Alginate Dressing Application in Hemostasis After Using Seldinger Peripherally Inserted Central Venous Catheter in Tumor Patients

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Abstract The aim of this study is to observe hemostatic effects of alginate dressing after using seldinger PICC catheter in tumor patients. Sixty tumor patients with PICC receiving chemotherapy were divided into the test group (30 cases) and the control group (30 cases) randomly. The test group was treated with alginate dressing and oppressed by the puncture point, while the control group was treated with gauze of the same size. PICC transparent films were used in both groups. Finally, dressing ooze blood soaked states on the puncture points and dressing change times were observed in the two groups for 1 week. Moreover, local infection rate and incidence of catheter leak were also evaluated. The results showed that the oozing of blood and the changing frequency in the test group were obviously less than that in the control group, and there has a statistical difference ($P < 0.05$). Infection rate of puncture point and incidence of catheter leak were simultaneously reduced in the test group. Alginate dressing is effective in preventing seldinger PICC catheter-induced hemorrhage.

Keywords Alginate dressing · Seldinger PICC catheterization · Hemostasis · Tumor · Chemotherapy

Introduction

Tumor patients are usually treated with chemotherapeutic drugs by intravenous infusion, but the traditional route of administration inevitably causes pain to the patients, and chemotherapy drugs cause damage to vessels or extravasation of chemotherapeutic drugs causes local tissue necrosis [1].

Seldinger peripherally inserted central venous catheter (PICC) is a centesis of peripheral vein including basilic vein, median cubital vein and cephalic vein that guided through catheter sheath by core-free needle, and the seldinger PICC is also a centesis with its pointed end located in superior vena cava [2]. Because blood flow is large in superior vena cava and thus it can decrease liquid osmotic pressure and drug concentrations rapidly, damage to peripheral vascular and stimulation on local tissues by chemotherapy drugs are excluded, and chemical phlebitis and tissue necrosis induced by extravasation of chemotherapeutic drugs were excluded [3–5]. PICC provides a safer, more effective and convenient method for tumor patients receiving tumor chemotherapy and patients with long-term infusion of hypertonic stimulation drugs. With the increased clinical application of seldinger PICC, local bleeding during puncture becomes one of the key problems for catheter nursing [6]. Bleeding often occurs after puncture in 1 week, and if it is not treated properly, long term bleeding often induces inflammation and increase panic of patients, which affects the prognosis of the diseases.

Alginate dressing is a soft non-woven fabrics extracted from seaweeds. When blood enters alginate dressing, blood platelet factors are released and enhance blood coagulation. Up to now, alginate dressing has been mainly used in concis, pressure sore, epistaxis and hemostasis of donor sites [7]. Alginate dressing was used in local pressure haemostasis of saidinger PICC puncture in our department

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from January of 2012 to August of 2012. The treatment effects were good and introduced here.

Materials and Methods

Clinical Data

Sixty patients receiving saidinger PICC and chemotherapy were collected in our department from January of 2012 to August of 2012. There were 34 men patients and 26 women patients with ages between 26 and 80 and mean age of 32.8. The patients were divided into two groups with each group of 30 subjects randomly according to order of admission to the hospital. There were no statistical difference in ages, genders, clotting times, platelet counts, and vascular conditions between the two groups ($P > 0.05$). Three directional valve type PICC tubes with parameter of 4.0 Fr was produced by German Budd Company and used in the two groups. The fixed dressing at puncture points was produced by 3 M company with transparent films of 8.5 and 10.5 cm. Hemostatic materials used at sites of puncture were Kang Huier alginate dressing with specification of 44 cm.

Methods

Initially, PICC operation was undertaken by skilled nurses according to the conventional catheterization procedures. Alginate dressing was taken out by assistant nurses under strict aseptic conditions. Then, two-layer square alginate dressing with 3 cm side were overlapped and covered at the centre of the PICC puncture sites, and polyurethane material for 3 M transparent dressing was further pushed on the puncture point for 30 min. Finally, a packing with elastic stockings was done outside the dressings and removed 24 h later. As for control groups, a uniform operation procedure was applied and the two-layer square alginate dressing was substituted by gauze dressing. No hemostatic, such as EACA or tranexamic acid solutions, was added in experimental and control groups. Patients in the two groups were advised to reduce activities of puncture limbs, and they were not allowed to move or lift heavy weights in 2 h. The patients were advised to exclude strenuous activities of punctured limbs in 1 week. When all procedures were completed, tube positions were confirmed by X-ray films, and lots of items including puncture time, date, types of PICC, insertion length, names of punctured vessels and puncture procedures were recorded.

