Research Paper

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Perioperative Blood Management Programme Reduces the Use of Allogenic Blood Transfusion in Patients Undergoing Total Hip and Knee Arthroplasty

Medical Science

KEYWORDS : Arthroplasty, Blood transfusion, Haemoglobin optimisation, Preoperative anaemia, Tranexamic

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ABSTRACT

Background: Optimisation of blood management in total hip (THA) and knee arthroplasty (TKA) is associated with improved patient outcomes. This study aimed to establish the effectiveness of a perioperative blood management programme in improving postoperative haemoglobin (Hb) and reducing the rate of allogenic blood transfusion.

Methods: This retrospective before and after study involves 200 consecutive patients undergoing elective TKA and THA before (Usual Care group) and after (Intervention group) the introduction of a blood management programme in an Indian teaching hospital. Patients in the Intervention group underwent preoperative treatment for anaemia and received intraoperative tranexamic acid (15 mg/kg). The primary outcomes were to compare postoperative Hb levels and the rate of blood transfusion. Secondary outcomes included measurements of total amount of allogenic blood transfused, transfusion-related complications, postoperative complications, need for inpatient rehabilitation and duration of hospital stay.

Results:

There were no differences between baseline characteristics between groups. The mean (SD) preoperative Hb was higher in the Intervention group compared to that in the Usual Care group: 138.7 (13.9) vs. 133.4 (13.9) g/L, p = 0.008, respectively. The postoperative day 1 Hb, lowest postoperative Hb and discharge Hb were all higher in the Intervention group (p < 0.001).

Blood transfusion requirements were lower in the Intervention group compared to the Usual Care group (6 vs. 20 %, p = 0.003). There were no differences in any of the secondary outcomes measured. Patients who were anaemic preoperatively and who underwent Hb optimisation had higher Hb levels postoperatively (odds ratio 5.7; 95%CI 1.3to 26.5; p = 0.024).

Conclusions:

The introduction of a perioperative blood optimisation programme improved postoperative Hb levels and reduced the rate of allogenic blood transfusion.

Background Surgery for total knee (TKA) and hip (THA) arthroplasty is common with a reported transfusion rate of approximately 26.8 % [1].

Eight to ten percent of all blood transfusions in the UK are due to TKA and THA surgery [2], and patients receiving blood from a matched donor carry a risk of blood transfusion-related complications [3, 4]. Furthermore, preoperative anaemia in elective TKA and THA is independently associated with transfusion and increased postoperative morbidity, supporting the need for preoperative evaluation and treatment [5].

The National Blood Authority in Australia has released a number of patient blood management initiatives recommending the establishment of a multidisciplinary, multimodal perioperative blood management programme to optimise preoperative red cell mass, minimise perioperative blood loss and tolerate postoperative anaemia [6].

Methods

Data from consecutive adult patients undergoing surgery for primary elective TKA and THA in a university teaching hospital were collected before (Usual Care group) and after (Intervention group) the introduction of a Hb optimisation programme that included the preoperative optimisation and treatment of anaemia (men <130 g/L and women <120 g/L) by a dedicated haematology clinic and the intraoperative use of tranexamic acid (15 mg/kg intravenously) (Fig. 1).

Standard perioperative care for both groups included strict transfusion practice in accordance with the Indian blood management perioperative guidelines [6]. In the absence of ischaemic heart disease, a transfusion trigger for blood transfusion was a Hb less than or equal to 80 g/L. Adjuncts to minimise intraoperative blood loss included the use of tourniquets in all total knee replacements. Haemostasis was achieved using diathermy without the use of adjunct fibrin sealants.

Continuous passive motion and flexed knee approach in the first hour in TKA patients was not used. Standard postoperative care for all patients included a physical therapy based early mobilisation programme, commencing on the day of surgery; multimodal analgesia led by a 24-h acute pain service; and enoxaparin 40 mg subcutaneous daily for venous thrombosis prophylaxis. Exclusion criteria included patients with congenital or acquired coagulopathy, congenital or acquired thrombophilia, history of thromboembolism, allergy to tranexamic acid and revision surgery. Patients were identified using the Department of Orthopaedic audit database and the hospital's health information system. The primary aims were to determine if patients in the blood management optimisation programme had higher Hb levels immediately postoperatively and on hospital discharge and if the rate of blood transfusion was lower compared to the Usual Care group.

Secondary aims included measurements of total amount of allogenic blood transfused, transfusion-related complications, postoperative complications, need for inpatient rehabilitation and duration of hospitals stay. Other data collected included patient characteristics including comorbidities, ASA status, preoperative incidence of anaemia, preoperative renal function, preoperative medications that impact on coagulation, surgical approach, duration of surgery, type of anaesthetic and amount of intravenous fluid administered. Postoperative complications were identified from patients' admission histories, defined on the diagnoses written by the treating doctors in patients' progress notes, with crosschecking with laboratory and radiological data. The data was collected by a principal investigator (PK) and with the assistance of a research nurse. At our institution,

the proportion of patients prior tothe study that required a blood transfusion in the

Results

Data from 200 consecutive patients were collected between 2011 and 2013. Figure 2 outlines the numbers of patients who were included and excluded in the study. There were no differences between groups for baseline patient characteristics, ASA status, comorbidities, or preoperative medications relevant to bleeding. The preoperative biochemistry and haematological results are presented in Table 2. There was no difference in coagulation profiles or renal function markers between groups. In terms of operative data, there was no difference between groups in the type of surgery, surgical approaches or total number of surgeons performing the operation. There was no significant difference in the number of patients who received a surgical drain (Usual Care group 6 % vs. Intervention group 4 %). The type of anaesthesia delivered did not differ except for a reduction in femoral nerve blocks inserted in the Intervention group. Intraoperatively, the mean (SD) fluid intervention was 1862 (609) mL vs. 2072 (736) mL in the Usual Care group, p = 0.029.However, at 24 h, fluid intervention did not differ significantly. The median (interquartile range (IQR)) duration of surgery was 120 (90:135) min in the Intervention group vs. 120 (105:150) min in the Control group, p = 0.0254.

