Hemostatic Effect of Tranexamic Acid on the Zhuang Nationality Patients with Chronic Kidney Disease in the Total Hip Arthroplasty

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Abstract

Purpose The hemostatic effect of Tranexamic Acid (TXA) is analyzed in total hip total hip arthroplasty (THA) operated on chronic kidney disease (CKD) patients in Zhuang nationality.

Methods A review of 53 Zhuang nationality patients with CKD who underwent unilateral total hip replacement at the People's Hospital of Guangxi Zhuang Autonomous Region from December 2012 to December 2019. They were divided into two groups: 28 patients in the TXA group and 25 patients in the non-TXA group. Nine aspects of comparison are operation time, blood loss during operation, postoperative drainage, changes of hemoglobin content before and after operation, prothrombin time before and after operation, recessive blood loss during operation, the number of patients with blood transfusion and that of thrombosis one month after operation.

Results Two groups of CKD patients Compared, there was no statistically significant difference ($p > 0.05$) in the following aspects, namely, preoperative hemoglobin, preoperative and postoperative prothrombin time, preoperative and postoperative creatinine, preoperative and postoperative blood urea nitroge, while in the aspects of immediate postoperative hemoglobin, 24-hour postoperative hemoglobin, intraoperative bleeding, postoperative drainage and 24-hour occult blood loss, the number of patients with blood transfusion (4 in TXA group and 10 in non-TXA group), there was statistically significant difference ($p < 0.05$). Deep venous thrombosis of lower extremities was found in both groups of CKD patients after one month. No cases of complications or death were reported in the included patients.

Conclusions In the THA, the use of TXA on CKD patients in Zhuang nationality can reduce dominant and recessive blood loss and decrease the incidence of lower extremity deep vein embolism.

Introduction

In total hip arthroplasty, there is a large amount of blood loss. However, blood transfusions affect the recovery of patients. Using hemostatic drug is the clinical method to reduce blood loss. TXA has been proven effective and safe for hemostasis of THA. Currently, TXA, a clinically effective antifibrinolytic drug that is cleared by glomerular filtration[1], is effective in hip replacement surgery and is widely used to prevent and treat blood loss during operation. Kidney excretion is the main way to eliminate TXA. However, there are different degrees of renal excretion on patients with CKD, so the study whether TXA is effective and safe in use is worth exploring. Guangxi Zhuang Autonomous Region, as one of the five major ethnic provinces in China, is a community of Zhuang nationality people. The People's Hospital of Guangxi Zhuang Autonomous Region is one of the largest general hospitals in Guangxi. The study is to explore the hemostatic effect of TXA in THA on the CKD patients admitted to our hospital.

Materials And Methods

General information

A total of 53 hips were selected from CKD patients (Zhuang nationality) who underwent unilateral total hip arthroplasty in the Department of Orthopaedics, People's Hospital of Guangxi Zhuang Autonomous Region from December 2012 to December 2019. The patients were divided into two groups: one was 28 cases using TXA, and the other, 25 cases without using TXA. Of all cases, 11 cases were osteoarthritis, 18 cases femoral neck fractures, 24 cases femoral head necrosis. TXA group used 28 hips, aged 52–70 (58.8 ± 8.4) years,10 males and 18 females, staging according to CKD: 7 cases in stage I, 11 cases in stage II, 4 cases in stage III, 6 cases in stage □ and 1 case in stage □. Non-TXA group used 25 hips, aged 43–67 (54.5 ± 7.2) years, 9 males and 16 females, staging according to CKD: 5 in stage □, 12 in stage □, and 5 in stage □, 3 cases of stage IV. There was no significant difference in gender, age, body mass index (BMI), operation time, and CKD stage between the two groups (P > 0.05), and they were comparable. (Tables 1 and 2)

Table 1
Comparison of preoperative general information with TXA group and non-TXA group

