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Clinical application of auricular point sticking in perioperative hemostasis for elderly patients with intertrochanteric fractures of the femur

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Abstract

We investigated the clinical application of auricular point sticking (APS) combined with tranexamic acid in perioperative hemostasis in elderly patients with intertrochanteric fractures of the femur.

This is a prospective cohort study, and we analyzed 86 elderly patients with intertrochanteric fractures of the femur who underwent closed reduction and internal fixation with proximal femoral nail antirotation (PFNA) between January 2016 and December 2016. The patients were divided into auricular point combined with tranexamic acid group (APS group, n = 43) and tranexamic acid alone group (Control group, n = 43). APS was performed for patients using *Vaccaria* seeds 1 to 2 days before the operation. The 4 acupoints of hemostasis, including spleen, diaphragm, pituitary, and adrenal gland, as well as acupoint of hip joint, were selected. Routine treatment was performed using tranexamic acid alone in the control group. Blood transfusion, intraoperative, postoperative, and total blood loss were compared between the 2 groups.

This study enrolled 36 males and 50 females aged 71 to 93 years (average age: 78.5 years). There were no significant differences in gender, age, height, weight, preoperative hematocrit level, fracture classification, operative time, and hospitalization stay ($P > .05$). Total blood loss was lower in the APS group than the control group (244.26, 197.87–258.50 ml vs 533.94, 424.00–598.09 ml, $P < .01$). The blood transfusion rate was 14.0% in the APS group and 34.9% in the control group ($P = .02$).

APS can reduce perioperative bleeding and decrease the need for blood transfusion in elderly patients with intertrochanteric fractures of the femur. This noninvasive method can be applied clinically. Randomized trials may be needed to confirm the findings.

Abbreviations: APS = auricular point sticking, DHS = dynamic hip screw, DVT = deep venous thrombosis, PBV = patlak blood volume, PFNA = proximal femoral nail antirotation.

Keywords: auricular point sticking, hemostasis, intertrochanteric fractures of the femur, operation, tranexamic acid

1. Introduction

Intertrochanteric fracture of the femur is associated with the osteoporosis in the elderly, and its incidence rate is increasing every year.[1,2] Based on the nature of the fracture and age of the patient, many treatment options have been recommended for trochanteric fractures, including proximal femoral nail antirotation (PFNA) and dynamic hip screw (DHS).[3] However, PFNA has less operative time, intraoperative blood loss, firm fixation, and length of incision than DHS.[4] Thus, most elderly patients are clinically tolerant to this surgery. Preoperative preparation is critical as most elderly suffer from several diseases and thus, preoperative preparation can effectively reduce the surgical risks.[5] Surgical treatment achieves firm and stable internal fixation for the fracture, early functional training, and reduces complications due to long-term bed rest. Patients older than 70 years usually suffer from osteoporosis, poor compensation capacity, along with skin, subcutaneous, and muscular atrophies, which leads to occult hemorrhage during and after the operation, resulting in massive blood transfusion for the patients.[6,7] Our experiences showed that perioperative hemorrhage was large for elderly patients with intertrochanteric fractures of the femur undergoing internal fixation with PFNA, and the patients often suffered from anemia and required transfusion therapy. Most elderly patients were also associated with cardiopulmonary insufficiency. Blood transfusion increases the hospitalization cost and the volume of infusion which further burdens the heart load of the patients, induces complications, such as heart failure and pulmonary edema, and even threatens the lives of the patients. Therefore, orthopedic doctors try to reduce perioperative hemorrhage and blood transfusion for elderly patients with intertrochanteric fractures of the femur.

Tranexamic acid has been shown to play a hemostatic effect by preventing plasmin to degrade fibrin.[8,9] Studies have further employed this homeostatic nature of tranexamic acid to reduce blood loss and transfusion rates in patients with intertrochanteric fracture undergoing PFNA.[10–13]

In traditional Chinese medicine, "ear is the center of various meridians", closely associated with visceral meridians and collaterals of the whole body. Similarly, the viscera, limbs, and all the bones of the human body have corresponding auricular

