Healing time, calcium and phosphorus contents as well as bone metabolism evaluation after Xianling Gubao-assisted surgical treatment of Colles fracture in elderly women

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ABSTRACT

Objective: To study the effect of Xianling Gubao-assisted surgical treatment on postoperative healing, calcium and phosphorus contents as well as bone metabolism in elderly women with Colles fracture. Methods: A total of 96 elderly female patients with Colles fracture treated in our hospital between June 2013 and December 2015 were selected and randomly divided into two groups, the observation group of patients received Xianling Gubao capsule combined with manual reduction and plaster external fixation therapy, and control group of patients only received reduction and external fixation therapy. The fracture healing time was followed up after treatment, and 3 months after treatment, serum was collected to determine the content of calcium-phosphorus metabolism indexes and bone metabolism indexes. Results: The fracture healing time of observation group was significantly shorter than that of control group; 1 month and 3 months after treatment, serum Ca, P, ALP, IGF-1, PDGF, BGP and PICP levels of both groups were significantly higher than those before treatment while CTX-1, tPINP and TRACP-5b levels were significantly lower than those before treatment; serum Ca, P, ALP, IGF-1, PDGF, BGP and PICP levels of observation group after treatment were significantly higher than those of control group while CTX-1, tPINP and TRACP-5b levels were significantly lower than those of control group. Conclusion: Adjuvant Xianling Gubao capsule therapy can promote the Colles fracture healing in elderly women, also improve calcium-phosphorus metabolism, promote bone formation and inhibit bone resorption.

1. Introduction

Colles fracture is a common clinical traumatic fracture, which specifically refers to the extension type fracture of distal radius, and trends to occur in the milled-aged and elderly with osteoporosis. The occurrence of Colles fracture in the elderly is associated with bone mineral density decrease, and the low-energy force caused by upper limb landing after falling down can lead to Colles fracture[1,2]. Elderly women are with high incidence of postmenopausal osteoporosis, and more prone to fractures under the effect of low-energy force. Manual reduction and plaster or small splint external fixation is a major means of clinical treatment of Colles fracture. Because elderly female patients with Colles fracture are often complicated with reduced bone mineral density and abnormal bone metabolism, so for elderly female patients with fracture, reduction and fixation combined with related drug treatment can achieve the purpose of increasing bone density, improving bone metabolism and promoting fracture healing. Xianling Gubao capsule is a Chinese patent medicine that can increase bone mineral density and improve bone metabolism, and it is used for the adjuvant treatment of osteoporosis. In this study, the effect of Xianling Gubao-assisted surgical treatment on the healing time, calcium and phosphorus contents as well as bone metabolism in elderly women with Colles fracture was analyzed.

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2. Subjects and methods

2.1 Research subjects

A total of 96 elderly female patients with Colles fracture treated in our hospital between June 2013 and December 2015 were selected as the research subjects, and the inclusion criteria were as follows: (1) female, > 60 years old; (2) with clear history of injury and treated within 24 h after injury; (3) diagnosed with Colles fracture after clinical symptoms, signs and X-ray examination. Patients with the diabetes, long-term use of hormone drugs and other factors that influenced the fracture healing, patients who received anti-osteoporosis treatment in last three months, and patients complicated with the fractures of other parts were ruled out. Random number table was used to divide the included patients into two groups, 48 cases in each group. Observation group received Xianling Gubao capsule combined with reduction and external fixation therapy, they were 65 years old and the time between injury and treatment was (15.4±1.9) h; control group only received reduction and external fixation therapy, they were 64 years old and the time between injury and treatment was (15.1±1.7) h. The two groups of patients were not significantly different in general information (\( P > 0.05 \)).

2.2 Treatment methods

Both groups of patients received manual reduction and plaster external fixation treatment after admitted to hospital, the reduction and fixation treatment operations were completed by the members of same treatment team, and X-ray was used to confirm whether the reduction was good; the fixation time was 4-6 weeks, the external fixation was removed after X-ray reexamination and physical examination confirmed the clinical fracture healing, patients were instructed for wrist flexion-extension and rotation, finger flexion-extension and other functional exercises. On the basis of the above conventional treatment, observation group received Xianling Gubao capsule treatment, and the method was as follows: oral administration of Xianling Gubao capsule, 3 pills/time, 2 times/d for 3 consecutive months.

