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# Does Tranexamic Acid Reduce Blood Transfusion Cost for Primary Total Hip Arthroplasty? A Case–Control Study

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ABSTRACT

Peri-operative tranexamic acid (TXA) significantly reduces the need for allogeneic blood transfusion in total hip arthroplasty (THA) and thus hospital costs are reduced. Before employing TXA in primary THA at our institution, facility costs were $286.90/THA for blood transfusion and required 0.45 man-hours/THA (transfusion rate 19.87%). After incorporating TXA, the cost for intravenous application was $123.38/THA for blood transfusion and TXA medication and 0.07 man-hours/THA (transfusion rate 4.39%) and the cost for topical application was $132.41/THA for blood transfusion and TXA and 0.14 man-hours/THA (transfusion rate 12.86%). TXA has the potential to reduce the facility cost per THA and the man-hours/THA from blood transfusions.


Tranexamic Acid (TXA) is a plasminogen-activator inhibitor that has been used widely in many surgical specialties to help reduce the need for allogeneic transfusion. TXA therapy has more recently been applied to total joint arthroplasty with similar reduction in allogeneic transfusion rates. The impact on patient care and outcomes of TXA application in the peri-operative period is primarily a reduction in the need for allogeneic transfusion in patients immediately after total hip arthroplasty [1–4]. Additionally, several risks secondary to blood transfusion are reduced or removed: transfusion reactions, infections, fluid overload and altered mental status; all of which may lead to prolonged hospitalization [5,6]. Health-care delivery is undergoing changes in focus; the economics of managed care, cost-bundling, and health-care reform mean that the financial impact of TXA could be very important to THA.

Although there have been many publications on the effectiveness of TXA on THA patient care as it relates to transfusion rates [1–4,7], there are few references to the economic savings that can be achieved by a health care system when this medication is properly applied peri-operatively [6,8].

The facility cost associated with TXA is not difficult to assess; we have defined it as the cost of TXA and the cost of allogeneic transfusion expressed in dollars per THA. The man-hour cost of allogeneic transfusion has been defined as the time needed to successfully deliver a unit of blood and to address possible transfusion reactions.

Our analysis will review the cost-savings achieved by one institution over a four-year period when TXA was used in a primary THA population. Cost-savings will be expressed as facility cost and man-hour cost. Thus we will determine how TXA can impact hospital resource utilization.

To this end we asked three questions: (1) Does TXA in THA result in reduced facility costs?, (2) Does TXA in THA result in reduced man-hour costs? and (3) Is there a difference in facility costs and man-hour costs depending on the delivery mechanism of TXA (IV versus Topical) in THA?

## Materials and Methods

We use the transfusion data and the patient cohort from a case–control study originally compiled by Wind et al. at our institution, to perform the cost analysis comparing TXA usage [4]. THA patients were categorized to one of the three treatment groups (no-TXA, IV-TXA, and Topical-TXA) during record reviews. From January 2009 to March 2013, four surgeons at a single institution performed all THAs in this study. One surgeon adopted the protocol initially; six months later two additional surgeons adopted the protocol; and six months after that (12 months since inception) a fourth surgeon adopted the protocol. All four surgeons involved in this analysis were fellowship trained in adult reconstruction at this tertiary care center.

Wind et al. identified patients through chart review of THAs performed between January 2009 and March 2013 [4]; IRB Approval was obtained before gathering patient data. Patients who did not receive TXA were designated as "controls" (n = 1047). Patients who received TXA during the course of surgery were defined as "cases" and

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were subdivided into IV-TXA (n = 478) or Topical-TXA (n = 70). It was these data from Wind et al. that we utilized for our measure of direct and indirect costs [4].

Patients were not randomized; allocation was dependent on date of THA (earlier THAs were performed without TXA) and on cardiovascular and thromboembolic health status (IV-TXA and Topical-TXA); all patients with complete records were included in this retrospective review. Wind et al. examined demographics for the study groups and found one significant difference ($P = 0.001$), males were approximately 5.45 years younger than females (60.55 ± 12.64 years versus 66.00 ± 11.35 years); there were no significant differences between treatment groups [Tables 1 and 2 reprinted with permission]. Wind et al. also reported rates of thromboembolic events and found no statistically significant differences between groups [4].

All patients, regardless of TXA group, received single shot spinal anesthetic unless contraindicated by history of spine surgery, spinal deformity, or anesthesiologist preference. At our facility at least 90% of our patients receive single shot spinal anesthetic. All patients received Coumadin as prophylaxis against deep vein thrombosis; and all patients received hemovac drains post operatively [4]. Patients who received THA surgery before the TXA protocol was implemented make up the control group (No-TXA). TXA protocol is divided into two groups: IV-TXA and Topical-TXA.

IV-TXA was administered as a one-gram infusion within one hour of incision with an additional gram administered as wound closure began [4]. The Topical-TXA group is made of patients who had a heart attack within the previous six months, who had a stent placement within the previous 12 months, or who had a previous embolic event [4]. For these patients, TXA was placed in the wound before closure and the hemovac drain was clamped for 30 min post operatively [4].

Autologous blood transfusion is the event for determining possible cost savings of TXA usage; therefore, a standard measure is needed to determine when to administer a transfusion. A hemoglobin below 8 g/dL was set as the transfusion trigger for all patients regardless of TXA dosage (No-TXA, IV-TXA, or Topical-TXA) [4].

