Surgical blood ordering system in Al-Yarmouk Teaching Hospital; lessons to learn from the results based on the Cross matched: Transfused ratio

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Abstract:

Background: The primary purpose of transfusion medicine is to provide safe and effective blood and its components on need. New procedures to reduce unnecessary work load are vital to improve the efficiency of blood transfusion services, therefore, the introduction, reappraisal and rationalization of the surgical blood order schemes are important developments in this respect.

Aim of the study: To audit the surgical blood ordering system adequacy in Al-Yarmouk Teaching Hospital in comparison to the defined Cross-matched: Transfused (C:T) ratio standards of the Maximum Surgical Blood Ordering Schedule (MSBOS).

Methods: This study was conducted retrospectively in Al-Yarmouk Teaching Hospital blood transfusion center for the years 2008 and 2009 to evaluate the elective surgical blood ordering system in this hospital which is totally based on the surgeon's decision, i.e., patient-specific blood ordering schedule (PSBOS). All whole blood units cross matched and all whole blood units' transfusion for elective surgical procedures using the major cross match technique were included.

Results: The amount of blood crossmatched (C) were 14780 units, the amount of blood transfused (T) were 11930 units, and the C:T blood ratio was 1.24:1.The sensitivity, specificity, positive predictive value and negative predictive value of the PSBOS are 98.9%, 75.8%, 80.7% and 98.6% respectively.

Conclusions: The quite clear success of patient-specific blood ordering system (PSBOS) over the maximum surgical blood ordering schedule (MSBOS) in reducing work load in Al-Yarmouk Teaching Hospital blood transfusion center entitles the continuation with its application. However, this system needs to be periodically audited because its success may be at least partially explained by that the surgeons are underestimating the expected need for blood transfusion in elective procedures and that the transfusions were not all medically justifiable.

Key words: Surgical blood ordering system, Cross matched: Transfused ratio

Introduction:

The primary purpose of transfusion medicine is to provide safe and effective blood and its components on need [1].

New procedures to reduce unnecessary work load are vital to improve the efficiency of blood transfusion services. The introduction, reappraisal and rationalization of surgical blood order schemes are important developments in this respect [2].

The Maximum Surgical Blood Ordering Schedule (MSBOS) is a table of elective surgical procedures which lists the number of units of blood routinely crossmatched for them preoperatively [2]. It aims to correlate as closely as possible the amount of blood crossmatched (C) to the amount of blood transfused (T) or C:T ratio, which can be used to monitor the efficiency of the blood order scheme, the lower the C:T ratio the better the application of the Surgical Blood Ordering Schedule, yet the C:T ratio should not be lowered to a degree that might compromise the patient's blood need safety [1, 3].

The introduction of a MSBOS has reduced the crossmatch work load with more efficient use of blood stocks and a reduction in wastage due to out-dating [2, 4, 5].

MSBOS is based on a retrospective comparison of the number of units of blood cross matched, and the

number actually transfused for each elective surgical procedure. Procedures that are likely to require blood have a ratio of crossmatched: transfused blood below 2.5:1.0 [6, 7].

In Iraq there is still no application of the concept of MSBOS due to many local factors including absence of practical application of antibody screen panels and abbreviated cross match procedure. Also the proximity of the blood transfusion laboratory to the operating theatre and the time it takes to provide compatible blood following a request can both be very variable. Therefore, the blood order for elective interventions is dependant solely on the surgeon's decision for each individual patient, which can also be called the patient-specific blood ordering schedule (PSBOS) [8].

Aim of the study:

To audit the surgical blood ordering system adequacy in Al-Yarmouk Teaching Hospital in comparison to the defined Crossmatched:transfused (C:T) ratio standards of the Maximum Surgical Blood Ordering Schedule (MSBOS).

Methods:

This study was conducted retrospectively in Al-Yarmouk Teaching Hospital blood transfusion center for the whole years 2008 and 2009 to evaluate the elective surgical blood ordering system in this hospital which is totally based on the surgeon's decision, i.e., patient-specific blood ordering schedule (PSBOS). All whole blood units cross matched for elective surgical procedures using the major cross match technique and all whole blood units transfusion were included in this study. The types of surgeries varied a lot and it included the fields of general, urinary, gynecological and obstetrics surgeries.

In this study the comparison was conducted between the already applied blood ordering system in Iraq, namely the PSBOS, and the worldwide accepted standard system, namely the MSBOS if it is to be applied ideally, i.e., with C:T ratio of 2:1, 100% sensitivity and 50% specificity. Assuming that the true positive (TP) crossmatched and transfused units would be 100%, the false positive (FP) crossmatched but not transfused units would be 50%, the true negative (TN) not crossmatched and not needed units for transfusion 100%, and the false negative (FN) not crossmatched but needed units for transfusion 0%.

The TN blood units for the PSBOS were calculated theoretically based on the C:T ratios difference between PSBOS and MSBOS multiplied by the total number of the transfused blood units, i.e., the number of units that were not needed and saved from crossmatching by applying PSBOS rather than the MSBOS [9].

