Effect of hydromorphone hydrochloride postoperative analgesia on the inflammatory cytokines, S-100β, and NSE in elderly patients after total hip replacement

Kan Li¹, Long Jiang², Xiuhui Fu³, Jingjing Zhang¹, Guangyuan Li¹, Yanchun Zhao¹, Qing Yang¹

¹The First Hospital of Zhangjiakou City, Hebei, 075000
²Zhuolu Hospital of Hebei Province, 075600
³The Fifth Hospital of Shijiazhuang City, Hebei, 050021

1. Introduction

Total hip replacement (THR) is the most effective method in the treatment of hip joint disease in the terminal stage, can effectively eliminate the pain, correct the hip joint deformity, and recover hip joint function, but moderate and severe pain after operation is usually accompanied by, which can severely affect the postoperative rehabilitation(1). Due to the inflammatory cascade, the surgical trauma can cause the excessive expressions of inflammatory cytokines and severe traumatic stress reaction, which are not beneficial for the postoperative rehabilitation(2-3). Hydromorphone hydrochloride is a new type opioid, with strong water solubility, has a preferable analgesia effect, and no obvious effect on renal function(4). The study is aimed to explore the effect of hydromorphone hydrochloride postoperative analgesia on the inflammatory cytokines, S-100β, and NSE in elderly patients after THR.

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ABSTRACT

Objective: To explore the effect of hydromorphone hydrochloride postoperative analgesia on the inflammatory cytokines, S-100β, and NSE in elderly patients after total hip replacement (THR). Methods: A total of 100 patients who were admitted in our hospital from January, 2015 to July, 2016 for THR were included in the study and randomized into the observation group and the control group with 50 cases in each group. After operation, the patients in the two groups were immediately given patient-controlled analgesia. The patients in the observation group were given hydromorphone hydrochloride (0.3 mg) + dexamethasone (5 mg) + normal saline (100 mL), while the patients in the control group were given sufentanil (150 μg) + dexamethasone (5 mg) + normal saline (100 mL). The morning fasting peripheral venous blood before operation, 24 h and 3 d after operation in the two groups was collected. ELISA was used to detect the serum CRP, IL-6, and TNF-α levels, and the plasma S-100β and NSE levels. Results: The serum CRP, TNF-α, and IL-6 levels 24 h and 3 d after operation in the two groups were significantly elevated when compared with before operation, and were reduced 3d after operation. CRP, TNF-α, and IL-6 levels at each timing point after operation in the observation group were significantly lower than those in the control group. The plasma S-100β and NSE levels 24 h and 3 d after operation in the two groups were significantly elevated when compared with before operation, and were reduced 3d after operation. The plasma S-100β and NSE levels at each timing point after operation in the observation group were significantly lower than those in the control group. Conclusions: Hydromorphone hydrochloride can relieve the postoperative pain in elderly patients with THR, effectively alleviate the inflammatory reaction, reduce the plasma S-100β and NSE levels, and alleviate the cerebral injury, whose pathogenesis remains a further deep study.
2. Materials and methods

2.1. Clinical materials

A total of 100 patients who were admitted in our hospital from January, 2015 to July, 2016 for THR were included in the study. The informed consents were obtained from all the patients. The study was approved by the Ethical Committee. Those who were merged with heart, kidney, and other vital organ dysfunction, had coagulation disorders, and hemorrhage diseases were excluded from the study. The patients were randomized into the observation group and the control group with 50 cases in each group. In the observation group, 32 were male, and 18 were female; aged from 63 to 76 years old, with an average age of 67 years old; 29 on the left side, and 21 on the right side; 34 had femoral head or femoral neck fracture, 13 had ischemic necrosis of femoral head, and 3 had rheumatoid arthritis. In the control group, 31 were male, and 19 were female; aged from 64 to 76 years old, with an average age of 66 years old; 28 on the left side, and 22 on the right side; 32 had femoral head or femoral neck fracture, 16 had ischemic necrosis of femoral head, and 2 had rheumatoid arthritis. The comparison of gender, age, part, and pathogenesis between the two groups was not statistically significant ($P>0.05$).

2.2. Methods

After operation, the patients in the two groups were immediately given patient-controlled analgesia. The self-controlled procedure was set as continuous administration, 0.2 mL/h, locking time of 30 min, 2 mL/time. The patients in the observation group were given hydromorphone hydrochloride (produced by Yichang Renfu Pharmaceutical Co., Ltd, Approval No. H20120100 0.3 mg) + dexamethasone (5 mg) + normal saline (100 mL), while the patients in the control group were given sufentanil (produced by Yichang Renfu Pharmaceutical Co., Ltd, Approval No. H20054256 150 μg) + dexamethasone (5 mg) + normal saline (100 mL).

