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Bilateral total knee arthroplasty-analysis of risk factors for blood loss and blood transfusion

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ABSTRACT

Background: Total knee arthroplasty in general is a safe and successful surgical procedure for end stage arthritis of the knee joint to relieve pain, correct the deformity and restore function in the joint. However, it is often associated with significant blood loss. In such cases, blood transfusion is not uncommon.
Methods: 100 patients who underwent simultaneous bilateral TKA from April 2022 to December 2022 at Sant Parmanand Hospital, New Delhi were taken up for the study.
Results: In this study among 100 patients who underwent simultaneous bilateral total knee replacement, 9% of the cases required blood transfusion. Preoperative haemoglobin (<12.64 gm/dl) continues to be a predictor in blood transfusions. A haemoglobin level of less than 10.34 gm/dl preoperatively, a postoperative haemoglobin day 1 level of less than 8.56 gm/dl and a postoperative day 3 level of less than 7.49 gm/dl increases the necessity for blood transfusion in simultaneously performed bilateral TKAs.
Conclusions: Asthma, Diabetes mellitus and patients on blood thinners are three major comorbidities than can cause increased blood loss. Age, gender, BMI and comorbidities are not related to the need for blood transfusion. Patients on blood thinners are at an increased risk for blood transfusion if they have a lower preoperative haemoglobin. Checking haemoglobin values on postoperative day 1 and day 3 are significant in terms of the need for blood transfusion.

Keywords: Total knee arthroplasty, Blood loss, Blood transfusion, Haemoglobin, Risk factors

INTRODUCTION

Total knee arthroplasty (TKA) is a successful and safe surgical procedure to relieve pain, correct deformity, and restore function in patients with end-stage knee arthritis.[1] Total knee arthroplasty however has been often associated with decrease in the hemoglobin (Hb) because of perioperative visible and hidden blood loss. In such cases, in the early postoperative period, blood transfusion is not uncommon, placing patients at risk of complications of transfusion.[2] Many studies have shown the disadvantages of allogeneic blood transfusion, including negative effects on postoperative complications, transfusion-related complications, a prolonged hospital stays, higher cost, and higher mortality.[3] Current research on perioperative blood management during total knee replacement is mainly focused on application of tourniquets and drainage, meticulous surgical techniques, sealing of the intramedullary femoral canal, and prescription of tranexamic acid (TXA) or other agents.[4-8] Although in contrast, the patterns of change in the Hemoglobin concentration after total knee replacement have rarely been a topic of investigation. The aims and objectives of this study include.

Primary

To compare and study the trend in change of preoperative and postoperative hemoglobin and packed cell volume levels in simultaneously performed bilateral total knee

replacements over the first three weeks of surgery in a tertiary care arthroplasty center–Sant Parmanand Hospital, Civil lines, New Delhi, India. To study the need for blood transfusion in simultaneously performed bilateral total knee replacements.

Secondary

To standardize an optimal cutoff for preoperative and postoperative hemoglobin levels in patients that will require blood transfusion.

METHODS

Study type

This was a prospective observational study.

Sample size

Sample size of 100 patients (200 knees).

Study place

The study was conducted at Delhi Institute of Trauma and Orthopaedics, Sant Parmanand Hospital, New Delhi, India.

Study duration

The study period from April 2022 to November 2022.

Statistical analysis

The quantitative variables were expressed as mean±SD and compared using paired t-test. Association between variables were assessed using Chi-square test. A p value<0.05 was considered statistically significant. The data was stored in MS Excel software and IBM Statistical Package for Social sciences (SPSS) version 20.0 was used for statistical analysis.

All the demographic and clinical details of the patient were taken as per the proforma given.

Inclusion criteria

All patients who underwent simultaneous bilateral knee replacement.

Exclusion criteria

Patients who were unwilling to participate in the study, unilateral knee replacement, revision knee replacement, robotic knee replacement.

After clearance from the ethics committee, all patients who met the inclusion and exclusion criteria (mentioned above), at Delhi Institute of Trauma and Orthopaedics, Sant Parmanand Hospital, Civil lines, New Delhi, were taken up for the study.

Table 1: Proforma.

