Original Article
Comparison the effects of pressurized salt ice packs with water ice packs on patients following total knee arthroplasty

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Abstract: The aim of this study was to estimate the effects of pressurized salt ice packs (PIP) with water ice packs (WIP) which are used to relieve pain and decrease swelling on patients following total knee arthroplasty (TKA). Sixty-nine patients undergoing primary unilateral TKA were randomly divided into two groups (PIP group and WIP group). We used a visual analog scale (VAS) to score knee pain and the score was recorded. The knee bilateral girth, the slipping times of the ice pack, and the times of wound dressing or bed moist were recorded during cryotherapy. The scores of pain between the two groups were significant difference in 12 h, 24 h, 48 h and 72 h after TKA (P < 0.05). No significant difference was found for the girth measurements of the operative knee on the two levels in 12 h, 24 h and 72 h, respectively. However, there was statistically difference for girth measurements between the two groups in 48 h after TKA (P < 0.05). PIP is a cheap, safe and simple method, which is more effective than WIP on reducing pain and swelling degree of patients. Thus, PIP is recommended in clinical nursing work.

Keywords: Cryotherapy, total knee arthroplasty, pain, swelling

Introduction

Nowadays, osteoarthritis (OA) is a very common joint disorder in worldwide. Radiographic evidence shows that majority of patients with OA aged 65 years or above and about 80% of patients with OA aged 75 years or older [1]. OA patients were charatered by frequent pain, loss of function and disability. OA currently ranked the eleventh leading cause among patients with disability [2]. In 2012, nearly one seventh adults aged over 45 years had doctor-diagnosed OA in South Sweden [3]. In US, it is second only to ischaemic heart disease as a cause of work disability in men over 50 years old, and accounts for more hospitalizations than rheumatoid arthritis (RA) every year [1]. It is reported that over 26000 new OA cases of 1000000 population aged 45 or older will have consulted healthcare by 2032 [3].

Total knee arthroplasty (TKA) is a common surgical procedure for patients who have an end-stage OA. In fact, the patients following TKA will undergo a severe pain and have frequent chronic pain. Several factors are associated with the severe acute pain after surgery, including psychological factors and severe preoperative pain [4]. Pain can affect patients’ walk ability, general exercise [5]. The rehabilitation time of patients will decrease when the pain is better managed [6].

To manage pain, a non-pharmaceutical approach maybe a valid method which reduces medication use. Evidences support that cryotherapy combined with pharmaceuticals for managing pain become more popular [7]. Cryotherapy can effectively relieve swelling and pain of patients [8]. Meanwhile, Cryotherapy also is a useful measure, adjunctive and analgesic. Many studies showed that cold can relieve the pain of wound which is an analgesic method to patients [9-11].

In present study, we aimed to compare the effects of managing pain and swelling between
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**Subjects and methods**

**Subjects**

This prospective study concerned patients who were undergoing primary unilateral TKA in the First Affiliated Hospital of Wannan Medical College. Patients were eligible for the study met the following criteria.

**Inclusion criteria**

Aged 42-81 years, the blood pressure was stable, severe osteoarthritis required TKA.

**Exclusion criteria**

Subjects had severe varus or valgus deformity, rheumatoid arthritis, peripheral vascular disease; Raynaud’s phenomenon associated acute pathology, cold urticaria, hypertension and diabetes, et al.

This study consists of 69 subjects, we divided them into experimental group 34 (11 males and 23 females) and control group 35 (10 males and 25 females). All patients gave written informed consent. This study was approved by local ethics committee.

**Preparations**

The production of PIP: PIP was made from abandoned sphygmomanometer cuffs and rubber bulbs. Firstly, we kept the blood pressure cuff airbags and automatic paste part. Secondly, we used the elastic tape to stitch the connection paste tape on both sides of the airbag. Thirdly, put the ice packs into the opened airbag. Finally, put 250 ml 10% sodium chloride solution into a 250 ml flexible packaging bag which was full of saline and then stored in refrigerator (at -18°C) for 12 hours. The production of WIP: we equipped the hot water bag with 250 ml water and kept it in a refrigerator (at -18°C) for 12 hours. Figure 1 shows the styles of PIP and WIP.

**Methods**

Two groups of patients were performed orthopaedic conventional treatment. Related knowledge about disease, preoperative and postoperative matters were explained to patients, and then we interpreted the reason for using ice packs after operation. Cold therapy was used for patients in both groups within 6 h after operation, which last three days (every day performed two split an hour long treatment). Patients in experimental group were treated by PIP, an ice pack was put on the patella, pressurized fixed. Patients in control group were used traditional WIP. The ice pack was wrapped with a towel, and then used a medical bandage to fix.

