Use of tranexamic acid in simultaneous bilateral total knee arthroplasty: a comparative study

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Background
Blood loss after total knee arthroplasty (TKA) is not something to neglect especially if it is bilateral. A lot of measures can be taken to reduce this blood loss such as tourniquets, autologous transfusion, and closed suction drains.
Purpose
The use of closed suction drains in TKA has downsides such as introducing a foreign body to the wound, increasing nursing care, etc. This leads to the question whether this use can be replaced by other modalities such as the use of tranexamic acid injections.
Patients and methods
Two groups of 13 patients undergoing bilateral TKA were compared. The first group had tranexamic acid injections while the other had closed suction drains. The number of transfusions and the hemoglobin drop 1 and 2 days postoperatively were assessed and compared between both groups.
Results
The hemoglobin drop both on the first and second day after the surgery were higher in the group operated with a closed suction drainage (P=0.000162 and 0.01512, respectively). The number of transfusions was also higher in the group operated with closed suction drainage (18 compared with four transfusions needed in the other group).
Conclusion
The use of drains may be replaced by tranexamic acid injections in bilateral TKA.

Keywords:
arthroplasty, bilateral, simultaneous, total knee replacement, tranexamic acid

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Introduction

With the healthcare development, life expectancies are becoming higher. Due to this and many other contributing factors, the incidence of osteoarthritis is rising as well. This condition is the most common affection leading to chronic disability in the United States [1] and it affects millions of people. After failure of conservative management, total knee arthroplasty (TKA) is proposed to relieve the patient of his symptoms and giving him back most of his mobility, which makes knee osteoarthritis the main reason for TKA [2]. This surgery has become one of the most successfully performed surgeries in orthopedics [3].

Perioperatively, the blood loss is not something to be neglected as it can exceed 1000 ml [1,2]. A tourniquet, hypotensive anesthesia, closed suction drainage, autologous transfusion, and antifibrinolytic agents can be used to reduce this loss [4–6]. When it comes to suction drainage, its use can prevent the formation of postoperative hematoma [4], but this advantage does not come free of adverse effects. Some of the downsides of using this drain are removing the tamponade effect, which will lead to more blood loss [7], introducing a foreign object that will increase the risk of postoperative infection [8], additional nursing care is required and the presence of this tube can hinder physiotherapy and recovery [9]. All this lead to questioning the desirability of using a drain after a TKA and if there are any other methods to get the benefits without the downsides. Different studies have shown that the use of tranexamic acid whether intravenously or locally can potentially replace the closed suction drainage in unilateral TKA, thus reducing the adverse outcomes of the drain without adding any new complications [10,11].

In this study, the efficacy of drain use in bilateral TKA was assessed by comparing the use of tranexamic acid in two groups of patients presenting for bilateral TKA. The first group did not have a drain put in while the

other did. The level of blood loss, hematoma formation, and thrombosis was assessed postoperatively. At the end of this study, a clearer answer should be available on whether closed suction drainage after bilateral TKA is needed and whether or not it can be replaced by antifibrinolytic agents such as tranexamic acid.

Patients and methods

Patients

Twenty-six patients diagnosed with an age averaging 70 years suffering from bilateral knee osteoarthritis were included in this prospectively designed clinical study from the Department of Orthopedics at Saint Georges Hospital University Medical Center, Beirut, Lebanon.

Inclusion criteria were the following:

(1) Bilateral knee osteoarthritis.
(2) Chronic pain of the knee refractory to conservative therapy (such as steroid injections, stem cell therapy, etc.) for a minimum of 12 months.
(3) Appropriate candidate for the surgical procedures.

Exclusion criteria were the following:

(1) Patients undergoing revision surgery.
(2) Patients with unilateral knee replacement.
(3) Patients with additional surgeries done during the same hospital stay.
(4) Knee arthroplasty for indications different from osteoarthritis such as trauma.
(5) Existing/planned pregnancy.
(6) Coexisting chronic pain condition or neurological disease.
(7) History of a coagulation disorder.

Protocols were approved by the local Ethics Committee at Saint Georges Hospital University Medical Center. The study was conducted according to the Declaration of Helsinki and of the World Medical Association (http://www.wma.net).

