Implementation of Maximum Surgical Blood Ordering Schedule and an Improvement in Transfusion Practices of Surgeons subsequent to Intervention

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Abstract Over ordering of blood is a common practice for elective surgeries in many developing countries. Over a decade back, our institution—The Aga Khan University, Pakistan noticed that surgeons were making unnecessary arrangement of red cells. This was reflected in their undesirably high cross-matched to transfusion (CT) ratios. A clinical audit conducted in 1998–2000 confirmed this. This prompted the institution for designing a maximum surgical blood ordering schedule (MSBOS) in 2000 based on the retrospective usage of blood in various elective surgeries. This study aimed at observing the impact of implementation of MSBOS on surgeons' transfusion practices by comparing pre and post intervention cross-matched to transfused ratio in selected elective surgeries. For this purpose, we conducted a clinical audit from 2009 to 2010 and data was retrieved for quantity of red cells units arranged and transfused in the peri-operative period. C:T ratio was computed and compared with those in 2000. Identification of patients and physicians were kept confidential. Baseline C:T ratios for C-section, TURP, total knee replacement, laparoscopic cholecystectomy and CABG were 32, 22, 11.42, 23 and 4.77 respectively. In 2009–2010, red cells were transfused in 86 of 1,224 C-sections (7 %), 599 of 727 CABG (82 %), 10 of 324 TURP (3 %), 16 of 890 laparoscopic cholecystectomy (1.7 %) and 14 of 85 total knee replacement (16.4 %). The C:T ratio in these surgeries was between 0 and 1.

Implementation of MSBOS and efforts of BUC showed a significant impact in transfusion practices of surgeons with marked reduction in the utilization of blood and the C:T ratio. We recommend that regular audits should be conducted in every institution to improve the quality of services, encourage team work and ensure high standards.

Keywords MSBOS · Blood · C:T ratio

Introduction

Blood is a precious resource which is dependent upon public donations. It is very necessary that this scarce and expensive commodity be used accurately and logically [1]. In developing countries, blood is ordered by doctors and blood banks having no authority of overriding their requests has resulted in unnecessary ordering of blood products. In elective surgeries, risk of procedure associated bleeding can be anticipated and therefore red cell requirement can be easily calculated [2]. Data from developing countries shows that only 40–70 % of the red cells units arranged for the patients are actually transfused [2, 3]. Such practices have several demerits such as increased work load on the blood transfusion laboratories, wastage of blood inventory due to outdated and increasing cost of medical care [4]. It is therefore, quite necessary to streamline the blood usage by incorporating a blood ordering schedule for such procedures [5]. In 1970s, Friedman and his colleagues proposed maximum surgical blood ordering schedule (MSBOS) as a way to limit outdated risk of blood stocks. MSBOS is a table of elective surgical procedures which lists the units of red cells routinely cross-matched for them pre-operatively [6]. MSBOS is basically designed to order enough blood for 85–90 % of

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patients for each surgical procedure. Advantages of MSBOS include reduction in cross-match workload on blood transfusion laboratories, reduction in level of stress, more appropriate use of blood stocks with less wastage and reduction of the cost [7, 8]. One of the important factors for the establishment of MSBOS is identification of those procedures in which there is no requirement of a pre-operative cross-match and these could be accommodated by a 'Group and Screen' procedure only. This ensures that a patient would be blood typed and evaluated for presence of atypical red cell antibodies and in a rare event of a need for transfusion, red cells can be safely given. Approximately 60 % cost reduction has been observed with implementation of MSBOS [7, 9].

Situated in Southern Pakistan, The Aga Khan University Hospital is a 700 bedded tertiary care hospital. Annually, over 20,000 elective surgeries are conducted and approximately 1,750 red cell units are transfused during these procedures. The institute conducted an audit during 1998–2000 and observed transfusion practices during elective surgeries. Red cell units crossmatched (C) were compared with those which were actually transfused (T) in the peri-operative period. This C:T ratio was computed for elective surgeries requiring arranging of blood at that time. The gold standard for the CT ratio was set at 2.5 or less according to guidelines laid by British committee for standards in Hematology [10]. The C:T ratios analyzed in 2000 were unacceptable for all planned surgeries. This prompted department of hematology and blood bank to work jointly with surgeons in designing and implementing MSBOS. MSBOS was formulated using the Mead's criterion, according to which the number of RBCs calculated are one and half times the transfusion index for that surgical procedure. Transfusion index is defined as the average number of units transfused for a given procedure. Each surgery was allotted a tariff based on this. In surgeries with a transfusion index of less than 0.5, there was no need of routine cross-match and only a 'group and save' was sufficient. Patients undergoing these procedures should only have their blood group established and their serum checked for antibodies. If the blood is found to be antibody negative, the sample is stored and if blood is required for that surgery it can be issued after a rapid immediate spin cross-match only. This 'group and save' provision allows rapid delivery of blood in an emergency and prevents unnecessary cross-matches.

