Effect of Pulse Irrigation on Prevention of Incision Infection in Tibiofibular Fracture

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Abstract. We aimed to describe the effect of pulse irrigation in preventing incision infection in tibiofibular fracture and to explore the effectiveness of pulse irrigation on the prevention of the infection, providing a theoretical basis for its clinical application. Clinical data of 158 patients with tibiofibular fracture admitted in our hospital between Jan. and Dec. 2015 and 158 with tibiofibular fracture admitted between Feb. and Nov. 2016 were reviewed, and the patients were divided into the observation group and the control group. Wound was flushed by conventional method before incision suture for the patients in the control group, and pulse irrigation was applied for those in the observation group before suture. Postoperative incision infection rate, primary healing rate and the level of incision healing were compared. Rates of incision infection and wound healing in patients of the control group were 9.5% and 90.5%, respectively, and the corresponding rates in the observation group were 1.3% and 98.7%. The differences between the two groups were statistically significant ($\chi^2=10.51$, $p<0.05$); level-A healing was observed in 132 patients of the control group and 150 in the observation group, with a statistically significant difference between groups ($\chi^2=10.68$, $p<0.05$). Pulse irrigation effectively reduces the incidence of incision infection in tibiofibular fracture and improves the incision healing level.

Introduction

Tibiofibula is one of the most common fracture sites, accounting for about 10% of all fractures, and tibiofibular fracture occurs in different age groups [1]. Most of tibiofibular fractures are caused by direct violence, such as smashing, colliding, and hitting, as well as indirect violence, such as falls at ground level or from height [2], and treated mainly by surgical procedures in clinical practice. Tibiofibular fractures are mainly open fractures and open wounds are seriously contaminated. Conventional flushing can clean only the contaminations on wound surface and is not effective for deep wounds and dead corners, leaving behind residues for secondary contamination and subsequent incisional wound infection and deep tissue infection. Standardized and effective flushing method has always been a research topic for medical professionals. Pulse irrigator can remove foreign matters and bacteria from tissue by high pressure pulse, and complete debridement is then achieved. Pulse irrigator has been widely used in joint replacement surgery, and gradually applied to orthopaedic trauma surgery in recent years. 158 patients with tibiofibular fractures admitted in our hospital between Feb. and Nov. 2016 were treated with pulse irrigator to prevent incision infection and favorable results were obtained, which was reported as follows.
Information and Methods

General Information

Clinical data of 158 patients with tibiofibular fracture admitted in our hospital between Jan. and Dec. 2015 and 158 with tibiofibular fracture admitted between Feb. and Nov. 2016 were reviewed. Patients were divided into the observation group and the control group and diabetes and other underlying diseases were excluded. Surgical operations were performed by surgeons with comparable work experience in a 40m2, hundred-level laminar flow operating room, at temperature of 22-25°C and humidity of 50-60%. The numbers of people entering the operating room and opening/closing doors were strictly limited during the operation. For the patients in both groups, routine 30mins preoperative prophylactic antibiotics and postoperative antibiotics for 3 days were administered, and conventional care, including drainage, cleaning, and dressing change, was adequately given. The two groups were comparable and no differences were noted in sex, mean age, and type of fracture.

Methods

Flushing method

Conventional method, i.e., flush with syringe or direct irrigation, was used in patients of the control group before incision suture. Specifically, incision was first flushed with 500ml diluted povidone iodine solution (1:10), followed by 1000-1500ml normal saline, to wash off dirt and blood from the surface. For patients in the observation group, pulse irrigator was employed to thoroughly flush the incision before suture. Incision was first flushed with 300-500ml povidone iodine solution (1:10) and then with 800-1000ml normal saline to completely remove any substances such as blood clots, tissue debris and bone scraps, and then sutured.

Evaluation indexes

Incision healing of the patients was evaluated as level A, B, and C, and incision infection was defined as those with redness, swelling, and pain or purulent secretion.

Statistical Methods

Data were collected and processed. All data were analyzed by using the SPSS21.0 statistical software. Numeration data were presented as ratios and the $\chi^2$ test was used for comparison; measurement data were presented as mean ± standard deviation ($\bar{x} \pm s$), and compared with independent t-test. P<0.05 was considered to indicate a statistically significant difference.

Results

Comparison of Incision Infection Rate and Primary Healin Rate between the Two Groups

Wound infection occurred in 2 patients in the observation group, with an infection rate of 1.3%, and 15 in the control group, with an infection rate of 9.5%. The incision infection rate of the observation group was significantly lower than that of the control group, and the difference was statistically significant (p<0.05); 156 out of the 158 patients in the observation group achieved primary healing, with a healing rate of 98.7%, and 143 patients out of the control group achieved primary wound healing, with a healing rate of 90.5%. The healing rate of the observation group was significantly increased compared with the control group, and the difference between two groups was statistically 1(p<0.05, Table 1).
Table 1. Comparison of the rate (%) of incision healing and the incidence (%) of infections between the two groups of patients.

