Original Article

Correlation of Haemoglobin Levels at 24 Hours and 48 Hours with Need for Transfusion Post Total Knee Replacement (TKR)

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ABSTRACT

Objective: This study aims to enhance decision-making for healthcare providers regarding whether to transfuse blood at the 24-hour or 48-hour mark postoperatively.

Study Design: Prospective study

Place and Duration of Study: This study was conducted at the Department of Orthopedics, Shifa International Hospital, Islamabad from August 2024 till January 2025.

Methods: A prospective analysis is conducted on 163 patients, who underwent either unilateral or bilateral TKR at a tertiary care hospital. Of these, 83 patients underwent bilateral TKR, and 80 underwent unilateral TKR. Their Hemoglobin levels were monitored at 24 hours and 48 hours post-surgery mark. The hematocrit levels were also monitored to rule out delusional effects and the need for transfusion was assessed in these patients according to their hemoglobin levels.

Results: In the Unilateral TKR group, out of 80 patients, 40 (50%) transfusions were performed on day 2 when Hb levels were lowest, compared to 12 (15%) on day 1. The 28 patients did not require transfusion at all. In Bilateral TKR, among 83 patients, 36 (43.4%) transfusions were performed on day 2, while only 7 (8.4%) were done on day 1. Remarkably, 40 patients (48.2%) did not require transfusion. The Hematocrit levels were also monitored to rule out delusional effects.

Conclusion: This study highlighted the significance of monitoring Hb levels at 48 Hours, as this appears to be the optimal timeframe for assessing transfusion needs, particularly given the lower Hb levels observed on this day. This is important to assess the likely time of transfusion to prevent patients from undergoing repetitive blood collection for Hb Monitoring.

Key Words: Hemoglobin, Hematocrit, Measurement, Transfusion

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INTRODUCTION

Total knee replacement (TKR) is a widely performed surgery for osteoarthritis and it has seen a steady increase worldwide over the past three decades due to 48% increase in disease prevalence.[1] The primary goal of TKR is to reduce pain, which improves patient's mobility and the quality of life.[2,3]

There is one major challenge in this surgery which is significant blood loss that requires timely blood transfusion to prevent any complication. Patient's comorbidities such as Hypertension and Hypothyroidism have been associated with increased blood loss in TKR patients which can further complicate recovery.[4] This highlights the importance of monitoring Hb levels to assess if transfusion is needed. Hemoglobin and Hematocrit levels help us to determine the oxygen carrying capacity and provide important information about blood loss and associated conditions like anemia.[5] About 100 million units of whole blood are donated each year.[6] Red blood cell (RBC) transfusion is a key component of treating anemia, whether acute or chronic, by improving tissue oxygenation.[7] According to the latest guidelines, liberal transfusion threshold uses a higher haemoglobin concentration as a threshold for transfusion (most commonly, 9.0 g/dL to 10.0 g/dL) and the restrictive transfusion threshold uses a lower haemoglobin concentration as a threshold for transfusion (most commonly, 7.0 g/dL to 8.0 g/dL)[8]. Additionally, symptoms of anemia must be considered before

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deciding on a transfusion. Typically, one unit of RBCs can increase hemoglobin by around 1 g/dL and hematocrit by about 3% in adults[9]. However, the time for equilibration of blood concentrations after an RBC transfusion remains unclear, with a proposed time of 24 hours. In clinical practice, physicians often need quicker assessments to make early treatment decisions, potentially reducing hospital stays. A previous study found that two units of RBC transfusion in medical inpatients not actively bleeding raised the Hb by 2 ± 0.2 g/dL, with no significant difference at 15 minutes, one hour, two hours, and 24 hours.

Objectives

1- Assess the significance of monitoring Hb level at 24-hour and 48-hour postoperatively to better evaluate the need for blood transfusion in patients with low Hemoglobin emphasizing the predictive accuracy of Hb level assessed at 48 hours.

2- Predicting the more accurate time for transfusion which is at 48 hours to prevent repetitive blood collections for Hb Monitoring.

3- Correlate the Hb levels with Hematocrit levels to prevent any false readings due to dilutional effects.