2.3 Clinical index collection methods

After treatment, the fracture healing condition and the fracture healing time of both groups were recorded. Before treatment on the first day of injury as well as 1 and 3 months after treatment, peripheral blood was collected from two groups of patients and centrifuged to separate serum, the automatic biochemical analyzer was used to determine calcium (Ca), phosphorus (P) and alkaline phosphatase (ALP) levels, and the enzyme-linked immunosorbent assay kits were used to determine platelet-derived growth factor (PDGF), human insulin growth factor-1 (IGF-1), osteocalcin (BGP), C-terminal propeptide of procollagen type I (PICP), type I collagen cross-linked C-terminal telopeptide (CTX-1), total N-terminal propeptide of procollagen type I (tPINP) and tartrate-resistant acid phosphatase 5 b (TRACP-5b) content.

2.4 Statistical methods

SPSS 21.0 software was used to input the experimental data, the differences in measurement data between two groups was analyzed by t test and \( P < 0.05 \) indicated statistical significance in differences.

3. Results

3.1 Fracture healing

Analysis of fracture healing between two groups of patients was as follows: the fracture healing time of observation group was (2.35±0.31) months and the fracture healing time of control group was (2.97±0.36) months. After t test, the fracture healing time of observation group was significantly shorter than that of control group, and differences in fracture healing time were statistically significant between two groups of patients (t=7.612, \( P < 0.05 \)).

3.2 Calcium-phosphorus metabolism indexes

Before treatment on the first day of injury as well as 1 month and Table 1.

<table>
<thead>
<tr>
<th>Groups</th>
<th>n</th>
<th>Treatment</th>
<th>Ca (mmol/L) ( \times 10^2 )</th>
<th>P (mmol/L) ( \times 10^2 )</th>
<th>ALP (U/L) ( \times 10^3 )</th>
</tr>
</thead>
<tbody>
<tr>
<td>Observation</td>
<td>48</td>
<td>Before treatment</td>
<td>2.21±0.27</td>
<td>1.42±0.17</td>
<td>113.52±14.58</td>
</tr>
<tr>
<td></td>
<td></td>
<td>1 month after treatment</td>
<td>2.65±0.31 *</td>
<td>1.75±0.19 *</td>
<td>224.54±28.79 *</td>
</tr>
<tr>
<td></td>
<td></td>
<td>3 months after treatment</td>
<td>2.98±0.34 *</td>
<td>1.93±0.22 *</td>
<td>316.76±35.64 *</td>
</tr>
<tr>
<td>Control</td>
<td>48</td>
<td>Before treatment</td>
<td>2.18±0.25</td>
<td>1.40±0.14</td>
<td>115.02±13.25</td>
</tr>
<tr>
<td></td>
<td></td>
<td>1 month after treatment</td>
<td>2.33±0.29 *</td>
<td>1.52±0.17 *</td>
<td>153.42±17.76 *</td>
</tr>
<tr>
<td></td>
<td></td>
<td>3 months after treatment</td>
<td>2.47±0.33 *</td>
<td>1.66±0.17 *</td>
<td>213.23±26.78 *</td>
</tr>
</tbody>
</table>

\*: compared with same group before treatment, \( P < 0.05 \); \#: compared with control group at the same point in time, \( P < 0.05 \).
3 months after treatment, analysis of serum Ca, P and ALP levels between two groups of patients was as follows: (1) before treatment, differences in serum Ca, P and ALP levels were not statistically significant between two groups of patients \( (P>0.05) \); (2) 1 month and 3 months after treatment, serum Ca, P and ALP levels were statistically significant within two groups before and after treatment \( (P<0.05) \); (3) 1 month and 3 months after treatment, serum Ca, P and ALP levels were significantly higher than those before treatment, and differences in serum Ca, P and ALP levels of both groups were significantly higher than those before treatment, and differences in serum IGF-1, PDGF, BGP and PICP content of control group were significantly higher than those of control group, and differences in serum CTX-1, tPINP and TRACP-5b levels of observation group were significantly lower than those of control group, and differences in serum CTX-1, tPINP and TRACP-5b levels of both groups were statistically significant between two groups of patients \( (P<0.05) \).

