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Hemostatic Effects of Tranexamic Acid on Geriatric Total Hip Arthroplasty

Xuewu Zhou[1,2]*, Hao Yao[1,2], Kangquan Shou[1,2]

[1]The First College of Clinical Medical Science, Three Gorges University, Yichang 443003, Hubei, China

[2]Yichang Central People's Hospital, Yichang 443003, Hubei, China

**Author to whom correspondence should be addressed.*

Abstract: *Objective:* The aim of this paper was to investigate the hemostatic effect of tranexamic acid in elderly patients undergoing artificial hip arthroplasty. *Methods:* Ninety-six patients who underwent artificial hip replacement surgery from June 2023 to January 2025 were selected and divided into two groups of 48 cases each. Tranexamic acid was applied intraoperatively in the observation group, and hemostasis was performed by conventional methods in the control group. Intraoperative bleeding, postoperative bleeding, total blood loss, proportion of blood transfusion, hemoglobin, erythrocyte pressure volume, and other complications were compared between the two groups. *Results:* The intraoperative bleeding volume, postoperative drainage volume, and total blood loss in the observation group were significantly lower than those in the control group ($P < 0.05$), and the transfusion rate was also significantly lower than that in the control group ($P < 0.05$). Postoperatively, hemoglobin and erythrocyte pressure volume decreased less in the observation group than in the control group ($P < 0.05$). There was no significant difference in the complication rate between the two groups ($P > 0.05$). *Conclusion:* Tranexamic acid applied to hip arthroplasty in the elderly can effectively reduce intraoperative and postoperative bleeding, reduce the rate of blood transfusion, and does not increase the risk of complications, and has clinical promotion and application values.

Keywords: Elderly; Hip arthroplasty; Tranexamic acid; Hemostatic effect

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1. Introduction

Hip arthroplasty is an important medical tool to treat hip diseases in the elderly, and it is effective in improving the joint function and quality of life of patients [1-3]. With the deepening of social aging, the number of elderly hip disease patients continues to rise, making the application of hip arthroplasty more and more common [4-6]. For example, femoral neck fracture is a common condition because the bones of the elderly are relatively loose, and the slightest external force can cause a fracture [7]; femoral head necrosis as well as osteoarthritis of the hip

joint also have a higher incidence in the elderly population [8,9]. These diseases greatly limit the patient's ability to perform daily activities, and in severe cases, patients may be bedridden for a long period of time, which may lead to a series of complications.

However, one of the prominent challenges of hip arthroplasty is intraoperative and postoperative bleeding [10,11]. Relevant studies [12] have shown that the hemophilia of elderly patients can reach 1500–2000 ml, and the transfusion rate is more than 68%. Elderly patients' body functions decline, cardiopulmonary function reserves are insufficient, and large blood loss will not only cause anemia, affecting the normal functioning of the body organs, but also may lead to reduced patient immunity, increasing the risk of infection [13]. Although blood transfusion can replenish blood volume, the adverse reactions that blood transfusion may bring, such as infection, allergic reaction, transfusion-associated acute lung injury, etc., add additional risks to patients, and in serious cases, may even be life-threatening [14,15]. In addition, bleeding and blood transfusion can prolong the patient's hospital stay and increase healthcare costs, causing a significant economic burden on the patient's family and society.

Tranexamic acid is a class of compounds with strong antifibrinolytic activity, which can prevent the degradation of fibrinogen by competitively blocking its binding to fibrin, and plays a role in hemostasis [16-18]. In recent years, the application of tranexamic acid in orthopedic surgery has gradually increased, and its safety and efficacy have been verified to a certain extent [19,20]. However, there is a lack of in-depth research on the optimal use regimen of tranexamic acid for the specific group of elderly hip arthroplasty and its effect on the long-term prognosis of patients. Therefore, an in-depth discussion of the hemostatic effect and safety of tranexamic acid in elderly hip arthroplasty is of great practical significance for optimizing clinical treatment protocols and improving patient prognosis.

2. Materials and methods

2.1. Case selection

Elderly patients who underwent hip arthroplasty in our Orthopedic Department from June 2023 to January 2025 were selected. The inclusion criteria were: (1) Age 60 years and above; (2) Confirmed diagnosis of osteonecrosis of the femoral head, fracture of the femoral neck, or osteoarthritis of the hip and the need for hip arthroplasty; (3) American Society of Anesthesiologists (ASA) grade I to III; and (4) Informed consent signed by the patient or family. Exclusion criteria included: (1) Allergy to tranexamic acid; (2) Coagulation disorders or hematological disorders; (3) Recent use of anticoagulant or antiplatelet drugs; (4) Severe hepatic and renal insufficiency; and (5) A combination of other serious medical illnesses that could not tolerate the surgery.

2.2. Grouping method

Using the random number table method, 96 patients were divided into two groups, with 48 cases in each group. The data of the two groups of patients in terms of general information were comparable, $P > 0.05$, the specific data are shown in **Table 1**.