Group	Gender (case)		Age	BMI	Operation time (min)
	□	□			
TXA group (28 cases)	10	18	58.8 ± 8.4	21.30 ± 1.70	98.5 ± 19.4
Non-TXA group (25 cases))	9	16	54.5 ± 7.2	21.10 ± 1.50	90.8 ± 17.9
Stats	χ2 = 0.000		t=-1.9887	t = 0.483	t = 1.598
P value	P = 0.983		P = 0.052	P = 0.631	P = 0.116

Table 2
Rank sum test analysis of CKD stage in two groups of CKD patients

Stage	Number of people	
	TXA group (28 cases)	Non-TXA group (25 cases)
□□	7	5
□□	11	12
□□	4	5
□□	6	3
□□	1	0
Z value	-0.962	
Note: P(=0.336)>0.05		

Surgical Methods And Materials

Anesthesia was combined with spinal and epidural anesthesia or general anesthesia, and was completed by the same senior professional doctor. The lateral approach was used for small incision surgery, that is, the gluteus medius-latissimus fasciae muscle approach. Materials: cementless artificial hip joint (Duralock metal mortar, Corail stem) from Johnson & Johnson, DePuy, was used.

Txa Method

The method of using TXA : 30 minutes before surgery, 20 mg/kg TXA (Ruiyang Pharmaceutical Co, Ltd. 19011112) was diluted intravenously in 100 ml normal saline [2, 3]; 1 hour after the operation, 20 mg/kg TXA diluted in 100 ml normal saline was continued for Intravenous drip.

2.4 Postoperative management

After returning to the wards, patients were encouraged to perform functional exercises. Drainage tubes were removed 24 h-48 h after surgery, and deep vein thrombosis was prevented after extubation. During the perioperative period, the patients were received COX-2 sequential analgesia. Patients with CKD-□ were treated with hemodialysis within 24 hours after surgery.

Observational Index

Comparing two groups of CKD patients with preoperative and postoperative hemoglobin, blood loss during operation, postoperative drainage, changes in haemoglobin content after surgery, recessive blood loss.Comparing two groups of CKD patients with prothrombin time before and after operation, creatinine before and after operation, urea nitrogen before and after operation, the patient numbers of blood transfusions, and lower limbs vessels thrombus1 month after the operation.

Calculation of blood loss. The patient's blood volume (PBV) can be calculated using the formula of Nadler, Hidalgo and Bloch: [4]

PBV = kl x height (m)3 + k2 x weight (kg) + k3

where kl = 0.3669, k2 = 0.03219, k3 = 0.6041 for men;

kl = 0.3561, k2 = 0.03308, k3 = 0.1833 for women

Multiplying the PBV by the haematocrit will give the total red cell volume. Any change in red cell volume can therefore be calculated from the change in haematocrit4 Total red blood cell (RBC) volume loss = PBV x (Hct preop - Hct post-op) [5].

Statistical analysis

Data analysis used SPSS18.0 statistical software. The data obtained by the test was expressed as mean ± standard deviation. Grouped comparison used T-test. Count data used $\chi 2$ test. P value < 0.05 indicated statistical significance.

Results

Between the two groups of CKD patients, there was no statistically significant difference in preoperative hemoglobin ($p > 0.05$). There was a statistically significant difference in hemoglobin immediately after surgery and 24 hours after surgery ($p < 0.05$)(Tables 3). There were statistically significant differences in blood loss during operation, postoperative drainage, and recessive blood loss after operation between two groups of CKD patients ($p < 0.05$) (Tables 4). There were statistically significant differences in the patient number of postoperative blood transfusions between two groups of CKD patients ($p < 0.05$) (Table 5). Between the two groups of CKD patients, there were no significant differences in the prothrombin time before and after operation, creatinine before and after operation, and urea nitrogen before and after operation ($p > 0.05$) (Tables 6 and 7)

In the two groups of CKD patients, deep vein thrombosis in lower extremities was re-examined one month after the operation. All patients were found to have deep vein thrombosis. No complications or death was reported in the included patients.

