Bone and Arthrosurgery Science, 2023, Volume 1, Issue 2
http://ojs.bbwpublisher.com/index.php/BAS

Clinical Value of Tranexamic Acid Combined with Total Knee Arthroplasty in the Treatment of Knee Osteoarthritis

Fei Zhang*, Jieyong Zhang

Department of Orthopedics, Shuyang Guangji Hospital, Suqian 223600, Jiangsu Province, China

Corresponding author: Fei Zhang, zfei1984@163.com

Abstract: This paper aims to explore the clinical value of tranexamic acid combined with total knee arthroplasty (TKA) in patients with knee osteoarthritis (KOA). The research period was from March 2020 to December 2022. A total of 50 samples of KOA patients were selected and divided into the study group (n = 25) and the control group (n = 25) by lottery method of medical record envelopes. The patients in the control group were treated with TKA, and the patients in the study group were treated with tranexamic acid combined with TKA. The surgery-related indicators, visual analogue pain score (VAS), inflammatory factor levels, motor function scores, and incidence of complications were compared between the two groups. The intraoperative blood loss in the study group was lower than that in the control group ($P < 0.05$), and there was no significant difference in postoperative hospital stay between the two groups ($P > 0.05$). The postoperative VAS scores in the study group were lower than those in the control group ($P < 0.05$), while the postoperative inflammatory factor levels of the study group were lower than those of the control group ($P < 0.05$). The postoperative motor function scores of the study group were higher than those of the control group ($P < 0.05$), and the incidence of complications in the study group was lower than that in the control group ($P < 0.05$). The treatment of KOA patients with tranexamic acid combined with TKA can reduce intraoperative blood loss, relieve pain, reduce the level of inflammatory factors, improve postoperative motor function, and reduce the incidence of complications, which can be widely applied in clinical practice.

Keywords: Tranexamic acid; Total knee arthroplasty; Knee osteoarthritis

Online publication: September 22, 2023

1. Introduction

Knee osteoarthritis (KOA) is a chronic joint disease with a high clinical incidence. The lesion is characterized by knee cartilage degeneration and bone hyperplasia. The main symptoms are knee joint pain and swelling, morning stiffness of joints, and inability to perform normal activities. In some patients, these are accompanied by joint deformities and muscle atrophy [1]. The clinical treatment of KOA includes conservative treatment and surgical treatment. Total knee arthroplasty (TKA) is the main surgical solution for the treatment of advanced severe KOA. During the operation, artificial prosthesis is used to replace the diseased knee joint tissue, which

can relieve pain and unfavorable activities, etc. [2,3]. Clinical studies have shown that TKA has a large trauma area with large amount of blood loss during the operation, and can damage the venous tissue around the knee joint. Postoperative problems such as prosthetic loosening and poor incision healing are very likely to occur. Therefore, other interventions must be combined during the operation to improve the prognosis [4]. Tranexamic acid is a procoagulant drug that has hemostatic, anti-inflammatory, and immune-regulating effects. In this study, 50 samples of KOA patients were selected to explore the clinical effect of tranexamic acid combined with TKA.

2. Materials and methods

2.1. Demographic of study population

The specific procedures of this study were submitted to the approval of the Medical Ethics Committee. The research period was from March 2020 to December 2022. 50 samples of KOA patients were selected and divided into study groups ($n = 25$) and control group ($n = 25$) by lottery method of medical record envelopes. In the study group, there were 10 males and 15 females. The age statistics were 62–70 years old, with an average of 66.48±3.25 years old, and the course of disease was 2–6 years, with an average of 4.09±0.72 years. In the control group, there were 9 males and 16 females. The age statistics were 64–69 years old, with an average of 66.52±3.19 years old ($P > 0.05$).

Inclusion criteria included that symptom observation and imaging examination were consistent with the KOA diagnostic criteria in the "Guidelines for Knee and Hip Osteoarthritis," TKA indications are met, and the cognitive consciousness is normal with agreement to cooperate with the research.

Exclusion criteria were patients having other joint diseases, or having circulatory system dysfunction and infectious diseases, and patients complicated with mental or psychological diseases, with low treatment compliance.