Besides, a hospital blood transfusion committee (BUC) was established with focus on appropriate utilization of blood products and strict adherence to MSBOS. BUC members included general and cardiac surgeons, haematologists, obstetricians, blood bank technologists and nurses. The committee aimed in taking surgeons and anaesthetists in confidence assuring the availability of

blood in all circumstances especially emergency situations. This was achieved through regular meetings, lectures and monitoring the quality indicators of blood utilization such as C:T ratio.

Hospital educational programmes were developed to improve the blood transfusion practices. These programmes included circulation of information sheets, arranging meetings with the clinicians, surgeons and nursing staff as well delivering lectures. Additionally a user friendly webpage was created for useful information regarding blood products indication, dosage and adverse effects.

The present study aimed at observing the effect of implementing MSBOS on surgeons' transfusion practices by comparing pre and post intervention cross-matched to transfused ratio in selected elective surgeries.

Materials and methods

Location of the study

Aga Khan University Hospital is a tertiary care academic 700 bedded institute. It caters patients from Southern Pakistan and has highly specialized medical and surgical facilities. The hospital has a blood bank which was established in 1985 and has a home brew blood bank information system to log the entire information with a provision of data retrieval. The blood bank has the capacity of storing approximately one thousand bags of blood components and it caters well to the needs of the hospital.

Method of cross-match for elective procedures

The cross-match procedure at AKUH blood bank begins when a blood transfusion request slip filled by the patient's doctor along with patient's blood sample is sent to the transfusion laboratory. The request slip mentions the name, the medical record number of the patient, the number of units to be cross-matched and the initials of the doctor. For surgeries which are allocated in the type and screen category according to MSBOS, only a type and screen request is sent. In blood bank, the patient's blood type (Classic DiaMed-ID, Cressier, Switzerland) is determined and cross-match is performed (Classic DiaMed-ID, Cressier, Switzerland). The compatible blood tagged with patient's name and medical record number is stored at 2–6 °C. For patient's with type and screen request, blood is only grouped and screened for antibodies. If antibody screen is positive, than antigen negative blood is arranged for the patient. In case of emergency, blood is made available to the patient within 2 h after an immediate spin cross-match only.

Computing C:T ratio and re-audit

A re-audit was conducted in 2009–2010 as sequelae to the audit of 1998–2000. Retrospective data was retrieved through computerized ISD (information services department, version 9) for the total number of elective surgeries, and the quantity of red cell units cross matched and transfused in the peri-operative period. The red cells arranged within and 3 days before and after surgery were totaled to compute the cross-match numerator. The number of red cells dispense from blood bank and transfuse to the patient within same period was considered in the calculation of denominator of transfusion. The trend in C:T ratio of only those elective surgeries was studied which were previously associated with high C/T ratios. The patient population for elective surgeries was matched for age, gender, indications of surgery during the two comparative periods of study. Patients with co-morbid, emergency surgeries and those requiring complicated surgeries were excluded from final analysis. This was compared with the 1998–2000 report regarding CT ratio from our institution.

Statistical analysis

All the data was analysed using SPSS version 19.0 (SPSS Inc., Chicago, IL, USA). The peri-operative cross matches and transfusion were computed. The post-procedure period was limited to three days following surgery. The calculated indices included C/T ratio which equals number of red cells units cross-matched/number of units transfused. Percentages were reported for data.

Ethical issues

Institutional ethical review committee does not require approval for the analysis of retrospective data provided anonymity is maintained.

Results

Red blood cell transfusions

Blood was arranged and transfused in 1,710 of 19,288 (8.8 %) and in 1,738 of 20,212 (8.5 %) elective surgeries in 2009 and 2010 respectively. In 2009, red cells were transfused in 43 of 416 C-sections (10 %), 303 of 370 CABG's (82 %), 4 of 155 TURP (2.5 %), 9 of 440 laparoscopic cholecystectomies (2 %) and 6 of 40 total knee replacements (15 %). Similar respective figures for 2010 were: 43/808 (5.3 %), 296/357 (82 %), 6/169 (3.5 %), 7/450 (1.5 %) 8/45 (17 %).

C:T ratios

Of 1,710 procedures performed in 2009, C:T ratio was 1 in 1,634 (95 %) procedures. Remaining C:T ratios are depicted in Table 1. Similarly in 2010, of 1,738 surgeries requiring transfusion, C:T ratio of 1 was seen in 1,668 (95.9 %) procedures.

