Perioperative Bleeding Control in Total Hip Arthroplasty: Oxidized Regenerated Cellulose vs. Tranexamic Acid - prospective, single-center, single-blind randomized controlled trial.

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INTRODUCTION:

Perioperative bleeding in total hip arthroplasty (THA) can cause various problems; thus, effective management of blood loss is necessary. Tranexamic acid (TXA), administered intravenously or topically, has been reported to effectively reduce blood loss and transfusion rates in THA. Oxidized regenerated cellulose (ORC), a fiber-based hemostatic agent derived from wood pulp, has been widely used since 1943 to achieve hemostasis primarily in surgical procedures. Available in powder form, ORC acts as a locally absorbable hemostatic agent that effectively covers bleeding sites to control local bleeding and oozing.

This study aimed to compare the efficacy of topical administration of ORC and TXA in controlling perioperative bleeding during THA.

METHODS:

This study was a prospective, single-center, single-blind randomized controlled trial and was registered with UMIN. We enrolled 114 consecutive patients who underwent THA for hip osteoarthritis at our joint center from May 2022, to March 2023. Based on the topical hemostatic agent used, patients were randomized into the ORC group (57 patients) or the TXA group (57 patients) using the envelope method. All procedure, performed by a single surgeon with cementless implants using a modified Watson-Jones approach. Each hemostatic agent (ORC 1.5g or TXA 1000mg) was applied and distributed subfascially prior to wound closure. ORC was administered as a powder and TXA as a clear liquid. No antithrombotic medication was administered postoperatively. Demographic data, operation time, intraoperative blood loss, and estimated circulating blood volume were recorded for each patient.

Primary outcomes were the estimated total blood loss (eTBL), estimated postoperative blood loss (ePBL), laboratory data (hemoglobin (Hb) levels obtained from preoperative to postoperative day 14, and hematocrit (Hct) levels obtained from preoperative to postoperative day 7), and transfusion rates. Estimated circulating blood volume was calculated using the Nadler formula. The eTBL was calculated using the Gross formula. The ePBL was calculated as the eTBL minus the intraoperative blood loss. Transfusion was performed when the Hb level dropped below 7.0 g/dL.

Secondary outcomes were clinical outcomes assessed using Western Ontario and McMaster Universities Osteoarthritis (WOMAC) score, Japanese Orthopedics Association (JOA) score, Forgotten Joint Score (FJS) score, and visual analog scale (VAS) score. WOMAC and JOA scores were obtained at baseline and 3 months postoperatively, FJS score was obtained at 2 months postoperatively, and VAS score was obtained at various time points up to 14 days postoperatively.

Statistical analysis involved comparisons between groups using the Mann-Whitney U test and chi-square test. The change in VAS score was compared using mixed-effects models. SPSS Statistics Version 26.0 was utilized for analysis, with $p<0.05$ indicating statistical significance.

RESULTS:

The mean age of all enrolled patients was 70.7 years, mean height 154.7 cm, mean weight 57.5 kg, and mean BMI 23.9 kg/m². Two patients in the ORC group and one patient in the TXA group had missing data, so 55 patients in the ORC group and 56 patients in the TXA group were finally included in the analysis. Demographics, operative time, intraoperative blood loss, and estimated circulating blood volume were similar between groups.

Regarding the primary outcomes, the eTBL in the ORC and TXA groups were 788.2±350.1 and 714.1±318.4 ml, respectively. There was no significant difference in eTBL between groups ($p=0.141$). The ePBL was slightly higher in the ORC group (437.5±332.8 ml) compared to the TXA group (332.1±317.2 ml), but the difference was not statistically significant ($p=0.064$). There were no significant differences in Hb and Hct between groups at any time point (Table 1). None of the patients received perioperative blood transfusions.

Regarding secondary outcomes, there were no significant differences in WOMAC and FJS scores between groups at any time point. JOA score was significantly different preoperative and postoperative month 3, but this difference itself was relatively small. In the mixed-effects models, the change in VAS score was similar between groups up to postoperative day 14 (Table 1).

DISCUSSION AND CONCLUSION:

The hemostatic efficacy of TXA in THA is well established; however, the efficacy of ORC in THA has not been extensively studied. To our knowledge, this study was the first prospective, single-blind, randomized controlled trial to compare the efficacy of ORC and TXA in controlling perioperative bleeding in THA. Our results indicate that there were no significant differences in eTBL, ePBL, and perioperative laboratory data (Hb, Hct) between the ORC and TXA groups. In addition, no

patient needed for perioperative blood transfusions in our study. This result suggests that both ORC and TXA are effective topical hemostatic agents for the management of perioperative bleeding in THA.

Regarding clinical outcomes, WOMAC, FJS, and VAS scores were not significantly different between groups. JOA score showed a statistically significant difference between the groups at preoperative and postoperative month 3, but this difference is not substantial enough to choose one agent over the other based on this score alone. This suggests that there was no difference in clinical outcomes in the early postoperative period regardless of which hemostatic agent was selected.

In conclusion, ORC has similar topical hemostatic efficacy as TXA in the management of perioperative bleeding in THA. We believe that further studies are needed to compare the differences in long-term postoperative clinical outcomes, cost-effectiveness, and other patient factors with the choice of these topical hemostatic agents.

Table 1. Comparisons in primary and secondary outcomes between groups defined by topical hemostatic agents

	ORC group N=55	TXA group N=56	p-value
Primary Outcomes			
eTBL (ml)	788.2 ± 350.1	714.1 ± 318.4	0.141 ‡
ePBL (ml)	437.5 ± 346.2	332.8 ± 317.2	0.064 ‡
Hb (g/dL)			
Preoperative	13.4 ± 1.1	13.0 ± 1.4	0.127 ‡
Postoperative day 1	11.2 ± 1.0	11.2 ± 1.6	0.737 ‡
Postoperative day 4	10.7 ± 1.1	10.9 ± 1.6	0.359 ‡
Postoperative day 7	11.0 ± 1.1	11.0 ± 1.4	0.719 ‡
Postoperative day 14	11.4 ± 1.1	11.2 ± 1.4	0.283 ‡
Hct (%)			
Preoperative	40.8 ± 3.0	39.7 ± 3.5	0.068 ‡
Postoperative day 7	33.7 ± 3.3	33.7 ± 4.0	0.883 ‡
minimam (up to postoperative day 7)	32.4 ± 3.0	32.5 ± 4.2	0.878 ‡
Secondary Outcomes			
WOMAC total score			
Preoperative	34.3 ± 17.1	41.6 ± 21.2	0.115 ‡
Postoperative month 3	9.0 ± 8.3	12.2 ± 14.8	0.890 ‡
JOA total score			
Preoperative	47.3 ± 10.7	42.7 ± 14.5	**0.032** ‡
Postoperative month 3	86.8 ± 8.0	85.4 ± 7.4	**0.033** ‡
FJS score			
Postoperative month 2	58.4 ± 23.6	63.4 ± 19.9	0.641 ‡
VAS score			0.180†

‡ : Mann-Whitney U test, †: mixed-effect model; Bolded P-values indicate statistical significance.

ORC, oxidized regenerated cellulose; TXA, Tranexamic acid ;eTBL, estimated total blood loss; ePBL, estimated postoperative blood loss; Hct, hematocrit; WOMAC, Western Ontario and McMaster Universities Osteoarthritis Index; JOA, Japanese Orthopedics Association; FJS, Forgotten Joint Score; VAS, visual analog scale.