

Original Research Article

The impact of putting a surgical drain in total knee arthroplasty on the postoperative hemoglobin level

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ABSTRACT

Background: The use of suction drains following total knee arthroplasty (TKA) remains controversial, with conflicting evidence regarding their impact on postoperative blood loss and hemoglobin levels.¹ To evaluate the impact of closed negative suction drainage on postoperative hemoglobin levels following primary unilateral total knee arthroplasty.

Methods: A retrospective cohort study was conducted involving 102 patients who underwent primary unilateral TKA. Patients were divided into two equal groups: 51 with closed suction drainage and 51 without drainage. Hemoglobin levels were measured preoperatively and 24 hours postoperatively. Statistical analysis was performed using SPSS with appropriate tests for continuous and categorical variables.

Results: No significant difference was observed in the hemoglobin drop between the drain group (1.1 ± 0.6 g/dl) and the no-drain group (1.3 ± 0.8 g/dl) ($p=0.142$). Both groups showed comparable preoperative hemoglobin levels and postoperative outcomes.

Conclusions: Closed negative suction drainage does not significantly impact postoperative hemoglobin levels within the first 24 hours following total knee arthroplasty, suggesting that routine drain use may not be essential for blood conservation in this patient population.

Keywords: Blood loss, Hemoglobin, Postoperative care, Suction drainage, Total knee arthroplasty

INTRODUCTION

Total knee arthroplasty represents one of the most successful orthopedic interventions for end-stage knee arthritis, providing significant pain relief and functional improvement for millions of patients worldwide.^{1,2} However, perioperative blood loss remains a significant concern that can impact patient outcomes, recovery time and healthcare costs.^{3,4}

The majority of blood loss following TKA occurs within the first few hours after surgery, primarily attributed to increased reactive blood flow to the surgical site once the tourniquet is released.^{5,6} The utilization of closed suction drainage systems following total knee arthroplasty has

been a subject of considerable debate within the orthopedic community for several decades.^{7,8} The theoretical benefits of drainage include the prevention of hematoma formation, reduction of postoperative ecchymosis and minimization of wound complications that might necessitate additional interventions such as reinforcement dressings or secondary procedures.^{9,10}

Proponents argue that effective drainage can reduce the risk of infection by eliminating potential culture media from the surgical site and may facilitate better wound healing by maintaining appropriate tissue apposition.^{11,12} However, emerging evidence has challenged these traditional assumptions. Several studies have suggested that postoperative drainage may paradoxically increase the

total amount of blood loss and subsequently elevate the need for blood transfusion.^{2,13,14} The mechanism proposed involves the active removal of blood and fluid that might otherwise undergo natural hemostasis and reabsorption. Conversely, other investigations have failed to demonstrate any significant difference in hemoglobin levels between patients managed with and without drainage systems, particularly in the context of bilateral TKA procedures.^{1,15,16}

These conflicting findings have created uncertainty in clinical practice, with some surgeons advocating for routine drain use while others have abandoned the practice entirely.^{17,18} The lack of consensus has been further complicated by variations in study design, patient populations and perioperative management protocols across different institutions.^{19,20}

Given the current state of equipoise in the literature and the potential implications for patient care, cost-effectiveness and resource utilization, there exists a compelling need for additional research to clarify the role of closed suction drainage in modern TKA practice. The primary objective of this study is to evaluate the impact of closed negative suction drainage on postoperative hemoglobin levels following primary unilateral total knee arthroplasty. Authors hypothesized that there would be no significant difference in hemoglobin decline between patients managed with and without closed suction drainage systems.

Literature review

The debate surrounding the use of drainage systems in total knee arthroplasty has evolved significantly over the past several decades, with mounting evidence challenging traditional practices. Early studies in the 1980s and 1990s generally supported the use of drainage systems, citing theoretical benefits including reduced hematoma formation and improved wound healing. However, as surgical techniques have advanced and perioperative blood management strategies have improved, the necessity of routine drainage has come under scrutiny.

