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Study on Preventive Intervention of Peri-knee Ecchymosis After Total Knee Replacement

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Abstract: Objective: To investigate the effectiveness, controllability and safety of fresh plasma infusion in preventing ecchymosis after total knee arthroplasty (TKA). Methods: Patients with osteoarthritis of the knee who received the initial TKA were assigned to study group, control group, and blank control group according to APTT and PT results on the first day postoperatively. Patients in the study group received 400ml fresh frozen plasma infusion on the first day after TKA, and patients in the control group and blank control group received conventional postoperative treatment. The incidence of ecchymosis, the circumference of the affected limb and visual analog scale (VAS) were compared and analyzed in the three groups. Results: 20 patients were included into each group, respectively. After the infusion of fresh frozen plasma, the number of peri-knee ecchymosis in the study group was significantly less than that in the control group on the 7th and 14th days after the operation ($P<0.05$). On the 14th day after operation, the circumference of the affected limb in the study group was significantly lower than that in the control group ($P<0.05$), the circumference of the affected limb in the control group was higher than that in the blank control group, and the circumference of the affected limb in the study group was similar to that in the blank control group ($P>0.05$). On the 7th and 14th day after surgery, the pain degree of the three groups was relieved, and the VAS score of the study group and the blank control group showed no statistically significant difference ($P>0.05$), while the VAS score of the study group was lower than that of the control group, the difference was statistically significant ($P<0.05$). Conclusion: For patients with abnormal coagulation function after TKA, timely postoperative infusion of fresh frozen plasma can reduce the incidence of postoperative ecchymosis and relieve pain, which has certain clinical reference significance.

Keywords: Total Knee Arthroplasty, Ecchymosis, Plasma

1. Introduction

The formation of subcutaneous ecchymosis around the surgical area after total knee arthroplasty (TKA) can negatively affect clinical outcomes. In recent years, many research results show that some of the intra-operative and postoperative processing measures, directly or indirectly affect ecchymosis formation, including the use of intra-operative tourniquet [1, 2], postoperative continuous femoral nerve block and anticoagulation drugs [3], the placement way of drainage tube [4-7], the placement of limb position [8, 9], the use of different anticoagulant drugs, etc. [10]. Clinical practice observation found that the incidence of postoperative massive bleeding was rare after the application of the above scheme, but the incidence of subcutaneous ecchymosis and limb swelling was high within 2 weeks after the operation which might make patients anxious and led to a negative impact on the clinical results and greatly affected the early functional exercise of the patients' knees. However, these studies failed to reveal the cause of postoperative ecchymosis in essence. Therefore, only by identifying the cause of ecchymosis can the occurrence of ecchymosis be fundamentally reduced, to avoid future negative effects after TKA. In this study, by observing the changes of APTT, PT and

HCT in patients on the first day after TKA, appropriate intervention measures, such as infusion of fresh plasma to supplement coagulation factors, may be taken timely in patients with significantly longer APTT and PT and significantly less HCT than before surgery.

2. Data and Methods

2.1. Patients and Methods

Patients with knee osteoarthritis hospitalized in Guangzhou Hospital of Integrated Traditional Chinese and Western Medicine and the First Affiliated Hospital of Jinan University from July 2020 to February 2020 were selected. All patients underwent primary knee joint replacement. TKA is recommended only in patients with severe joint instability, pain, deformity, and dysfunction caused by osteoarthritis, strictly following the surgical indications. Coagulation function and blood routine in all patients were measured pre-operation and on the first day after TKA.

2.2. Inclusion and Exclusion Criteria

Inclusion criteria: (1) Patients diagnosed with knee osteoarthritis were referred to the 2018 edition of the Osteoarthritis Diagnosis and Treatment Guidelines of the Chinese Society of Orthopedics [11].

Exclusion criteria:

(1) patients with a history of hemorrhagic disease or preoperative blood coagulation test showing bleeding tendency;

(2) Previous history of venous thromboembolism;

(3) Combination of other drugs that may affect the results of the study.