Case number
Name
Age
Sex
Weight (kg)
BMI (kg/m^2)
Varus/valgus
Comorbidities
Intraoperative blood loss (ml)
Preoperative hemoglobin (gm/dl)
Postoperative hemoglobin day 1 (gm/dl)
Postoperative hemoglobin day 3 (gm/dl)
Postoperative hemoglobin day 21 (gm/dl)
Need for transfusion
Amount of transfusion (ml)
Any adverse effect of transfusion
Any other complications

Surgical technique

All patients were operated bilaterally under tourniquet. The tourniquet was inflated prior to incision. Intravenous 1gm Tranexamic acid was also be given five minutes prior to the incision. A standard midline incision was be used. It was followed with a medial parapatellar arthrotomy. The patella is everted and the infrapatellar fat pad is removed as per exposure. The ACL and the menisci shall be cut. The deep MCL shall be released. The Whiteside's line and the trans epicondylar axis of the femur is then marked. Medial to the junction of these lines, femoral canal is opened up followed by a lavage. An intramedullary jig is placed and the distal femoral cut is taken. The other cuts – anterior, posterior, anterior chauffer, posterior chauffer and box cuts are then taken.

The knee is placed in full flexion allowing the tibia to subluxate. The PCL, the rest of the menisci and posterior osteophytes are then removed. Proximal tibia cut is taken using an extramedullary jig. The tibial canal is then opened up followed by a lavage. The extension and flexion gap are then assessed and balanced by appropriate soft tissue releases. The cocktail injection is then given medially and laterally to the posterior capsule and retinaculum. Trials are taken. The intramedullary canal of the femur shall be sealed with a bone plug prior to implantation. Cementing is done and implants are placed as per trails. All patients had implants of posterior stabilized knees (Posterior cruciate ligament sacrificing implant). Extensive lavage is done and the rest of the cocktail injection is injected around the subcutaneous tissues. The contents of the cocktail injection include–20 ml bupivacaine 0.5%, 0.5 ml Adrenaline 1:1000,0.5 ml Clonidine 150 mcg and 1 ml Amikacin 500 mg. Amikacin was not given for diabetic patients and for those whom nephrotoxic drugs should be

avoided. The closure shall be done in layers. Vicarly 2-0 and 1-0 were used for suturing the patellar/quadriceps tendon and for subcutaneous layer respectively. Skin closure was done with staples and a compressive dressing was given. The tourniquet shall be deflated after the compressive dressing. The intraoperative blood loss will be calculated as suction collected minus total volume of saline/wash used, the total number of mops used in surgery. Mop used of size 30×30 and on an average 50 ml of blood loss per mop will be taken.

Postoperatively, the compressive dressing is removed only the next day postoperative day 1. The postoperative haemoglobin levels were checked on the morning of postoperative day 1 and on postoperative day 3. The requirement for blood transfusion shall be assessed depending on the haemoglobin levels. If the haemoglobin is <8 gm/dl, then a unit of packed cells are transfused and the post transfusion haemoglobin is again checked in the morning of the following day. The postoperative haemoglobin levels will be further checked at postoperative day 21 when patient is being called for suture removal

RESULTS

Age

In our study of 100 patients, there were 2 (2%) patients between 40-50 years, 30 (30%) were between 50-60 years, 49 (49%) were between 60-70 years and 19 (19%) patients were above 70 years. The mean blood loss for the age group 40-50 years was 150 ml ± 14.14, for the age group 50-60 years was 153 ml ± 18.45, for the age group 60-70 years was 157.96 ± 19.78 and for the age group >70 years was 163.68±13.82. However, the values were statistically insignificant. The mean age for transfusion was 68 years ± 5.6 and for those who didn't require transfusion were 63.35 years ±7.37. The values however were statistically insignificant.

