Blood Loss Reduction with Tranexamic Acid and a Bipolar Sealer in Direct Anterior Total Hip Arthroplasty

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Author Affiliation | Disclosures

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Take-Home Points

- TXA reduces blood loss and transfusion requirements in THA.
- The bipolar sealer enhances surgical hemostasis by sealing vessels at the surgical site through radiofrequency ablation.
- The use of TXA, with and without the concomitant use of a bipolar sealer, decreases intraoperative blood loss and postoperative transfusion requirements.
- The addition of a bipolar sealer did not offer an advantage to transfusion requirements in anterior THA.
- TXA should be used routinely in THA.

Historically, patients undergoing total hip arthroplasty (THA) have significant blood loss and required blood transfusions. Blood transfusions increase not only the risk of complications but also the cost of the procedure. Although less invasive techniques in hip surgery may decrease blood loss, intraoperative blood loss remains a concern. Optimization of anemia and blood conservation techniques include preoperative autologous blood donation, perioperative hemodilution, meticulous surgical hemostasis, and the use of antifibrinolytic agents. Antifibrinolytics are inexpensive and have been shown to reduce blood loss during THA and total knee arthroplasty (TKA).

Tranexamic acid (TXA), a synthetic analog of the amino acid lysine, is one antifibrinolytic that has recently been
adopted in total joint arthroplasty. TXA competitively inhibits the lysine binding site of plasminogen, inhibiting fibrinolysis and leading to clot stabilization. 18-20 Because of its safety and low cost, TXA has been readily accepted. The bipolar sealer enhances surgical hemostasis by sealing vessels at the surgical site through radiofrequency ablation. In contrast to standard electrocautery, a bipolar sealer uses saline to maintain tissue temperatures at <100°C, minimizing damage to surrounding tissues. 21 Many applications of a bipolar sealer have been reported in the fields of surgical oncology, 21 pulmonary surgery, 21 liver resection, 22 THA 23,24 and TKA, 25,26 and spine surgery. 27 We recently published our reduction in transfusion rates during direct anterior (DA) THA with use of a bipolar sealer. 28

Although many studies have analyzed the use of TXA and a bipolar sealer with the posterior and lateral approaches to hip arthroplasty, there is a paucity of research analyzing its use in the DA approach. This study retrospectively reviews the effectiveness of TXA alone and in conjunction with a bipolar sealer in reducing allogeneic blood transfusions in DA THA.

**Methods**

This is a retrospective, comparative study evaluating the efficacy of TXA with and without a bipolar sealer in unilateral DA THA. The study included 173 patients who underwent standard DA THA performed by 2 surgeons in the period April 2013 to April 2014. Patient demographic information is summarized in Table 1.

Three cohorts were created based on intraoperative blood loss management practices at the surgeon’s discretion. The first group included 63 patients who underwent DA THA with TXA but not a bipolar sealer. The second group included 49 patients who underwent DA THA with TXA and a bipolar sealer. The third (control) group included 61 patients who underwent DA THA without TXA or a bipolar sealer. Data for the control group were collected prospectively as a part of a randomized trial, which demonstrated a reduction in transfusion requirements and blood loss with the use of a bipolar sealer in DA THA. 28 All patients received a surgical hemovac suction drain, which was removed at 24 hours after surgery. All patients received 40 mg of enoxaparin daily for 2 weeks for venous thromboembolism prophylaxis starting the day after surgery.

