International Scholars Journals

African Journal of Medicine and Surgery ISSN 2756-3324 Vol. 9 (5), pp. 001-004, May, 2022. Available online at www.internationalscholarsjournals.org © International Scholars Journals

Full Length Research Paper

Cross-Match to Transfusion Ratios: Implications for Blood Management and Cost Efficiency in Hospital Settings

Enosolease Mathew Ebose[1]* and Imarengiaye Charles Osalumese[2]

[1]Department of Haematology and Blood Transfusion, School of Medicine, College of Medical Sciences, University of Benin, Benin City, Nigeria, and University of Benin Teaching Hospital, P. M. B. 1111, Benin City, Nigeria. [2]Department of Anaesthesiology, School of Medicine, College of Medical Sciences, University of Benin, Benin City, Nigeria.

Accepted 05 January, 2022

The objective of this work is to audit blood utilization by different specialties in the hospital using the Cross-match ratio as a guide to achieving effective transfusion practices. This was a prospective study. The blood bank of University Teaching Hospital in Benin City, Nigeria was used for the study. We analysed all blood orders from January to December, 2008. Data collection included number of units of red blood cells ordered and the origin of the orders, the actual numbers of units transfused and points of use. A total of 8988 units of red blood cells were available but 19147 cross-matches (units) were ordered for 3067 patients, representing approximately 6 cross-match per patients and the mean cross-match/transfusion ratio of 2.2 (19147/8988). Cross-match/transfusion ratio for various departments/units were: Medicine 1.8; Paediatrics 2.6; Obstetrics and Gynaecology 1.6; Surgery /Orthopaedics 3.3; Accident and Emergency 3.3 and Theatres 1 and the probability that cross-matched blood might not be used were 43, 61, 39, 70, 0 and 58%, respectively. Cost implication of unnecessary cross-match was 7, 879,500:00 Nigeria Naira (69,118.42 United States Dollar) per annum with surgical units accounting for nearly 3,000,000:00 Nigeria Naira (26,315.9 United States Dollar) for the period of the study. Cross-match orders and C/T ratio vary from one department or unit to another. The unnecessary cross-match has financial and personnel implications on transfusion service in the hospital. It may be clinically prudent to streamline transfusion and cross-match orders so as to ensure the best transfusion practices.

Key words: C/T ratio, blood transfusion, cost of cross-match.

INTRODUCTION

Availability of allogeneic blood and is components have had important impact on surgical management of patients as well as other clinical healthcare issues. For instance, resuscitation following trauma, radical surgeries, radical chemotherapy or radiotherapy including organ/tissue transplant are only possible when blood and blood products are available (Lemos et al., 1996). When used appropriately blood and its components transfusion has continued to be invaluable in the management of patients.

The place of blood transfusions during the US civil wars through the world wars is instructive. Thus, it has been demonstrated that approximately 2% of health-care budget spent on blood transfusion services benefit about 50% of the total healthcare services in US (Teresa, 2008).

Despite the obvious benefits of blood and its components transfusion, donor base has continued to dwindle. Allogeneic donor-based population began a steady decline particularly in the 1980s when the fear of acquiring HIV was prevalent and donors were therefore tested for transfusion transmitted pathogens including hepatitis (Lemos et al., 1996; Enosolease et al., 2004). Striking a balance between the declining blood supply and increasing demand for donor blood has been a major challenge. This has led to attempts at providing guidelines for prudent utilization of blood. The increasing demand for donor blood has implications on the workload on blood bank staff as well as wastage of reagents (Enosolease et al., 2004; Imarengiaye et al., 2006). Indeed, anecdotal reports indicate a recent increase in

*Corresponding author. E-mail: mateenos@yahoo.co.uk.

Table 1. Comparison of blood order and pattern of utilization.

Unit	Number of orders	Units transfused	Non-transfused units	CTR	Non-usage probability (%)
Medicine	2892	1695	1287	1.75	43
Paediatrics	3232	1258	1974	2.56	61
Obs/Gyn	3682	2237	1445	1.64	39
Surgery	5316	1590	3726	3.34	70
Operating theatre	512	512	0	1	0
Accident and Emergency	3523	1449	2074	2.43	58
Total	19247	8741	10506	2.2	54

the workload of the blood bank staff due to expanding clinical services in the hospital. This is critical in a situation where the carrying capacity of our hospital has risen from only 400 poorly booked beds 5 years ago to 800 beds capacity that are nearly always fully booked with no commensurate increase in blood bank staff.