Contemporary research has yielded conflicting results regarding the efficacy of drainage systems.⁹ Parker and Roberts conducted a comprehensive Cochrane review examining closed suction drainage for hip and knee arthroplasty, concluding that the evidence for routine drainage use remains inconclusive. Their analysis highlighted the need for higher-quality randomized controlled trials with standardized outcome measures.

Several studies have specifically examined the impact of drainage on blood loss and transfusion requirements.² Kia et al, performed a meta-analysis focusing on the effect of surgical drains on blood loss and transfusion rates in total knee arthroplasty, finding that drain use was associated with increased visible blood loss but did not significantly affect transfusion rates. This finding supports the

hypothesis that drains may collect blood that would otherwise be reabsorbed by the body's natural mechanisms. The concept of "hidden blood loss" has emerged as an important consideration in evaluating drainage systems.³ Sehat et al, Evans et al and Newman et al introduced this concept, demonstrating that traditional calculations of blood loss often underestimate the true extent of perioperative blood loss.

Their work emphasized the importance of considering both visible and hidden components when assessing the effectiveness of blood conservation strategies. Gender-specific considerations have also been explored in the literature, with some studies suggesting that hormonal and vascular differences between men and women may influence bleeding patterns and wound healing.²² However, the clinical significance of these differences in the context of drainage system use remains unclear.

The advent of enhanced recovery protocols and improved perioperative blood management strategies, including the routine use of tranexamic acid and refined surgical techniques, has further complicated the evaluation of drainage systems.²³ These advances may have reduced the potential benefits of drainage while maintaining or even increasing the associated risks and costs.

METHODS

Study design

This investigation employed a retrospective cohort study design to evaluate the impact of closed negative suction drainage on postoperative hemoglobin levels following total knee arthroplasty. The data was collected from Khoula Hospital, in the Sultanate of Oman, between January 2022 and December 2024. The study was conducted in accordance with the principles outlined in the Declaration of Helsinki and received appropriate institutional review board approval.

Patient population

A total of 102 patients who underwent primary unilateral total knee arthroplasty were included in this analysis. The study population was evenly distributed between two groups: 51 patients managed with closed suction drainage and 51 patients managed without drainage. All procedures were performed by two experienced orthopedic surgeons using standardized surgical techniques.

Inclusion criteria

Patients included in the study were symptomatic due to advanced knee osteoarthritis, who underwent primary unilateral total knee arthroplasty. All participants had complete preoperative and postoperative hemoglobin measurements available and were managed using a standardized perioperative protocol.

Exclusion criteria

Patients were excluded from the study if they had underlying coagulopathy, bleeding disorders or chronic anemia. Additional exclusion criteria included undergoing bilateral total knee arthroplasty, complex or revision total knee arthroplasty, as well as having incomplete medical records or missing laboratory values.

Surgical technique and perioperative management

All surgical procedures were performed using a standardized approach with pneumatic tourniquet application to minimize intraoperative blood loss. Tranexamic acid was administered to all patients prior to tourniquet inflation as part of the institutional blood conservation protocol. The decision to use closed suction drainage was based on surgeon preference and was not randomized. For patients in the drainage group, a single closed suction drain was placed in the knee joint prior to closure. The drainage system was maintained under negative pressure, by emptying the drain bag of air, with drainage clamp released about 15 minutes after the procedure upon arrival to the recovery bay and the drain was removed at 24 hours postoperatively.

Data collection

Demographic data including age and gender were collected for all patients. Hemoglobin levels were measured using standardized laboratory techniques at two time points: one day preoperatively and 24 hours postoperatively. The primary outcome measure was the change in hemoglobin level from the preoperative to the postoperative measurement.

Statistical analysis

All statistical analyses were performed using SPSS software (IBM Corp., Armonk, NY). Descriptive statistics were calculated for all variables, with continuous variables presented as means with standard deviations and categorical variables presented as frequencies with percentages.

The normality of continuous variables was assessed using the Kolmogorov-Smirnov test. For normally distributed continuous variables, independent sample t-tests were used to compare means between groups, with Levene's test used to assess equality of variances. Categorical variables were compared using chi-square tests. A p value of less than 0.05 was considered statistically significant for all analyses. Effect sizes were calculated where appropriate to assess the clinical significance of any observed differences.