All patients in the first 2 groups received 2 g of TXA administered intravenously in 2 doses: the first dose was given preoperatively, and the second dose was given immediately postoperatively in the recovery room. The bipolar sealer was utilized as needed perioperatively according to the manufacturer’s instructions to address specific bleeding targets. The common sites and steps of a DA THA, in which bleeding typically occurs, are:

- The medial femoral circumflex artery during the approach to the capsule;
- The anterior hip capsule vessels prior to capsulotomy;
- The deep branch of the medial femoral circumflex artery and the nutrient vessels to the lesser trochanter encountered while exposing the medial neck and releasing the medial capsule;
- The posterior-superior retinacular arteries encountered after femoral neck osteotomy and removal of the femoral head along the posterior capsule; and
- The branch of the obturator artery encountered during exposure of the acetabular fovea. 29-31

At the time of this study, the transfusion criteria included hemoglobin <8 g/dL in the presence of clinical symptoms.
Outcome Measures and Data Analysis

Primary outcome measures were transfusion requirements and estimated blood loss. Secondary outcome measures were postoperative decrease in hemoglobin, length of stay, and postoperative drain output. Demographic and operative data were compared between groups to ensure that there were no statistically significant differences in blood loss and transfusion requirements. All data were recorded in a password encrypted file and subsequently transferred to the REDCap system (Research Electronic Data Capture, Vanderbilt University).

Statistical Analysis

A priori sample size calculation was performed on the basis of a prior study, which evaluated surgical blood loss reduction utilizing a bipolar sealer. This study suggested a sample size of 20 per group to detect the minimal clinically important difference of 1.5 (standard deviation (SD) = 1.5, $\alpha = 0.05$, $\beta = 0.20$). Additionally, a general estimate for detecting a 1-unit change on an ordinal scale of 136 (SD = 1.0, $\alpha = 0.05$, $\beta = 0.20$) resulted in the same number. We conservatively chose to include at least 24 patients in each study arm in the event of greater true variance. The Wilcoxon rank-sum test was used for comparison of continuous data between groups. Differences between means were analyzed using 2-sided $t$ tests. Comparison of categorical data was performed using Pearson’s chi-square or Fisher’s exact probability test as indicated. Ordinal ranking scores were compared using the Mantel-Haenszel test.

Results

There were no statistically significant differences between groups with respect to sex, age, body mass index, or preoperative hemoglobin level (Table 1). Two patients in the TXA group and 10 patients in the control group were transfused ($P = .02$). In the TXA + bipolar sealer group, 1 patient was transfused ($P = .02$). A comparison of the transfusion rate between the TXA group and the TXA + bipolar sealer group yielded no significant difference ($P = .99$). The estimated blood loss was 310.3 mL ± 182.5 mL in the TXA group ($P = .004$), 292.9 mL ± 130.8 mL in the TXA + bipolar sealer group ($P = .003$), and 404.9 mL ± 201.2 mL in the control group ($P = .71$) (Table 2).

The total drain output was 326.3 mL ± 197.5 mL in the TXA group ($P < .001$ for comparison with the control group), 309.8 mL ± 196.3 mL in the TXA + bipolar sealer group ($P < .001$ for comparison with the control group), and 473.6 mL ± 199.7 mL in the control group ($P = .58$). The decrease in hemoglobin was 3.5 g/dL ± 0.8 g/dL in the TXA group ($P < .001$), 3.5 g/dL ± 1.1 g/dL in the TXA + bipolar sealer group ($P < .001$), and 4.3 g/dL ± 1.2 g/dL in the control group (Table 2). The length of stay was 2.2 ± 0.6 days for the TXA group ($P = .004$) and 2.2 ± 0.9 days ($P = .03$) for the TXA + bipolar sealer group, and 2.6 ± 0.8 days in the control group ($P = .78$) (Table 2).

Discussion

This study shows that the use of TXA alone provides a significant decrease in transfusion rates and estimated blood loss, a benefit which was not further increased with the addition of a bipolar sealer (Table 2). Many studies have demonstrated that TXA reduces blood loss and transfusion rates in patients undergoing THA and TKA. However, TXA’s acceptance as a more readily used hemostatic medication has been hindered by the theoretically increased risk of thromboembolism in susceptible, high-risk patients. In a 2012 meta-analysis conducted by Yang and colleagues, the use of TXA led to significantly less blood loss per patient and fewer transfusions.
without leading to an increased risk of thromboembolic events.

