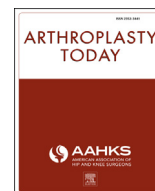




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Original research

Tranexamic acid increases early perioperative functional outcomes after total knee arthroplasty

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ABSTRACT

Background: The purpose of this study was to investigate the influence of tranexamic acid (TXA) on functional outcomes in the immediate postoperative period after total knee arthroplasty (TKA). We hypothesized that the known benefits of TXA would confer measurable clinical improvements in physical therapy (PT) performance, decrease pain, and decrease hospital length of stay (LOS).

Methods: We retrospectively analyzed 560 TKA patients, including 280 consecutive patients whose surgery was performed before the initiation of a standardized TXA protocol and the first 280 patients who received TXA after protocol initiation. Outcome measurements included postoperative changes in hemoglobin and hematocrit, LOS, pain scores, destination of discharge, and steps ambulated with PT over 5 sessions.

Results: TXA administration resulted in less overall drops in hemoglobin ($P < .001$) and hematocrit levels ($P < .001$). Moreover, patients administered TXA ambulated more than their counterparts during every PT session, which was statistically significant during the second ($P = .010$), third ($P = .011$), and fourth ($P = .024$) sessions. On average, the TXA cohort ambulated 20% more per PT session than patients who did not receive TXA ($P < .001$). TXA administration did not influence pain levels during PT, hospital LOS, or discharge destination in this investigation.

Conclusions: It is well known that TXA reduces postoperative anemia, but this study also demonstrates that it confers early perioperative functional benefits for TKA patients. Potential mechanisms for this benefit include reduced rates of postoperative anemia and reduced rates of hemarthroses.

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Introduction

Over the last decade, the perioperative use of tranexamic acid (TXA) during total knee arthroplasty (TKA) has been shown to confer significant benefits. Multiple randomized controlled trials

have clearly demonstrated clinically significant reduction in perioperative bleeding, perioperative anemia, and transfusion requirements with both intravenous (IV) and topical TXA administration [1–5]. Reduction in perioperative bleeding is reported between 110 and 690 mL, with a mean difference of 245 mL [1]. Reduction in transfusion rates across 14 studies showed a mean relative risk reduction of 2.56 ($P < .001$) [1].

Achieving faster and safer recovery in the perioperative period is of increasing importance in the arthroplasty field. Accelerated recovery can lead to decreased costs through increased patient independence, a shorter hospital stay, and decreased need for posthospital rehabilitation facilities. The considerable reductions seen in perioperative blood loss related outcomes with the use of TXA may translate to improved functional benefits in this period. Improving postoperative anemia and decreasing intra-articular

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hematoma formation may lead to decrease pain and measurable clinical improvement in functional outcomes in the acute postoperative period.

The primary purpose of this study was to investigate the influence of TXA on functional improvement in the immediate postoperative period after TKA. We hypothesized that TXA would confer measurable clinical improvement in physical therapy (PT) performance by improving postoperative anemia and decreasing pain associated with intra-articular hematomas, which would result in short hospital length of stay (LOS) and a decreased rate of patient discharges to a rehabilitation facility.

Material and methods

Experimental protocol

After institutional review board's approval, we retrospectively analyzed patients receiving a TKA by the senior surgeon at one institution between October 1, 2010 and November 1, 2014. Our institution began implementing the use of TXA protocol for TKA patients in May 2013. Patients undergoing bilateral TKA, or who had an operative diagnosis that included infection or trauma, and patients who suffered from blood-related disorders that may have affected their need for transfusion were excluded.

In this case-control study, the patients were divided into 2 groups. The control group consisted of 280 consecutive patients who underwent surgery between October 2010 and May 2013, and did not receive TXA, whereas the TXA cohort comprised the subsequent 280 patients, who underwent TKA between May 2013 and November 2014 after initiation of the TXA protocol. These patients received 1 gram of IV TXA immediately before incision and an additional 1 gram of IV TXA before wound closure. There were 22 patients who did not have complete records and were eliminated from the analysis leaving 264 patients in the TXA cohort and 274 patients in the control cohort.