Twenty patients (20 %) in the Usual Care group required a perioperative blood transfusion vs. six patients (6 %) in the Intervention group (p = 0.003). The median (IQR) number of units of blood transfused was 2 (1:2.75) units in the Usual Care group and 2 (2:4.75) units in the Intervention group (p = 0.126). The median (IQR) Hb transfusion trigger was 76.0 (71: 82) g/L in the Usual Care group vs. 74.0 (IQR 67: 87) g/L in the Intervention group (p = 0.98). There were no differences between groups in the length of hospital stay, need for inpatient rehabilitation, complication rates or mortality .Preoperative anaemia alone was strongly associated with the requirement for a perioperative blood transfusion (odds ratio 6.1; 95 % CI 3.0 to 12.2). On multivariate regression modelling, patients who were anaemic preoperatively and who underwent perioperative Hb optimisation (i.e. preoperative treatment for anaemia plus intraoperative tranexamic acid) had higher Hb levels immediately postoperatively (odds ratio 5.7; 95 % CI 1.3 to 26.5; p = 0.024). A drop in Hb by 30 g/L or more on postoperative day 1 (odds ratio 0.19; 95 % CI 0.05 to 0.99; p = 0.048) and age greater than 65 years (odds ratio 0.19; 95 % CI 0.04 to 0.86; p = 0.031) were the only factors associated with Hb less than 100 g/L on hospital discharge. Use of either tranexamic acid alone or iron optimisation alone, ASA status, duration of surgery, individual surgeons, intraoperative fluid use, gender and BMI > 30 kg/m2 were not associated with lower transfusion rates or higher Hb values in the postoperative period.

Discussion

Key study findings We performed a retrospective quality assurance programme evaluating the effectiveness of a change of practice of preoperative treatment of anaemia utilising iron supplementation together with intraoperative tranexamic acid as recommended by National Blood Authority Patient Blood Management Guidelines [6] to reduce the rate of allogenic blood transfusion at our institution. In addition, patients undergoing elective THA and TKA who underwent a perioperative blood management programme had a lower incidence of allogenic blood transfusion. Patients who were anaemic preoperatively benefited most from the programme. This has significant pharmacoeconomic and resource considerations for institutions implementing similar blood management strategies.

The programme significantly reduced the rate of allogenic blood transfusion and length of stay. In our study, we observed that there was no difference to length of hospital stay between patients in the blood management programme and the Usual Care groups. Similar findings were reported by Wong et al. [13], who evaluated the effectiveness of a comprehensive blood conservation algorithm using a cluster randomisation trial design involving 29 hospitals.

Their programme consisted of specific blood conservation strategies including recombinant human erythropoietin or autologous blood donation and transfusion guidelines. Similar to our study, they demonstrated that the comprehensive blood conservation was superior to usual care for reducing allogenic transfusion, despite no differences to length of hospital stay.

Our programme utilised treatment of preoperative anaemia including use of iron supplementation and intraoperative tranexamic acid. Previous studies in orthopaedic procedures have demonstrated that preoperative iron supplementation can reduce the need for transfusion, particularly in the context of expected postoperative anaemia [8]. Approximately 20 % of patients who are anaemic at presentation for joint reconstructive surgery will have an anaemia that is responsive to iron therapy [8, 9]. On regression modelling, we observed that patients who appeared to benefit most from the programme were the patients who were anaemic preoperatively and who

Data from meta-analyses have previously supported tranexamic acid in blood conservation in THA and TKA without predisposing to thromboembolic complications [10, 11]. In our study, similar to these studies, we observed no complications relating to use of tranexamic acid.

Interestingly, we found that the use of tranexamic acid was not an independent factor associated with improvements of Hb postoperatively. However, our study aims were to evaluate the effectiveness of the introduction of preoperative Hb optimisation programme together with intraoperative tranexamic acid to improve Hb levels postoperatively and reduce the rate of blood transfusion. Inferences should therefore not be made about the independent effectiveness of tranexamic acid alone, as the study was not designed nor powered for this purpose. The dosing strategy used in our study (15 mg/kg) is considered a 'low' dose regime [10, 11], and further research is still required to determine the optimal dosing of tranexamic acid in the setting of major arthroplasty surgery. In addition to our study, we noted a significant reduction in the operative time in the Intervention group. Reductions in operative times related to in traoperative tranexamic acid use was not reported in three large meta-analyses examining the use of tranexamic acid in patients undergoing total hip and knee arthroplasty [10, 11, 15]. It is plausible that the use of tranexamic acid reduced time to achieve haemostasis, hence reducing the duration of surgery. However, we consider an effect size of 12 min for total duration of surgery to be of little clinical significance. Future studies will need to validate this finding with more robust study design for this particular endpoint with consideration of its clinical and economic importance.

Conclusions

The introduction of a preoperative blood optimisation programme utilising iron supplementation combined with intraoperative tranexamic acid has effectively reduced the

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use of allogenic blood transfusion in elective total hip and knee arthroplasty surgeries at our institution. Patients who were anaemic preoperatively benefited most from the programme. Our findings support the use of a multidisciplinary blood optimisation programme in this setting. These results can be used to build hypotheses for further controlled trials