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Are we cross-matching too much blood for elective open abdominal aortic aneurysm repair?

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Abstract

Objectives: This study aims to identify current blood transfusion requirements in elective open abdominal aortic aneurysm repair and to compare this to an existing maximum surgical blood order schedule.

Methods: We retrospectively identified patients who underwent elective open abdominal aortic aneurysm repair over a 40-month period in our institution. Pre-operative number of units cross-matched and the number of units actually transfused were identified. The cross-match to transfusion ratio was then calculated.

Results: Blood transfusion at any time post-operatively was required in 23 (48.9%) cases. Patients needing an intra-operative blood transfusion had a median of 2 units. Of the pre-operative cross-matched units (123), only 43 were used, giving a cross-match to transfusion ratio of 2.86.

Conclusion: Our current maximum surgical blood order schedule is poorly followed and a cross-match to transfusion ratio of 2.86 indicates we are cross-matching too many units for elective open abdominal aortic aneurysm repair. A carefully considered individualised management of blood products, with the requirement of at least a valid group and save sample, may be more appropriate.

Keywords

Elective, aneurysm, autologous transfusion

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Introduction

Patients undergoing elective abdominal aortic aneurysm (AAA) repair are at risk of requiring a blood transfusion in the perioperative period. Despite the advances of endovascular aneurysm repair (EVAR), there will always remain a group of patients for which EVAR is not suitable. Open AAA repair carries a greater risk of blood loss and it is therefore essential that these patients are prepared adequately prior to surgery in terms of their blood management. Local guidelines may exist in the form of a maximum surgical blood order schedule (MSBOS),[1] outlining how many units should be ordered for elective operations, and thereby saving laboratory time and money from unnecessarily cross-matching red blood cell units.[2] However, often these guidelines are out-dated and do not take into account the fact laboratories are now able to electronically issue blood units quickly from a 'group and save' sample. Furthermore, there have been recent advances in the use of auto-transfusion including intra-operative cell saver techniques. Cell salvage has been found to reduce allogenic blood use and reduces hospital stay in open AAA repair.[3]

The efficiency of an MSBOS can be monitored from retrospective analysis of blood usage. The amount of blood cross-matched (C) should closely match the amount transfused (T); the cross-match to transfusion (CT) ratio should ideally be 1, but no more than 2.[4] Unused cross-matched blood is a waste of laboratory resources, it exposes the blood to risk of expiry and means that blood stocks are maintained at higher levels than are needed. Balancing the risks of needing a blood transfusion with adequate resource allocation is

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an important consideration in elective open AAA repair. Blood loss in these patients is expected, but can be variable, and this study aims to identify the blood transfusion requirements in light of recent advances in patient blood management. Secondary objectives are to assess the efficiency of our current MSBOS by finding the CT ratio.

Methods

All patients undergoing elective open AAA repair at the Royal Derby Hospital between 3 August 2010 and 16 December 2013 were included in the study. Ruptured aneurysms and endovascular repairs were excluded. There were a total of 47 patients, 4 of which were admitted via an acute admissions unit but were operated on as an urgent but elective case and therefore were still included in the study. The remaining 43 patients were all referred to a routine vascular outpatient department, either from the national aneurysm screening programme, their general practitioner or by incidental finding on an abdominal scan. The decision to offer an open aneurysm repair was made by a consultant vascular surgeon. The patients were reviewed in a pre-op assessment clinic to prepare them for their procedure, including carrying out routine blood tests according to local protocol. The current MSBOS stated that patients undergoing elective open aneurysm repair should have four units cross-matched. Patients were admitted on the day of their procedure and further pre-op blood tests may have been requested at this point also by the admitting clinician. Data were collected retrospectively from electronic and paper case notes, as well as the electronic blood bank database.