### Table 2
Comparison of serum bone formation indexes between two groups of patients before and after treatment (ng/mL).

<table>
<thead>
<tr>
<th>Groups</th>
<th>n</th>
<th>Treatment</th>
<th>IGF-1</th>
<th>PDGF</th>
<th>BGP</th>
<th>PICP</th>
</tr>
</thead>
<tbody>
<tr>
<td>Observation</td>
<td>48</td>
<td>Before treatment</td>
<td>221.32±32.67</td>
<td>106.76±13.51</td>
<td>3.68±0.51</td>
<td>77.64±9.15</td>
</tr>
<tr>
<td></td>
<td></td>
<td>1 month after treatment</td>
<td>308.98±37.5±</td>
<td>189.63±22.34</td>
<td>5.46±0.77</td>
<td>114.72±13.45</td>
</tr>
<tr>
<td></td>
<td></td>
<td>3 months after treatment</td>
<td>392.14±47.43</td>
<td>253.42±31.27</td>
<td>7.63±0.93</td>
<td>187.65±22.36</td>
</tr>
<tr>
<td>Control</td>
<td>48</td>
<td>Before treatment</td>
<td>219.38±26.73</td>
<td>109.12±13.24</td>
<td>3.74±0.48</td>
<td>78.14±8.93</td>
</tr>
<tr>
<td></td>
<td></td>
<td>1 month after treatment</td>
<td>255.64±32.49</td>
<td>142.32±16.84</td>
<td>4.31±0.57</td>
<td>93.22±10.27</td>
</tr>
<tr>
<td></td>
<td></td>
<td>3 months after treatment</td>
<td>303.58±41.38</td>
<td>182.14±22.32</td>
<td>5.96±0.78</td>
<td>131.38±17.65</td>
</tr>
</tbody>
</table>

\( ^* \): compared with same group before treatment, \( P<0.05 \); \( ^# \): compared with control group at the same point in time, \( P<0.05 \).

### 3.3 Bone formation indexes

Before treatment as well as 1 month and 3 months after treatment, analysis of serum bone formation indexes IGF-1, PDGF, BGP and PICP between two groups of patients was as follows: (1) before treatment, differences in serum IGF-1, PDGF, BGP and PICP content were not statistically significant between two groups of patients \( (P>0.05) \); (2) 1 month and 3 months after treatment, serum IGF-1, PDGF, BGP and PICP levels of both groups were statistically significant within two groups before and after treatment \( (P<0.05) \); (3) 1 month and 3 months after treatment, serum IGF-1, PDGF, BGP and PICP levels of observation group were significantly higher than those of control group, and differences in serum CTX-1, tPINP and TRACP-5b levels of both groups were significantly lower than those before treatment, and differences in serum IGF-1, PDGF, BGP and PICP levels of both groups were statistically significant between two groups of patients after treatment \( (P<0.05) \).

### 3.4 Bone resorption indexes

Before treatment as well as 1 month and 3 months after treatment, analysis of serum bone resorption indexes CTX-1, tPINP and TRACP-5b between two groups of patients was as follows: (1) before treatment, differences in serum CTX-1, tPINP and TRACP-5b levels were not statistically significant between two groups of patients \( (P>0.05) \); (2) 1 month and 3 months after treatment, serum CTX-1, tPINP and TRACP-5b levels of both groups were significantly lower than those before treatment, and differences in serum CTX-1, tPINP and TRACP-5b levels were statistically significant within two groups before and after treatment \( (P<0.05) \); (3) 1 month and 3 months after treatment, serum CTX-1, tPINP and TRACP-5b levels of observation group were significantly lower than those of control group, and differences in serum CTX-1, tPINP and TRACP-5b levels were statistically significant between two groups of patients after treatment \( (P<0.05) \).