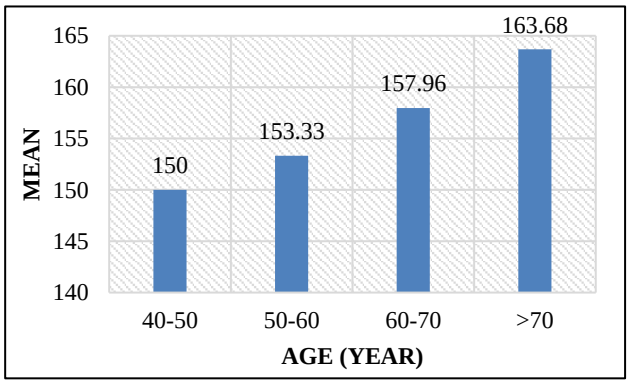

Figure 1: Age vs blood loss.

Gender

Among 100 patients, there were 80 females (80%) and 20 (20%) males. The mean blood loss in females was 156.25 ml±17.46 and the mean blood loss in males was 162.5 ml ±21.73. The comparison however proved to be statistically insignificant. The number of females who required transfusion were 6 out of 80 patients and number of males who required transfusion were 3 out of 20 patients. The rest of the 74 females and 17 males did not require blood transfusion. This comparison was statistically insignificant. Bleeding per rectum 80%, weight loss 60%, anemia 60% and altered bowel habits 77.13 % were the presenting symptoms. All patients were subjected to biopsy or fine needle aspiration cytology and the diagnosis confirmed. Other investigations done are ultrasonography, barium enema, CT scan, CEA etc. Figure 1 represents the various surgical management in the series.

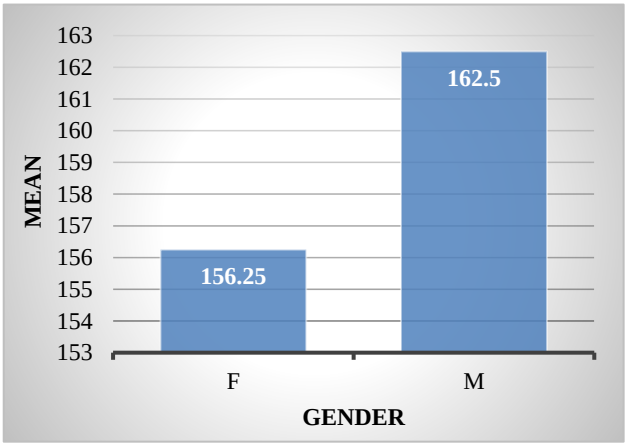

Figure 2: Gender vs blood loss.

BMI

The mean blood loss in the BMI group between 18.5-24.9kg/m2 was 175ml ±7.07, between 25-29.9kg/m^2 was 156ml ±17.93 and more than 30kg/m^2 was 160.87±19.98. The mean BMI who received transfusion was 29.03kg/m^2±2.04 and the mean BMI who didn't receive transfusion was 29.11±2.50. This comparison however was not statistically significant.

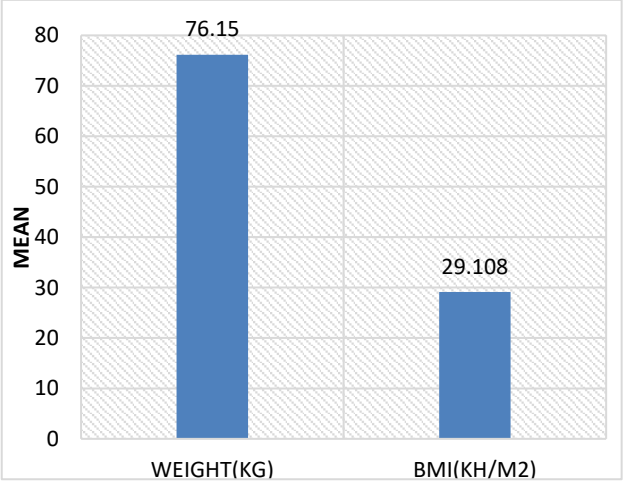

Figure 3: Mean weight And BMI in the study.

Need for transfusion

The need for blood transfusion was noted for 9 cases (9%) while the rest of the 91 cases (91%) did not require the same. The amount of transfusion was 330ml each to the 9 cases who required transfusion. No adverse effects of blood transfusion were noted in the 9 cases.

Co-morbidities

The highest mean blood loss was for patients with Asthma – 165 ml ± 21.21 followed by Diabetes mellitus – 164.67 ml ± 17.67 and followed by patients on blood thinners – 164.64 ± 16.43.