2.2. Methods

The patients in the control group were treated with TKA. An airbag tourniquet was tied to the appropriate part of the lower limbs of the patients, and the pressure was controlled at 270–290mmHg. Spinal anesthesia or general anesthesia was performed after the ideal lower limb hemostasis effect was achieved. After the anesthesia took effect, the doctor marked the nerves and blood vessels to determine the surgical plan. Before the operation, 250ml of normal saline was injected into the appropriate part of the knee joint, and an incision was made in the center of the prepatellar area of the patient. In order to obtain a clear surgical field, the cruciate ligament and meniscus were removed, the tibia and femur were washed, and osteotomy was performed. After the above operations, the doctor properly placed the knee prosthesis, fixed it properly with bone cement, checked the effect of the operation with a C-arm machine, transfused an appropriate amount of blood, sutured the joint capsule, loosened the tourniquet, placed a drainage tube, and sutured the surgical incision.

The patients in the study group were treated with tranexamic acid combined with TKA. 100ml of normal saline mixed with 1g tranexamic acid was administered intravenously 30 minutes before operation, and before tourniquet was inflated during operation. Hemostasis, preoperative preparation, and anesthesia plan were consistent with those in the control group. A mixture of 1g of tranexamic acid and 250ml of normal saline was injected at a suitable position of the knee joint before setting the incision approach. The operation plan was the same as that of the control group. The patients were consistent. After the prosthesis replacement, the doctor injected a mixture of 3g of tranexamic acid and 50ml of normal saline into the joint cavity, and sutured the joint capsule without blood transfusion. The tourniquet was removed without an indwelling drainage tube, 0.5g of tranexamic acid was injected into the joint cavity before suturing the incision. Patients in the two

groups received analgesia and anti-infection treatment after operation. Patients in the study group removed the urinary catheter on the first day after operation, they were guided to get out of bed, and completed knee joint rehabilitation training in a standardized manner. Patients in the control group underwent knee joint rehabilitation after the drainage tube was removed.

2.3. Evaluation criteria

The operation-related indicators of the two groups of patients were collected, including intraoperative blood loss and length of hospital stay. The visual analogue pain scale (VAS) scores of the two groups were evaluated before operation, 6 hours after operation, 24 hours after operation, and 48 hours after operation. The full score is 10 points. The higher the score, the more severe the pain. The physicians collected 3ml of venous blood samples from two groups of patients before operation and 7 days after operation. After high-speed centrifugation, the supernatant was taken, and the level of C-reactive protein (CRP) was detected by immunoturbidimetry, and the tumor necrosis factor-alpha (TNF-α) level was detected by enzyme-linked immunosorbent assay. The motor function of the two groups was evaluated before operation and 3 months after operation. The scoring scale was the Fugl-Meyer Assessment scale (FMA), and the lower limb scoring items in the scale were used for evaluation. The more functional the limb, the better the recovery. The incidence of complications in the two groups of patients was counted.

2.4. Statistical methods

SPSS23.0 software was used to analyze the research data, measurement data ($\bar{x}$±s) was *t* test, count data % was x^2 test, $P < 0.05$ indicated that there was a statistical level difference.

3. Results

3.1. Comparison of surgical related indicators

As shown in **Table 1**, the intraoperative blood loss in the study group was lower than that in the control group ($P < 0.05$), and there was no significant difference in the postoperative hospital stay between the two groups ($P > 0.05$).

Table 1. Comparison of surgery-related indicators between the two groups ($\bar{x}$±s)

Group	Intraoperative blood loss (ml)	Length of hospital stay (d)
Study group (n = 25)	70.58±3.66	13.86±1.77
Control group (n = 25)	91.84±6.95	14.03±1.75
t value	13.533	0.314
P value	0.000	0.734

3.2. Comparison of VAS scores

As shown in **Table 2**, the postoperative VAS score of the study group was lower than that of the control group ($P < 0.05$).