This study has been reviewed and approved by the Ethics Committee of Guangzhou Hospital of Integrated Traditional Chinese and Western Medicine and the First Affiliated Hospital of Jinan University, and patients signed relevant informed consent before inclusion.

2.3. Methods

Drainage tubes were placed in all patients after surgery, and the tubes were removed within 24-48 hours postoperative. No temporary tube clamped. Cefazoline was routinely given for prevention of infection and parecoxib sodium for analgesia 3 days after operation. After surgery, elastic socks were routinely worn. Rivaroxaban 10mg/ time was given 12-24 hours after surgery, once per day, ankle pump exercise was performed on the first day after surgery, and walking exercise was performed with the aid of walking AIDS and other measures to prevent deep vein thrombosis.

Patients with APTT longer than 10s, PT longer than 2s on the first day after surgery, and HCT difference between preoperative and postoperative values greater than 8 were included in the study group, which was injected with 400ml fresh frozen plasma on the first day after surgery. The patients without plasma transfusion were the control group. The patients with APTT length ≤10s, PT≤2s and HCT difference ≤8 on the first day after surgery were the blank control group.

2.4. Observation Target

The incidence of ecchymosis around the operative field in three groups after TKA was calculated. The incidence of ecchymosis around the operative field in the 3 groups on the 1st, 7th and 14th day after surgery were respectively counted. The circumference of 10cm on the knee of the affected limb was measured preoperatively and postoperatively. The visual analogue scale (VAS) were compared. All outcomses were compared on the 1^{st}, 7^{th}, 14^{th} days postoperatively.

2.5. Statistical Analysis

Statistical analysis SPSS20.0 statistical software was used for statistical analysis. The measurement data of normal distribution were expressed as mean±standard deviation, and analysis of variance was used for comparison between groups. Enumeration data were expressed by rate, and comparison between groups was performed by chi-square test. $P<0.05$ was considered to be statistically significant.

3. Results

3.1. Preoperative General Data of Three Groups of Patients

A total of 60 patients were enrolled, including 20 in the study group, 20 in the control group and 20 in the blank control group. There were 9 males and 11 females, with an average age of (67.5±4.85) years and a BMI of (26.4±2.41) kg/m^2. In the control group, there were 8 males and 12 females, with an average age of (68.1±4.13) years and a BMI of (27.4±2.87) kg/m^2. In blank control group, there were 10 males and 10 females, with an average age of (66.1±3.91) years old and a BMI of (26.5±2.43) kg/m^2. There was no statistical significance in the general information of the three groups (P>0.05), as shown in Table 1. There were no statistically significant differences in preoperative gender, age, BMI, diabetes or hypertension among the three groups (Table 1).

Table 1. *Preoperative general data of three groups of patients.*

Group	Number	Male/Female	Age (Year)	BMI (kg/m^2)	Complicated with diabetes mellitus (N)	Complicated with hypertension (N)
Study group	20	9/11	67.5±4.85	26.4±2.41	4	5
Control Group	20	8/12	68.1±4.13	27.4±2.87	3	6
Blank Control Group	20	10/10	66.1±3.91	26.5±2.43	4	6
χ^2/F	5.542	0.836	2.014	0.457	0.254	0.234
P	0.756	0.6187	0.125	0.685	0.697	0.653

3.2. The Incidence of Ecchymosis Aroundthe Operative Field in the Three Groups After Operation

After plasma infusion, the number of patients in the study group who developed ecchymosis around the operative field on the 1st, 7th and 14th days after the operation was 8, 9 and 9, respectively, and the incidence was 40, 45 and 45%. In the control group, the number of patients with ecchymosis around the operative field on day 1, 7 and 14 was 14, 16 and 16, respectively, and the incidence rate was 70, 80 and 80%. In the blank control group, 2, 3 and 3 patients developed ecchymosis around the operative field at day 1, 7 and 14, respectively, with an incidence rate of 10, 15 and 15%. There was statistical significance in the incidence of ecchymosis among the three groups (P<0.05). The incidence of ecchymosis around the operative field in the study group was lower than that in the control group on the 1st, 7th and 14th days after operation, and the difference was statistically significant (P<0.05) (shown as table 2).