Several elements contribute to facility cost: cost of packed red blood cells per unit, cost associated with tranexamic acid per dose, cost of pre-hospitalization lab work as well as lab work required when a transfusion is ordered, and finally equipment utilization costs. Assistance from the hospital billing and purchasing departments allowed us to assign specific values to each element.

The man-hour cost was determined by working directly with hospital administration, nursing services and laboratory services. The pathway for a unit of packed red blood cells (PBRCs), from donor to THA patient recipient, was evaluated. Provider, nursing, and blood bank protocols were reviewed to identify the minimum man-hour components of each element on the transfusion pathway. The elements were analyzed for three different outcomes: (1) the time needed to transfuse one unit of PRBCs, (2) the time required to transfuse additional units of PRBCs, and (3) the time associated with management of a transfusion reaction. To measure transfusion reaction cost, only the standard steps of treating any transfusion reaction were measured, i.e. nursing protocol of stopping blood transfusion and sending to un-transfused blood to blood bank, blood bank employees processing that un-transfused blood, pathologist review of un-transfused blood, and the charting and administrative steps of all three levels, once again to evaluate the minimum man-hour component. Average institutional salary information was then used to determine the cost associated with manpower utilization.

Statistical analyses of costs were not performed. Our goal was not to determine if there was a statistically significant reduction but to determine if there was a cost reduction that would have practical significance.

**Table 1**
Demographic Information for Male Patients (n = 684) [Reprinted From Wind et al. [4].

| | Average Age | Average Height | Average Weight | Average BMI |
|---|---|---|---|---|
| No-TXA (n = 464) | 60 | 5'10" | 210 lb | 30 |
| Range | 25–93 | 5'6"–6'0" | 99–396 | 15.1–55.3 |
| IV-TXA (n = 80) | 61 | 5'10" | 209 lb | 29.3 |
| Range | 38–85 | 5'5"–6'5" | 125–298 | 19.1–41 |
| Topical-TXA (n = 22) | 65 | 5'10" | 210 lb | 30 |
| Range | 38–87 | 5'4"–6'4" | 133–335 | 20.3–43.1 |

**Table 2**
Demographic Information for Female Patients (n = 911) [Reprinted From Wind et al. [4].

| | Average Age | Average Height | Average Weight | Average BMI |
|---|---|---|---|---|
| No-TXA (n = 594) | 66 | 5'4" | 174 lb | 30 |
| Range | 19–90 | 4'3"–6'4" | 91–389 | 17.2–54.4 |
| IV-TXA (n = 111) | 64 | 5'4" | 172 lb | 29 |
| Range | 33–86 | 4'4"–6'0" | 101–389 | 18.7–49.1 |
| Topical-TXA (n = 25) | 70 | 5'3" | 165 lb | 29 |
| Range | 53–88 | 4'10"–5'8" | 106–239 | 19.3–42.3 |

## Results

Facility cost is calculated as the cost of allogeneic blood transfusion plus the cost of TXA, for the control group (No-TXA) facility cost is only the cost of allogeneic blood transfusion (Table 3). Examination of hospital billing practices at our institution allowed us to determine that the cost of packed red blood cells (PRBCs) was $1130/unit, each additional unit of PRBC was $291/unit, and the cost of a transfusion reaction during the first unit of transfused blood was $1197/reaction. The cost associated with TXA per dose was $39.14, one dose being used intra-operatively for topical application. For the two-dose regimen that was needed for intravenous application during this study, the cost was $78.28. In the No-TXA group, there were 208 blood transfusions (19.87% of 1047 THAs) at a facility cost of $300,380 ($286.90/THA). This is compared to 21 transfusions in the IV-TXA group (4.39% of 478 THAs) with a facility cost of $58,977.95 ($123.38/THA) and is compared to 9 transfusions in the Topical-TXA group (12.86% of 70 THAs) with a facility cost of $9269.84 ($132.41/THA). The ratio of money spent on blood transfusion when TXA is used versus when it is not used revealed that when Topical TXA is utilized, there is a 54% reduction in cost associated with blood transfusion, and when IV TXA is used, the savings is 57% when compared blood transfusion in patients that do not receive TXA (Table 3).

The man-hours required for allogeneic blood transfusion and possible transfusion reactions are a second area of possible cost savings with the use of TXA (Table 4). The man-hour required to transfuse the first unit of PRBC is at least 95 min. When additional units are ordered, an additional 40 min per unit is added to the initial 95 min. So a patient receiving 2 units of PRBC will require 135 min (95 + 40), while a person receiving 4 units would require 215 min (95 + (3 × 40)). If a patient had a blood transfusion reaction, the additional nursing, administrative and blood bank procedures would require 205 min; this was assuming that the transfusion reaction was noted during the first unit of transfused blood (Table 3). In the No-TXA group, transfusions cost 472.2 man-hours (0.45 h/TH) while the man-hours cost for IV-TXA was 32.2 man-hours (0.07 h/THA) and the man-hours cost for Topical-TXA group was 9.9 man-hours (0.14 h/THA). The ratio of man-hours spent on blood transfusions when TXA is used versus when it is not used revealed that when Topical TXA is utilized, there is a 68.89% reduction in man-hours associated with blood transfusion, and when IV TXA is used, there is an 84.44% reduction in man-hours when compared to patients who did not receive TXA (Table 3).