Table 2. Comparison of VAS scores between the two groups ($\bar{x}$±s)

Group	Preoperative	6 hours after operation	24 hours after operation	48 hours after operation
Study group (n = 25)	3.62±1.08	4.11±0.83	3.25±0.77	2.88±0.53
Control group (n = 25)	3.59±1.02	5.26±1.29	4.83±1.23	4.09±1.02
t value	0.101	3.748	5.444	5.263
P value	0.920	0.000	0.000	0.000

3.3. Comparison of inflammatory factor levels

As shown in **Table 3**, the levels of inflammatory factors in the study group were lower than those in the control group after surgery ($P < 0.05$).

Table 3. Comparison of inflammatory factor levels between the two groups ($\bar{x}$±s)

Group	CRP (mg/L)		TNF-α (ng/L)	
	Preoperative	7d after operation	Preoperative	7d after operation
Study group (n = 25)	33.98±2.35	36.88±2.59	748.96±21.05	811.26±25.98
Control group (n = 25)	34.02±2.31	42.76±3.72	749.02±20.97	903.75±33.62
t value	0.061	6.486	0.010	10.884
P value	0.952	0.000	0.992	0.000

3.4. Comparison of FMA scores

As shown in **Table 4**, the FMA score of the study group was higher than that of the control group after operation ($P < 0.05$).

Table 4. Comparison of FMA scores between the two groups ($\bar{x}$±s)

Group	Preoperative	3 months after operation
Study group (n = 25)	16.28±1.53	23.08±1.96
Control group (n = 25)	16.36±1.49	20.17±1.02
t value	0.187	6.585
P value	0.852	0.000

3.5. Comparison of the incidence of complications

As shown in **Table 5**, the incidence of complications in the study group was lower than that in the control group ($P < 0.05$).

Table 5. Comparison of complication rates between the two groups (n/%)

Group	Deep vein thrombosis	Prosthesis loosening	Poor incision healing	Complication rate
Study group (n = 25)	1	1	0	2 (8.0)
Control group (n = 25)	3	3	2	8 (32.0)
x^2 value	-	-	-	4.500
P value	-	-	-	0.033

4. Discussion

KOA has a high incidence rate in obese people, middle-aged and elderly people. The main features of the lesion are knee cartilage degeneration and bone hyperplasia, which can lead to knee joint pain and movement disorders, as well as knee deformity and muscle atrophy, which can reduce patients' quality of life of [5]. The clinical treatment of KOA includes conservative treatment and KTA. KTA is often used for severe patients, but the trauma area in this operation is large with high blood loss, and postoperative complications such as prosthetic loosening are very likely, which in turn affects the knee joint. Therefore, functional recovery requires

other therapeutic interventions [6,7].

The results of this study showed that the surgery-related indicators and the incidence of complications in the study group were better than those in the control group. This may be due to the fact that conventional TKA operation only adopts the conventional hemostasis plan, causing the patient to have a large amount of blood loss during the operation, and longer postoperative recovery period. Tranexamic acid can combine with fibrin in plasminogen and plasmin, block the decomposition of fibrin caused by plasmin, and then achieve a good hemostatic effect, which can significantly reduce intraoperative blood loss and surgical costs, decrease trauma, accelerate the recovery of physiological functions of patients, and lower the incidence of complications [8,9]. This study confirmed that the postoperative VAS score of the study group was lower than that of the control group. This may be explained by the effects of tranexamic acid, which include inhibiting the allergic immune response, weakening the rejection reaction after implantation of the prosthesis, and thus reducing the degree of postoperative pain [10]. The results also showed that the postoperative inflammatory factor levels in the study group were lower than those in the control group. Tranexamic acid can effectively inhibit the synthesis of various active peptides, inhibit allergic reactions, reduce vascular permeability, and relieve inflammatory reactions, while conventional surgery has no such effects [11,12]. Moreover, the results confirmed that the FMA score of patients in the study group was higher than that in the control group after surgery. Tranexamic acid has the effects of anti-inflammation, hemostasis, and allergies inhibition, which can reduce the discomfort of the knee joint after prosthesis implantation and reduce surgical trauma, without the need for indwelling drainage tubes, thus patients can get out of bed early, which contributes to the recovery of patients' knee function after surgery [13-15].