Table 3

Preoperative and Postoperative hemoglobin (s) of two groups of CKD patients $(\bar{x} \pm s)$

Group	Preoperative hemoglobin(g/L)	Hemoglobin immediately after surgery (g/L)	Hemoglobin 24 hours after surgery (g/ L)
TXA group (28 cases)	103.3 ± 10.8	96.6 ± 5.3	92.3 ± 5.1
Non-TXA group (25 cases)	105.6 ± 8.7	91.2 ± 4.2	86.2 ± 3.8
T value	-0.8471	4.0768	4.8885
P value	0.4009	0.000	0.000

Table 4

Comparison of blood loss during operation between two groups of CKD patients $(\bar{x} \pm s)$

Group	Blood loss during operation (mL)	Postoperative drainage (mL)	Recessive blood loss(mL)
TXA group (28 cases)	433.9 ± 72.3	240.8 ± 65.7	261.8 ± 32.8
Non-TXA group (25 cases)	511.7 ± 85.7	320.2 ± 70.2	382.8 ± 59.5
T value	3.801	4.514	9.758
P value	0.000	0.000	0.000

Table 5
Comparison of the patient number of postoperative blood transfusions between two groups of CKD patients

Stage	Patient number of blood transfusions	
	TXA group (28 cases)	Non-TXA group (25 cases)
Blood Transfusion	4	10
No blood Transfusion	24	15
χ^2	4.493	
P value	0.034	

Table 6
Comparison of indexes of preoperative coagulation function and renal function between two groups of CKD patients $(\bar{x} \pm s)$

Group	Prothrombin time (s)	Creatinine (mmol/L)	Urea nitrogen(mmol/L)
TXA group (28 cases)	12.35 ± 2.64	325.5 ± 215.6	8.93 ± 1.85
Non-TXA group (25 cases)	13.74 ± 1.87	268.5 ± 176.9	8.48 ± 2.02
T value	-1.1849	1.0445	0.8465
P-value	0.2410	0.3010	0.2006

Table 7
Comparison of indexes of coagulation function 24 hours after operation and renal function between two groups of CKD patients $(\bar{x} \pm s)$

Group	Prothrombin time (s)	Creatinine (mmol/L)	Urea nitrogen(mmol/L)
TXA group (28 cases	12.62 ± 3.35	362.5 ± 251.3	10.46 ± 2.09
Non-TXA group (25 cases)	13.49 ± 4.42	306.7 ± 247.2	9.86 ± 2.67
Stats (t)	-0.8127	0.8132	0.9160
P-value	0.4200	0.4190	0.3642

Discussion

Despite advances in blood management strategies during THA, perioperative blood loss during THA remains a major problems[6], which includes the recessive blood loss caused by intraoperative blood loss and hemolysis[7, 8]. In 10–32% of THA, allogeneic blood transfusion (ABT) is required to help recover perioperative anemia, with concomitant risk of infection, immune response stimulation, transfusion-related acute lung injury (TRALI), and transfusion-related sepsis (TAS), Hemolytic transfusion reaction (HTR), prolonged hospital stay (LOS), and kidney injury[9, 10]. A large number of literature has demonstrated that TXA can improve coagulation, reduce blood loss and allogeneic transfusion[11, 12]; Therefore, it has become a common tool for blood management after primary THR. With the effectiveness in preventing the degradation of blood coagulation and its 90% renal clearance in 24 hours, TXA is the top-choice drug in surgeries [13] By blocking lysine-binding sites of plasminogen, TXA suppresses fibrinolysis, thus led to reduced proteolytic activity on the fibrin monomers and fibrinogen and reduced blood loss [14]. TXA's action mechanism is that it combines with plasminogen and prevents plasmin from degrading fibrin, without an increase of fibrin synthesis[4]. It can help reduce bleeding and blood loss caused by surgical trauma and tissue plasminogen activator release by reducing fibrinolysis [14] .The clinical application of TAX has a good effect: it can effectively control blood loss during surgery, alleviate the drop in postoperative hemoglobin, and reduce the need for blood transfusion[15, 16].

