Effect of safflower yellow pigment sodium chloride injection on hemorheology and blood coagulation function in patients with hip replacement surgery

Zhi Wang¹, Wei-Xin Yang²*, Xiu-Hua Zhang¹, Xian Jiang¹

¹Department of Rehabilitation, Wuxi Tongren International Rehabilitation Hospital, Jiangsu, Wuxi 214151, China
²Department of Rehabilitation, The First Affiliated Hospital of Soochow University, Jiangsu, Suzhou 215000, China


Objective: To investigate the effect of safflower yellow pigment sodium chloride injection on hemorheology and coagulation function in patients with hip replacement surgery.

Methods: A total of 80 cases of hip joint replacement were divided into two groups according to the random number table method, 40 cases in each group. Patients in two groups were conducted with regular hip replacement, postoperative conventional symptomatic treatment. Based on it, patients of the observation group started to get the safflower yellow pigment and sodium chloride injection in the first week after operation, intravenous injection. A total of 3 weeks of treatment. blood rheological index were compared including plasma viscosity, whole blood viscosity at high shear, low shear whole blood viscosity, red blood cell hematocrit and blood coagulation indexes: prothrombin time (PT), activation activated partial thromboplastin time (APTT), thrombin time (TT), D-Dimer (D-D), fibrinogen (FIB) between the two groups postoperative 1 week, postoperative 2 weeks and postoperative 4 weeks.

Results: The plasma viscosity, high shear viscosity of whole blood, low shear viscosity of whole blood, D-D in control group postoperative 2 week and 4 week were significantly higher than that of preoperative 1 week; while red blood cell volume, PT, APTT, TT, Fib were significantly lower than preoperative 1 week (P<0.05); The hemorheology indexes after surgery in observation group remained stable, and the difference was not statistical significant compared with the preoperative 1 week (P>0.05). The PT, APTT in observation group postoperative 2 week and 4 week were significantly increased compared with preoperative 1 week, and the TT in observation group postoperative 4 week was significantly increased compared with preoperative 1 week (P<0.05); The plasma viscosity, high shear viscosity of whole blood, low shear viscosity of whole blood, D-D in control group postoperative 2 week and 4 week were significantly lower, while the PT, APTT, TT, Fib in observation group were significantly higher than that in control group in the same time point (P<0.05). Conclusions: Hip replacement will cause the change of blood rheology in patients. Blood is in high coagulation state. The safflower yellow pigment and sodium chloride injection can maintain blood rheology stable, and improve the function of blood coagulation.

1. Introduction

As hip arthroplasty operation technology is gradually skilled, hip arthroplasty artificial joint prosthesis materials and production technology has constantly improved and updated, hip arthroplasty has become the effective method in the treatment of femoral head ischemic necrosis, femoral neck fracture and many other hip diseases[1-3]. However, with the popularity of the operation, an increasing number of patients postoperative suffer with deep vein thrombosis (DVT) of the lower extremity. Study suggests that DVT formation may be related to the change of postoperative hemorheological state and the blood in hypercoagulable state[4-6]. Safflower yellow pigment, the main component of Safflower...
yellow pigment sodium chloride injection, has an effect on reducing reperfusion injury and relieving inflammation[7-10]. This study discussed the effect of safflower yellow pigment sodium chloride injection on hemorheology and coagulation function in patients with hip replacement surgery.