Ethics, funding and potential conflicts of interest

The authors declare no conflicts of interest related to this work. They confirm that no financial support, benefits or

incentives either direct or indirect were received from any commercial entity in connection with the subject matter of this article. Additionally, the study did not receive any funding support.

RESULTS

Group 1: with negative suction drain

In the drainage group, 51 patients underwent primary unilateral total knee arthroplasty with the implementation of a closed suction drainage system. The patient demographic analysis revealed a mean age of 64.1 ± 7.4 years, with a gender distribution of 13 males (24.5%) and 38 females (74.5%). Hemoglobin analysis indicated that the mean preoperative hemoglobin (Hb) level was 12.2 ± 1.5 g/dl, while the postoperative Hb measured at 24 hours post-surgery was 11.1 ± 1.5 g/dl.

The primary outcome, defined as the change in hemoglobin from preoperative to postoperative values, showed a mean drop of 1.1 ± 0.6 g/dl. Statistical validation confirmed that the data were normally distributed (Kolmogorov-Smirnov test, $p > 0.200$) and that variances were equal (Levene's test, $p > 0.05$), justifying the use of independent sample t-tests for analysis.

The results showed no statistically significant reduction in hemoglobin levels, suggesting that closed suction drainage did not confer a significant advantage in reducing perioperative blood loss in this cohort.

Group 2: with no drain

The no-drainage group also consisted of 51 patients who underwent the same surgical procedure without the use of a postoperative drain. The demographic profile for this group showed a mean age of 63.3 ± 7.2 years, with a gender distribution of 3 males (5.9%) and 48 females (94.1%).

This gender distribution was significantly different from that of the drainage group ($p = 0.006$), though the age difference was not statistically significant ($p = 0.597$). Hemoglobin analysis in this group revealed a mean preoperative Hb level of 12.4 ± 1.1 g/dl and a mean postoperative level of 11.1 ± 1.2 g/dl.

The primary outcome, the hemoglobin drop, averaged 1.3 ± 0.8 g/dl. While this decrease was marginally higher than in the drainage group, the difference was not statistically significant ($p = 0.142$). As with the drainage group, statistical validation confirmed normal distribution and homogeneity of variances, supporting the use of parametric tests.

Overall, the findings indicate that omitting the use of a drain did not result in significantly greater blood loss as measured by hemoglobin reduction, although gender distribution differences should be taken into account when interpreting the results.

Table 1: Comparison of hemoglobin levels between groups.

Variable	With drain (n=51)	Without drain (n=51)	P value
Age ^a	64.1±7.4	63.3±7.2	0.597 ^b
Gender			0.006 ^c
Male	13 (24.5%)	3 (5.9%)	
Female	38 (74.5%)	48 (94.1%)	
Pre op Hb ^a	12.2±1.5	12.4±1.1	0.410 ^b
Post Op Hb ^a	11.1±1.5	11.1±1.2	0.965 ^b
Pre op Hb-post op Hb ^a	1.1±0.6	1.3±0.8	0.142 ^b

a: One-Sample Kolmogorov-Smirnov test for all the variables is 0.200, thus normal distribution is followed. b: Independent sample t-test used. Levene's Test for equality of variance was more than 0.05, thus equal variances assumed. c: Chi-square test.

DISCUSSION

This study evaluated the impact of closed suction drainage on postoperative hemoglobin levels following primary unilateral TKA. The analysis found no statistically significant differences in key parameters between the drainage and no-drainage groups. Below, we interpret these results in comparison with corresponding findings from earlier studies.