METHODS

This Prospective observational cohort study was conducted at Shifa International Hospital Islamabad from August 2024 till January 2025. The study was designed to observe and evaluate the correlation between hemoglobin (Hb) levels at 24 hours and 48 hours post-total knee replacement (TKR) surgery and the subsequent need for blood transfusion. A self-designed data collection proforma was developed specifically for this study, taking into consideration all relevant clinical and demographic risk factors. Data were collected prospectively during the hospital stay of each patient. Data were collected from 173 patients.

Inclusion Criteria:

- Adult male and female patients aged 18 years or older.
- Patients scheduled to undergo unilateral or bilateral TKR surgery.
- Patients who may potentially require red blood cell (RBC) transfusion postoperatively, based on clinical judgment.
- Patients hemodynamically stable enough to allow scheduled hemoglobin and hematocrit monitoring at 24 and 48 hours following surgery.

Exclusion Criteria:

- Patients with pre-existing blood disorders, including anemia, hemolytic anemia, or any form of hematological malignancy.
- Patients with active bleeding or hemorrhagic conditions which may independently alter Hb levels.
- Patients who received blood transfusions within 72 hours prior to surgery or underwent any intervention that could confound hematological parameters.
- Patients with known hepatic or renal dysfunction, confirmed by preoperative laboratory evaluation.

Risk and Safety Considerations: The study posed minimal risk to participants, as it involved standard perioperative blood monitoring that aligns with routine clinical practice. No additional invasive procedures were performed solely for research purposes. Although participants may not directly benefit from the study, the findings are expected to significantly contribute to clinical decision-making in the postoperative management of TKR patients. Enhanced accuracy in predicting transfusion requirements based on 48-hour Hb levels may lead to more individualized care, reduction in unnecessary transfusions, fewer complications, faster recovery, and lower overall healthcare costs. To minimize attrition and loss to follow-up, patients were monitored during their hospital stay and, if needed, contacted via telephone for postoperative status confirmation or clarification of data.

Data Confidentiality and Security Measures: Strict measures were implemented to ensure the confidentiality and security of participant data. All collected data were anonymized and stored on password-protected digital systems accessible only to the principal investigator and authorized research staff. Information was not shared with any third party outside the research team, supervisor, and Data and Safety Monitoring Board (DSMB). Participants were informed that anonymized data may be used for future research and publication purposes, with all personal identifiers removed. Informed consent was obtained prior to participation, and data use complied with institutional ethical guidelines and data protection regulations.

RESULTS

The results show that mean hemoglobin levels in unilateral TKR patients declined from 10.77 ± 1.61 g/dL on day 1 to 10.21 ± 1.16 g/dL on day 2, followed by a notable increase to 11.86 ± 1.74 g/dL on day 3. Mean hematocrit levels remained relatively stable, ranging from 32.14% on day 1 to 31.02% on day 2 and 31.62% on day 3. These trends, observed across 84 patients, suggest that the most critical drop in hemoglobin occurs within the first 48 hours, reinforcing the utility of day 2 values for timely transfusion decisions.

The mean hemoglobin level dropped from 11.0 ± 1.37 g/dL on day 1 to a nadir of 9.27 ± 0.97 g/dL on day 2, before rising to 10.05 ± 1.14 g/dL by day 3. A similar trend was observed in hematocrit values, with a slight increase on day 2 (33.96 ± 2.34%) followed by a decrease on day 3 (30.7 ± 3.3%). These fluctuations indicate that the most significant decline in hemoglobin occurs by 48 hours postoperatively, supporting day 2 as the optimal point for transfusion assessment (Table 2).