Patients with both diabetes and hypertension had a mean blood loss of 163.81ml ± 18.56. Hypertensive patients had a blood loss of 154.17ml ± 17.30 and hypothyroid patients had a blood loss of 151.76ml ± 15.90. Patients with no comorbidities had the least mean blood loss of 147.50ml ± 17.52.

These comparisons were tabled, studied and found to be statistically significant. Out of 9 patients who received blood transfusions, 3 were hypertensive patients, 3 were both diabetic and hypertensive patients, 2 were hypothyroid patients and 1 patient was just a diabetic patient. After comparisons, these results were statistically insignificant.

However, 6 of the patients were taking blood thinners. P value was found to be 0.01 here indicating this as statistically significant. However, it's interesting to note that all patients who received blood transfusion had at least one comorbidity.

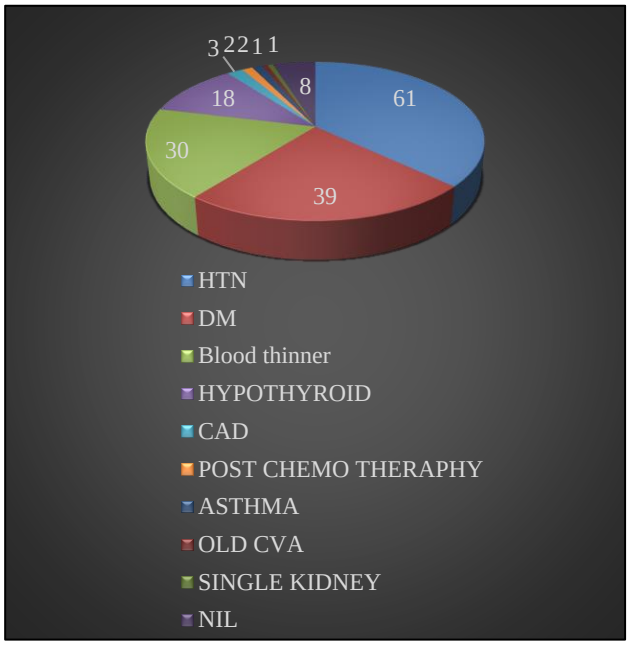

Figure 4: Co-morbidities of the patients noted in the study.

Pre and postoperative haemoglobin

The mean preoperative hemoglobin was 10.34gm/dl ± 0.83 in those which required transfusion and 12.64gm/dl ± 1.10 who didn't require transfusion. The mean postoperative hemoglobin on day 1 was 8.56 gm/dl ± 0.77 in those which required transfusion and 10.98 gm/dl ± 0.99 who didn't require transfusion

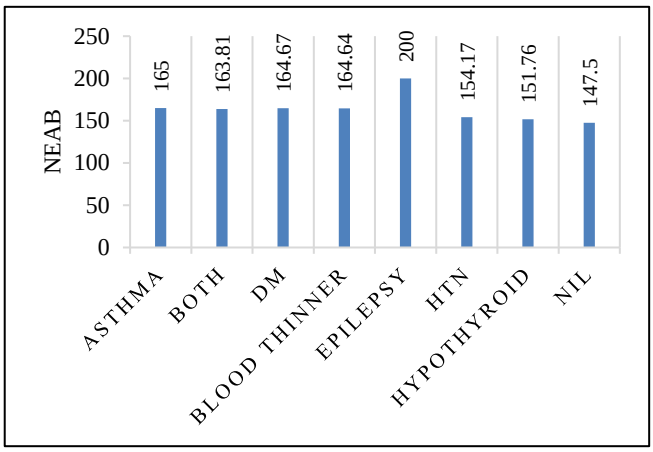

Figure 5: Co-morbidities vs blood loss.