Table 2. *The incidence of ecchymosis around the operative field in the three groups after operation (%).*

Group	Postoperative Day 1	Postoperative Day 7	Postoperative Day 14
Study group	8 (40)	9 (45)*	9 (45)*
Control Group	14 (70)	16 (80)	16 (80)
Blank Control Group	2 (10)	3 (15)	3 (15)
P	0.031	0.015	0.015

*Compared with Control group, the difference was statistically significant (*P*<0.05)

3.3. Comparison of Perioperative and Postoperative Knee Diameter in Three Groups

On the first day after operation, the affected limbs of the three groups all had swelling of different degrees, and there was no significant difference in the swelling degree of the affected knee among the three groups (P>0.05). On the 7th and 14th day after surgery, the knee circumference of the study group was significantly smaller than that of the control group, with statistical significance (P<0.05). On the 14th day after surgery, the knee circumference of the study group was similar to that of the blank control group, and the difference was not statistically significant (P>0.05) (Table 3).

Table 3. *Comparison of perioperative and postoperative knee diameter in three groups (cm).*

Group	Postoperative Day 1	Postoperative Day 7	Postoperative Day 14
Study group	46.68±2.34	50.59±3.19*	47.10±2.04*
Control Group	46.59±2.19	52.65±3.08	49.28±2.38
Blank Control Group	46.41±2.27	49.73±3.29	47.08±2.23
F	1.146	1.452	2.317
P	0.708	0.041	0.021

* Compared with Control group, the difference was statistically significant (*P*<0.05)

3.4. Comparison of Postoperative VAS Scale Scores in Three Groups

There was no significant difference in the VAS scores among the three groups on the first day after surgery (P>0.05), but the VAS scores of the research group were lower than that of the control group on the 7th and 14th days after surgery, and the difference was statistically significant (P<0.05) (Table 4).

Table 4. *Comparison of postoperative VAS scale scores in three groups.*

Group	Postoperative Day 1	Postoperative Day 7	Postoperative Day 14
Study group	7.55±1.58	4.65±1.35*	2.82±0.84*
Control Group	7.45±1.61	5.97±1.29	3.17±0.89
Blank Control Group	7.41±1.56	4.63±1.18	2.67±0.81
F	-0.881	4.245	2.862
P	0.859	0.005	0.001

* Compared with Control group, the difference was statistically significant (*P*<0.05)

4. Discussion

TKA is a mature and effective technique for the treatment of end-stage knee joint diseases. With the re-recognition of happiness index, the "survival with pain" or even "abnormal life" of knee joint is gradually withdrawing from the stage of human history. The aging process has further intensified the growth of TKA in the future inevitably following with various complications. The patients after TKA are often in the state of high viscosity, high thickening and high coagulation, which maybe easily lead to thrombosis. If there is no corresponding drug or physical means and other preventive measures, the overall incidence of venous thromboembolism (VTE) will reach 40~80%. The mortality rate of symptomatic pulmonary

embolism reaches 2% [12, 13]. So in 2013, the American College of Orthopaedic Surgeons (AAOS) and the American College of Chest Physicians (ACCP) jointly developed evidence-based guidelines for the prevention of VTE after joint replacement, recommending that one of the following protocols be routinely used for prevention within 14 days after joint replacement. The guideline includes warfarin, low molecular weight heparin, aspirin, rivaroxaban or portable mechanical pressurizing devices, but attention should be paid to monitoring bleeding tendency and bleeding indicators [12]. Clinical practice observation found that the incidence of postoperative massive bleeding was rare after the application of the above scheme, but the incidence of subcutaneous ecchymosis and limb swelling of the operative limb was relatively high within 2 weeks after the operation. At this time, patients would have worries and anxiety, which had a negative impact on the clinical results and greatly affected the early functional exercise of patients' knee joint [14, 15]. Therefore, studying the root cause of ecchymosis formation in patients after TKA and taking targeted measures to prevent ecchymosis as early as possible are the most urgent and cutting-edge research topics in the field of complications after TKA.