Hemoglobin drop

The study reported a mean hemoglobin drop of 1.1±0.6 g/dl in the drainage group and 1.3±0.8 g/dl in the non-drainage group. This finding is consistent with the results from Agarwala et al and Mohrir et al who observed a similar non-significant difference in hemoglobin reduction between drain (1.4±0.7 g/dl) and no-drain groups (1.6±0.9 g/dl) in patients undergoing simultaneous bilateral TKA.¹

Similarly, Kia et al conducted a meta-analysis showing that although drain use may slightly increase visible blood loss, it does not significantly reduce overall hemoglobin drop or transfusion rates.²

Preoperative hemoglobin

The preoperative hemoglobin levels were nearly identical between our two groups (12.2±1.5 g/dl vs. 12.4±1.1 g/dl).¹ Agarwala et al and Mohrir et al also reported similar baseline hemoglobin values in their study (drain group: 12.3±1.2 g/dl; no-drain group: 12.5±1.1 g/dl), reinforcing the appropriateness of comparing postoperative hemoglobin changes. Thompson highlighted that age and physiological reserve can affect preoperative hemoglobin values, yet in our population the consistent age and hemoglobin baselines reduce confounding.²³

Postoperative hemoglobin

Postoperative levels were the same between groups (11.1±1.5 g/dl vs. 11.1±1.2 g/dl).¹ Agarwala et al and Mohrir et al also observed similar postoperative hemoglobin values (drain: 10.9±1.3 g/dl, no-drain: 10.8±1.2 g/dl), suggesting that the absence of a drain does

not adversely affect postoperative hemoglobin stabilization. In comparison, the Cochrane review by Parker et al and Roberts et al summarized several trials and concluded that drainage did not significantly impact postoperative hemoglobin levels, echoing our observation.⁹

Transfusion requirement

Though the study did not record transfusion rates, the insignificant difference in hemoglobin drop implies a likely negligible effect on transfusion need.² Kia et al similarly reported that drain usage does not significantly lower transfusion rates, reinforcing our inference.

Age and gender distribution

The mean age between our groups (64.1 vs. 63.3 years) was statistically similar.²³ Thompson emphasized the importance of age in perioperative outcomes, yet our results suggest minimal impact in this relatively narrow age range. The gender imbalance (more females in the no-drain group) is a noted limitation. However, Milman described that while females often present with lower hemoglobin levels due to hormonal and metabolic differences, our comparable preoperative values suggest that this did not bias our outcome.²²

Use of tranexamic acid

All patients received tranexamic acid as part of the perioperative protocol. This mirrors the study designs of several contemporary trials, including Kia et al where tranexamic acid was used and minimized overall bleeding regardless of drainage status.² This highlights that adjunctive therapies may diminish the potential role of drainage systems in modern TKA.

Study design and protocol uniformity

Like Sehat et al who emphasized the significance of hidden blood loss and consistent protocols for data interpretation, our study ensured surgical and perioperative consistency.³ This enhances the credibility of our findings and their comparability with standardized trials.

This study has limitations. Its retrospective nature limits control over confounding factors and the gender imbalance could have influenced outcomes. The 24 hours follow-up window may not capture delayed bleeding or hematoma formation. Additionally, results from a single institution may not be widely generalizable, especially to revision or bilateral TKA procedures.

Future research should focus on prospective randomized trials with longer follow-up, broader populations and subgroup analyses. Including cost-effectiveness and patient-reported outcomes will offer a more complete understanding of the role drainage systems should play in modern TKA practice.

CONCLUSION

This retrospective cohort study demonstrates that closed negative suction drainage does not significantly impact postoperative hemoglobin levels within the first 24 hours following primary unilateral total knee arthroplasty. The findings suggest that routine drainage may not be essential for blood conservation in contemporary TKA practice, particularly in the context of modern perioperative blood management protocols including tranexamic acid administration and improved surgical techniques.

The results support a more selective approach to drainage use, potentially reserving these systems for specific clinical scenarios where the risk-benefit ratio favors intervention. This could lead to reduced healthcare costs, simplified postoperative care and potentially improved patient outcomes through the elimination of unnecessary interventions. However, the decision to omit drainage should be individualized based on patient-specific factors, surgical complexity and surgeon experience.

Future prospective studies with balanced demographics and extended follow-up periods are needed to confirm these findings and provide additional guidance for clinical practice. The ongoing evolution of total knee arthroplasty techniques and perioperative care protocols necessitates continued reassessment of traditional practices to ensure that patient care remains evidence-based and optimized for contemporary surgical environments.

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Ethical approval: The study was approved by the Institutional Ethics Committee

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