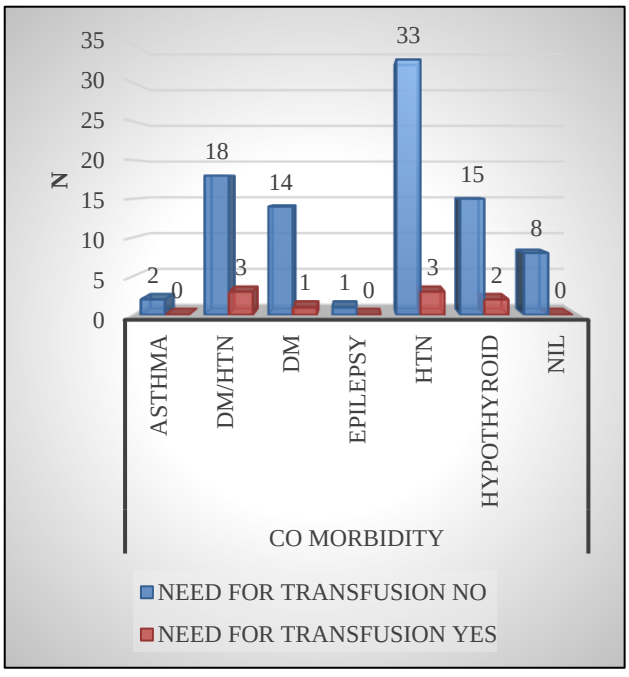

Figure 6: Co-morbidities vs blood transfusion.

The mean postoperative hemoglobin on day 3 was 7.49gm/dl ± 0.53 in those which required transfusion and 9.44gm/dl±0.97 who didn't require transfusion. The mean postoperative hemoglobin on day 21 was 9.74 gm/dl ±0.37 in those who were given transfusion and 10.29 gm/dl ± 0.96 who didn't require transfusion.

The hemoglobin values preoperatively, on postoperative day 1 and postoperative day 3 were statistically significant

with respect to the need for transfusion. However, the values on postoperative day 21 were found to be statistically insignificant. The average drop of hemoglobin in our study at three weeks proved to be 2.22 gm/dl. Although a mean hemoglobin of 10.34 gm/dl preoperatively was noticed in the ones who required blood transfusions, a hemoglobin level of greater than 11.6 gm/dl did not require a blood transfusion at all in our study. This study lends credence to the fact that need for blood transfusion is likely to be negligible in patients with preoperative hemoglobin > 12.64 gm/dl and the chances of transfusion increases with a preoperative hemoglobin <10.34 gm/dl in simultaneously performed TKAs.

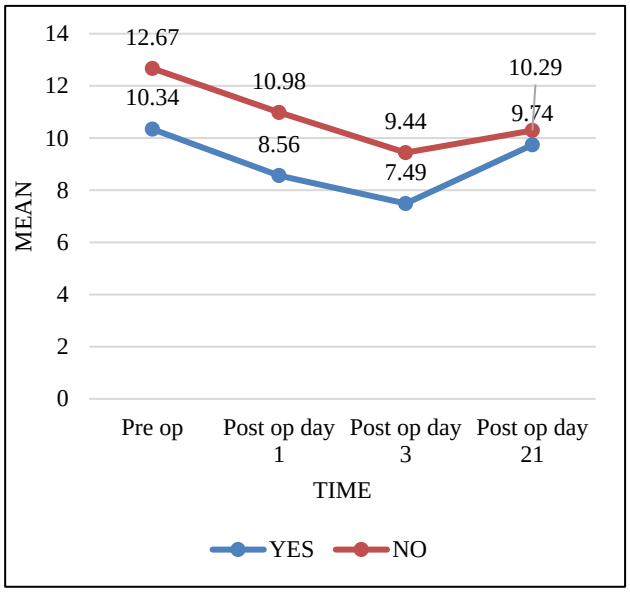

Figure 7: Haemoglobin trends vs blood transfusion.

DISCUSSION

Total knee arthroplasty (TKA) is currently the most common elective orthopaedic surgical procedure.[9] TKA is often associated with substantial blood loss and allogenic blood transfusion although it improves the function of the joint and the quality of life of the patient. Few centres indicate that 20%–40% of cases who had undergone B/L TKA received blood transfusions.[10] The anaemia effectively gets corrected by blood transfusion, but also increases the economic burden placed on patients and society.