Patient variables recorded include gender, age, pre- and post-op haemoglobin levels. The number of red cell units cross-matched pre-operatively was recorded for each patient, including the location of the requesting clinician. Whether or not the patient had a valid 'group and save' sample was identified (a valid sample was defined as having at two blood samples, and at least one within 7 days of the planned procedure, in accordance with local policy). The number of units actually transfused were identified and recorded with the time and location they were given. Descriptive statistics were used. From this information, the CT ratio was calculated by comparing the total number of units requested pre-operatively to the total number of the cross-matched units transfused. In order for a patient to have a 'safe' blood bank status, they should either be able to have electronic issue of blood from their 'group and save' sample or have cross-matched units ready for them. Those patients who were found to have red cell antibodies are not eligible for electronic issue and had to have blood units cross-matched in order to be classified as 'safe'.

Results

The median age of the study group was 71 years old and 89.4% were male (see Table 1). Pre-operatively, the median haemoglobin count was 140 g/L, and on average, haemoglobin levels fell by a median of 22 g/L (range, +2 to −62 g/L) after the operation. All patients included in this study used intra-operative cell saver.

Table 1. Baseline demographics.

Type of admission	Elective *n* (%)	43 (91.5)
	Urgent *n* (%)	4 (8.5)
Age (years)		Median = 71
		Range = 55–82
Sex	Male *n* (%)	42 (89.4)
	Female *n* (%)	5 (10.6)
AAA size (cm)		Median = 6.4
		Range = 5.3–10.7
AAA position	Infra-renal *n*	26
	Juxta-renal *n*	21
Pre-operative haemoglobin count (g/L)		Median = 140
		Range = 91–169

AAA: abdominal aortic aneurysm.

From the total study population, at any point post-operatively, 23 patients (48.9%) received a transfusion. Of the patients who were given a transfusion, a median of 2 units (range, 1–11) were transfused, with a mean transfusion trigger of 78 g/L. Intra-operatively, 16 patients (34%) needed a red blood cell transfusion with a median of 2 units (range, 1–4) given during their operation. There were three patients (6.3%) who required more than 2 units during their operation. The majority of blood transfusions occurred intra-operatively, with 34 out of the 64 units (53.1%) transfused occurring in theatre.

Of the 43 elective cases, 30 patients (69.8%) had cross-matched blood ordered prior to theatre. The four urgent cases were excluded from the analysis of pre-operative blood bank status because they were admitted to hospital via the emergency route and not via a pre-operative assessment clinic; they had a median of 8 units cross-matched (range, 6–10). Of the elective cases, only 17 patients (39.5%) had 4 units cross-matched, which would be in line with current local guidelines. There was a median of 4 units cross-matched (range, 0–10) for each patient. Importantly, this study identified only 38 patients (88.4%) had a safe blood bank status during their procedure.

From the blood units that had been cross-matched pre-operatively, only 43 units (35%) were transfused. The remaining 80 units (65%) were returned to the blood bank. Therefore, our CT ratio is 2.86, which is higher than the ideal ratio of 2 and suggests we are unnecessarily cross-matching too many units of blood, highlighting inefficient practice.

Discussion

The results of this study have identified that around half (48.9%) of patients undergoing elective open AAA repair will require a blood transfusion at some point during their

hospital stay, with around one-third (34%) needing a transfusion in theatre, an average of 2 units intra-operatively. This is comparable to other studies that have reported between 35% and 46% of cases requiring intra-operative transfusions with the use of cell saver.[5,6] This figure substantiates the importance of safe blood management prior to theatre.

The majority (69.8%) of the patients in this study had cross-matched blood ordered pre-operatively. Only 39.5% of elective cases had four units cross-matched, showing that our current MSBOS is poorly followed. Moreover, this study shows that the current MSBOS may be inadequate. Of the pre-operatively cross-matched units, 65% were returned to the shelf. The CT ratio stands at 2.86 and we are therefore requesting a cross-match for almost three times as much blood as we are using. This is an inefficient use of resources, particularly when blood can be available via electronic issue very quickly. A similar UK study found a CT ratio of 11.1 for EVAR and 10.5 for open repair, with 33% of open repair patients needing an intra-operative transfusion.[7] Their results for intra-operative transfusion are comparable to ours, whereas their CT ratio was much higher.