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points. Therefore, lesions in some parts of the human body can be transmitted to their corresponding auricular points by the meridians. There are several explanations on the mechanism of auricular acupuncture based on bioelectric theory, biological control therapy, biological holographic theory, gate control theory, immunologic theory, and delta reflex theory.[14] Currently, auricular point therapy has been clinically applied as an analgesic and to treat diseases in the nervous system, digestive system, and endocrine system.[12,13] The analgesic effect of auricular points was confirmed in preemptive analgesia in total hip arthroplasty by Binbin[15] and in perioperative analgesia of knee fracture by Yang Liming et al.[16] Studies have shown that auricular points can effectively reduce vaginal bleeding after medical abortion,[17] and they have a good therapeutic effect in treating mucosal erosive epistaxis.[18] Although it has been suggested that the combined application of the articular points and tranexamic acid may achieve synergistic hemostasis, but there have been no reports to prove the same. We performed a prospective cohort study to investigate the effect of auricular point sticking (APS) in combination with tranexamic acid to reduce the perioperative blood loss for elderly patients with intertrochanteric fracture of femur who underwent closed reduction and internal fixation with PFNA. We propose that this method could provide a new treatment strategy for reducing perioperative blood loss in clinical applications.

2. Methods

2.1. Patients

The study was approved by the local Medical Ethics Committee, which enrolled patients treated in No. 1 Department of Orthopedic Surgery of Tianjin Baodi Hospital between January 2016 and December 2016. All patients signed the informed consent.

Inclusion criteria were the following:

(1) elderly patients older than 70 years with intertrochanteric fractures of the femur alone, whose AO classification was 31 A1–A3 type;
(2) patients who underwent unilateral closed reduction and internal fixation with PFNA;
(3) patients with normal blood coagulation;
(4) patients without severe heart, lung, liver, and kidney dysfunctions;
(5) patients without the history of gastrointestinal ulcer, bleeding, and coagulation disorders;
(6) patients without a previous history of deep venous thrombosis (DVT).

Exclusion criteria were the following:

(1) patients with contraindication of tranexamic acid;
(2) patients with DVT or pulmonary embolism;
(3) patients who cannot tolerate APS.

With informed consent, they were divided into auricular and the control groups based on their own choice. Each group consecutively enrolled 43 cases similar to the sampling method employed in a previous study.[19,20]

2.2. Surgical method

Closed reduction and internal fixation with PFNA (Suzhou Kangli Orthopedics Instrument Co. Ltd., China) was performed for all patients under spinal anesthesia or general anesthesia. The surgery was performed by one team of physicians (2 deputy chief physicians and 1 chief physician).

2.3. Perioperative hemostasis

Routine treatment with tranexamic acid (Guangxi Wuzhou Pharmaceutical Group Co., Ltd.) alone was performed for patients in the control group. Hemostasis was performed by intravenous infusion of tranexamic acid (2 g) for both the groups.

2.4. APS group

The auricular points were pressed with the seeds of *Vaccaria* (Fig. 1A) in the APS group patients from 1 to 2 days before the operation until the third day after the operation. The selected auricular points included the hemostatic acupuncture points of the spleen, diaphragm, pituitary, adrenal gland, and hip joint (Fig. 1B). The same physician performed APS, and family members of the patient conducted the pressing. Family members of the patients were formally trained by the physicians. The auricular points were pressed every 2 hours before and after the operation (except for sleep time at night). Each auricular point was pressed for 3 to 5 minutes each time until it started aching.

2.5. Transfusion standards

It was recommended to transfuse erythrocytes if Hb <70 g/L and (or) Hct <0.21 to maintain Hb at 70 to 90 g/L, or Hct at 0.21 to 0.27 (1C). For post-resuscitated trauma patients, whether erythrocytes were transfused depended on the degree of anemia, cardiopulmonary compensatory function, the presence of an increase in metabolic rate and age when Hb was 70 to 100 g/L and (or) Hct was 0.21 to 0.30 (1B).[21]

2.6. Outcome measures

Intraoperative and postoperative total blood loss along with blood transfusion was observed. We measured the total blood loss as:

$$\text{Total blood loss} = \text{Patlak blood volume of the patients (PBV)} \times (\text{preoperative Hct} - \text{postoperative Hct}).$$

$$\text{Male PBV} = 0.3669 \times \text{height}\,(\text{m}^3) + 0.03219 \times \text{body mass}\,(\text{kg}) + 0.6041.$$

$$\text{Female PBV} = 0.3561 \times \text{height}\,(\text{m}^3) + 0.03308 \times \text{body mass}\,(\text{kg}) + 0.183322.$$

2.7. Complications

Wound healing and the presence of lower extremity DVT were observed for the 2 groups of patients.

