Investigating the Effect of Using a Drain on Changes in Fe, TIBC and Hb Levels in Knee Joint Replacement Surgery

Abstract

Introduction: Knee osteoarthritis is one of the most common causes of joint pain and destruction in people over forty years old. This research has investigated the effect of using a drain on Fe, TIBC, and Hb levels in knee joint replacement surgery in a 6-months period, as a prospective cohort study.

Materials & Methods: All patients who were candidates for knee joint replacement in one hospital, were included in a prospective study. The grouping of patients included those who had post-operative drain (45 patients)and the ones with no drain (45 cases). and the control group were those who did not undergo drainage after the intervention. Fe, TIBC, and Hb levels were compared 3 months post-surgery.

Results & Discussion: A total of 21 men and 69 women were in the case and control groups. The average age in the case group was 67.67 years and in the control group was 68.96. The confounding variables considered in this study, including age, gender, and underlying diseases (including hypertension, diabetes, and hypothyroidism) were examined in both groups, and there was no significant difference between the group with and without a drain; Therefore, the difference between the two groups in this study was caused by the blood indices. However, the ferritin level of preoperative patients was different in the two groups. The most important blood index that was significant in all analyzes was hemoglobin changes before and after the operation. Also, significant changes in TIBC were present.

Conclusion: Drain use in knee replacement surgery results in less HB drop. Good blood loss strajedy can lower the drop in TIBC in 3 months follow-up.

Keywords: Hemoglobins, Total knee replacement, Drainage.

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Introduction

Knee osteoarthritis is among the most common causes of pain and joint degeneration in individuals over 40 years of age, and it represents the most prevalent degenerative joint disease[1,2]. One of the principal treatment strategies for advanced disease is total knee arthroplasty (TKA), which is now one of the most common orthopedic surgeries. In 2010, over 600,000 TKAs were carried out annually in the United States, with an upward trend continuing[3,4]. Projections suggest that by 2050, the annual number of TKAs performed in the United States will have increased by 143% compared to 2012[5]. In appropriately selected candidates, TKA results in substantial relieving pain and marked improvements in physical function and quality of life. However, as a major surgical intervention, it is associated with a range of perioperative and postoperative complications. Among these, hematologic complications—particularly postoperative hemoglobin reduction and anemia—are of significant clinical concern[6].

The human body contains 3–5 grams of iron: 65% bound to hemoglobin, 4% to myoglobin, and roughly 30% stored in ferritin and hemosiderin. Approximately 0.25% functions as an enzymatic cofactor, while around 0.1% is bound to transferrin. Measurement of serum ferritin and transferrin provides a reliable estimate of total body iron stores[7]. It has been hypothesized that in the absence of a drain, residual intra-articular blood may be reabsorbed, thereby attenuating excessive hematologic loss.

This consideration is particularly important in elderly patients, women, individuals with suboptimal nutrition or inadequate iron intake (e.g., vegetarians and raw food consumers), and those with chronic disease, iron deficiency, or thalassemia. In these populations, baseline iron levels are often reduced, and the physiologic stress of major surgery may precipitate a more profound decline in hematologic indices, increasing the need for additional therapeutic measures such as blood transfusion, intravenous iron, or iron and folic acid supplementation, which also impose greater healthcare costs. Conversely, some surgeons prefer to place drains to evacuate accumulated blood and secretions from the joint cavity[8]. However, this approach has been associated with further declines in hemoglobin, ferritin, and TIBC levels. Currently, no standardized guidelines exist regarding the routine use or avoidance of drains in TKA, and decisions are largely based on surgeon experience and preference. The present study was designed to evaluate the effect of drain placement on changes in serum iron, TIBC, and hemoglobin levels in patients undergoing TKA at Baqiyatallah Hospital during 2022–2023 (corresponding to 1401–1402 in the Iranian calendar).

Materials & Methods

This study was applied in purpose and observational–analytical in design, employing a prospective cohort methodology.

The main outcome variable was the presence or absence of a drain, and the primary study variables included hemoglobin, serum iron, and ferritin levels. Ninety patients scheduled for TKA were enrolled and randomly assigned into two groups of 45 each: one with drain placement and one without. Preoperatively, all patients underwent routine laboratory testing, including complete blood count (CBC), serum iron (Fe), and TIBC. To assess the impact of drain placement, the same hematologic indices were re-evaluated three months postoperatively.
Collected data were entered into SPSS software for statistical analysis. Data collection was performed using a structured checklist, and analyses were conducted in both descriptive and inferential domains. Descriptive statistics included frequency and percentage for qualitative variables, and mean ± standard deviation for quantitative variables. Inferential analysis was performed using chi-square and independent t-tests. All statistical tests were conducted using SPSS version 26, with a significance level of p = 0.05

Results

This study included 45 patients with drains and 45 patients without drains. Of these, 21 were male and 69 were female. The mean age in the drain group was 67.67 years and in the no-drain group 68.96 years. (Table 1). The mean values of hemoglobin, ferritin, and TIBC before and after surgery are presented in Table 2.