### 4. Discussion

Elderly women are the high-risk group of osteoporosis, postmenopausal ovarian function declines and the estrogen secretion significantly reduces, so the bone metabolism loses the protection from the estrogen, the bone resorption increases, bone mass is gradually lost and osteoporosis is formed. In the presence of pathological factors such as bone loss and osteoporosis, elderly women are more prone to fractures under the action of low-energy force[3,4]. Colles fracture is a common fracture type in elderly women, and as patients themselves are with abnormal bone density, the protection of estrogen is lost, the metabolism of bone is disturbed, the bone resorption increases, and fractures occur.
metabolism, delayed union is common after conventional reduction and fixation treatment[5,6]. Based on the understanding between abnormal bone metabolism and nonunion as well as delayed union after fracture, auxiliary bone metabolism-regulating drugs during fracture treatment can correct abnormal bone metabolism and improve fracture healing[7].

Xianling Gubao capsule is a Chinese patent medicine that regulates bone metabolism, which uses Chinese herbal medicine epimedium as the main drug and the by salvia miltiorrhiza, radix rehmanniae, radix dipaci, fructus psoraleae and others as auxiliary drugs, has the effects of promoting blood circulation to remove meridian obstruction as well as strengthening tendons and bones, and is widely used in the prevention and treatment of osteoporosis. Clinical research of Chinese scholars has shown that perioperative application of the Xianling Gubao capsule in patients with osteoporosis and femoral intertrochanteric fracture has obvious improving effect on fracture healing and joint function recovery[8]. In the study, Xianling Gubao capsule was used as auxiliary treatment after Colles fracture fixation, aiming to exert the effect of the capsule on regulating bone metabolism. In order to define the effect of Xianling Gubao capsule on Colles fracture, the fracture healing time was followed up at first after treatment, and the result showed that the fracture healing time of observation group was significantly shorter than that of control group. This means that adjuvant Xianling Gubao therapy can promote Colles fracture healing and shorten fracture healing time. Calcium-phosphorus metabolism is an important factor that affects bone metabolism and fracture healing, and good calcium-phosphorus metabolism can promote new bone formation and bone mineralization[9,10]. Analysis of the calcium-phosphorus metabolism between two groups of patients after fracture showed that serum Ca, P and ALP levels of observation group were significantly higher than those of control group. This means that adjuvant Xianling Gubao capsule therapy can improve the calcium-phosphorus metabolism during fracture healing, can also increase the release of ALP and promote calcium-phosphorus deposition in bones, and is conducive to fracture end healing.

During fracture healing, IGF-1 and PDGF can induce mesenchymal stem cell differentiation to the osteoblasts and promote osteoblast proliferation, they have obvious promoting effect on the intramembranous ossification during fracture healing, and serum IGF-1 and PDGF levels can reflect the differentiation degree and proliferation activity of osteoblasts[11,12]; BGP is the most abundant collagen in bone tissue, has regulating effect on bone mineralization and transformation process, and can reflect both bone formation rate and osteoblast variability in vivo[13]; PICP is the product in the collagen type I generation in the bone, and can reflect the collagen deposition process[14]. In the study, analysis of the content of above osteoblast activity and bone formation marker molecules showed that serum IGF-1, PDGF, BGP and PICP levels of observation group after treatment were significantly higher than those of control group. This means that Xianling Gubao capsule has promoting effect on osteoblast activity and bone formation process in Colles fracture healing.

In addition, the fracture healing is not only related to bone formation process and osteoblast activity, but also affected by osteoclast activity and bone resorption process. CTX-1 and tPINP are the products during the type I collagen catabolism, type I collagen is massively degraded during bone resorption, and CTX-1 and tPINP generation also increase accordingly; TRACP-5b is a newly discovered bone resorption marker molecule, it is secreted by osteoclasts and can degrade bone matrix, and serum TRACP-5b content can reflect the osteoclast activity and bone resorption process[15,16]. Analysis of these osteoclast activity and bone resorption marker molecules in the study showed that serum CTX-1, tPINP and TRACP-5b levels of observation group after treatment were significantly lower than those of control group, which means that Xianling Gubao capsule can inhibit the osteoclast activity and bone resorption process in Colles fracture healing.

Based on above discussion, it is concluded that adjuvant Xianling Gubao capsule therapy can promote the healing process after Colles fracture reduction and fixation in elderly women, and has improving effect on calcium-phosphorus metabolism and bone metabolism process.

References