Data collected included demographics, preoperative functional status based on American Society of Anesthesiologists (ASA) physical status classification system, preoperative hemoglobin (HGB) and hematocrit (HCT) levels. Outcome measures collected included postoperative changes in HGB and HCT levels, transfusion events, LOS, visual analogue scale (VAS) pain scores, distance ambulated with PT over 5 sessions or until discharge, and destination of discharge (home or rehabilitation center).

Statistical analysis

Demographics, preoperative functional status, and preoperative HGB and HCT levels were compared between the 2 groups to identify any baseline differences between the 2 cohorts. Preoperative differences and postoperative outcome measures between the

2 groups were compared using chi-square analysis or Fischer exact test for categorical variables, and Student *t* test for continuous variables. Multivariate analysis using multiple logistic regression comparing outcome measures for each group were performed while controlling for gender, BMI, age, preoperative HCT and HGB levels, and preoperative functional status. A *P* value <.05 was considered significant for all analyses.

Results

Patient demographics and preoperative characteristics

The patient cohorts had similar demographics and preoperative variables including age, ASA grade, body mass index (BMI), and preoperative HGB and HCT levels (Table 1). However, there were a significantly higher proportion of female patients in the TXA cohort (76.1%) compared with the control cohort (66.1%) (*P* = .01).

Outcomes for TXA vs control cohort

TXA administration resulted in reduced postoperative decreases in HGB (1.9 vs 2.6) and HCT (5.8 vs 7.8) (*P* < .001) (Table 2). There was also a trend toward decreased transfusion rates in TKA patients receiving TXA, although this was not significant (1.1% vs 3.7%, *P* = .089).

Patients administered TXA ambulated more than their counterparts during every PT session (Fig. 1, Table 3), which was statistically significant during the second (*P* = .010), third (*P* = .011), and fourth (*P* = .024) sessions. On average, the TXA cohort ambulated 20% more per PT session than patients who did not receive TXA, 65.8 feet vs 54.9 feet (*P* < .001). TXA did not significantly influence VAS pain scores taken before and after PT sessions, or mean VAS score through hospital stay (Table 3). There was no significant difference in knee range of motion (ROM) between the 2 cohorts at 3 months (control 115.0°, TXA 114.1°, *P* = .54) and 1 year follow-up (control 117.1, TXA 118.6, *P* = .36).

Clinical pathways between the 2 cohorts remained the same, with regards to similar multimodal pain management protocols (including a preoperative femoral nerve block), anesthesia protocols, rehabilitation protocols, and mobilization protocols. The average hospital LOS for controls (3.8 days) and TXA patients (3.6 days) was not significantly different (Table 2). There was no difference in the distribution of patients going home vs rehabilitation at the time of discharge, with about 36% of patients able to go home after TKA regardless of TXA administration.

Multivariate analysis

When taking into account age, BMI, gender, preoperative functional ASA status, and preoperative HCT and HGB levels,

Table 1
Patient demographics and preoperative characteristics.

Variable	Total (n = 538)	Control cohort (n = 274)	TXA cohort (n = 264)	<i>P</i> value
Age, y	69.1 (19–94, 10.4)	69.5 (35–92, 10.0)	68.7 (19–94, 10.9)	.202
Gender				
Male	155 (29)	92 (34)	63 (24)	.010 ^a
Female	383 (71)	182 (66)	201 (76)	
BMI, kg/m ²	31.0 (18.1–92.2, 6.7)	31.1 (18.1–58.2, 6.0)	31.0 (18.2–54.6, 7.5)	.368
Preoperative HGB, g/dL	13.1 (7.6–17.3, 1.4)	13.1 (7.6–17.3, 1.4)	13.1 (9–16.9, 1.4)	.837
Preoperative HCT, %	39.9 (23.4–51.7, 3.7)	39.7 (23.4–51.7, 3.7)	40.1 (28.5–49.9, 3.7)	.530
ASA status	2.3 (1–4, 0.5)	2.4 (1–4, 0.5)	2.3 (1–4, 0.5)	.283
PNB, %	528 (94)	260 (93)	268 (96)	.152

PNB, peripheral nerve block.

For continuous variables mean (range, standard deviation); for categorical variables N (%).

^a Significant for *P* value <.05.

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