units for upper lobectomy and pneumonectomy, and 1unit for lower lobectomy. Decortication, Bullectomy, hydatid cyst excision, lung abscess drainage and wedge resection were suitable for Type and Screen (T&S)

Conclusion: Blood ordering based on surgical category can provide a rational and efficient way of blood ordering and management of resources in patients undergoing lung surgeries.

Keywords: Maximum surgical blood ordering schedule(MSBOS), Lung surgeries, Transfusion.

Introduction

Lung surgeries are considered moderate to high risk surgeries. Although the risk of blood loss in lung surgeries is significant, the amount can significantly vary depending on the pathology and nature of surgery. The literature on the requirement of blood transfusion across different types of lung surgeries is scarce and mostly comes from western world.[1,2] As per our knowledge no study has been published in Indian patients. In the absence of clear evidence, often inappropriate amount of blood is cross matched, ordered and sometimes transfused. Excessive blood ordering can increase the burden on the blood bank and add to the cost of medical service. This study was undertaken to analyze the intraoperative blood transfusion practices currently used for patients undergoing major lung surgery at our center and propose a maximum blood ordering schedule(MSBOS) for optimizing blood ordering practices.

Methods

The entire patient cohort who underwent open thoracotomy and major lung surgery at our center between July 2014 and June 2016 was evaluated retrospectively. All the adult subjects more than 18 years who underwent the following procedures were included. Lobectomy, Pneumonectomy, decortication, Hydatid cyst excision, lung abscess drainage, Bullectomy, wedge resection.

Patients undergoing emergency surgery, redo surgery, minor procedures like biopsy or thoracotomy for non-pulmonary surgeries were excluded.

Data on variables like age, sex, weight, comorbid conditions, diagnosis, nature of disease(Tubercular or non-tubercular), surgery undertaken, baseline hemoglobin (Hb), the final Hb at the end of surgery, number of blood units cross matched and reserved, ordered, and transfused were acquired from the electronic database of the cardiothoracic surgery department/ anesthesia charts and blood bank registry of our hospital. The data was entered on excel data sheet. All the patients were grouped under 7 surgical

categories namely 1-upper lobectomy, 2- middle lobectomy 3-lower lobectomy, 4-Bilobectomy 5-pneumonectomy, 6-decortication and 7-others (Hydatid cyst excision/lung abscess drainage/ Bullectomy/wedge resection). Under each category Cross match to transfusion ratio(C:T ratio), Transfusion probability(T%), and Transfusion Index(TI) were calculated and Maximum surgical blood ordering schedule (MSBOS) were proposed

C: T ratio is defined as Number of units cross matched ÷Number of units Transfused.

Transfusion Index (TI) is defined as Number of units Transfused ÷ Number of patients cross matched

Transfusion probability (T%) is defined as (Number of patients Transfused ÷ Number of patients cross matched) × 100.

Maximal surgical blood order schedule was calculated using mead's criteria[3](R)

MSBOS= 1.5 × TI

The whole number next to the MSBOS was decided as the number of units to be cross matched and saved. Surgical groups having MSBOS number <0.5 were deemed to have low blood requirement and were grouped under type and screen only instead of cross match and save.

Statistical analysis: The data was analyzed using SPSS version 20(2011, IBM, Armonk, NY, United States of America). Continuous variables were expressed as Mean ± SD and categorical variables as frequency of occurrence and percentage. Analysis of Variance (ANOVA) with post hoc analysis using bonferonni test was used for statistical analysis. A p value less than 0.05 was considered significant.

Results

A total of 258 patients underwent thoracotomy during the study period. Out of these, 4 patients had re do surgery, 5 patients had thoracotomy for open biopsy and 5 patients had thoracotomy for diaphragmatic hernia repair. Thus these were excluded. Out of the remaining 244 patients, complete medical records could not be retrieved for 15 patients. So 229 patients were included for final analysis. None of the patients underwent middle lobectomy or bilobectomy. Thus the data was analyzed in five groups (1-Upper lobectomy, 2-Lower lobectomy, 3-Pneumonectomy, 4-Decortication, 5- Others).

The demographic details of study cohort are tabulated in Table 1. Mean age of cohort was 40years and more than 2/3rd of patients were operated for late sequelae of tuberculosis. Baseline and post-operative Hb of the study cohort was 12.95±1.8 and 10.47±1.77 respectively. Base line Hb was comparable in all the surgical sub categories.

All the intraoperative transfusions were done by the anesthesia faculty in charge of the case. As per our institute protocol, intraoperative transfusion is given to a patient if Hb<8gm/dl or Hb<9gm/dl in patients with Coronary artery disease(CAD), or If blood loss exceeds >20% of estimated blood volume with hemodynamic instability.

Four hundred seventy eight units were cross matched and reserved for the total cohort and 162 units were transfused in 90 patients. Only 33.8% of cross matched units were transfused and 39.3% patients received transfusion. The details of C:T ratios, TI, Transfusion probability in various surgical categories are given in Table 2. Based on the MSBOS formula as stated earlier, a blood ordering schedule for various surgical categories was proposed and is detailed in Table 3.