One important finding is that not all of our patients going into theatre had blood immediately available. All of the patients with an unsafe blood bank status had a sample sent from the outpatient department, but did not have a second sample on admission to hospital on the day of their procedure. Ensuring the patient has a safe blood bank status is not currently part of the pre-operative checklist at our hospital. The second 'group and save' sample has an expiry date of 7 days. The requirement for an in-date second sample may be impacted by the fact that elective operations are at risk of being postponed and therefore vigilance in ensuring a safe blood bank status should be high. Ensuring a patient has a valid 'group and save' or cross-matched blood ready can easily be integrated into the emerging culture of pre-operative safety checklists. This was a retrospective audit and since the study period of our data, the World Health Organization surgical safety checklist has been introduced as part of routine practice and should work to address this patient safety issue.

This retrospective study was designed to audit current blood use requirements in one hospital. The sample size was relatively small but the data set spans over a 40-month period (2010–2013). Unfortunately, it could not take into account surgical blood loss volumes due to inconsistent recording of this data in patient notes. It also did not look at independent variables, which may be able to predict patients at risk of high volumes of blood loss, which would be a useful outcome.

The introduction of autogenic methods of transfusion may be seen to be changing transfusion practice in open AAA repair. However, a Swedish study found there was little change in transfusion practice for open AAA repair between 1992 and 2008.[8] Long et al. looked at changes in transfusion practice in America since 1980. They found that significantly less intra-operative transfusions were given in the more recent cohort (2003–2006), with less allogenic units transfused. They attributed this change to the use of auto-transfusions, as the total number of units transfused (auto- or allogenic) did not change.[9] Furthermore, using auto-transfusion devices reduces the morbidity associated with allogenic transfusion.[10]

Other blood products are occasionally used in elective AAA repair, such as fresh frozen plasma (FFP) and platelet transfusion. In our study, there was only one individual (2.3%) who required 4 units of FFP and one platelet transfusion to manage disseminated intravascular coagulation. From our experience, other blood products are rarely used and the routine cross-matching of these products is unnecessary.

Blood transfusions are associated with increased morbidity and mortality, including myocardial infarction, acute kidney injury and adult respiratory distress syndrome. Transfusions also expose the patient to other potential risks such as bacterial contamination, anaphylactic reactions and transfusion-related acute lung injury. Eckstein et al.[11] found that blood transfusion is an independent predictor of perioperative mortality in open AAA repair (odds ratio = 1.79, 95% confidence interval = 1.27–2.51), although they did not state whether this included intra-operative or post-operative transfusion or whether there were any other indicators for a post-operative transfusion that may have acted as a confounding factor. Bursi et al.[12] also found transfusion was linked to an increased risk of myocardial infarction (hazard ratio = 3.3, 95% confidence interval = 1.7–6.1) and death (hazard ratio = 11.72, 95% confidence interval = 3.92–35.10) at 30 days, even adjusting for surgical risk, bleeding, and propensity to receive a transfusion. It may be that transfused red blood cells do not provide as much oxygen carrying capacity as previously assumed. For these reasons, it may be sensible to conclude that a conservative approach to blood transfusion in elective AAA repair is preferable. Other means of blood conservation include screening for and treating anaemia pre-operatively, adjusting the use of anticoagulants and antiplatelets pre-operatively and reducing blood loss intra-operatively with careful surgical technique where possible.[13]

Conclusion

Around one-third of patients undergoing elective open AAA repair with cell saver available require an intra-operative blood transfusion and therefore we need to carefully consider our patient blood management practices. Our current MSBOS is poorly followed and a CT ratio of 2.86 indicates we are cross-matching too many units. Perhaps more individualised management of blood products, with the requirement of at least a valid group and save sample, may be more appropriate. In a national health service that relies on voluntary donations of blood, this may relieve some of the

pressure of high demand for red blood units. It is hoped that this study will prompt other vascular units to monitor their own blood management for elective operations.

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