Table 1. Comparison of general information of patients in two groups

Info		Observation group (n = 48)	Control group (n = 48)	t/χ^2	P
Gender	Male	26	25	0.042	0.838
	Female	22	23		
Age		68.47 ± 5.34	67.96 ± 6.18	0.433	0.666
BMI (kg/m^2)		23.39 ± 3.62	23.68 ± 3.17	0.418	0.677
Disease type	Femoral head necrosis	19	16	0.405	0.525
	Femoral neck fracture	15	17	0.188	0.665
	Hip osteoarthritis	14	15	0.049	0.824
ASA	I	11	9	0.253	0.615
	II	27	30	0.389	0.533
	III	10	11	0.061	0.805

2.3. Treatment methods

Surgical method: In this study, hip arthroplasty in both groups was performed by the same surgical team to ensure the consistency and stability of the surgical operation. The specific operations are as follows: (1) General anesthesia; (2) Posterior lateral approach: With the patient in the supine position, incision was made from the posterior side of the hip, the skin, subcutaneous tissue, and deep fascia were incised sequentially, the greater trochanter was separated, the external rotator muscle group was exposed and the attachment point of the external rotator muscle group was pulled inward, exposing the hip capsule; (3) Joint dislocation and exposure: The joint capsule was incised and the head of the femur and the acetabulum were exposed. The hip joint was dislocated by manipulation or instruments to better expose the surgical field and facilitate subsequent operations; (4) Femoral side preparation: The femoral head was removed, the medulla was expanded using a medullary file, the appropriate type of femoral prosthesis was selected according to the patient's bone condition and implanted into the femoral medullary cavity, ensuring that the position of the prosthesis was appropriate and securely fixed; (5) Acetabular side preparation: An acetabular file was used to grind the acetabulum so as to match with the acetabular prosthesis; a suitable acetabular prosthesis was chosen to be implanted into the acetabulum, usually using cemented or non-cemented fixation to ensure that the acetabular prosthesis was stable; (6) Prosthesis installation and reset: The femoral head prosthesis was installed on the femoral stem, and then the hip joint was reset to check whether the joint mobility, stability, and position of the prosthesis were good.

Hemostatic method: (1) The control group adopted the conventional hemostatic method; during the operation, the surgical team carefully and meticulously performed a hemostatic operation on the surgical wound to reduce intraoperative bleeding as much as possible. After completing the hip replacement surgery, a drainage tube was placed at the incision in order to drain out the blood and fluid seepage from the postoperative wound and prevent the accumulation of blood and fluid from causing infection or other complications. (2) In the observation group, the application of tranexamic acid was added on the basis of conventional hemostasis. Specifically, tranexamic acid was given to patients by intravenous drip at a dose of 15 mg/kg 10 minutes before skin incision, so that the drug entered the patient's body in advance to exert its hemostatic effect. When the surgery was carried out before closing the incision, 1 g tranexamic acid was diluted in 200 ml saline and the wound was locally irrigated so that tranexamic acid could act directly on the surgical wound, and then the irrigating fluid was retained in the joint

cavity without suction in order to continuously exert the local hemostatic effect. Postoperatively, a drain was also placed at the incision site. The entire surgical process strictly followed the principle of aseptic operation, and the surgical team worked closely together to ensure the successful completion of the surgery.

2.4. Observation indicators

(1) We recorded the intraoperative bleeding volume (estimated by the volume of blood in the suction bottle and the volume of blood absorbed by gauze), the postoperative drainage volume (24-hour postoperative drainage volume), and the total blood loss of both groups [calculated according to Gross' equation: total blood loss = preoperative blood volume × (preoperative erythrocyte pressure volume – postoperative erythrocyte pressure volume)/preoperative erythrocyte pressure volume + postoperative drainage volume, wherein the preoperative blood volume is estimated according to the patient's body weight and gender].

(2) The blood transfusion rate of patients in the two groups was counted, and the criteria for blood transfusion were set as postoperative hemoglobin < 70g/L or patients with obvious anemia symptoms.

(3) Blood routine indexes: Patients' venous blood was collected before the operation, on the 1st postoperative day, and on the 3rd postoperative day, respectively, and the levels of hemoglobin and erythrocyte pressure volume were measured.

(4) Complications: We observed and recorded the occurrence of postoperative complications in the two groups of patients, such as incision infection, deep vein thrombosis, pulmonary embolism, and so on.

2.5. Statistical methods

The data obtained were statistically analyzed by SPSS22.0 software, the count data were recorded as the number of cases and percentage, and analyzed by the method of χ^2 test, the measurement data were recorded as the mean and standard deviation (SD), and analyzed by the method of *t*-test, and the difference existed at the statistical level when $P < 0.05$.

3. Results

3.1. Comparison of blood loss and blood transfusion rate

The intraoperative bleeding volume, drainage volume, and total blood loss of patients in the observation group were significantly less than those of the control group, $P < 0.05$. The blood transfusion rate of the observation group was lower than that of the control group, $P < 0.05$, and the detailed data are shown in **Table 2**.