It is pertinent to put in a place strategies at reducing the work load of the blood bank staff, minimize wastage of reagents and improve transfusion practice in the hospital. Hence, it becomes incumbent and desirable to critically and systematically evaluate and analyse the pattern of our blood transfusion order so as to determine cross-match/transfusion per user or user clinical department.

MATERIALS AND METHODS

Routine blood bank activities

Routine screening of donor blood is conducted daily. All donors blood are grouped (typed) and screened for transfusion transmissible pathogens (HIV, HBsAg and HCV) before storage. Any transfusion order thereafter was fully cross-matched and issued or tagged and labelled in reserve for the indexed recipient for not more than 48 h after which it would re-enter blood bank inventory.

Data collection

Approval was sought and received from the Research and Ethics Committee of the Hospital. We collected data on all blood inventories into the blood bank anonymously from January 1 to December 31, 2008. All blood prescriptions and their sources were noted according to the clinical departments (wards/units). These are Medical wards including haematology/haemato-oncology; Pediatrics including children emergency, special-care-baby-unit and P-ward; Surgery including Orthopaedics; Obstetrics and Gynae-cology and Accident and Emergency. The number of transfusion orders, the number of units requested and the number of unit actually collected within 48 h of the initial order were recorded.

Statistical analysis

Simple proportions were used throughout to calculate percentages and C/T ratios.

RESULTS

A total of 8988 units of donors red blood cells were available out of which 8741 units were issued in the 12-month period. Against only 8988 unit of red cells, 19247 cross-match orders were received and performed. The actual number of patients for whom blood was ordered stood at 3037 representing an average of 6 cross-matches per patient and at least 19247/8988 or approximately 2 cross-matches for every unit of blood available. One hundred and forty seven units of blood were issued but returned to blood bank for various reasons such as the demise of the patients, or senior medical officer felt red cells transfusion was no longer necessary and hence re-entered into the blood bank inventory while 247 units were discarded for reasons varying from suspected contaminations (arising from several collections of aliquots for cross-match) or expiration. Table 1 shows the number of cross-match orders and the actual units transfused according to the requesting units/departments, the C/T ratio and the probability that a cross-matched unit might not be used. The mean C/T ratio was 2.2 and the probability that a cross-matched unit of red cells might not be used is 55%. Peri-operative (theatre rooms-transfusion request at point of care) blood order showed C/T ratio of 1 while surgery, A&E and paediatrics (children emergency) recorded a high CTR of 3.3, 2.4 and 2.6 with non-usage probability of 70, 58 and 61% respectively. O&G department carried out the highest units of red blood cells transfusions with a C/T ratio of 1.6 and non-usage probability of 39%.

Table 2 shows the magnitude of cost implications of avoidable and unnecessary cross-match. A total of 10,506 of the ordered cross-matches amounting to N7, 879,500:00 (69,118.42 USD) was wasted fund. Surgical orders alone wasted nearly N3m on avoidable cross-match.

DISCUSSION

Our study shows that an overall ratio of the number of

Table 2. Cost analysis of unnecessary cross-matching.

Dept/Units	Non-transfused Cross-match	Unit cost at ₦750 (6.8 USD)
Medicine	1287	965,250:00 (8.467.10 USD)
Paediatrics	1974	1,480,500:00 (12,986.80 USD)
Obs/Gyn	1445	1,083,750:00 (9,506.58 USD)
Surgery	3726	2,794,500:00 (24,513.16USD)
Operating theatre	0	0:00 (0.00 USD)
Accident and Emergency	2074	1,555,500:00 (13,644.74 USD)
Total	10506	7879,500:00 (69,118.42 USD)

units of blood ordered to the actual transfusion was 2:1. This finding is close to the formulated guidelines on blood transfusion recommended by the British Committee for Standards in Haematology (The British Committee for Standards in Haematology, 2001). This notwithstanding, there are varying ratios from unit to unit. Specifically, the ratios in the emergency units of the hospital were higher than other points of care in the institution. In the Accident and Emergency Unit of the hospital, the ratio of 2:4 may appear marginal but high. This rather high ratio may be explained by the panic response to a bleeding patient with an attempt at transfusion of donor blood even when full and comprehensive examination has not be concluded. The panic response is further re-enforced by the rowdy environment in most A&E often due to mass critical event, from road traffic accidents, gunshot injuries in victims of armed robbery attacks or even communal clashes (Ehiawaguan, 2007).