Similarly, the bipolar sealer has been shown to decrease transfusion rates and stabilize perioperative hemoglobin levels.\textsuperscript{25-27} In this recent prospective clinical trial evaluating the use of a bipolar sealer during DA THA, we observed decreased intraoperative blood loss and transfusion requirements in patients managed with a bipolar sealer.\textsuperscript{28} However, in a study conducted by Barsoum and colleagues\textsuperscript{37} evaluating the use of a bipolar sealer in THA with a posterior approach, there were no significant postoperative benefits in terms of blood loss, transfusion requirements, clinical evaluations, functionality, or health-related quality of life in patients managed with a bipolar sealer.

Although the results of our research are in line with those of previous publications, it is important to address 3 limitations within this study. First, only the control group in this study was enrolled prospectively; the remaining groups were reviewed retrospectively. Second, our adoption of TXA was recent; therefore, a confounding factor is that our surgeons had more experience in the anterior approach when using TXA. Third, the established transfusion threshold of <8 g/dl for this study led to more liberal use of transfusions. Since the conclusion of this study, we have adopted stricter transfusion criteria (hemoglobin <7.0 g/dL with clinical symptoms) which has led to even lower transfusion requirements.

**Conclusion**

In the reviewed patient population, TXA decreased blood loss and transfusion requirements following DA THA. However, the addition of a bipolar sealer did not provide an advantage. The results of this study do not support the routine use of a bipolar sealer in DA THA.

**Key Info**

**Figures/Tables**

Figures / Tables:

**Table 1. Demographic Data**

<table>
<thead>
<tr>
<th></th>
<th>All (N = 173)</th>
<th>TXA Only (n = 63)</th>
<th>TXA + Bipolar Sealer (n = 49)</th>
<th>Control (n = 61)</th>
<th>P-value (TXA vs Control)</th>
<th>P-value (TXA + Sealer vs Control)</th>
<th>P-value (TXA + Sealer vs TXA)</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Age (y)</strong></td>
<td>64.8 ± 10.5</td>
<td>66.9 ± 9.9</td>
<td>62.1 ± 11.0</td>
<td>64.7 ± 10.4</td>
<td>.31</td>
<td>.24</td>
<td>.03</td>
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<td></td>
<td>(28.4-87.6)</td>
<td>(47.2-87.6)</td>
<td>(28.4-86.3)</td>
<td>(38.3-85.8)</td>
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<tr>
<td><strong>Gender</strong></td>
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<tr>
<td><strong>Male</strong></td>
<td>82 (47.4%)</td>
<td>30 (47.6%)</td>
<td>23 (46.9%)</td>
<td>29 (47.5%)</td>
<td>.99</td>
<td>0.95</td>
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<tr>
<td><strong>Female</strong></td>
<td>91 (52.6%)</td>
<td>33 (52.4%)</td>
<td>26 (53.1%)</td>
<td>32 (52.5%)</td>
<td>.99</td>
<td>0.95</td>
<td>.94</td>
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<td></td>
<td>BMI (kg/m²)</td>
<td>Preoperative hemoglobin level&lt;sup&gt;a&lt;/sup&gt;</td>
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<td>(17.5-40.6)</td>
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<td>(17.5-39.8)</td>
<td>(17.5-39.8)</td>
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<td>TXA Only (N = 63)</td>
<td>27.9 ± 4.4</td>
<td>13.6 ± 1.3 (10.5-17.2)</td>
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<tr>
<td>TXA + Bipolar Sealer (n = 49)</td>
<td>27.8 ± 3.3 (21.6-35.9)</td>
<td>13.9 ± 1.2 (11.5-17.1)</td>
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<tr>
<td>Control (n = 61)</td>
<td>29.1 ± 5.3</td>
<td>13.5 ± 1.4 (10.5-16.6)</td>
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<tr>
<td><em>P</em>-value (TXA vs Control)</td>
<td>.16</td>
<td>.10</td>
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<tr>
<td><em>P</em>-value (TXA + Sealer vs Control)</td>
<td>.03</td>
<td>.98</td>
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<tr>
<td><em>P</em>-value (TXA + Sealer vs TXA)</td>
<td>.13</td>
<td>.10</td>
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</tbody>
</table>

<sup>a</sup>Result values are expressed as mean ± standard deviation (range). <sup>b</sup>Result values are expressed as number of cases (percentage of column header population).