Significant potential risks and complications with allogenic blood transfusion include infections, fluid overload, cardiac arrhythmia, prolonged hospitalization, and an increase in mortality.[11] Minimizing blood loss and blood transfusions associated with TKA is necessary to avoid complications and unnecessary expense. The prevention of blood loss around the knee during TKA can minimize lower limb swelling, postoperative pain, hemarthroses and analgesic usage.[2] These outcomes facilitate better outcomes during the postoperative rehabilitation period, thus improving patient satisfaction.

As per studies by Narayana et al, Adam et al and Patinson et al, age and gender had no role in intraoperative blood loss or the necessity for blood transfusion in bilateral total knee arthroplasty. In our study, age and gender had no role in blood loss or as a risk factor for receiving blood transfusion.[9,12,13]

In the study done by Adam et al, a BMI of < 30kg/m2, was a risk factor for receiving blood transfusion. In particular, chances of receiving a transfusion decreased with increasing BMI. Weight and BMI had no role in blood loss or the need for blood transfusion in our study. In the study done by Ojemolon et al, DM patients had a lower need for blood transfusion when compared to non – diabetics. Yuan et al. did a study of the risks noting that hypothyroid patients had increased blood loss and lower postoperative haemoglobin (Hb) level. Although the postoperative anaemia rate was lower in the control group, there was no significant difference in the transfusion rate between the two groups. Interestingly, intramuscular venous thrombosis rate in hypothyroid patients was significantly lower than that in the control group.[10]

Russo et al, did a study between postoperative hypertension after TKA and its effect on transfusion rates. They confirmed that low pre-operative haematocrit contributes to increased transfusions, they did not find a relationship between post-operative blood pressure and transfusions. In our study, asthma, diabetes mellitus and patients on blood thinners are three major comorbidities than can cause increased blood loss. Patients on blood thinners were found to be at an increased risk of blood transfusion if they had a lower preoperative haemoglobin. The mean intraoperative blood loss was 228 ml in the study done by Narayana et al. The difference seen in blood loss could be attributed to the fact that tourniquet was deflated prior to closure in the study conducted by Narayana et al. The mean intraoperative blood loss in our study was 157.50 ml ± 18.443.

The blood transfusion rate was 18.3% and 14% in the studies conducted by Adam et al and Narayana et al respectively. In our study, the blood transfusion rate was 9%. The difference seen in blood transfusion rates between our study and the above two studies could be attributed to the fact that drainage tube was used in these studies and was removed 48 hours postoperatively. The threshold for blood transfusion being 8gm/dl in our study and the above two studies.

Keating et al, their average pre-operative Hb was 14.02 gm/dl and the mean haemoglobin level at the time of discharge was 9.48gm/dl. The average drop of Hb in bilateral TKA was 4.54gm/dl. The criteria for transfusion were set at a haemoglobin level less than 9gm/dl. They also concluded that preoperative anaemia was the biggest risk factor for blood transfusion.[14]

Narayana et al, the average preoperative haemoglobin was 11.9 gm/dl % and the average drop in haemoglobin was

2.44 gm/dl. They repeated haemoglobin values at postoperative day 1, day 2, day 7 and day 14. The mean postoperative haemoglobin on day 1 was noted to be 10.02gm/dl. The mean postoperative haemoglobin on day 2 was noted to be 9.51 gm/dl. The mean postoperative haemoglobin on day 7 was noted to be 9.66 gm/dl. The mean postoperative haemoglobin on day 14 was noted to be 9.75 gm/dl. In our study, the mean preoperative haemoglobin noted was 12.46 gm/dl. The mean postoperative haemoglobin on day 1 was noted to be 10.76 gm/dl. The mean postoperative haemoglobin on day 3 was noted to be 9.26 gm/dl. Among those who required transfusions, the mean preoperative haemoglobin was 10.34 gm/dl ±0.83, mean postoperative haemoglobin on day 1 and day were 8.56 gm/dl ± 0.77 and 7.49 gm/dl ± 0.53 respectively. The average drop of hemoglobin in our study at three weeks proved to be 2.22 gm/dl.

Limitations of the study was that it lacks of consensus prior to the study regarding the cutoff for transfusion. Bigger sample size and a larger multicentric study to prove the same.