2. Materials and methods

2.1. Clinical data

A total of 80 patients with hip joint replacement operation in hospital from January 2013 to November 2015 were selected, all patients were in accordance with the following inclusion criteria: ① They were diagnosed by medical imaging examination combined with clinical symptoms, and met the indications for hip replacement surgery, intending to be treated with hip replacement; ② They should be no younger than 40 year-old, American Society of anesthesiologists (ASA) grade I-II; ③ Their heart, kidney, liver, lung and other organs function well; ④ With no anticoagulant drugs and other analgesics, promoting blood circulation drugs postoperative 1 week; ⑤ Excluding those with hematological diseases; ⑥ Excluding those with coagulation function disorder; ⑦ Excluding patients with hip joint infections and severe osteoporosis. According to the random number table method, the patients were divided into two groups, 40 cases in the observation group, including 25 male and 15 female patients; old age 42-79, average age (60.46±18.81) year-old; body mass index (BMI) 18.20-31.13 kg/m², mean BMI (24.23±6.73) kg/m²; disease types, 22 cases of osteoarthritis of the hip joint, 18 cases of avascular necrosis of the femoral head; all for single hip. 40 cases in the control group, the male 23, female 17; age 44-77, average age (59.17±18.60) year-old; body mass index (BMI) 18.20-31.13 kg/m², mean BMI (24.23±6.73) kg/m²; disease types, 24 cases of osteoarthritis of the hip joint, 16 cases of avascular necrosis of the femoral head; all for single hip. General information of the two groups were comparable.

2.2. Treatment methods

Patients in both groups were conducted regular hip replacement surgery, without pneumatic using tourniquet or blood transfusion. Conventional anti infection, rehydration, examination of the liver and kidney function, articular cavity drainage, low molecular weight heparin anticoagulation and early rehabilitation exercise postoperative was done. Based on it, patients of the observation group started to get the safflower yellow pigment and sodium chloride injection in the first week after operation, 1 times a day, one bottle each time (100 mL., containing containing safflower yellow 80 mg) intravenous injection. A total of 3 weeks of treatment was a course.

2.3. Observation indexe

2.3.1. Blood rheological index

Hemorheology indexes were detected respectively by the LBY-N7500B automatic Hemorheology measurement instrument postoperative 1 week, postoperative 2 weeks and postoperative 4 weeks, including plasma viscosity, whole blood viscosity at high shear, low shear whole blood viscosity, red blood cell volume.

2.3.2. Coagulation index

ACL elite Pro automated coagulation analyzer was used to measure the blood coagulation function indexes respectively in postoperative 1 week, postoperative 2 weeks and postoperative 4 weeks, including prothrombin time (PT), activated partial thromboplastin time (APTT), thrombin time (TT). Immune turbidity method was to detect D-Dimer (D-D), and Clauss method fiber for detecting fibrinogen (FIB).

2.4. Statistical analysis

Both groups of indicators were used mean±standard deviation, using the analysis of variance and t test, both in the SPSS20.0 statistical software, with $P<0.05$ for significant difference.

3. Results

3.1. Changes of hemorheology indexes of two groups at different time points after operation.

The plasma viscosity, high shear viscosity of whole blood, low shear viscosity of whole blood in the control group postoperative 2 week and 4 week were significantly higher than that of preoperative 1 week; while red blood cell volume was significantly lower than preoperative 1 week ($P<0.05$); The hemorheology indexes after surgery in observation group remained stable, it showed no statistical significant difference compared with the preoperative 1 week ($P>0.05$). The plasma viscosity, high shear viscosity of whole blood, low shear viscosity of whole blood in observation group were significantly lower, while red blood cell volume was significantly higher than that in control group in the same time point ($P<0.05$) (Table 1).

3.2. Changes of blood coagulation indexes at different time points after operation in two groups

The PT, APTT, TT, Fib in control group postoperative 2 week and 4 week were significantly lower than that of preoperative 1 week; while D-D was significantly higher ($P<0.05$); The PT, APTT in observation group postoperative 2 week and 4 week were significantly increased compared with preoperative 1 week, and
the TT in observation group postoperative 4 week was significantly increased compared with preoperative 1 week \( (P<0.05) \); Comparison on FIB, D-D after operation at different time point showed no statistical significance differences \( (P>0.05) \). The PT, APTT, TT, Fib in observation group were significantly higher than that in control group in the same time point, while D-D in observation group were significantly lower \( (P<0.05) \) (Table 2).