Comparison of C:T ratio before and after MSBOS

Prior to implementation of MSBOS, the C:T ratios found for Caesarean section, coronary artery bypass grafting (CABG), trans-urethral resection of prostate (TURP), laparoscopic cholecystectomy and total knee replacement were 32, 4.7, 22, 23 and 11.7 respectively.

Following the introduction of MSBOS the calculated C/T ratio for all these surgeries was found to be 1 in the present audit (Table 2).

Discussion

Effective utilization of blood and blood components is fundamental for proper functioning of blood banks. There is always a shortage of blood because of an increased demand of blood components in surgeries, trauma and oncology patients and a limited number of public donations

Table 1 CT ratio of elective surgeries in 2009–2010

CT ratio	2009 <i>n</i> (%)	2010 <i>n</i> (%)
Total surgeries	1,710	1,738
1.0	1,634 (95)	1,668 (95.9)
1.1–1.5	50 (2.9)	47 (2.7)
1.6–2.0	22 (1.3)	22 (1.2)
2.1–3.0	4 (0.6)	1 (0.1)

Table 2 Cross match to transfusion ratio pre and post MSBOS

Surgeries	CT ratio (pre-MSBOS)	CT ratio (post MSBOS)
C-section ^a	32	1
CABG ^b	4.7	1
TURP ^c	22	1
Lap chole ^d	23	1
Total knee replacement	11.7	1

^a Caesarian section

^b Coronary artery bypass graft

^c Transurethral resection of prostate

^d Laparoscopic cholecystectomy

available due to stringent selection criteria. Blood, therefore is a scarce resource which is critical for patient care and must be utilized judiciously so that it is available for crisis [11]. The indiscriminate ordering of blood which is done for elective surgeries results in holding up of blood bank reserve. When a unit is cross-matched for a patient, it is removed from the blood bank inventory and is unavailable for use by other patients. This can result in ageing of the unit and wastage of blood bank resources [12].

It is important that blood requests should be placed appropriately according to a planned policy to avoid over-ordering of blood [13]. An evidence-based approach to blood ordering results in reduction of unnecessary cross-matches providing substantial time and financial savings [14]. Before the implementation of an evidence-based blood ordering schedule at our institution, it was observed that lot of blood was ordered for elective surgeries which was not being utilized. This ended up burdening the resources of the health care facility.

The results of the initial audit showed that the C:T ratio for elective surgeries was very high. MSBOS was formulated and put into immediate effect after that audit. The hospital blood bank and blood utilization committee played a major role in the formulation of blood ordering schedule. After implementation of MSBOS the calculated C:T ratio for all these surgeries was found to be 1. This is the standard ideal C:T ratio and it shows that over-ordering of blood was not done and there was no excessive cross-matching for these procedures. When compared with the previous C:T ratio there is a drastic improvement. The very high C:T ratios reported previously have not just dropped but have come down to the ideal level which is an evidence of our improved transfusion practices and successful implementation of MSBOS. Similar results were shown in a study conducted by Vibhute et al. [15]. In this study, the transfusion practices for 500 elective general surgical procedures were evaluated and MSBOS was introduced. Implementation of MSBOS improved the blood ordering pattern for the next 150 patients [15]. In another recent study from UK done by Mahadevan et al. [14], transfusion practices were analysed for patients under going total hip and knee replacement. MSBOS protocol was created based on the Transfusion index and impact of MSBOS on transfusion services was assessed prospectively on 125 patients by comparison of C:T ratios. The results showed marked improvement in blood ordering and reduction in the C:T ratios. This proves that MSBOS brings about improvement in blood utilization and reduces wastage.

Implementation of MSBOS is associated with logical use of blood bank reserves. It prevents misplacement of blood requests for those surgeries in which preoperative blood is not required, eliminates the need to determine the number of blood components required for each surgery,

reduces pre transfusion compatibility testing thereby decreasing workload and avoids expiry of components [16].

Although MSBOS significantly improves the efficiency of blood ordering, it has some limitations. The transfusion requirements of different patients undergoing the same surgical procedure may vary and MSBOS does not account for this individual difference. The schedule needs to be extended so as to take into account individual patient risk factors which may predict the need for transfusion. These factors include low preoperative haemoglobin concentration, low weight, elderly patients over the age of 65 years and female patients. In addition, the transfusion needs of patients with significant co-morbidities also differ from that of general population. Patients with ischaemic heart disease require a higher transfusion threshold because of a risk of anaemia-associated adverse outcomes postoperatively.