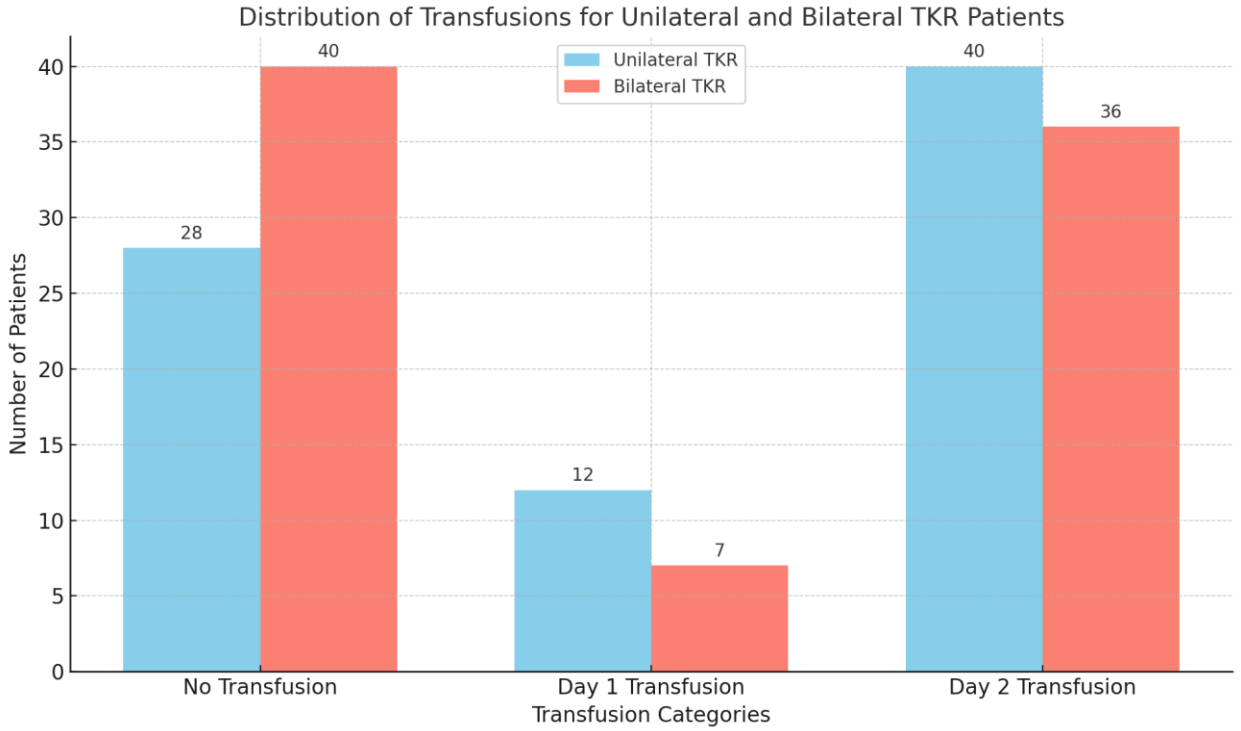

Figure No.1: The chart shows that most transfusions occurred on Day 2 for both unilateral (40 patients) and bilateral (36 patients) TKR, confirming that 48-hour hemoglobin levels are the most predictive for transfusion need. Notably, Day 1 transfusions were fewer, and a significant number of patients especially in the bilateral group did not require any transfusion.

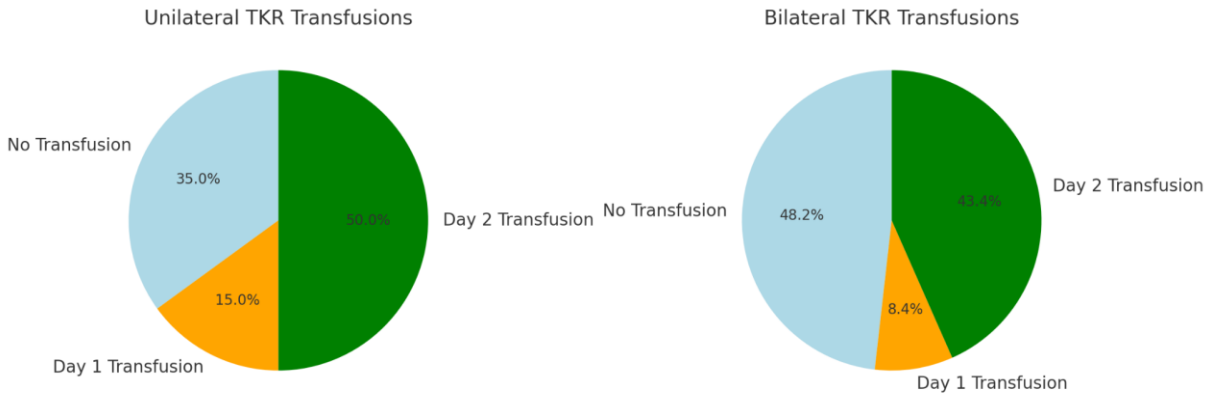

Figure No.2: These pie charts show that day 2 transfusions were the most common in both unilateral (50%) and bilateral (43.4%) TKR patients. Unilateral patients had more day 1 transfusions (15%), while bilateral patients had a higher proportion with no transfusion (48.2%), indicating the importance of monitoring hemoglobin at 48 hours.