### 4. Discussion

With the wide application of hip replacement surgery, the incidence of postoperative complications is gradually being valued. DVT is a common complication after hip replacement surgery. Wakabayashi et al.[11] found that more than 40% hip arthroplasty patients will occur DVT after surgery without any effective preventive measures. The occurrence of DVT not only affects the recovery of the disease, but also can lead to pulmonary embolism. And severe cases die after surgery. The pathogenesis of DVT after hip arthroplasty has been the hotspot of research in recent years. Now, it is commonly believed that, DVT occurs due to postoperative patients with lower extremity activity limitation. Lying in bed for a long time results in lower limb blood flow speed slower and vein circumfluence restriction. Together with vascular intimal injury, it leads to coagulation activation, showing venous stasis, platelet aggregation, blood was high pour point and high viscosity state management[12,13]. This study found that plasma viscosity, high shear viscosity of whole blood, low shear viscosity of whole blood, D-D in control group postoperative 2 week and 4 week were significantly higher than that of preoperative 1 week; while red blood cell volume, PT, APTT, TT, Fib were significantly lower than preoperative 1 week \( (P<0.05) \). It indicated that hip arthroplasty could cause patients with the change of blood rheology, blood in hypercoagulable state and remaining for a long time. And it is consistent with Citak et al.[14].

In modern medicine, the formation of DVT is mainly influenced by three factors: venous blood stasis, blood coagulation and vascular intima injury. Studies from Diez-Ewald et al.[15] have found that the use of artificial prosthesis and bone cement in the operation can cause the intramedullary pressure rise, resulting in slow blood flow. Hip replacement surgery makes the body in a state of stress, releasing large amounts of prothrombin, tissue factor, resulting in a series of plasminogen activated. The coagulation system opens and plasminogen activator inhibitor compounds increase, while thrombomodulin is inhibited, forming the coagulation process and causing thrombus; In addition, intraoperative improper operation may cause vascular intimal injury, and damage vascular endothelial cells, activating the clotting factor. With the vascular intimal connective tissue and basement membrane collagen fiber bare, platelet adhesion and aggregation increases, activating intrinsic coagulation system, and making blood in hypercoagulable state[16].

DVT belong to "swelling", "vein arthralgia" category in the motherland medicine. TCM believes that hip arthroplasty damages blood gas of human body. Qi deficiency induced gasification weakness; blood flow is unable to push, causing the increase of blood coagulation and estrangement, block of the meridians, blood stasis in the choroid. The obstruction causes the pain and causes the disease, the treatment rule is promoting blood circulation by removing blood stasis, invigorating qi and promoting blood circulation[17]. Safflower yellow sodium chloride injection has the function of expanding blood vessels, increasing cardiac output, blood circulation, inhibiting thrombosis, and anticoagulant effect. The study, giving intravenous injection of safflower yellow Sodium Chloride Injection to 50 cases

### Table 1
Changes of hemorheology indexes of two groups at different time points after operation.

<table>
<thead>
<tr>
<th>Groups</th>
<th>n</th>
<th>Time after operation</th>
<th>Plasma viscosity (mPa•s)</th>
<th>Whole blood viscosity (mPa•s)</th>
<th>Hematocrit</th>
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<tr>
<td>Control group</td>
<td>50</td>
<td>1 week after operation</td>
<td>1.16±0.24</td>
<td>4.51±0.54</td>
<td>9.17±1.13</td>
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<td></td>
<td></td>
<td>2 weeks after operation</td>
<td>1.85±0.31</td>
<td>6.09±0.62</td>
<td>13.08±1.65</td>
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<td></td>
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<td>4 weeks after operation</td>
<td>1.89±0.37‡</td>
<td>6.18±0.69</td>
<td>12.84±3.12‡</td>
</tr>
<tr>
<td>Observation group</td>
<td>50</td>
<td>1 week after operation</td>
<td>1.10±0.24</td>
<td>4.76±0.60</td>
<td>9.10±1.10</td>
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<tr>
<td></td>
<td></td>
<td>2 weeks after operation</td>
<td>1.33±0.25*</td>
<td>5.09±0.78</td>
<td>9.24±1.33*</td>
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<td>4 weeks after operation</td>
<td>1.24±0.30*</td>
<td>4.94±0.80*</td>
<td>9.18±1.32*</td>
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</table>

Note: compared with 1 weeks after surgery, * \( P < 0.05 \); compared with the control group, ‡ \( P < 0.05 \).