2.3. Observation indicators

The morning fasting peripheral venous blood before operation, 24 h and 3 d after operation in the two groups was collected. ELISA was used to detect the serum CRP, IL-6, and TNF-$\alpha$, and the plasma S-100 $\beta$ and NSE levels.

2.4. Statistical analysis

SPSS 19.0 software was used for the statistical analysis. The measurement data were expressed as mean ± SD, and $t$ test was used. Chi-square test was used for the enumeration data. $P<0.05$ was regarded as statistically significant.

3. Results

3.1. Comparison of the serum cytokine levels after operation between the two groups

The serum CRP, TNF-$\alpha$, and IL-6 levels 24 h and 3 d after operation in the two groups were significantly elevated when compared with before operation ($P<0.05$), and were reduced 3 d after operation. CRP, TNF-$\alpha$, and IL-6 levels at each timing point after operation in the observation group were significantly lower than those in the control group ($P<0.05$) (Table 1).

3.2. Comparison of the plasma S-100 $\beta$ and NSE levels after operation between the two groups

The plasma S-100 $\beta$ and NSE levels 24 h and 3 d after operation in the two groups were significantly elevated when compared with before operation ($P<0.05$), and were reduced 3 d after operation. The plasma S-100 $\beta$ and NSE levels at each timing point after operation in the observation group were significantly lower than those in the

Table 1.
Comparison of the serum cytokine levels after operation between the two groups.

<table>
<thead>
<tr>
<th>Groups</th>
<th>Time</th>
<th>CRP</th>
<th>IL-6</th>
<th>TNF-$\alpha$</th>
</tr>
</thead>
<tbody>
<tr>
<td>Observation</td>
<td>Before treatment</td>
<td>25.42±3.16</td>
<td>13.46±5.36</td>
<td>13.45±3.17</td>
</tr>
<tr>
<td></td>
<td>24 h after treatment</td>
<td>34.46±3.54*</td>
<td>26.41±6.38*</td>
<td>25.43±5.15*</td>
</tr>
<tr>
<td></td>
<td>3 d after treatment</td>
<td>27.26±2.57*</td>
<td>16.45±5.71*</td>
<td>16.45±3.28*</td>
</tr>
<tr>
<td>Control</td>
<td>Before treatment</td>
<td>25.36±3.25</td>
<td>12.73±5.66</td>
<td>13.39±3.41</td>
</tr>
<tr>
<td></td>
<td>24 h after treatment</td>
<td>47.19±3.58*</td>
<td>32.41±5.39*</td>
<td>30.19±5.33</td>
</tr>
<tr>
<td></td>
<td>3 d after treatment</td>
<td>32.38±4.51*</td>
<td>24.36±6.42*</td>
<td>19.75±4.63</td>
</tr>
</tbody>
</table>

* $P<0.05$, when compared with before operation; *$P<0.05$, when compared with the control group.
control group (P<0.05) (Table 2).

Table 2.

Comparison of the plasma S-100β and NSE levels after operation between the two groups.

<table>
<thead>
<tr>
<th>Groups</th>
<th>Time</th>
<th>S-100β</th>
<th>NSE</th>
</tr>
</thead>
<tbody>
<tr>
<td>Observation</td>
<td>Before operation</td>
<td>0.25±0.17</td>
<td>2.81±0.41</td>
</tr>
<tr>
<td></td>
<td>24 h after operation</td>
<td>1.36±0.37</td>
<td>8.75±0.72</td>
</tr>
<tr>
<td></td>
<td>3 d after operation</td>
<td>0.42±0.13</td>
<td>3.63±0.35</td>
</tr>
<tr>
<td>Control</td>
<td>Before operation</td>
<td>0.26±0.18</td>
<td>2.83±0.43</td>
</tr>
<tr>
<td></td>
<td>24 h after operation</td>
<td>1.71±0.23</td>
<td>11.61±0.73</td>
</tr>
<tr>
<td></td>
<td>3 d after operation</td>
<td>0.64±0.14</td>
<td>5.16±0.34</td>
</tr>
</tbody>
</table>

*P<0.05, when compared with before operation; **P<0.05, when compared with the control group.