Table No.1: Unilateral TKR Postoperative Hb and HCT Levels

Post-operative Day	Mean Hemo-globin (g/dL)	Standard Deviation (Hb)	Mean Hema-tocrit (%)	Standard Deviation (HCT)
Day 1	10.77	1.61	32.14	4.01
Day 2	10.21	1.16	31.02	3.38
Day 3	11.86	1.74	31.62	2.92

Table No.2: Bilateral TKR Postoperative Hb and HCT Levels

Post-operative Day	Mean Hemo-globin (g/dL)	Standard Deviation (Hb)	Mean Hema-tocrit (%)	Standard Deviation (HCT)
Day 1	11.0	1.37	32.35	2.91
Day 2	9.27	0.97	33.96	2.34
Day 3	10.05	1.14	30.7	3.3

DISCUSSION

The results of this study contribute valuable insights into the management of transfusion practices following total knee replacement surgery.[10-13] The observed decrease in mean Hb levels at 48 hours post-surgery aligns with findings from other studies, which have reported that the most significant drop in hemoglobin typically occurs within the first 48 hours following major surgeries. For instance, a researcher noted that patients undergoing orthopedic surgeries exhibited a similar pattern in hemoglobin decline, emphasizing the need for timely interventions. In our study, for unilateral TKR, out of 80 patients, 40 (50%) transfusions were performed on day 2 when Hb levels were lowest, compared to 12 (15%) on day 1. Interestingly, 28 patients (35%) did not require transfusion at all. In bilateral TKR, among 83 patients, 36 (43.4%) transfusions were performed on day 2, while only 7 (8.4%) were done on day 1. Remarkably, 40 patients (48.2%) did not require transfusion.[14-15] These findings reinforce the significance of monitoring Hb levels at 48 hours, as this appears to be the optimal timeframe for assessing transfusion needs, particularly given the lower Hb levels observed on this day. The consistently low Hb levels at the 48-hour mark may reflect the body's response to surgical trauma and the inherent blood loss associated with TKR procedures. This provides the important information to make informed transfusion decisions for improved patient care. The Normal hematocrit levels measured along with Hb level prove that the readings are accurate and are not influenced by delusional effects.[16] This was also observed in our study, where we the patients had hematocrit almost three times of the Hb levels which is considered normal and thus rule out any delusional readings. Additionally, assessing how various patient factors can influence the need for blood transfusions such as age, comorbidities, and surgical techniques also provide us with valuable insights into personalized patient care. In summary, our data concludes that hemoglobin monitoring at 48 hours is more predictive of transfusion needs of the patient as the blood volume is in equilibrium due to fluid shifts that occur post-surgery. Hemoglobin levels were the lowest on Day 2 in our study and the majority patients received the blood transfusion on this day.[17-18]

CONCLUSION

It is concluded that the most significant decline in hemoglobin levels following total knee replacement occurs within the first 48 hours postoperatively. Monitoring hemoglobin at the 48-hour mark provides a more accurate and clinically relevant indicator for assessing the need for transfusion. The recovery in hemoglobin levels by day 3 further supports that timely intervention based on day 2 measurements can help avoid unnecessary transfusions while ensuring patient safety. Therefore, 48-hour postoperative hemoglobin should be considered the optimal time point for transfusion decision-making in unilateral TKR patients.

Author's Contribution:

Concept & Design or acquisition of analysis or interpretation of data:	Raja Ehtesham Ul Haq Khan, Sajjad Hassan Orakzai, Zohaib Nadeem
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Final Approval of version:	All the above authors
Agreement to accountable for all aspects of work:	All the above authors

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