In summary, tranexamic acid combined with TKA treatment for KOA patients can reduce intraoperative blood loss, relieve pain, reduce the level of inflammatory factors, improve postoperative motor function, and reduce the incidence of complications. The number of samples of KOA patients included in this study is small, and the specific mechanism of tranexamic acid combined with TKA therapy still requires further research and analysis.

Disclosure statement

The authors declare no conflicts of interest.

References

[1] Alimujiang Y, Abduupur H, Qin Q, et al., 2023, Efficacy and Safety of Tranexamic Acid and Aminocaproic Acid in the Perioperative Period of Total Knee Arthroplasty. Chinese Tissue Engineering Research, 27(36): 5812–5817.

[2] Wang Y, 2023, Effects of Intravenous Combined Intra-Articular Injection of Tranexamic Acid on Blood Loss and Safety of Total Knee Arthroplasty. Reflexology and Rehabilitation Medicine, 4(5): 148–150,154.

[3] Cheng J, Ding Y, Dong L, et al., 2023, Efficacy and Safety of Total Knee Replacement Combined with Tranexamic Acid. Chinese Tissue Engineering Research, 27(22): 3514–3520.

[4] Wang P, 2023, Research Progress on the Efficacy and Safety of Tranexamic Acid in Total Knee Arthroplasty. Chinese Prescription Drugs, 21(2): 186–189.

[5] Li S, 2023, Effects of Tranexamic Acid Intravenous Infusion and Joint Cavity Perfusion on Blood Loss in Total Knee Replacement. Clinical Medicine, 43(1): 7–10.

[6] Sun B, Sun Y, 2023, Effect Analysis of Periarticular Injection and Infusion of Tranexamic Acid in Total Knee Arthroplasty. Systematic Medicine, 8(8): 115–118, 127.

[7] Liu J, Yin L, Zhang Y, et al., 2022, Effects of Different Volumes and Doses of Intra-Articular Injection of Tranexamic Acid on Blood Loss in Total Knee Replacement. Chinese Tissue Engineering Research, 26(33): 5303–5310.

[8] Zhang J, Yang T, Zhang B, et al., 2023, Effect of Cold Compress Combined with Tranexamic Acid on Early Local Reaction after Total Knee Arthroplasty. Ningxia Medical Journal, 45(5): 397–400.

[9] Zhao H, Zhang J, Zhang B, et al., 2022, Comparison of the Effect of Intravenous Injection of Different Doses of Tranexamic Acid in Elderly Patients with Total Knee Replacement. Chinese Journal of Gerontology, 42(17): 4180–4183.

[10] Zhang J, Man J, Feng S, et al., 2022, Comparison of the Efficacy of Periarticular Injection of Tranexamic Acid and Intra-Articular Infusion in Total Knee Arthroplasty. Journal of Practical Medicine, 38(14): 1788–1792.

[11] Zhang J, Yang Z, 2022, Meta-Analysis of Hemostatic Efficacy of Tranexamic Acid and ε-Aminocaproic Acid in Hip and Knee Arthroplasty. Chinese Orthopedics, 35(5): 484–490.

[12] Wu X, Zhang G, Chen W, et al., 2022, Effect of Cold Compress Combined with Tranexamic Acid on Early Local Reaction After Total Knee Arthroplasty. Journal of Clinical and Experimental Medicine, 21(8): 853–856.

[13] Sun S, Lu W, Shi S, 2022, Effects of Local Application of Bone Wax and Tranexamic Acid on Postoperative Bleeding and Short-Term Knee Joint Function in Unicompartmental Arthroplasty. Hebei Medicine, 28(12): 2017–2022.

[14] Wan X, Xu K, Wang H, et al., 2022, Bibliometric Analysis of Tranexamic Acid in Total Knee Arthroplasty Based on CiteSpace. China Medical Herald, 19(36):11–16.

[15] Wang W, Ping W, Song W, et al., 2022, Effect of Postoperative Intravenous Infusion of Tranexamic Acid on Perioperative Blood Loss in Patients Undergoing Knee Arthroplasty. Chinese Journal of Physician Training, 45(6): 502–505.