Original Article

Study on treating tumor patients with a peripherally inserted central catheter

Jiao Zhong1*, Bin Wang2*, Qiaoling Huang2

1Department of Oncology, The Central Hospital of Wuhan, Tongji Medical College, Huazhong University of Science and Technology, Wuhan 430014, Hubei Province, China; 2Department of Chest Tumor, Xiangyang Central Hospital, Affiliated Hospital of Hubei University of Arts and Science, Xiangyang 441021, Hubei Province, China. *Equal contributors and co-first authors.

Received July 1, 2020; Accepted November 6, 2020; Epub January 15, 2021; Published January 30, 2021

Abstract: Objective: To investigate the clinical effects of a peripherally inserted central catheter (PICC) compared to a clavicularly inserted venous catheter (CIVC), and formulate nursing measures for allergy response to transparent film after catheterization. Method: A total of 250 tumor patients treated in our hospital were randomized into the Routine Group (RG, receiving CIVC) and the PICC Group (PICCG, receiving PICC). The number of attempts for successful catheterization, puncture time and catheter indwelling time, incidences of adverse reactions during and after puncture were recorded in both groups. Twenty-five patients who were not allergic to catheterization but to the transparent film during affixation after PICC were divided into the Observation Group (OG, n=13, transparent dressing after routine nursing and alcohol application) and the Control Group (CG, n=12, transparent dressing after disinfection). Results: The one-time success rate of catheterization was 94.03% in the PICCG and 79.17% in the RG ($X^2=10.312, P<0.05$); the two groups exhibited no statistical difference in the total success rate ($X^2=0.421, P>0.05$); the PICCG showed shorter puncture time and longer indwelling time ($P<0.05$), but no significant difference was found in the completion rate between both groups within the set time ($P>0.05$). The total incidence of abnormal puncture was 13.24% in PICCG and 22.22% in RG ($X^2=5.179, P<0.05$). The PICCG exhibited higher incidences of phlebitis and catheter occlusion and lower incidences of puncture leak, catheter disconnection and catheter infection ($P<0.05$). The incidence of new allergies at 7 d in the OG was significantly lower than that in the CG ($P<0.05$). Conclusion: PICC is an ideal therapy to shorten the puncture time and reduce the incidences of abnormal puncture, leak after catheterization and catheter disconnection. Using gauze soaked in gentamicin and dexamethasone injections plus Chitosan wound dressing to prevent skin rash around the PICC point at 7 d after operation has demonstrated obvious efficacy and effectively improved the nursing safety.

Keywords: PICC indwelling, malignant tumor, allergy, nursing measures

Introduction

With the aggravation of environmental pollution, both food and health safety can be threatened, and since electrical radiation equipment and pollution are increasing, this leads to an increasing incidence of tumors year by year. Chemotherapy and surgery are the main methods to treat tumors at present, among which chemotherapy can be added to adjunctive therapy after tumor operation [1]. Peripherally inserted central catheter (PICC) is the primary administration route of chemotherapy and has marked effects in reducing the exudation of chemotherapeutic drugs [2]. In order to reduce the incidences of complications related to PICC occlusion and infection, and prolong the catheter indwelling time, routine or quality nursing is provided in clinic [3].

Some patients may be allergic to the transparent film used in catheterization, especially in spring and summer, which causes infection and seriously threatens their life [4]. It has been found that improper nursing during chemotherapy may damage vessels and lead to exudation of chemotherapeutic drugs, resulting in tissue necrosis at the needle insertion point and further affecting the progress and outcomes of chemotherapy [5]. Henceforth, a good puncture regime and a rational nursing regime may improve the survival of tumor patients. In PICC
nursing, allergy to the transparent film is a key issue that needs to be addressed [6]. In order to prolong the use time of PICC and ensure the safety of patients’ use and medication, as well as effectively avoid the occurrence of complications, this study illustrated the prevention and nursing of common complications after PICC in tumor patients. This study has made remarkable achievements in treating tumor patients with PICC and preventing allergy to catheterization by gentamicin and dexamethasone and allergy to transparent film by alcohol deiodination.

Materials and methods

General data

A total of 250 tumor patients admitted to our hospital from January 2018 to April 2020 were enrolled and randomized into the Research Group (RG, n=99) and the PICC Group (PICCG, n=151). This was their first chemotherapy treatment, and catheterization was necessary.

Inclusion and exclusion criteria

Inclusion criteria: patients with lymphoma, gastric cancer, lung cancer, breast cancer, esophageal cancer and colorectal cancer; and patients who all were successfully catheterized at one time were included. All patients signed the written informed consent. This study was approved by the ethics committee of our hospital.