Chances are that CKD patients have poor surgical results[17] with the combination of their own medical problems[18, 19], including infections, blood transfusions, medical complications, re-admissions and death rate, and their own diseases which have been reported as an independent risk factor. Generally, with lower levels of hemoglobin and a higher risk of blood loss, CKD patients take a higher risk of transfusions[20]. However, for the blood management of perioperative period in the THA, it is not certain whether TXA is effective or not on renal impairment patients. Our research result reports that CKD patients have a great risk of blood loss and a high proportion of transfusions in THA, and that compared with non-TXA patients, TXA patients have more advantages in reducing intraoperative blood loss, postoperative drainage and recessive blood loss. Retrospectively analyzing 779 joint-replacement patients with CKD stage Ⅲ, Ⅳ, and Ⅴ, Deegan et al.[21] believed that chronic kidney disease patients with stage Ⅴ are more likely to undergo the postoperative death than those with stage I & II, and that there was no difference in other aspects.Literature shows that TAX at 20 mg/kg is effective and does not increase the risk of deep venous blood[2, 3]. According to the pharmacokinetic equation of TXA, the optimal plasma concentration of thromboxane is between 10–20 mg/ml[22]. In our study, the TAX dose was 20 mg /kg; the results reported effective, with no side effects of tranexamic acid and no changes in creatinine and urea nitrogen biochemical indicators. The exact role of TXA in uremia bleeding remains controversial. Galbusera et al.[23] believe that only in acute phase is intravenous TXA an option on hemodialysis patients, with a report of satisfactory result. TXA is an effective antifibrinolytic drug that is cleared by glomerular filtration; however, for the hemodialysis patients, TXA can not be ruled out and thus causes an increase of blood concentration. In the present study, there was only one patient with hemodialysis; the hemodialysis was performed on the first day after surgery. Therefore, there was no increase in blood concentration on him. The present study involves only one case of CKD patients with

stage V (the rest of cases with decompensated stage) —– such a small sample size of CKD patients with end stage is, unfortunately, the limitation of the present study.

In the Present study, the result reported that the risk of postoperative deep vein thrombosis for TXA group CDK patients was the same as that for non-TXA group ones, and that no case occurred. The result also reported that there was no case of pulmonary embolism in either group. There was also no significant change in the blood clotting function on CKD patients. We have a very reason to believe that it is safe to use TXA on CDK patients. Although some studies show that TXA increases the risk of thrombosis events, including deep vein thrombosis and pulmonary embolism, the incidence is low. Most studies exclude patients with a history of venous thromboembolism. Therefore, most of the available data may support TXA safety in healthy patients, rather than those at a higher risk for thromboembolic events. However, according to a recent retrospective study by Sabbag et al.[24], patients with a history of deep vein thrombosis (DVT) have a lower risk of recurring VTE after modern THA and TKA (2%). Besides, their research result also reports that intravenous TXA does not increase the transfusion rate. Miric Alexander et al.[25] found that there was no statistically significant differences in perioperative deep vein thrombosis and pulmonary embolism between patients with CKD and the ones without CKD .

Conclusions

For the Zhuang nationality people, the use of TXA on patients with CKD in the THA can reduce both dominant and recessive blood loss, and decrease the incidence of deep venous embolism in the lower extremitie.

Abbreviations

TXA
Tranexamic Acid; THA:total hip arthroplasty; CKD:chronic kidney disease; DVT:deep vein thrombosis

Declarations

Competing interests
The authors declare that they have no competing interests.
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Ethics approval and consent to participate

All procedures performed in this study were following the ethical standards of the people's hospital of guangxi zhuang autonomous region research committee and with the 1964 Helsinki Declaration and its later amendments or comparable ethical standards.

Consent for publication

All authors have seen the manuscript and approved it to submit to your journal.

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