Both intra-operative and postoperative operations of TKA may affect the occurrence of postoperative ecchymosis, but most of the factors analyzed are controversial. How to predict the occurrence of ecchymosis essentially and take effective measures to avoid the occurrence of ecchymosis remains to be further studied. Some studies have suggested that postoperative blood transfusion greater than 400ml and clamping of drainage tube within 4 hours after surgery are independent risk factors for postoperative ecchymosis formation [15]. After clamping tube, although by increasing the joint on the surface of the cavity pressure reducing incision oozing, but limited to inhibit the action of the deep wound ooze blood, for example in the medullary cavity and ooze blood around the prosthesis, will lead to the recessive bleeding and hematoma formation, when the stress reaches a certain degree, gore will fascia around the periphery of the knee joint and muscle clearance penetration, the formation of subcutaneous ecchymosis [16].

In 2016, Malone et al. [17] studied the etiology of deep vein thrombosis and confirmed that changes in the coagulation system and hemorheological state played an important role in the process of deep vein thrombosis. Therefore, it is of great clinical application value to study the changes of postoperative coagulation system and hemorheological function in patients with TKA and take appropriate measures as soon as possible to prevent and reduce the occurrence of postoperative VTE and reduce the occurrence of subcutaneous ecchymosis. In this study, APTT and PT were used as research cut-off points, and the probability of postoperative ecchymosis in patients with prolonged APTT and PT was higher than that in those without prolonged PT, suggesting that prolonged APTT and PT could be used as predictive tools for postoperative ecchymosis. APTT is the most reliable, commonly used and sensitive screening test for endogenous coagulation factor deficiency. Although there is a tourniquet in TKA, the blood loss in the medullary cavity and extensive bleeding on the soft tissue wound after osteotomy, especially the lack of ligation and hemostasis of the inferior blood vessels outside the knee, will inevitably lead to increased postoperative hidden blood loss and loss of endogenous coagulation factors [17]. However, anesthesiologists pay more attention to the supplement of red blood cells to correct the intraoperative blood loss and carry out adequate volume enlargement, but often ignore the supplement of fresh plasma to improve the loss of endogenous coagulation factors, so that the extension of APTT on the first day after the operation is more than 10s than that before the operation, inducing bleeding tendency.

The results of this study showed that for TKA patients with prolonged APTT and PT on the first day after TKA, timely fresh frozen plasma can be supplemented with rich endogenous coagulation factors, improve endogenous coagulation pathway, and thus achieve hemostasis and reduce the occurrence of ecchymosis. It can reduce the occurrence of ecchymosis, relieve the pain degree of patients, and improve the functional recovery of patients' knee joint to a certain extent.

5. Conclusion

The loss of endogenous coagulation factor after TKA is one of the main causes of ecchymosis. The loss of endogenous coagulation factor and even the decrease of concentration are the main factors of operation, blood loss and even dilatation during the operation. Many of these factors cannot be effectively controlled intraoperatively, but they can be remedied by postoperative interventions, such as endogenous clotting factor supplementation. However, the feasibility of such measures and the reliability of the early warning effect of related indicators still need to be further verified and discussed by increasing the sample size and extending the study time, which will provide theoretical basis and practical data for the effective prevention of ecchymosis.

Conflict of Interest

All the authors do not have any possible conflicts of interest.

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References

[1] Li B, Wang G, Wang Y, et al. Effect of Two Limb Positions on Venous Hemodynamics and Hidden Blood Loss following Total Knee Arthroplasty [J]. J Knee Surg, 2017, 30 (01): 70-74.