**Table 1. The general character of patients before the operation**

<table>
<thead>
<tr>
<th>Group</th>
<th>Male</th>
<th>Female</th>
<th>Age</th>
<th>Pre-operation VAS score</th>
<th>Pre-operation swelling (cm)</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td></td>
<td></td>
<td></td>
<td>PB-5</td>
<td>PB+5</td>
</tr>
<tr>
<td>PIP</td>
<td>11</td>
<td>23</td>
<td>66.91±8.84</td>
<td>2.79±0.73</td>
<td>1.15±1.09</td>
</tr>
<tr>
<td>WIP</td>
<td>10</td>
<td>25</td>
<td>64.97±6.61</td>
<td>2.94±0.64</td>
<td>1.20±1.85</td>
</tr>
<tr>
<td>t</td>
<td>0.166 ($\chi^2$)</td>
<td>1.034</td>
<td>0.902</td>
<td>0.144</td>
<td>1.222</td>
</tr>
<tr>
<td>$p$</td>
<td>0.733</td>
<td>0.305</td>
<td>0.370</td>
<td>0.886</td>
<td>0.288</td>
</tr>
</tbody>
</table>

Figure 1. Schematic pictures of PIP and WIP styles.
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Pain scores

We used a visual analog scale (VAS) to evaluate knee pain and the scores were recorded when patients were taken rest. Drew a 10 cm line and its ends were marked 0 and 10, which represent painless and most severe pain, respectively. The patients were asked to make a vertical mark on the line at the place that best reflected the intensity of the pain.

Swelling

The bilateral girth of Knee was measured by a meter rule between 5 cm below and 5 cm above the patella. The value of swelling equals the circumference of operative knee minus the circumference of healthy knee.

Statistical analysis

Data were summarized as frequency counts, or as the mean and standard deviation (SD) for continuous data. We used the two independent sample t-tests to measure the pain scores and swelling of the patients. Chi-square tests were used to test the slipping times of ice packs and the times of the wound dressing or the bed unit moist between the two groups. SPSS 18.0 was used to analysis the data, and statistical significance was claimed at \( P < 0.05 \).

Results

The general character of patients before the operation was showed in Table 1. Pain scores of knee (mean ± SD) were recorded in 12 h, 24 h, 48 h and 72 h after TKA and they were showed in Figure 2. The scores of pain between two groups were significant difference in 12 h, 24 h, 48 h and 72 h after TKA (\( P < 0.05 \)). The swelling of the knee was measured by the girth
measurements of the operative knee, which was shown in Figures 3 and 4. Except for 48 h after TKA, no significant difference was found for the girth measurements of the operative knee on two levels in 12 h, 24 h and 72 h, respectively ($P > 0.05$). The slipping times between the two group patients during using ice packs have significant difference ($P < 0.05$), and the times of the wound dressing or bed unit moist also have significant difference ($P < 0.05$), and we can see it in Table 2.

**Discussion**

The aim of our study was to evaluate the effects of PIP on patients after TKA, and to compare the superiority of it with the traditional WIP. In our study, we found that the scores of pain between the two groups were significant difference in 12 h, 24 h, 48 h and 72 h after TKA ($P < 0.05$) (Figure 2). As demonstrated in the earlier studies [12-15], cryotherapy had an analgesic function and can relieve the pain. Although some research advances of pain mechanisms were gained in recently, pain after TKA is still an inevitable issue which can affect the quality of life and rehabilitation on patients undergoing TKA [16]. It is reported that acute postoperative pain at rest after joint replacement, particularly TKA, was poorly managed [17], although it did not reach the severity of preoperative pain, it also necessary to relieve the pain of patients.

Nowadays, cryotherapy is applied to reduce the degree of swelling whether in theory or clinical practice after trauma [18]. Cold can reduce oedema. The analgesic action by applying cold is related to vascular spasm and the decrease of local blood flow [19]. In our study, no significant difference was found for the girth measurements of the operative knee on two levels in 12 h, 24 h and 72 h, respectively. This may due to PIP can decrease the early swelling of the patients and has a better effect than the WIP. When we put the two frozen ice packs out of the refrigerator, the ice in the PIP was frosted while the WIP was ice cubes. As the time went by, the ice in the PIP became a mixture which was composed of frost and water. However, the ice in the WIP became a mixture composed of ice cubes and water. The temperature of the PIP was lower than WIP.

The slipping times of WIP was 85 (40% of the total) and the times of the wound or bed unit moist was 67 (31.9% of the total) (Table 2). However, the times of slippage to PIP was 0 and the wound or bed unit moist was 2 (0.98% of the total). There were significant differences for cold therapy effects between the two groups. We could see that it’s difficult to fix the bags and the cold therapy effect of PIP was better than WIP.

As far as we know, our study is the first to use the cuffs of abandoned sphygmomanometer and rubber bulbs to given pressure to the knee joint. The pressure given to the knee joint can be tolerated by the patients and did not make the ice packs slip. Due to the cuff is waterproof material, However, there are no consensuses about the best time to use cryotherapy [20, 21]. It was reported that the use of cryotherapy may cause frostbite [22-24]. There were some limitations in our study, such as the sample size was too small, the effects of cryotherapy may be influenced by the dressing types [25]. Thus, further studies need to increase simple size and control some factors to further evaluate the effects of cryotherapy.

**Conclusion**

PIP is a cheap, safe and simple methods, which are more effective than WIP on reducing patients’ pain and swelling degree. Thus, PIP is recommended in clinical nursing for reducing patients’ pain and swelling degree.

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Disclosure of conflict of interest

None.

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References


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