2.8. Statistical analysis

Statistical analysis was performed by SPSS 16.0 software (SPSS Inc., Chicago, IL). Continuous data which satisfied normal distribution were represented by mean ± standard deviation ($x \pm s$), and t test was applied for normal distribution. Continuous

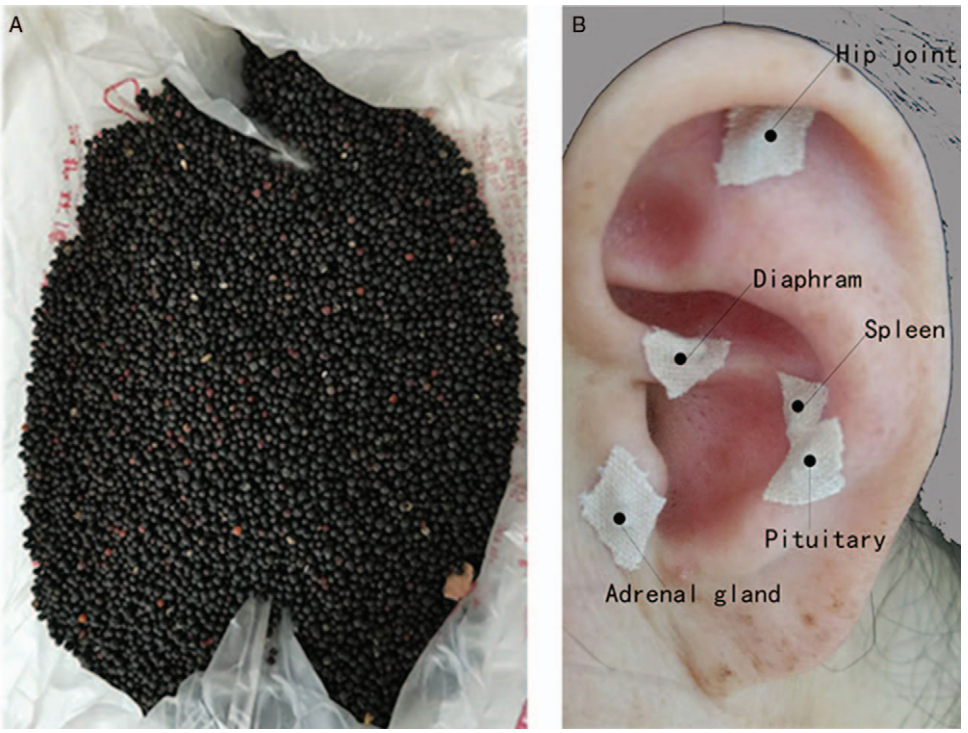

Figure 1. A: the *Vaccaria* seeds; B: the auricular points of spleen, diaphragm, pituitary, adrenal gland, and hip joint which were pressed using the seeds during the study.

data that did not meet normal distribution were expressed as the median and quartile. The groups were compared using the Wilcoxon Mann–Whitney rank test for 2 samples. Categorical data were represented by percentage (%), and group-wise comparison was performed using the χ^2 test. Ranked data between groups were compared by rank-sum test. $P < .05$ was considered to be statistically significant.

3. Results

A total of 86 elderly hospitalized patients, including 36 males and 50 females with intertrochanteric fractures of the femur undergoing closed reduction and internal fixation with PFNA were enrolled in this study. The age of the patients ranged from 71 to 93 with an average age of 78.5 years. There were no significant differences in gender, age, height, weight, preoperative hematocrit (Hct), fracture classification (AO 31 A1–A3), operative time, and hospitalization stay between the control and APS groups ($P > .05$, Table 1).

3.1. Intraoperative and postoperative total blood loss was reduced in the auricular point group

Results showed that the intraoperative and postoperative total blood loss together with blood transfusion were significantly different between the control and auricular point group ($P < .05$). Total blood loss was 244.26 ml (197.87, 258.50) in the APS group and 533.94 ml (424.00, 598.09) in the control group ($P < .01$). The blood transfusion rate was 14.0% in the APS group and 34.9% in the control group ($P = .02$). The APS group

Table 1

Baseline characteristics of the control and auricular point groups.