Exclusion criteria: patients who were lost to follow-up; those who were not able to withstand catheterization; and who were accompanied by mental disorders or unconsciousness were excluded.

Puncture mode

Preparation before catheterization: Silica gel catheters were selected based on patients' conditions and vessel diameters. In this study, the PICC single-lumen catheters produced by the American company BD were used in view of its flexible walls and high affinity to human body. Patients maintained a posture best for puncture. PICC puncture method: sterility was ensured throughout the process. A catheter was placed into a vein in the right hand of patients wearing a tourniquet. Patients were observed during this time. The operation was stopped if patients felt uncomfortable; otherwise, the operation was continued by securing the catheter. Routine puncture method: a catheter was placed to a depth of 12-14 cm at the incisura middle point of the jugular vein. The skin was then sutured and secured, and the position of the catheter was determined by X-ray imaging. Twenty-five patients who were not allergic to catheterization but to the transparent film during affixation after PICC were randomized into the Observation Group (OG, n=13) and the Control Group (CG, n=12). For patients in the CG, nursing and dressing were done according to PICC procedures. For patients in the OG, a solution was prepared by mixing 15 mg of gentamicin injection and 2.0 mg of dexamethasone with 40 ml of normal saline. A piece of sterile gauze wet with the solution was applied to the skin with the rashe for 25 to 35 min, and then the PICC was secured with Chitosan wound dressing.

Prevention of allergy to transparent film: CG: after routine disinfection and dressing, a transparent dressing was affixed to the catheterization point. OG: alcohol deiodination was added between the steps of disinfection and affixation of transparent dressing for the CG.

Observation indicators: The number of attempts for successful catheterization, puncture time and catheter indwelling time, and incidences of adverse reactions during and after puncture were recorded and compared between the two groups.

Statistical analysis

Statistical analysis was performed with SPSS 17.0. In case of numerical data it was expressed as mean ± standard deviation (mean ± SD), comparison studies were carried out through t test; in case of nominal data it was expressed as [n (%)], comparison studies were carried out through $\chi^2$ test for intergroup comparison. For all statistical comparisons, significance was defined as $P<0.05$ [7].

Results

Comparison of general data between the two groups

The RG included 58 males and 41 females, with the mean age of (55.6±6.3) years. The PICCG included 87 males and 64 females, with the mean age of (54.2±4.1) years. The two
Effects of PICC and CIVC

Comparison of groups in gender and age

Groups were not statistically different in gender and age ($P > 0.05$).

Comparison of success rate between the two catheterization methods

The one-time and two-time success rates of catheterization in PICCG were 94.03% and 3.97%, and 79.17% and 10.42% in the RG ($P < 0.05$). The three-time success rate in PICCG was 98.01%, and 93.93% in the RG ($P > 0.05$) (Table 1).

Comparison of puncture time and catheter indwelling time between the two groups

The PICCG exhibited significantly shorter puncture time and significantly longer indwelling time than the RG ($P < 0.05$). * indicates that compared with the regular group, ($P < 0.05$).

Comparison of incidence of abnormal puncture between the two groups

The incidences of local hemorrhage and hematoma and catheter displacement were 5.29% and 7.94% in the PICCG, and 6.06% and 1.01% in the RG ($P < 0.05$). The incidences of hemoptoememothorax and misplacement into an artery were significantly lower in PICCG ($P < 0.05$) (Table 2).

Comparison of incidences of adverse reactions after catheterization between the two groups

The incidences of phlebitis, catheter occlusion, puncture leak, catheter infection and catheter disconnection were 17.88%, 22.51%, 1.32%, 2.64% and 0.00% respectively, in the PICCG; and 5.05%, 7.07%, 5.05%, 4.04% and 6.06% respectively, in the RG ($P < 0.005$) (Table 3).

Comparison of efficacy and effects of preventing allergy to catheterization between the CG and the OG

Whether allergy prevention was effective was verified from the date on which patients were found with an allergic reaction according to the clinical records. Any new allergy within one week after allergic treatment was also recorded. The incidence of new allergies in the OG was significantly lower than that in the CG ($P < 0.05$) (Table 4). New allergies were defined as number of allergic cases occurring in the same day. The score of allergic reaction was positively correlated to its severity. Healthy subjects with no allergy had no points, and patients with allergic shock had 100 points.