Table 1: Patient demographics. Data expressed at mean±standard deviation or frequency as percentages

Variables	
Age(in years)	40±13
Sex(Male: female)	171:58(74.6%:25.4%)
Weight(in Kgs)	52.82±10.32
Comorbid conditions Hypertension-n (%) Diabetes Mellitus- n (%) CAD-n (%)	 54(23.6%) 56(24.5%) 5(2.2%)
Nature of disease (Tubercular:non tubercular)	167:62(72.9%:27.1%)

Table 2: Details of Surgical category wise C:T ratio, Transfusion index(TI), and transfusion probability(T%)

Surgery type	Number of patients	units cross matched	patients transfused	units of blood transfused	C:T	TI	T%
I-Upper lobectomy	67	142	37	68	2.08	1.01	55
II-Lower lobectomy	60	122	19	30	4.06	0.5	31
III-Pneumonectomy	48	106	26	53	2	1.10	54
IV-Decortication	31	62	6	9	6.8	0.29	19

V-Others	23	46	2	2	23	0.08	8.6
VI-Overall	229	478	90	162	2.95	0.70	39

Table 3: Suggested Blood Order Schedule in various surgical categories.

Surgical category	MSBOS (as per Mead's criteria)	Suggested blood order schedule
Upper lobectomy	1.52	Cross match and save 2 unit
Lower lobectomy	0.75	Crossmatch and save 1 unit
Pneumonectomy	1.65	Crossmatch and save 2 units
Decortication	0.43	Type and screen
Others	0.12	Type and screen

Discussion

C:T ratio, TI and T% are commonly used indices to judge the requirement and usage of blood. The concept of C:T ratio has been in use since long. Researchers have shown that a C:T ratio of less than 2.5 indicates a considerable requirement of blood transfusion during surgery.[4] They published their article on over ordering of blood. Subsequently many authors have shown over ordering in their studies.[5-7] Griffiths et al, in a study on thoracotomy patients showed a C:T ratio of 4.02.[1] In the present study the overall C:T ratio was 2.95. But it was less than 2.5 in upper lobectomy and pneumonectomy. All the other groups showed over cross matching.

The concept of transfusion probability(T%) was raised by Meads et al.[3] A value of 30% and above denotes appropriateness of the number of units cross matched. In the current study both upper lobectomy and lower lobectomy along with pneumonectomy had a T% of >30%. Meads et al found a T% of only 5% in thoracotomy patients however he did not define the nature of procedure included under thoracotomy. Friedman showed a T% of 47.7% for lobectomy and pneumonectomy and 15.9% for local/segmental resections.[2] Regarding transfusion index, a value of 0.5 and above is an indication of efficient use of blood. Though the TI for the overall cohort was 0.68, it was actually less than 0.5 in both decortication and others group.

In the present study 32.6% of cross matched blood was used for transfusion. Bhatia et al in his study in general elective surgical population found that 40% of cross matched units were not used.[7] In a similar study by Vibhute et al, 500 patients undergoing general surgical procedures were studied for transfusion efficacy and 76.86% of cross matched units were not transfused.[5] It is evident from many studies that the requirement of intraoperative blood can vary greatly across surgeries of different specialty and in various procedures within the same specialty.[5,8] Subramanian et al conducted a study on transfusion requirement in patients undergoing orthopedic surgeries and showed a significantly different transfusion requirement in all the 12 procedures that were included.[8] Some of the earlier studies have included thoracotomy as a subset of their study cohort along with other surgeries for auditing their transfusion practices.[2,3,9] However very few studies have evaluated blood requirement and transfusion practice in various categories of lung surgeries.[1,2] Griffith et al found that 58.6% of patients required blood while only 20% of patients undergoing lobectomy were transfused. However they did not note the difference between upper and lower lobectomy. They also noticed that tubercular patients required more blood than non-tubercular pathology. In Indian setting late pulmonary sequelae of tuberculosis continues to be an important cause of lung surgery and upper lobe is often commonly affected. Thus we studied the transfusion requirement both in the upper and lower lobectomy separately.

Appropriate placement of blood requests based on evidence based planned schedule can reduce over ordering of blood units. This concept of streamlining blood requests based on retrospective analysis of the blood requirement for a particular procedure is in use for nearly 40 years.[2] MSBOS is a list of the maximum number of RBC units that the blood bank will crossmatch, usually preoperatively for a specific procedure, as well as procedures for which a only Type and screen (T and S) is appropriate. We used mead's formula for calculating the number of units to be cross matched. Earlier studies have shown that implementation of MSBOS reduces cross matching and blood over ordering drastically along with financial benefit. In the present study upper lobectomy and pneumonectomy were found suitable for crossmatch of 2 units of blood units while lower lobectomy was suitable for crossmatch of 1 unit.

The concept of "type and screen" has been in use since many years and many authors have shown that merits far outweigh the perceived demerits.[10] In this method, no crossmatch is done in the preoperative period. Instead, grouping is performed followed by screening for antibody. This method is reported to be 99% effective in preventing incompatible transfusions.[11] This is due to the high efficacy of antibody screening in the detection of potentially clinically significant antibodies. Benefits of such a type and screen (T and S) include reduced cost of reagents (used for crossmatch), lesser turnaround time, and decreased workload of the blood bank. Our study found that decortication, and others (Hydatid cyst excision/lung abscess drainage/ Bullectomy/wedge resection) had a low blood usage and were suitable for T and S.

Limitations

This is a single center study. Difference in surgical skill and techniques can lead to variation in blood loss and blood transfusion requirement in other institutions. We did not review the financial benefit that could be achieved with reduction of over ordering if MSBOS is implemented.

Conclusion

Two of the 5 surgical sub categories studied, had a gross over cross matching of blood. As per the MSBOS, 3 procedures were found suitable for crossmatch and save while the rest two were suitable for T and S only. Thus we conclude that formulation of Institution wise MSBOS for surgical subcategories can provide a rational and efficient way of blood ordering and management of resources in patients undergoing lung surgeries.

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