Table 2. Comparison of bleeding volume and blood transfusion rate between the two groups (mean ± SD)

Groups	*n*	Intraoperative hemorrhage (ml)	Postoperative drainage (ml)	Total blood loss (ml)	Transfusion rate (%)
Observation group	48	325.49 ± 80.27	207.13 ± 50.41	852.46 ± 159.74	10.42 (4/48)
Control group	48	467.54 ± 101.23	314.67 ± 69.87	1101.58 ± 204.76	25.00 (12/48)
t/χ^2		7.618	8.648	6.646	7.293
P		0.000	0.000	0.000	0.007

3.2. Changes in hemoglobin and erythrocyte pressure volume

Comparison of hemoglobin and erythrocyte pressure volume levels between the two groups of patients before the operation was not significant, $P > 0.05$. On the 1st and 3rd day after the operation, hemoglobin and erythrocyte pressure volume decreased in both groups, but the decrease in the observation group was smaller than that in the control group, $P < 0.05$, the specific data are shown in **Table 3**.

Table 3. Comparison of changes in hemoglobin and erythrocyte pressure area between the two groups (mean ± SD)

Groups	*n*	Time	Hemoglobin (g/L)	Erythrocyte pressure (%)
Observation group	48	Preoperative	130.5 ± 10.2*	38.5 ± 3.0*
		1 day after surgery	$105.6 \pm 8.5^{\#\triangle}$	$32.0 \pm 2.5^{\#\triangle}$
		3 days after surgery	$100.8 \pm 7.8^{\#\triangle}$	$30.5 \pm 2.0^{\#\triangle}$
Control group	48	Preoperative	131.2 ± 10.5	38.8 ± 3.2
		1 day after surgery	$92.5 \pm 9.0^{\triangle}$	$28.5 \pm 2.8^{\triangle}$
		3 days after surgery	$88.0 \pm 8.2^{\triangle}$	$26.8 \pm 2.2^{\triangle}$

Note: Compared with the control group before surgery, $^{*}P > 0.05$; compared with the control group at 1 and 3 days after surgery, $^{\#}P < 0.05$; compared with the preoperative period, $^{\triangle}P < 0.05$.

3.3. Incidence of complications

Comparison of the complication rates of the two groups was not significant, $P > 0.05$ (**Table 4**).

Table 4. The occurrence of complications in the two groups [*n* (%)]

Groups	*n*	Incision infection	Deep vein thrombosis	Pulmonary embolism	Overall incidence
Observation group	48	1 (2.08)	1 (2.08)	0 (0.00)	2 (4.17)
Control group	48	2 (4.17)	2 (4.17)	1 (2.08)	5 (10.42)
t					1.387
P					0.239

4. Discussion

The results of this study clearly demonstrate the significant advantages of tranexamic acid in geriatric hip arthroplasty. After the application of tranexamic acid in the observation group, intraoperative bleeding, postoperative drainage, and total blood loss were significantly less than those in the control group, which directly indicates that tranexamic acid can effectively reduce surgery-related blood loss. The combination of intravenous drip before skin incision and topical application before closure of the incision played a hemostatic role from the beginning to the end of the surgery, effectively controlling the bleeding. The significant reduction in the transfusion rate not only reduces the risks of infection and allergy that may be associated with blood transfusion, but also lowers medical costs and the financial burden on patients.

In terms of changes in hemoglobin and erythrocyte pressure volume, the postoperative decrease in the observation group was smaller than that in the control group, which indicates that the use of tranexamic acid

helps to maintain the stability of the patient's blood indexes in the postoperative period, promoting the patient's postoperative recovery. Good blood indexes play a key role in the recovery of the normal function of various organs, and can effectively reduce dizziness, fatigue, and other uncomfortable symptoms caused by anemia, thereby enhancing the quality of life of the patient.

In terms of complications, although there was no significant difference in the complication rate between the two groups, there were cases of pulmonary embolism in the control group, while no serious thrombosis-related complications occurred in the observation group, which suggests that tranexamic acid does not increase the risk of thrombosis and has a high degree of safety when used appropriately. This may be due to the fact that tranexamic acid mainly acts on the local fibrinolytic system and has less effect on systemic coagulation.

However, this study has some limitations. The relatively small sample size may not fully reflect the differences in response to tranexamic acid in different individuals. The short follow-up period makes it difficult to assess the effect of tranexamic acid on the long-term prognosis of patients, aspects such as the long-term joint function recovery and periprosthetic osteolysis are still unclear. Future multicenter studies with larger scale and longer follow-up time are needed to further clarify the optimal use of tranexamic acid in geriatric hip arthroplasty and its effect on the long-term prognosis of patients.

5. Conclusion

Tranexamic acid used in geriatric hip arthroplasty can effectively reduce intraoperative and postoperative bleeding, lower the blood transfusion rate, improve the postoperative hemoglobin and erythrocyte product levels, and will not increase the risk of complications, which is conducive to patient recovery and is worthy of promotion and application in the clinic. However, in the process of application, it is still necessary to pay close attention to the patients' coagulation function and the occurrence of complications to ensure the safety and effectiveness of treatment.

Disclosure statement

The authors declare no conflict of interest.

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