The results from the Paediatric service also had a high CTR. This is similar to the practice in the Accident and Emergency Unit. The Children Emergency Room represents a major point for request for and transfusion of blood /blood products. A high CT appears to be a feature in Paediatric Emergency services. In a previous study, Grupp and Tanz reported a C/T for all patients to be 4:3 in a paediatric emergency department (Grupp-Phelan and Tanz, 1996). However, the C/T ratios were very high and different for many diagnostic categories. Reasons for the high C/T in our paediatric emergency are different. Malaria and sickle cell disease are leading causes of severe anaemia requiring transfusion in the tropical setting (Okuonghae et al., 1992). In addition, excessive cross-match orders by junior medical officers which may be subsequently cancelled by senior colleagues on later review of the patients are not uncommon.

The surgical utilization of ordered blood in our hospital is 30% with a C/T ratio of 3:3. This finding appears to compare differently with practices in Kuwait and United States. On the one hand, a Kuwaiti Hospital recorded a higher surgical utilization of ordered blood and a lower value in the United States (Marshall, 2004; Ayantunde et al., 2008). It is not clear whether the differences observed between these two centres are due to institutional transfusion guidelines or differences in the economy of the countries. Nonetheless, blood ordering practice may be improved upon by adhering to point of need cross-match orders as demonstrated in our study. Indeed, Palmer and colleagues had reported patient specific blood ordering system, (PSBOS) to be more accurate in predicting peri-operative blood transfusion (Palmer et al., 2003). Some authors have evaluated and identified some independent factors that are predictive of patients' likelihood of blood transfusion such as age over 70 years, pre-operative haemoglobin of < 11 g/dl, locally advanced tumour, peri-operatve complications such as post sepsis or anastomotic leak (Marshall, 2004; Coutre et al., 2002; Marconi et al., 1996). Our study did not evaluate blood ordering pattern in specific surgical indications. It is however helpful to have a high index of suspicion of likely perioperative transfusion. And this will help in reducing the high C/T ratio and improve on the rather low surgical utilization of ordered blood. A plethora of literature exist that emphasize the methods and means of improving surgical utilization of ordered blood (Ehiawaguan, 2007; Marconi et al., 1996; Fenton, 2008; Juma et al., 1990; Rahman and Akhtar, 2001). It has been argued that transfusion should be delayed until after sound clinical judgment on individualized patient care to determine the critical point for transfusion (Palmer et al., 2003; Coutre et al., 2002; Marconi et al., 1996). A more restrictive transfusion trigger of haemoglobin < 8.0 g/dl has been also been suggested (Fenton, 2008; Juma et al., 1990; Rahman and Akhtar, 2001; Vibhute et al., 2000). In addition, the surgeons and blood bank managers can jointly determine cross-match order on the basis of actual need, thus reducing unnecessary cross-match and serological workload.

The impact of cost containment should be of paramount importance in an under resourced blood bank in terms of human capital and fund. This is acutely critical in blood shortage situation where there is no budget either at local hospital level or even a health ministry level. Though the individual patient is fully responsible for payment of any blood transfused, there is no payment by patients for any cross-match unit that was not transfused. This is obviously wasted man-hour and reagents. The current charge by the Blood bank per unit cross-match is N750:00 (6.58 USD) for reagents only. The sum of ₦7, 879,500:00 (69,118.42) is lost annually to avoidable cross-matches of blood that would be transfusion on reagents alone. Surgery department alone accounts for the loss of approximately N3, 000, 000: 00 (26,315.58 USD) or 35.5%. The cost implications of unnecessary cross-match is widely reported (Ayantunde et al., 2008; Rahman and Akhtar, 2001; Chawtlat et al., 2001; Muizuiddin et al., 2007; Cousins et al., 1996; Gower et al., 1998; Silver et al., 1992; Davies et al., 2006). At UK general hospital, an annual saving of £8000:00 was made from handling charge alone by reducing C/T ratio to1 (Muizuiddin et al., 2007). Similarly, Lichtiger, (1994) reported an 18.6% reduction in the cost of red cells transfusion in a study where some selected physicians alone were allowed to order blood (Lichtiger, 1994).

In a prospective analysis of cross-match orders and transfusion practices, our results indicate a high C/T ratio. The elevated C/T ration was differentially represented in the various units particularly the surgical departments, Paediatric Service and Accident and Emergency Unit. In addition, the unnecessarily high C/T ratio resulted in wasted man hours and reagents. Clinical prudence in the management of cross-match orders would result in a more efficient utilization of blood products, material resources and personnel.

ACKNOWLEDGEMENT

We wish to thank Mrs J. E. Igeitei for her assistance with data collection.