<table>
<thead>
<tr>
<th>Group</th>
<th>n</th>
<th>Infection cases</th>
<th>Primary number</th>
</tr>
</thead>
<tbody>
<tr>
<td>Control group</td>
<td>158</td>
<td>2</td>
<td>156</td>
</tr>
<tr>
<td>Observation group</td>
<td>158</td>
<td>15</td>
<td>143</td>
</tr>
</tbody>
</table>

\[ \chi^2 \] 10.51

\[ p \] P < 0.05

Comparison of Incision Healing Level between the Two Groups

150 cases with level-A incision healing and 6 with level-B incision healing were observed in the observation group, which was significantly better than the control group, as shown in Table 2.

Table 2. The status of the incision healing of the two groups of patients (case).

<table>
<thead>
<tr>
<th>Group</th>
<th>Level of healing</th>
<th>n</th>
<th>A</th>
<th>B</th>
<th>C</th>
</tr>
</thead>
<tbody>
<tr>
<td>Control group</td>
<td></td>
<td>158</td>
<td>132</td>
<td>11</td>
<td>15</td>
</tr>
<tr>
<td>Observation group</td>
<td></td>
<td>158</td>
<td>150</td>
<td>6</td>
<td>2</td>
</tr>
</tbody>
</table>

Discussion

Significance of Incision Irrigation in Patients with Fracture

Surgical site infection has always been the key concern for medical professionals. Patients with fracture are mostly traumatically injured and their conditions are urgent. These patients are often complicated with severe trauma, massive blood loss, and reduced body resistance against adverse factors, and prone to infections. Once infected, fractured patients are not easy to control in later stage, which may lead to delayed healing or even nonunion. If the infection involves soft tissue and bone tissue, risk of amputation may present and irreversible damage will occur, threatening the patient's life. Keeping incision clean and controlling the infection to leave the fracture healing unaffected is also the key to fracture treatment \[^{[3]}\]. No bacterial contamination is a prerequisite for incision healing, and clean incision is particularly important. Thorough cleaning and irrigation are required before surgical incision closure to ensure the healing of the incision.

Pulse Irrigation to Prevent Incision Incision Infection

Conventional flushing method has been long used in clinical practice, i.e., surgical site is flushed with a syringe or irrigated with sterile solution using a medical bowl. Surgical sites cannot be completely cleaned via this method, and blood clots, tissue debris and necrotic tissue are still remained in deep wound and dead corner, where conventional flush or irrigation are not effective and residual substances are not completely removed. Studies have shown that tissue debris left in the surgical site is correlated with the incision infection \[^{[4]}\]. On the other hand, irrigation solution is poured by itinerant nurses and the process may be
repeated when large volume is needed, which is likely to introduce bacteria; meanwhile, irrigation solution is easy to overflow when using the conventional method, resulting in the soaked dressing around the surgical site. Most wound dressing currently used in China is made from cotton-woven fabrics and the impermeability is poor. Soaked dressing loses its barrier effect and becomes a suitable medium for bacteria growth \[5\], increasing the probability of incision contamination. Pulse irrigator dissociates pathogens or foreign matters from tissues by vibrations from pulse pressure and the pressure may thoroughly clean the blood clots and residual tissues in incision, so the surface of wound can be completely cleaned. Studies have also showed that certain pressure is required to flush incision to remove pathogenic microorganisms from the wound surface \[6\]. At the same time, pulse irrigation is a process, in which irrigation and aspiration are conducted simultaneously, i.e., all irrigation solution is aspirated from the wound surface while irrigation continues. Therefore, the dressing around the incision will not be soaked and infection-related factors are avoided; the simultaneous irrigation and aspiration also simplifies the process and saves operation time by omitting the repeated pouring and removing solution after irrigation. Operation time is positively correlated with the incidence of infection, and shortened operation time reduces the incidence of infection \[7, 8\]. In the present study, both incision infection rate and wound healing level of the observation group treated with pulse irrigation were significantly higher than the control group and pulse irrigation was effective in preventing incision infection in tibiofibular fracture.

**Measures to Prevent Incision Infection in Fractured Patients**

Patients with fracture are mostly hospitalized in emergency and preoperative preparation is inadequate. So corresponding management process should be set: (1) Emergency patients should be transferred to an internal cart when entering an operating room and covered with surgical drapes or quilt. For those cannot be transferred, supplies on the patient’s bed should be removed as possible and the external cover quilt is replaced with a surgical drape or quilt from the operating room, to reduce the contamination in operating room with the patient’s clothing. Before entering the operating room, dust on the wheels of the operation table is removed by passing through an adhesive dust control mat twice. (2) Rational use of antibiotics. Process and regulation of antibiotic application in the operating room should be strictly followed. 30mins preoperative antibiotic application and an additional intraoperative antibiotic application when operation time is longer than 3 hours should be conducted; (3) strengthen the management of the operating room. Operating room is an important link and department to prevent incision infection. Quality of air in the operating room should be ensured to correspond to the standards and aseptic techniques should be strictly followed during operation. Training and cultivation of sterile awareness in health care providers should be emphasized; control should be combined with management to reduce the incidence of surgical wound infection.

**References**