Technique

The patients will be operated by a single surgeon and using the same indication for surgery. Patients will be divided into two groups: each group consisting of 13 patients with bilateral knee replacement. Group 1 will receive a single preoperative dose of 1 g intravenous tranexamic acid. Group 2 will have one suction Hemovac drain placed to drain the surgical site. The tests needed to complete the study are the usual daily complete blood count tests and physical examination, with no special specimens or tests to be done for the sake of the study itself. Patients are scheduled for the surgery at the outpatient clinic, where they are informed about the study and sign an informed consent for the study as well as for the surgery. They will be informed about the computer-based randomization of the study and that they may or may not have postoperative drains depending on the randomization. As part of the usual informed consent needed for the surgery, the patient will be informed about the potential risks for bleeding, infection, anesthesia-related complications, and other possible complications of the surgery. The patient would have also be informed in the clinic during explanation of his/her condition about the alternative treatments such as conservative therapy with pain medications and injections of hyaluronic acid and corticosteroid injections, as well as PRP and stem cell injections as a conservative plan. Note that surgical decision is never taken before trial and failure of adequate course of conservative treatment. They will all be consenting to undergo the surgery after understanding the risk/benefit of this intervention.

Patients' assessment

The hemoglobin count was assessed both preoperatively and postoperatively. The need for transfusion was also assessed postoperatively.

Statistical analysis

Preoperative and postoperative hemoglobin count drop was compared between both groups using Student's *t* test in IBM SPSS Statistics for Windows, Version 25.0, Released 2017 (Armonk, NY: IBM Corp.). Probability value less than 0.05 was considered statistically significant.

The number of transfusions needed was descriptively compared between both groups.

Results

Patients' mean age in both groups was 70 years.

Number of transfusions needed postoperatively

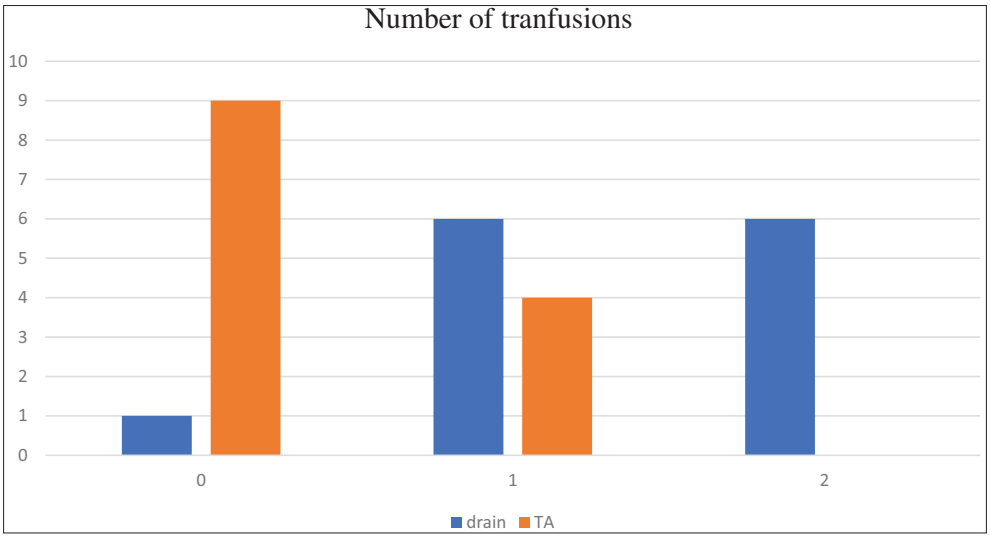
The number of transfusions needed in the group operated on tranexamic acid without drains was 4 with a mean of 0.31 transfusions/patient (±0.48) compared with 18 transfusions needed in the group operated with drains and without tranexamic acid with a mean of 1.38 transfusions/patient (±0.65) (Fig. 1).

Hemoglobin drop

Day 1

Descriptive analysis: the mean hemoglobin drop (Hbd) 1 day postoperatively was 2.29 ± 1.12 for the group operated on tranexamic acid without drains compared with 3.09 ± 1.03 for the group operated with drains and without tranexamic acid (Table 1).

Figure 1



Number of transfusions required by both groups. X-axis: number of transfusions. Y-axis: number of patients.

Table 1 Various results of this study comparing the group operated with a closed suction drain with the group operated with tranexamic acid injections

	Drain group	TA group	*P* value
Number of transfusions	18	4	X
Transfusion/patient (mean)	1.38	0.31	X
Hemoglobin-drop 1 day postoperatively (mean)	3.09	2.29	0.000162
Hemoglobin-drop 2 days postoperatively (mean)	3.72	3.15	0.01512

TA, tranexamic acid.

Student's t test: using the Student's *t* test to compare Hbd 1 day postoperatively between the group operated with tranexamic acid without drains and the group operated with drains without tranexamic acid showed a statistically significant difference (P=0.000162<0.05).

Day 2

Descriptive analysis: the mean Hbd 2 days postoperatively was 3.15 ± 1.1 for the group operated on tranexamic acid without drains compared with 3.72 ± 1.27 for the group operated with drains and without tranexamic acid.