CONCLUSION

In this study among 100 patients who underwent simultaneous bilateral total knee replacement, 9% of the cases required blood transfusion. Preoperative haemoglobin (<12.64 gm/dl) continues to be a predictor in blood transfusions. A haemoglobin level of less than 10.34 gm/dl preoperatively, a postoperative haemoglobin day 1 level of less than 8.56 gm/dl and a postoperative day 3 level of less than 7.49 gm/dl increases the necessity for blood transfusion in simultaneously performed bilateral TKAs. Asthma, Diabetes mellitus and patients on blood thinners are three major comorbidities than can cause increased blood loss. Age, gender, BMI and comorbidities are not related to the need for blood transfusion. Patients on blood thinners are at an increased risk for blood transfusion if they have a lower preoperative haemoglobin. Checking haemoglobin values on postoperative day 1 and day 3 are significant in terms of the need for blood transfusion.

We recommend checking haemoglobin values on postoperative day 3 also along with postoperative day 1 in bilateral TKA. For performing simultaneous bilateral TKA, a haemoglobin level of more than 12.64 gm/dl is desired. If the preoperative haemoglobin level is less than 10.34 gm/dl, either optimization of the haemoglobin should be carried out or the surgery should be carried out in a staged manner.

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Conflict of interest: None declared
Ethical approval: The study was approved by the Institutional Ethics Committee

REFERENCES

1. Thienpont, E, Schwab, P, Fennema, P. Efficacy of patient-specific instruments in total knee arthroplasty: a systematic review and meta-analysis. J Bone Joint Surg Am. 2017; 99:521-30.
2. Lu, Q, Peng, H, Zhou, GJ. Perioperative blood management strategies for total knee arthroplasty. Orthop Surg. 2018;10:8-16.
3. Hart, A, Khalil, JA, Carli, A. Blood transfusion in primary total hip and knee arthroplasty. Incidence, risk factors, and thirty-day complication rates. J Bone Joint Surg Am. 2014;96:1945-51.
4. Xu, H, Xie, J, Lei, Y. Closed suction drainage following routine primary total joint arthroplasty is associated with a higher transfusion rate and longer postoperative length of stay: a retrospective cohort study. J Orthop Surg Res. 2019;14:163.
5. Kim, TK, Bamne, AB, Sim, JA. Is lower tourniquet pressure during total knee arthroplasty effective? A prospective randomized controlled trial. BMC Musculoskelet Disord. 2019;20:275.
6. Watts, CD, Pagnano, MW. Minimising blood loss and transfusion in contemporary hip and knee arthroplasty. J Bone Joint Surg Br. 2012;94:8-10.
7. Li, X, Qi, X, Han, X. Effects of sealing the intramedullary femoral canal in total knee arthroplasty: a randomized study. Medicine (Baltimore). 2017;96:7388.
8. Shen, PF, Hou, WL, Chen, JB. Effectiveness and safety of tranexamic acid for total knee arthroplasty: a prospective randomized controlled trial. Med Sci Monit. 2015;21:576-81.
9. Hart A, Khalil JA, Carli A, Huk O, Zukor D, John Antoniou J. Blood transfusion in primary total hip and knee arthroplasty. incidence, risk factors, and thirty-day complication rates. J Bone Joint Surg Am. 2014;96:1945-51.
10. Gombotz H, Rehak PH, Shander A, Hofmann A. The second Austrian benchmark study for blood use in elective surgery: results and practice change. Transfusion. 2014;54:2646-457.
11. Friedman R, Homering M, Holberg G, Berkowitz SD. Allogeneic blood transfusions and postoperative infections after total hip or knee arthroplasty. J Bone Joint Surg Am. 2014;96:272-8.
12. Narayana P. “Blood loss in total knee arthroplasty: an analysis of risk factors.” International orthopaedics. 2007;31(1):39-44.
13. Pattison E, Protheroe K, Pringle RM, Kennedy AC, Dick WC. Reduction in haemoglobin after knee joint surgery. Ann Rheum Dis. 1973;32:582-4.
14. Keating EM, Meding JB, Faris PM, Ritter MA. Predictors of transfusion risk in elective knee surgery. Clin Orthop Relat Res. 1998;357:50-9.

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