[2] Fan Y, Liu Y, Lin J, et al. Drainage does not promote post-operative rehabilitation after bilateral total knee arthroplasties compared with nondrainage. Chin Med Sci J. 2013; 28 (4): 206-10.

[3] Idestrup C, Sawhney M, Nix C, et al. The incidence of hematoma formation in patients with continuous femoral catheters following total knee arthroplasty while receiving rivaroxaban as thromboprophylaxis: an observational study. RegAnesth Pain Med. 2014; 39 (5): 414-7.

[4] Gylvin S H, Fink-Jensen A, Johansson P I, et al. Psychopharmacologic treatment and blood transfusion in fast-track total hip and knee arthroplasty [J]. Transfusion, 2017, 57 (4): 971-976.

[5] Zhang S, Xu B, Huang Q, et al. Early Removal of Drainage Tube after Fast-Track Primary Total Knee Arthroplasty. [J]. J Knee Surg, 2017, 30 (06): 571-576.

[6] Yin D, Delisle J, Banica A, et al. Tourniquet and closed-suction drains in total knee arthroplasty. No beneficial effects on bleeding management and knee function at a higher cost [J]. Orthopaedics& Traumatology Surgery & Research, 2017, 103 (4): 583.

[7] Erne F, Wetzel S, Wülker N, et al. Closed Suction Drainage after Primary Total Knee Arthroplasty: A Prospective Randomized Trial. [J]. Journal of Knee Surgery, J Knee Surg 2018; 31 (08): 804-810.

[8] Wu Y, Yang T, Zeng Y, et al. Effect of different postoperative limb positions on blood loss and range of motion in total knee arthroplasty: An updated meta-analysis of randomized controlled trials [J]. International Journal of Surgery, 2017, 37: 15-23.

[9] Yuangang Wu, Yi Zeng, Canfeng Li, et al. The effect of post-operative limb positioning on blood loss and early outcomes after primary total knee arthroplasty: a randomized controlled trial [J]. Int Orthop, 2019, 43 (9): 2083-2091.

[10] Zou Y, Tian S, Wang Y, et al. Administering aspirin, rivaroxaban and low-molecular-weight heparin to prevent deep venous thrombosis after total knee arthroplasty. Blood Coagul Fibrinolysis. 2014; 25 (7): 660-4.

[11] Guidelines for the diagnosis and treatment of osteoarthritis in China (2018 edition) [J]. Chinese Journal of Orthopaedics, 2018, 38 (12): 705-715.

[12] Lieberman JR, Pensak MJ. Prevention of venous thromboembolic disease after total hip and knee arthroplasty. J Bone Joint Surg Am. 2013; 95 (19): 1801-1811.

[13] He ML, Xiao ZM, Lei M, et al. Continuous passive motion for preventing venous thromboembolism after total knee arthroplasty. Cochrane Database Syst Rev. 2014, 7: CD008207.

[14] Hong K H, Pan J K, Pan B Q, et al. Comparison between autologous blood transfusion drainage and closed-suction drainage / no drainage in total knee arthroplasty: a Meta-analysis [J]. Bmc Musculoskeletal Disorders, 2016, 17 (1): 142.

[15] Wang D, Xu J, Zeng W N, et al. Closed Suction Drainage Is Not Associated with Faster Recovery after Total Knee Arthroplasty: A Prospective Randomized Controlled Study of 80 Patients.[J]. Orthopaedic Surgery, 2016, 8 (2): 226-233.

[16] Leung P, Kudrna J C. Growth of an intrapelvicpseudotumor associated with a metal-on-metal total hip arthroplasty after revision arthroplasty causing a femoral nerve neuropathy [J]. Arthroplasty Today, 2016, 2 (3): 105-109.

[17] Malone P C, Agutter P S. Deep venous thrombosis: The valve cusp hypoxia thesis and its incompatibility with modern orthodoxy [J]. Medical Hypotheses, 2016, 86: 60-66.