Table 1: Descriptive report of demographic characteristics

Variables		Drain group: 45 patients	Non-drain group: 45 patients	P-Value
(Mean ± SD) Age		67.67 ± 6.76	68.96 ± 6.31	0.46
Sex	Male	8	13	0.32
	Female	37	32	
Comorbidity	Diabetes	17	18	1.00
	Hypertension	23	29	0.29
	Hypothyroidism	12	6	0.19

Table 2: Hematological parameters in patients

	Hb (gr/dL)		Ferritin (ng/dL)		TIBC (µg/dL)	
	Preoperative	Postoperative	Preoperative	Postoperative	Preoperative	Postoperative
Non-drain group: 45 patients	14.8±1.88	12.48±1.57	70.03±20.89	60.32±15.62	323.69±56.51	304.13±51.48
Drain group: 45 patients	13.16±1.61	12.65±1.80	95.94±65.98	79.00±54.67	203.88±50.59	312.51±50.24

Considering a significance level of 0.05, hematological indices were analyzed using the independent parametric t-test. Normality analyses were initially performed based on the Kolmogorov–Smirnov test, which confirmed that all quantitative data followed a normal distribution (P-value > 0.05). Furthermore, the confounding variables considered in this study, including age, sex, and underlying comorbidities (hypertension, diabetes mellitus, and hypothyroidism), were assessed in both groups using Fisher's exact test and the independent t-test. None of the aforementioned confounding variables showed significant differences between the drain and non-drain groups. Therefore, it can be inferred that the groups were relatively homogeneous, and the observed differences in values could not be attributed to confounding factors. In the preliminary analysis using the independent t-test, among the hematological indices under investigation, only ferritin levels showed a significant difference between the two groups. This finding indicated marked heterogeneity in ferritin values within the study population, making direct conclusions in case of observed differences unreliable (P-value < 0.001). To ensure accuracy, a non-parametric test (Mann–Whitney U) was subsequently applied, which revealed no significant differences in any of the variables.

For analytical clarity, a new variable was defined to represent the difference in each index before and after surgery. The mean differences in hemoglobin (P < 0.001) and total iron-binding capacity (P = 0.025) were statistically significant, whereas the difference in ferritin was not.

Further analyses stratified by sex and underlying comorbidities also demonstrated no significant differences. In the complementary analyses, logistic regression was employed to model the simultaneous relationship between independent quantitative variables and dependent categorical outcomes. Accordingly, age and the main independent variables identified as significant in preliminary analyses (WBC, Hct, and Plt) were entered into the regression model. The results showed that the two groups were comparable regarding background and confounding variables.

In the regression model, changes in hemoglobin levels between the two groups remained statistically significant (P = 0.004, OR = 1.88, 95% CI: 1.22–2.89). No other variables produced significant results in the regression analyses.

Discussion

The findings of this study demonstrated that changes in hemoglobin and TIBC levels before and after surgery were statistically significant, with the use of drains associated with less reduction in hemoglobin and a slight increase in TIBC.

Total knee arthroplasty (TKA) is one of the most important surgical procedures in orthopedics, primarily performed in elderly patients due to osteoarthritis. With the expected growth of the elderly population, understanding the surgical response in this group is of increasing importance[9]. Blood loss during TKA remains a major concern, as 18-67% of patients need postoperative transfusion. Allogeneic transfusion is associated with risks such as allergic and hemolytic reactions, 30-day mortality, infection in surgical site, transmission of disease, periprosthetic joint infection, and venous thromboembolism. Due to all risks, many strategies have been suggested to minimize perioperative and postoperative blood loss such as: tourniquets, autologous transfusion, clamping drain, and reinfusion systems. Among these, drain clamping has been considered an important technique.

Similar to findings from certain studies, our results showed that the use of drains did not lead to postoperative transfusion in any patient, indicating no clear advantage of drain clamping in this regard. However, drain clamping reduced drain output, helped preserve patients' blood, and minimized excessive bleeding. Nevertheless, given the absence of critical clinical conditions or severe reductions in hematologic indices, routine drain clamping may not be strictly necessary[10,11]. Some studies, however, have reported potential benefits, including reduced hematoma formation and decreased blood loss.

Other investigations have suggested that the using drains in TKA is not essential. In contrast to the present study, several reports have indicated that drain clamping does not confer any clear benefits, as drainage systems fail to alter hematologic outcomes in patients[12-14]. Still, certain studies support our findings. For instance, one study proposed a protocol of 3-hour drain clamping as a novel strategy to decrease blood loss after TKA. This protocol effectively minimized postoperative hemoglobin decline without changing clinical thromboembolic events or wound complications[15]. Similarly, a 4-hour clamping method was shown to significantly reduce drain output and hemoglobin drop. For surgeons who

continue to use closed suction drains, clamping may represent an effective means of reducing blood loss after surgery and any need for transfusion[16,17].

Other adjunctive approaches have also been investigated. For example, some studies have demonstrated that clamping the drain along with using tranexamic acid can significantly reduce blood loss post operation and needs transfusion after TKA compared with tranexamic acid or drain clamping alone[18].

Based on current evidence, the use of drains in TKA remains controversial. The available data suggest that drains are not effective in reducing blood loss or transfusion rates in TKA. However, drain clamping may improve outcomes when drains are utilized. More studies with larger size sample and varying clamping intervals are required to better clarify the effects and potential benefits of drain use in TKA.

Conclusion

In this study, we concluded that, overall, prolonged use of drains may be associated with a smaller reduction in hemoglobin levels in patients around 70 years of age. Additionally, with appropriate management of postoperative bleeding, drain use may contribute to a slight increase in TIBC within this timeframe. Nevertheless, further studies are recommended to better clarify the effects and potential benefits of drains in this context.

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