4. Discussion

THR is currently the main means for the treatment of hip joint lesion and femoral neck fracture, and can effectively improve the motor function, correct the deformity, and alleviate the pain degree[5]. Due to the reduced tolerance of elderly patients to the operation and anesthesia, the acute postoperative pain can cause the blood pressure fluctuation to a certain degree and induce the heart attack; therefore, effective postoperative analgesia is of great significance in reducing the occurrence of complications and promoting the postoperative recovery[6]. Hydromorphone hydrochloride is a partially synthetized strong opioid analgesic to play the analgesia effect through activating the central nervous system μ-opioid receptor, and has advantages of rapid effect taking, long duration, small respiratory depression, low addiction rate, no effect on cerebral blood flow and oxygenation, and no active metabolites[7].

After THR, the inflammatory cytokines will aggregate around the hip joint, which can stimulate the peripheral nerve endings to induce the occurrence of pain; moreover, the release of inflammatory cytokines will aggravate the sensitivity of central nervous system and peripheral nerves to stimulation[8]. Some researches demonstrate that the surgical trauma can induce the inflammatory reaction persisting for several days[9,10]. The inflammatory reaction can activate various transcription factors and enzymes, synthesize and release the cytokines, inflammatory mediators, reactive oxygen, and chemotactic factors through initiating the signal transduction pathway inside the inflammatory cells. The excessive inflammatory reaction can extensively damage the vascular endothelial cells and histocytes, resulting in systemic inflammatory reaction syndrome, acute lung injury, MODS, and other perioperative complications. CRP is an acute phase protein and synthesized by stimulating the hepatocytes when the tissues are damaged or the body is invaded by the microorganisms, whose elevated degree can reflect the trauma and inflammatory reaction degree[11]. IL-6 is a key cytokine to initiate the acute inflammatory reaction after operation, is released when there is an infection, anesthesia, or surgical stress, is the unique constant elevated cytokine after tissue injury, and is a sensitive indicator for the acute inflammatory reaction[12]. TNF-α is the cytokine firstly secreted after harmful stimulation, and is the early sensitive marker for tissue injury[13]. It is reported that[14] after THR, hydromorphone hydrochloride is applied in the postoperative analgesia, IL-1, IL-6, CRP, and THF-α levels 1d and 5d after medication are significantly lower than those in the routine treatment group. The results in the study showed that the serum CRP, TNF-α, and IL-6 levels 24 h and 3 d after operation in the two groups were significantly elevated when compared with before operation (P<0.05), and were reduced 3 d after operation; CRP, TNF-α, and IL-6 levels at each timing point after operation in the observation group were significantly lower than those in the control group (P<0.05), indicating that hydromorphone hydrochloride can effectively reduce the release of inflammatory cytokines in elderly patients after THR.

S-100β is mainly existing in the neurogliocytes. Before the non-detection of cerebral injury by the imaging examination, S-100β concentration is greatly elevated, suggesting that S-100β can early predict the occurrence of cerebral injury. When the injury is in a subclinical state, S-100β can be served as a potentially effective indicator of cerebral injury. It is argued that the plasma S-100β can reflect the cerebral injury degree[15]. NSE is mainly existing in the neuroendocrine cells and brain nerve cells, and is one of the marker enzymes of neuron damage. In the normal condition, the plasma NSE content is extremely low, whose elevated level suggests the neuron damage[16]. Some researches demonstrate that the trauma or inflammatory reaction can destroy the integrity of neurocyte membrane[17], and release S-100β and NSE into the intracellular space, cerebrospinal fluid, and blood, resulting in the elevation of serum S-100β and NSE levels; therefore, it is argued that the reactive elevation of S-100β and NSE is the biochemical manifestation of neuron ultrastructure damage degree. The results in the study showed that the plasma S-100β and NSE levels 24 h and 3d after operation in the two groups were significantly elevated when compared with before operation (P<0.05), and were reduced 3d after operation, suggesting that the cerebral injury in a subclinical level is existing in the perioperative period in the elderly patients with THR, and the injury is mild and reversible; moreover, the plasma S-100β and NSE levels at each timing point after operation in the observation group were significantly lower than those in the control group (P<0.05), indicating that hydromorphone hydrochloride can effectively relieve the postoperative pain in patients with THR.
alleviate the inflammatory reaction, reduce the plasma S-100β and NSE levels, and alleviate the cerebral injury degree.

In conclusion, hydromorphone hydrochloride can relieve the postoperative pain in elderly patients with THR, effectively alleviate the inflammatory reaction, reduce the plasma S-100β and NSE levels, and alleviate the cerebral injury, whose pathogenesis remains a further deep study.

References