Comparison of efficacy and effects of preventing allergy to transparent dressing between the CG and the OG

Any new allergy within one week after medication was recorded in both groups. In case of degree of allergy expressed as numerical data, comparison studies were carried out through t

Table 1. Comparison of success rate of between the two catheterization modes [n (%)]

<table>
<thead>
<tr>
<th>Group</th>
<th>One-time success</th>
<th>Two-time success</th>
<th>Three-time success</th>
<th>Total success rate</th>
</tr>
</thead>
<tbody>
<tr>
<td>PICCG (n=151)</td>
<td>142 (94.03)</td>
<td>6 (3.97)</td>
<td>3 (1.98)</td>
<td>98.01</td>
</tr>
<tr>
<td>RG (n=99)</td>
<td>76 (79.17)</td>
<td>17 (10.42)</td>
<td>6 (6.25)</td>
<td>93.93</td>
</tr>
<tr>
<td>$X^2$</td>
<td>10.30</td>
<td>0.41</td>
<td></td>
<td></td>
</tr>
<tr>
<td>$P$</td>
<td>&lt;0.05</td>
<td>&gt;0.05</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

Figure 1. Comparison of puncture time and catheter indwelling time between the two groups. The PICCG exhibited significantly shorter puncture time and significantly longer indwelling time than the RG ($P < 0.05$). * indicates that compared with the regular group, ($P < 0.05$).
Effects of PICC and CIVC

### Table 2. Comparison of the incidences of abnormalities during puncture [n (%)]

<table>
<thead>
<tr>
<th>Group</th>
<th>Local hemorrhage and hematoma</th>
<th>Hematopneumothorax</th>
<th>Misplacement into an artery</th>
<th>Catheter displacement</th>
<th>Total incidence</th>
</tr>
</thead>
<tbody>
<tr>
<td>PICCG (n=151)</td>
<td>8 (5.29)</td>
<td>0</td>
<td>0</td>
<td>12 (7.94)</td>
<td>20 (13.24)</td>
</tr>
<tr>
<td>RG (n=99)</td>
<td>6 (6.06)</td>
<td>5 (5.05)</td>
<td>10 (10.10)</td>
<td>1 (1.01)</td>
<td>22 (22.22)</td>
</tr>
</tbody>
</table>

\[ X^2 \]

\[ P < 0.05 \]

### Table 3. Comparison of incidence of adverse reactions after catheterization between the two groups [n (%)]

<table>
<thead>
<tr>
<th>Group</th>
<th>Phlebitis</th>
<th>Catheter occlusion</th>
<th>Puncture leak</th>
<th>Catheter infection</th>
<th>Catheter disconnection</th>
</tr>
</thead>
<tbody>
<tr>
<td>PICCG (n=151)</td>
<td>27 (17.88)</td>
<td>34 (22.51)</td>
<td>2 (1.32)</td>
<td>4 (2.64)</td>
<td>0 (0.00)</td>
</tr>
<tr>
<td>RG (n=99)</td>
<td>5 (5.05)</td>
<td>7 (7.07)</td>
<td>5 (5.05)</td>
<td>4 (4.04)</td>
<td>6 (6.06)</td>
</tr>
</tbody>
</table>

\[ X^2 \]

\[ P < 0.05 \]

\[ P < 0.05 \]

\[ P < 0.05 \]

\[ P < 0.05 \]

### Table 4. Comparison of the incidence of allergy within 1 week after preventing allergy to catheterization between the two groups (%)

<table>
<thead>
<tr>
<th>Group</th>
<th>New allergy rate</th>
<th>Allergy score within 1 week</th>
<th>1</th>
<th>2</th>
<th>3</th>
<th>4</th>
<th>5</th>
<th>6</th>
<th>7</th>
</tr>
</thead>
<tbody>
<tr>
<td>PICCG (n=151)</td>
<td>4.76</td>
<td>76.60 61.70 50.90 39.20 27.30 20.60 10.80</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>RG (n=99)</td>
<td>17.86</td>
<td>78.20 69.70 66.80 60.20 58.20 56.60 50.70</td>
<td></td>
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<td></td>
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</tbody>
</table>

### Table 5. Comparison of the incidence of allergy within 1 week after preventing allergy to transparent dressing between the two groups (%)

<table>
<thead>
<tr>
<th>Group</th>
<th>New allergy rate</th>
<th>Allergy score within 1 week</th>
<th>1</th>
<th>2</th>
<th>3</th>
<th>4</th>
<th>5</th>
<th>6</th>
<th>7</th>
</tr>
</thead>
<tbody>
<tr>
<td>PICCG (n=151)</td>
<td>9.52</td>
<td>59.20 50.00 41.10 30.20 20.50 11.90 8.20</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>RG (n=99)</td>
<td>19.05</td>
<td>62.70 60.50 55.70 50.90 47.80 44.40 39.10</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

test; in case of new allergies expressed as nominal data, comparison studies were carried out through \( X^2 \) test. The number of new allergies and the score of degree of allergy were significantly lower in the OG (\( P < 0.05 \)) (Table 5).