### Table 2
Changes of blood coagulation indexes at different time points after operation in two groups.

<table>
<thead>
<tr>
<th>Groups</th>
<th>n</th>
<th>Time after operation</th>
<th>PT (S)</th>
<th>APTT (S)</th>
<th>TT (S)</th>
<th>FIB (mg/L)</th>
<th>D-D (mg/L)</th>
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<tr>
<td>Control group</td>
<td>50</td>
<td>2 weeks after operation</td>
<td>11.43±1.69</td>
<td>26.54±4.23</td>
<td>8.87±1.03</td>
<td>3.85±0.68</td>
<td>1.80±0.32</td>
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<td></td>
<td></td>
<td>2 weeks after operation</td>
<td>8.26±1.36 ‡</td>
<td>23.23±3.72‡</td>
<td>7.46±1.22‡</td>
<td>2.20±0.57‡</td>
<td>2.54±0.46‡</td>
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<td></td>
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<td>2 weeks after operation</td>
<td>9.09±1.47†</td>
<td>23.68±4.15†</td>
<td>7.67±1.18†</td>
<td>2.09±0.48†</td>
<td>2.49±0.47†</td>
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<tr>
<td>Observation group</td>
<td>50</td>
<td>1 week after operation</td>
<td>11.80±1.64</td>
<td>26.83±4.68</td>
<td>9.10±1.08</td>
<td>3.90±0.74</td>
<td>1.78±0.33</td>
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<tr>
<td></td>
<td></td>
<td>2 weeks after operation</td>
<td>13.31±1.78*</td>
<td>29.86±4.90*</td>
<td>10.09±1.10*</td>
<td>4.01±0.79*</td>
<td>1.76±0.35*</td>
</tr>
<tr>
<td></td>
<td></td>
<td>2 weeks after operation</td>
<td>13.42±1.65*</td>
<td>30.31±5.23*</td>
<td>12.37±1.27*</td>
<td>3.87±0.83*</td>
<td>1.65±0.37*</td>
</tr>
</tbody>
</table>

Note: compared with 1 weeks after operation, ‡ \( P < 0.05 \); compared with the control group, * \( P < 0.05 \).
of hip replacement patients in the observation group after operation, found that hemorheology indexes after surgery in observation group remained stable, it had no statistical difference compared at different time points. The PT, APTT in observation group postoperative 2 week and 4 week were significantly increased compared with preoperative 1 week, and the TT in observation group postoperative 4 week was significantly increased compared with preoperative 1 week, the differences were statistically significant: The plasma viscosity, high shear viscosity of whole blood, low shear viscosity of whole blood, D-D in observation group were significantly lower, while the PT, APTT, TT, Fib in observation group were significantly higher than that in control group at the same time point, differences were statistically significant. The results of this study shows that giving safflower yellow sodium chloride injection after hip replacement surgery can maintain the blood rheology stable, and improve the function of blood coagulation. Safflower yellow element, the main component of safflower yellow pigment sodium chloride injection, is extracted from Carthamus tinctorius, and it is a kind of natural pigment. The main components, safflower flavone, can invigorate the circulation of blood, Tongmai, remove blood stasis, promote fibrinolysis, and increase the activity of plasmin. Modern pharmacological studies have showed that safflower yellow pigment can promote blood circulation, dilate blood vessels, reduce vascular resistance, inhibit platelet aggregation and free radicals, and reduce thrombosis[18-20]. In addition, safflower yellow is also able to reduce reperfusion injury, reduce blood viscosity, anti-oxidation, inhibit inflammatory cells, protect the function of endothelial cell, and so on[21].

In summary, the results of this study showed that hip replacement would induce histologic changes of Hemorheology in the patients, and made blood in hypercoagulable state. But intravenous injection of safflower yellow and sodium chloride injection postoperative could maintain blood rheology and stability, improving the function of blood coagulation. It may help to reduce DVT after hip arthroplasty, and it has important clinical significance.

References