REFERENCES

Lemos Mark S, Healy William L (1996). Burlington Massachusetts. Current concept Review-Blood Transfusion in Orthopaedic Operations. J. Bone Joint Surg. Am. 78-A: 1260-1271.

Teresa JN (2008). Clinical Guidelines, Audit and Haemovigilance in Managing Blood Transfusion Needs. Transfusion Alter Transfusion Med. 10(2): 61-64.

Enosolease ME, Imarengiaye C, Awodu AO (2004). Donor Blood procurement and Utilization at the University of Benin Teaching Hospital, Benin City. AJRH, 8(2): 59-63.

Imarengiaye CO, Enosolease ME, Iribhogbe PE, Ehigiegba A (2006). Risk of transfusion-transmitted hepatitis C virus in a tertiary hospital in Nigeria. Public Health, 120: 274-278.

The British Committee for Standards in Haematology (BCSH) (2001). Guidelines for Use of Red Cells Transfusion. Br. J. Haematol. 113: 24-31.

Ehiawaguan IP (2007). Mass casualty incidents and Disasters in Nigeria: the need for better management strategies. Niger Postgrad. Med. J. 14: 341-345

Grupp-Phelan J, Tanz RR (1996). How rational is the cross-matching of blood in a paediatric Emergency department. Arch Pediatr Adolesc Med. 150 (11):1140-1144.

Okuonghae HO, Nwankwo M, Ofor E (1992). Malaria parasitaemia in children with sickle cell anaemia. J. Trop. Pediatr. 38 (2):83-85.

Marshall JC (2004). Transfusion Trigger: When to Transfuse. Critical care. 8(Suppl 2): 531-533.

Ayantunde AA, Ng MY, Pal S, Welch NT, Parson SL (2008). Analysis of Blood Transfusion Predictors in Patients Undergoing Elective Oesophagiectomy for Cancer. BMC Surg. 8: p. 3.

Palmer T, Wahl JA, Relly MO (2003). Greenfield MLVH: Reducing unnecessary cross-matching: A patient Specific Blood Ordering is more accurate predicting who will receive a blood transfusion than the maximum blood ordering system. Anaesth Analg. 96: 369-375.

Coutre DE, Ellegala DB,Dumont AS, Mintz PD, Kassel NF (2002). Blood Use in Cerebrovascular Neurosurgery. Stroke, 33: 994-997.

Marconi M, Almimi D, Pizzi MN, Riccardi D, Bergaramaschi W, Giovanetti AM (1996). Transfusion Medicine. Quality assurance of clinical transfusion practice by implementation of the priviledge of blood prescription and computerized prospective audit of blood requests. 6: 11-19.

Fenton MP (2008). Managing Situations of Blood Loss with Limited Resources. Transfus. Altern. Transfus. Med. 10(2): 82-89.

Juma T, Baraka A, Abu-Lisan M, Asfar SK (1990). Blood ordering habits for elective surgery: time for change. JRSM, 83(6): 368-370.

Rahman M, Akhtar GN (2001). Audit of blood ordering practices in hospital queen Elizabeth, Kota Kunabalu, Sabah, Malasia. Pak J Med Sci. 17(3): 147-150.

Vibhute M, Kamth SK, Shetty A (2000). Blood Utilization in Elective Surgery; Requirements, Ordering and Transfusion Practices. JPGM, 26(1): 13-17.

Chawtlat 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. JPMA, 51(7): 251-257.

Muizuiddin M, Jawaid M, Alam SN, Soomro S, Manzar S (2007). Utilization of Blood in Elective Cholescystectomy. Pak. J. Med. Sci. 23(3): 331-333.

Cousins LM, Teplick FB, Poeltler DM (1996). Pre-caesarean blood bank orders: a safe and less expensive approach. Obstet. Gynaecol. 87: 912-916.

Gower LM, Hussuein AI, Briggs PJ, Dewar MS (1998). Blood utilization in hip and knee arthroplasty: a cost-minimization study. J.R. Coll Surg. Edimb. 43: 397-399.

Silver H, Tahnan HR, Anderson J, Lachman M (1992). A non-computer dependent prospective review of blood component utilization. Transfusion, 32: 260-265.

Davies L, Brown TT, Haynes S, Payne K, Elliott RA, McCollum C (2006). Cost-effectiveness of the cell salvage alternative methods of minimising peri-operative allogeneic blood transfusion: a systematic review and economic model. Health Technol. Assess. 10(44): iii-iv, ix-x, i-21

Lichtiger B (1994). Monitoring the safety of transfusion practices in the U.S. Transfusion Clinique et Biologique. 3: 247-250.