Abbreviations: BMI, body mass index; TXA, tranexamic acid.

### Table 2. Patient-Related Outcomes

<table>
<thead>
<tr>
<th></th>
<th>TXA Only (N = 63)</th>
<th>TXA + Bipolar Sealer (n = 49)</th>
<th>Control (n = 61)</th>
<th><em>P</em>-value (TXA vs Control)</th>
<th><em>P</em>-value (TXA + Sealer vs Control)</th>
<th><em>P</em>-value (TXA + Sealer vs TXA)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Patients Transfused&lt;sup&gt;a&lt;/sup&gt;</td>
<td>2 (3.2%)</td>
<td>1 (2.0%)</td>
<td>10 (16.4%)</td>
<td>.02</td>
<td>.02</td>
<td>.99</td>
</tr>
<tr>
<td>Hemoglobin Drop (g/dL)&lt;sup&gt;b&lt;/sup&gt; = preoperative Hb-lowest Hb</td>
<td>3.5 ± 0.8 (1.8-6.3)</td>
<td>3.5 ± 1.1 (1.7-6.0)</td>
<td>4.3 ± 1.2 (2.0-7.5)</td>
<td>&lt;.001</td>
<td>&lt;.001</td>
<td>.60</td>
</tr>
<tr>
<td>Total Drain Output (mL)&lt;sup&gt;b&lt;/sup&gt;</td>
<td>326.3 ± 197.5 (15-1050)</td>
<td>309.8 ± 196.3 (20-920)</td>
<td>473.6 ± 199.7 (90-960)</td>
<td>&lt;.001</td>
<td>&lt;.001</td>
<td>.58</td>
</tr>
<tr>
<td>Calculated Blood Loss (mL)&lt;sup&gt;b&lt;/sup&gt; = 1000 x total Hb loss/preoperative Hb</td>
<td>1217.8 ± 335.8 (573.0-2514.4)</td>
<td>1289.5 ± 382.4 (536.1-2418.2)</td>
<td>1514.7 ± 467.9 (789.4-3451.1)</td>
<td>&lt;.001</td>
<td>.005</td>
<td>.43</td>
</tr>
<tr>
<td>Estimated Blood Loss (mL)&lt;sup&gt;b&lt;/sup&gt;</td>
<td>310.3 ± 182.5 (100-1400)</td>
<td>292.9 ± 130.8 (75-600)</td>
<td>404.9 ± 201.2 (150-1000)</td>
<td>.004</td>
<td>.003</td>
<td>.71</td>
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<tr>
<td>Length of Stay (d)&lt;sup&gt;a&lt;/sup&gt;</td>
<td>2.2 ± 0.6 (1-4)</td>
<td>2.2 ± 0.9 (1-5)</td>
<td>2.6 ± 0.8 (1-5)</td>
<td>.004</td>
<td>.03</td>
<td>.78</td>
</tr>
</tbody>
</table>

<sup>a</sup>Result values are expressed as mean ± standard deviation (range). <sup>b</sup>Result values are expressed as number of cases (percentage of column header population).

Abbreviation: TXA, tranexamic acid.

### References

References


31. Sevitt S, Thompson RG. The distribution and anastomoses of arteries supplying the


**Multimedia**

**Product Guide**

- **BioComposite SwiveLock Anchor**
- **BioComposite SwiveLock C, with White/Black TigerTape™ Loop**
- **BioComposite SwiveLock Anchor, With Blue FiberTape Loop**
- **Knotless SutureTak® Anchor**

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