**Discussion**

In intravenous infusion, stainless needles have been replaced by intravenous indwelling tubing. PICC has been widely used in clinical infusion treatment [8]. It can maintain a reliable venous channel in the body to reduce the pain of inserting needles, reduce the labor intensity and workload undertaken by medical staff, and improve work efficiency [9]. With the development of medical technologies, the application of PICC in the medical field has further expanded from blood transfusion and infusion to the role of examination channel for central venous pressure. Besides, for tumor patients, PICC forms a channel for chemotherapy drug infusion and nutritional support [10, 11]. Tumor patients require longer periods of central catheterization. Repeated needle insertion will not only increase pain, but also cause many complications [12, 13]. It was found in this study that the puncture time was shorter in the PICC mode owing to the simple operations which improved medical staffs’ work efficiency.

In this study, it was found that the catheter indwelling time in the PICC group lasted for a longer time, about 6 months on average, avoiding repeated puncture and pain. According to the success rate of puncture, PICC resulted in a
Effects of PICC and CIVC

high one-time success rate and less pain to patients, suggesting its simplicity in operation. During PICC insertion, hematopneumothorax and misplacement into an artery were not reported, but local hemorrhage and hematoma and catheter displacement were observed. Even so, the overall incidence of adverse reactions was still lower than in the RG. Studies on the adverse reactions after catheterization indicated that the incidences of phlebitis and catheter occlusion were higher in the PICCG. This could be due to a bacterial infection caused by the catheter indwelling in the body for too long, or poor personal hygiene after discharge leading to infection of the catheterization point [14]. Some studies have pointed out that catheter occlusion and dislocation are also common complications after catheterization, and catheter occlusion is mainly caused by catheter sealing, incorrect flushing methods, drug precipitation, catheter distortion, catheter dislocation, fiber sheath wrapping, etc. [15]. The nursing countermeasures in this study are to control the infusion speed during the infusion of patients, keep the catheter unobstructed, and prevent the catheter from being buckled or twisted. The catheter should be sealed immediately after the infusion is completed, and the blood clot should be drawn in time to avoid the catheter occlusion. Studies have shown that intravenous infusion of drugs may cause blood reflux and coagulation which block the catheter. Both adverse reactions were probably due to the long catheter indwelling time in the PICC mode [16]. The low incidences of puncture leak and catheter disconnection in the PICC mode suggested that the catheter was firmly secured and connected as a result of its fixing method, which significantly improved the safety of catheterization [17]. A series of adverse reactions with less serious consequences were also reported in the PICC mode, including phlebitis which disappeared after medication and catheter occlusion which was mitigated by dredging [18, 19]. According to this study, patients receiving PICC should be treated for infection to avoid adverse reactions associated with PICC. Allergy is usually expected after PICC insertion, mainly manifested as rash around the puncture point. The causes of rashes are allergy to the material of PICC, sweat stimulation, compromised physical resistance due to increased times of chemotherapies and repeated dressing at the catheterization point. In this study, wet compress with gentamicin injection and dexamethasone injection showed good prevention and treatment effects with skin rashes at the catheterization point [20-22]. According to the principle of PICC, the central veins were prone to nosocomial infection in the process of dressing. Therefore, during affixation of the transparent film after catheterization, sterilization and disinfection were necessary [23-25].

In conclusion, regardless of the high incidences of phlebitis and catheter occlusion arising from the long catheter indwelling time, PICC manages to shorten the puncture time, extend the catheter indwelling time, avoid repeated punc- tures, mitigate pains and discomforts during catheterization, and improve the catheterization effectiveness and safety, which deserves to be popularized in the clinic. In this study, the prevention and treatment of allergy after catheterization or allergy to transparent film are feasible, but there are also some limitations. Therefore, how to prevent allergy in PICC nursing shall be further studied in the light that the nursing of tumor patients is a complicated and changeable pathological process. Patients’ physical conditions, immunity and anti-allergic ability may change in the process of radiotherapy or chemotherapy, which requires different prevention regimes for different patients at different stages. The limitations of this study are as follow: (1) Due to the time limitation, the sample size is small, which makes it impossible to analyze the influencing factors of allergies after PICC intubation, such as whether dietary factors, mental factors, drug factors, etc. will affect the appearance of allergies; (2) There are only a few ways explored in this study to improve PICC intubation allergy.

Disclosure of conflict of interest

None.

Address correspondence to: Qiaoling Huang, Department of Chest Tumor, Xiangyang Central Hospital, Affiliated Hospital of Hubei University of Arts and Science, No. 136, Jingzhou Street, Xiangcheng District, Xiangyang 441021, Hubei Province, China. Tel: +86-710-3522567; E-mail: huangql567@163.com

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Effects of PICC and CIVC