The following statistical equations were applied for measurement of accuracy of screening tests [10]:

*Sensitivity= TP / (TP+FN)

*Specificity= TN / (TN+FP)

*Positive predictive value= TP/ (TP+FP)

*Negative predictive value= TN/ (TN+FN)

*Positive DLR = Sensitivity/ (1- Specificity); or Positive DLR= {TP/ (TP+FN)} / {FP/ (FP+TN)}

*Negative DLR= {FN/ (FN+TP)} / {TN/ (TN+FP)}

Results:

The amount of blood crossmatched (C), the amount of blood transfused (T) and the crossmatched:transfused (C:T) ratio using PSBOS in Al-Yarmouk Teaching Hospital blood transfusion center for each month of the years 2008 and 2009 are respectively summarized in **table (1).**

The validity assessment of PSBOS including TP, TN, FP and FN parameters illustrated in **table (2).**

The accuracy parameters of PSBOS and ideal application of MSBOS are illustrated in **table (3).**

Table (1): PSBOS C: T ratio for the years 2008 and 2009:

Month (2008 plus 2009)	Cross matched (C)	Transfused (T)	C:T ratio
January	840	790	1.06 : 1.0
February	1026	834	1.23 : 1.0
March	1408	1072	1.31 : 1.0
April	1340	980	1.37 : 1.0
May	1230	994	1.24 : 1.0
June	1100	870	1.26 : 1.0
July	1628	1208	1.35 : 1.0
August	1360	1174	1.16 : 1.0
September	1158	912	1.27 : 1.0
October	1240	1024	1.21 : 1.0
November	1140	990	1.15 : 1.0
December	1310	1084	1.21 : 1.0
Total	14780	11932	1.24 : 1.0

Table 2: Validity assessment of PSBOS:

Validity parameter	Number of whole blood units crossmatched according to PSBOS
True positive	11932
True negative	9084
False positive	2848
False negative	127

Table 3: Accuracy parameters of blood ordering schedules:

Accuracy parameter	PSBOS	Ideal MSBOS
Sensitivity (%)	98.9	100
Specificity (%)	75.8	50
Positive predictive value (%)	80.7	50
Negative predictive value (%)	98.6	100

Discussion:

Maximum Surgical Blood Order Schedule was invented as a way to limit the number of units held out of circulation and thus limit outdating risk. The MSBOS guidelines are worldwide widely accepted and have been repeatedly shown to decrease blood bank costs by reducing unnecessary cross-matching. Despite its benefits, the MSBOS still recommends that for patients with a high likelihood of blood transfusion, the number of units cross-matched be twice the median requirement for that surgical procedure, i.e., C:T ratio of 2:1, to preserve the patient's blood need safety margin [9]. Moreover, the ideal application of the MSBOS may not be always possible as in the study by Palmer et al [9] in which the C:T ratio was 4:1.

From the results of this audit it is obvious that the C:T ratio is well below the desired goal of less than 2.0:1.0 in each month of the years 2008 and 2009, and also in summation for the whole years' ratio.

There are several paired characteristics that can be used to describe the quality and usefulness of a test as compared to a reference or "gold standard", i.e., accuracy of it. Accuracy can be expressed through sensitivity and specificity or positive and negative predictive values. Each measure of accuracy should

be used in combination with its complementary measure [10].

In this study the sensitivity and negative predictive values of PSBOS (98.9% and 98.6% respectively) are almost approaching that of the ideally, hypothetically, applied MSBOS (100%), and these parameters assure that PSBOS can identify safely the proportion of patients who would really need transfusions.

The specificity and positive predictive values of PSBOS (75.8% and 80.7 respectively) are much higher than that of the ideally applied MSBOS (50%) and this in turn indicate that more unnecessary cross-matches are omitted by using PSBOS rather than MSBOS.

The primary conclusion of this study is that the elective surgical blood ordering system is apparently highly appropriate to reduce the "unnecessary" work on blood transfusion services although it is entirely dependent on the surgeon's decision, and therefore it apparently makes sense to continue along with it for this year 2010. This conclusion is supported by Palmer et al 2003 [9] and Sakurai and Okada 2001 [11] who found that the PSBOS reduced the ordered units more effectively than the MSBOS, and it also reduced C:T ratio. However, Ralf and Volker 2003 [3] disagree with this conclusion.

The quite clear success of PSBOS over MSBOS in reducing the work load in Al-Yarmouk Teaching hospital blood transfusion center was surprising and raised a question mark on whether the surgeons are underestimating the expected need for blood transfusion in elective procedures which proved to be true in a later on conducted audit with only few of the surgeons in this hospital. The logic behind this underestimation might be that Iraq had had a chronic blood shortage and hence a chronic flag to minimize blood usage, therefore, a low C:T ratio may simply be a reflective of low availability of blood and may still be indicative of inappropriate blood ordering. Also it turned out in the same audit that the transfusions were not all medically justifiable and this may add a lot to the explanation of the excellent C:T ratio in our center.

Conclusions:

Elective surgical blood ordering system is appropriate in Al-Yarmouk Teaching Hospital blood transfusion center to decrease the blood banking workload.

The observed low C:T ratio may be partially explained by that the surgeons are underestimating the expected need for blood transfusion and not all the transfusion are medically justifiable.

Re-auditing the adequacy of the applied elective surgical blood ordering system can be useful.

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