Student's t test: using the Student's *t* test to compare Hbd 2 days postoperatively between the group operated with tranexamic acid without drains and the group operated with drains without tranexamic acid showed a statistically significant difference (P=0.01512<0.05).

Discussion

TKA is a common procedure with good results [12]. TKA is linked to high postoperative blood loss, and bleeding problems are considerably more common in patients who have both knees replaced at the same time [13–15]. Bleeding into the soft tissues around the knee is likely to make healing more painful, stiff, and time-consuming.[16]. This buildup of blood also provides an ideal bacterial culture medium [17]. Infection is a catastrophic and dreaded complication that frequently jeopardizes the joint's function as well as the patient's health [12]. Many surgeons prefer closed suction drainage to avoid the formation of hematomas and infection although statistically meaningful results are lacking [12]. In addition, blood clots in the knee joint can cause edema and slow wound healing [18]. TKA frequently necessitates allogeneic blood transfusions, particularly after simultaneous bilateral surgeries, when transfusion rates have been reported as high as 76% of the time, with an average of 2.6 PRBC units transfused per patient requiring blood transfusion [19]. Tranexamic acid is a fibrinolysis inhibitor that has received a lot of traction in joint arthroplasty [20].

According to three recent meta-analyses, tranexamic acid reduces blood loss after unilateral TKA [21–23]. While there is a lot of information out there about unilateral TKA, there are not many research on bilateral TKA [20]. The use of tranexamic acid in bilateral TKA has been shown to significantly reduce blood loss and the rate of transfusions needed per patient [20,24,25]. In our study, when comparing the use of tranexamic acid to the use of drains, both the Hbd 1 and 2 days postoperatively along with the number of transfusions needed per patient were lower in the group where tranexamic acid injections were used.

Studies by Watanabe *et al.* [4], Lee *et al.* [26], and Demirkale *et al.* [27] showed a lower Hbd, and a lower rate of transfusion when no drain was used [4]. To contrast these findings, studies by Kumar *et al.* [28], Sundaram and Parkinson [29], and Al-Zahid and Davies [30] showed no difference in postoperative

hemoglobin levels and autologous transfusion rates when comparing the presence with the absence of drain in TKA. The closed suction drainage group had more homologous blood transfusions when compared with a group without suction, according to a systematic review by Zhang *et al.* [12], and this may be explained by the lack of a tamponade effect in the drained [9,31].

Another study by Esler *et al.* [9] reported a shorter time to get back the straight-leg raising when the knees were operated without a drain whereas Lee *et al.* [26] showed opposite results. Even though, theoretically, the range of movement and knee swelling improves when drains are used, a systematic review by Quinn *et al.* [32] showed that the use of postoperative suction drains after TKA had no effects on knee flexion or swelling, length of hospital stay, or even hemoglobin levels. In our study, the difference in functional outcomes was not assessed between both groups.

A systematic review by Zhang *et al.* [12] showed that the rate of infection, which was one of the main reasons to implement the use of drainage in TKA was not different when comparing a group of patients operated with closed suction drainage to another group without the use of the latter.

A research by Maniar *et al.* [10] showed a higher consumption of opioids during the first 6 h postoperatively when the knees were operated without a drain; this may lead to the conclusion that a drain may decrease the immediate postoperative pain.

Two researches conducted by Esler *et al.* [9] and Tao *et al.* [33] showed that when no drain is used, the volume of blood in the dressing was greater when compared with a group where a drain was implemented. According to Omonbude *et al.* [34], the nondrainage group had a greater hematoma range than the closed suction drainage group.

The incidence of deep venous thrombosis, the function of the quadriceps muscle, and postoperative range of motion were comparable whether a drain was used or not [34–36], but a higher incidence of wound discharge and ecchymosis/erythema around the wound was reported when there was not a drain [26,37].

When assessed radiographically and clinically after 5.5 years, no differences were found in knees managed with or without suction drainages [4]. Drains also serve to enhance the demands on nursing care and physiotherapy in order to accommodate the drain's presence [32].

Conclusion

Even though the use of closed suction drains has been thought to reduce the rate of infection and improve functional outcomes by reducing hematoma collection, reviews showed that there are no significant differences in infection rate, functional, and radiographic outcomes, whether a drain was implemented after a TKA or not. Furthermore, its use showed an increase in the number of transfusions/patient and the Hbd postoperatively. The use of closed suction drains may decrease postoperative pain, but it also increases the demand on nursing care and physiotherapy. Also, the use of tranexamic acid perioperatively can replace drains in unilateral and bilateral TKA showing a smaller Hbd postoperatively and a lower rate of needed transfusions.

Limitations

Limitations of this study include the small number of patients used and the absence of a radiological and clinical follow-up to compare these outcomes between both groups.

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Conflicts of interest

There are no conflicts of interest.

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