	APS Group	Control Group	*P* value
	n = 43	n = 43	
Female, n (%)	19 (44.2)	17 (39.5)	.66
Age (years)	79.81 ± 4.79	78.72 ± 4.27	.27
Height, median (range)	1.63 (1.60,1.74)	1.62 (1.60,1.75)	.69
Weight, mean ± SD	70.37 ± 7.77	70.86 ± 6.70	.76
Side (right/left)	20/23	18/25	.66
Preop. hematocrit level (%), mean±SD	0.35 ± 0.18	0.35 ± 0.23	.12
AO fracture classification, n (%)			.90
31 A1	17 (39.5)	16 (37.2)	
31 A2	15 (34.9)	17 (39.5)	
31 A3	11 (25.6)	10 (23.3)	

Table 2

Comparisons of outcomes between 2 groups.

	APS Group	Control Group	*P* value
	n = 43	n = 43	
Total blood loss, median (range)	244.26 (197.87,258.50)	533.94 (424.00,598.09)	<.01
Blood transfusion, n (%)			.02
0 ml	37 (86.04)	28 (65.11)	
400 ml	1 (2.32)	1 (2.32)	
600 ml	4 (9.30)	8 (18.60)	
800 ml	1 (2.32)	6 (13.95)	
Transfusion rate, n (%)	6 (14.0)	15 (34.9)	.02
Operative time (min, mean ± SD)	52.79 ± 7.74	53.02 ± 7.80	.89
Hospitalization stay (days, mean ± SD)	8.07 ± 1.08	8.25 ± 1.03	.42

required lower volumes of blood transfusion where 2.3% of patients required 400 ml of transfusion and 86.04% of patients required no blood transfusion. In the APS group, 14% of patients required 400 ml of transfusion and the 65% of patients required no transfusion (Table 2).

3.2. Complications

Poor wound healing was not observed during follow up for the 2 groups, and no DVT complications were observed during the venous ultrasound of the lower extremities.

4. Discussion

Closed reduction and internal fixation with PFNA is a standard surgery to treat elderly patients with intertrochanteric fractures of the femur. However, a great amount of occult hemorrhage often occurs during and after the operation. To reduce the hemorrhage, we performed perioperative hemostasis using APS in combination with tranexamic acid which led to significantly reduced perioperative blood loss and lower blood transfusion rates compared with the control. However, comparative analyses with previous similar studies are further needed, as well as randomized clinical trials to eventually confirm the findings.

Numerous clinical studies have confirmed the diagnostic and treatment effects of auricular points, including analgesia, endocrine regulation, immunological regulation, neuromodulation, and blood viscosity regulation.[14–17,22–24] The mechanism of APS to regulate hemostasis is not yet clear. Huang Lichun performed several electrical measurements for the auricle, and revealed that resistance values of the lesions-related auricular points decreased about 10 to 15 times when diseases occurred in the human body, visceral tissues, and organs.[25] Furthermore, disease-related auricular points with good conduction were significantly different compared with normal parts.[26] In addition, the 4 hemostatic auricular points have been proposed, including the hemostatic effects of the spleen, diaphragm, pituitary, adrenal gland. And the auricular point of the hip joint was selected based on bleeding sites.[25,26]

From the perspective of modern anatomy, the auricle is rich in nerves and blood vessels.[27] Many auricular points are named based on modern medical theories, such as sympathetic acupoint, subcortical acupoint, acupoint of the adrenal gland, and endocrine acupoint. The acupoint of the adrenal gland is named due to its regulation of adrenal gland.[28] Thus, there is a need to understand the auricular points based on their functions and applications in modern medicine.

The study had a small sample size. Moreover, it was non-randomized, single-center study, and we could not perform it blind due to the nature of the intervention.

In this study, APS provided better hemostatic effect by reducing perioperative hemorrhage and blood transfusion during PFNA for elderly patients with intertrochanteric fractures of the femur compared with the control group. Additionally, the simple and noninvasive procedure is worthy of clinical application. Randomized trials may be needed to confirm the findings.

Author contributions

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