MSBOS is subjected to constant improvement and modification [17]. The treating clinicians, anesthetists, surgeons, nurses, along with the blood bank staff should all give their inputs and contribute for improving the transfusion practices [18]. The hospital transfusion committee should be a source of guidance, provide support and conduct surveillance. Educational programs are fundamental and be conducted regularly within the hospital for the sake of improved blood transfusion practices and provide a framework for conducting blood bank audits.

This study shows that auditing clinical practice is important in order to improve the quality of service, encourage team work and ensure high standard which has clinical as well as financial implications. The evidence-based MSBOS that was created had made our transfusion service more efficient and logical with establishment of gold-standard C:T ratio.

References

1. Subramanian A, Rangarajan K, Kumar S, Sharma V, Farooque K, Misra MC (2010) Reviewing the blood ordering schedule for elective orthopedic surgeries at a level one trauma care center. *J Emerg Trauma Shock* 3(3):225–230
2. Bhutia SG, Srinivasan K, Ananthakrishnan N, Jayanthi S, Ravishankar M (1997) Blood utilization in elective surgery: requirements, ordering and transfusion practices. *Natl Med J India* 10(4): 164–168
3. Hardy NM, Bolen FH, Shatney CH (1987) Maximum surgical blood order schedule reduces hospital costs. *Am Surg* 53(4): 223–225
4. Lowery TA, Clark JA (1989) Successful implementation of maximum surgical blood order schedule. *J Med Assoc Ga* 78(3): 155–158
5. Murphy WG, Phillips P, Gray A, Heatley L, Palmer J, Hopkins D et al (1995) Blood use for surgical patients: a study of Scottish hospital transfusion practices. *J R Coll Surg Edinb* 40(1):10–13

6. Friedman BA, Oberman HA, Chadwick AR, Kingdon KI (1976) The maximum surgical blood order schedule and surgical blood use in the United States. *Transfusion* 16(4):380–387
7. Storm H, Morshuis WJ, Kluft O, Posma FD (1989) More effective blood transfusion policies in elective surgery by objective transfusion guidelines. *Ned Tijdschr Geneeskd* 133(23):1170–1174
8. Richardson NGB, Bradley WN, Donaldson DR, O'Shaughnessy DF (1998) Maximum surgical blood ordering schedule in a district general hospital saves money and resources. *Ann R Coll Surg Engl* 80(4):262–265
9. Chawla T, Kakepoto GN, Khan MA (2001) An audit of blood cross-match ordering practices at the Aga Khan University Hospital: first step towards a maximum surgical blood ordering schedule. *J Pak Med Assoc* 51(7):251–254
10. Voak D, Napier JAF, Boulton FE, Cann R, Finney RD, Fraser ID et al (1990) British committee for standards in haematology blood transfusion task forces guidelines for implementation of a maximum surgical blood ordering schedule. *Clin Lab Haematol* 12:321–327
11. Shortt J, Polizzotto MN, Waters N, Borosak M, Moran M, Comande M et al (2009) Assessment of the urgency and deferability of transfusion to inform emergency blood planning and triage: the bloodhound prospective audit of red blood cell use. *Transfusion* 49(11):2296–2303
12. Argov S, Shechter Y (1981) Is routine crossmatching for two units of blood necessary in elective surgery? *Am J Surg* 142(3):370–371
13. Seshadri RS, Odell WR, Roxby D, Morley AA (1979) Effective use of blood in elective surgical procedures. *Med J Aust* 2(11):575–578
14. Mahadevan D, Challand C, Clarke A, Keenan J (2011) Maximum surgical blood ordering schedules for revision lower limb arthroplasty. *Arch Orthop Trauma Surg* 131(5):663–667
15. Vibhute M, Kamath SK, Shetty A (2000) Blood utilisation in elective general surgery cases: requirements, ordering and transfusion practices. *J Postgrad Med* 46(1):13–17
16. Iwasaki T, Nishiyama T, Otsuka M, Ohara Y, Kobayashi O, Seto K (1995) Evaluation of preoperative blood preparation and blood consumption for implementation of type and screen and maximum surgical blood order schedule. *Masui* 44(6):880–884
17. Jayaranee S, Prathiba R, Vasanthi N, Lopez CG (2002) An analysis of blood utilization for elective surgery in a tertiary medical centre in Malaysia. *Malays J Pathol* 24(1):59–66
18. Spencer J, Thomas SR, Yardy G, Mukundan C, Barrington R (2005) Are we overusing blood transfusing after elective joint replacement?—a simple method to reduce the use of a scarce resource. *Ann R Coll Surg Engl* 87(1):28–30