Parameters Observation

Local bleeding and dressing change times were observed in patients in 1 week. Bleeding was rated various classes. When

there was no bleeding or little bleeding at the puncture sites, it belonged to normal phenomenon and designated as 0 class. When there was little bleeding and it lasted for 2–3 days, it was designated as I class. When there was bleeding at the puncture sites for 4–5 days, it was designated as II class. When there was bleeding at the puncture sites for 6 days or more, it was designated as III class. Local infection was graded as: (1), skin red swelling of entry of catheter was defined as low-grade infection; (2), sclerosis of skin was defined as intermediate-grade infection; (3), purulent secretion of skin was defined as severe-grade infection. Catheter leak was graded by area of subcutaneous exudation: (1), Less than 1 cm × 1 cm was defined as low-grade; (2), More than 2 cm × 2 cm was defined as severe-grade; (3), The remaining was defined as intermediate-grade.

Statistical Analysis

Experiment in each group was repeated three times. SPSS 13.0 software was used for analysis. Data described in this study are demonstrated as percentages. Statistical significance between multiple groups was determined and analyzed by one-way analysis of variance (ANOVA), and comparison between two groups was analyzed by Student's *t*-test using SPSS version 13.0 software. Chi square test or exact probability calculation method was used in comparison of count data between groups. A *P* value of less than 0.05 was considered statistically significant.

Results

Alginate Dressing Application Decrease the Severity of Hemorrhage

In the present study, we investigated the effects of alginate dressing application on the PICC catheter-induced hemorrhage. The results indicated that the cases in the higher class (class I, class II and class III) in the control group were significantly more than that in experimental group (Table 1; Fig. 1, $P < 0.05$). However, the cases in lower class (class 0) in control group were significantly fewer than that in experimental group (Table 1; Fig. 1, $P < 0.05$). These illustrated that the treatment of alginate dressing

Table 1 Comparison of two groups of patients with hemorrhage case (cases)

Groups	Cases	0 Class	I Class	II Class	III Class
Experiment group	30	22*	5*	3**	0*
Control group	30	11	9	6	4

Note compared with control group

* $P < 0.05$, ** $P < 0.01$

Fig. 1 Alginate dressing application decreases the severity of hemorrhage. * $P < 0.05$, ** $P < 0.01$ represent experiment group compared with control group, respectively

could decrease the occurrence and severity of PICC catheter-induced hemorrhage significantly.

Dressing Change Times in One Week

In the otherwise, the severity also due to the dressing times in 1 week. Thus we studied the dressing time in the two groups in 1 week. The results showed that there were 14 patients for dressing times with 3–4 times, and 16 patients with 1–2 times in 1 week, but no patients more than 5–6 times per week (Table 2). Meanwhile, there were two patients for dressing time more than even times and 12 patients with 5–6 times per week (Fig. 2a). Furthermore, the average dressing changes times for the experimental group were 1.5 times per week, and 2.8 times in the control group (Table 1). The average dressing changes times were fewer significant compared with the control group (Fig. 2b, $P < 0.05$).

Correlation Between Severity of Hemorrhage and Dressing Times per Week

In this study, the correlation between severity of hemorrhage and dressing times was also investigated in both groups. The results indicated that the severity of hemorrhage was

Table 2 Average dressing change time comparison of two groups of patients with hemorrhage case (cases)

Group	Cases	>7 times/ week	5–6 times/ week	3–4 times/ week	1–2 times/ week
Experiment group	30	0*	0*	14*	16*
Control group	30	2	12	13	3

Note compared with control group

* $P < 0.05$, ** $P < 0.01$

positively correlated with the dressing times per week (Fig. 3, $r = 0.6812$, $P < 0.05$).

Local Infection Rate and Incidence of Catheter Leak

To rule out potential adverse effect of alginate dressing, the infection rate of puncture point and incidence of catheter leak were also evaluated. As depicted in Table 3, infection cases, especially low-grade infection, were significantly decreased in experimental group ($P < 0.01$). Moreover, catheter leak cases, especially intermediate-grade catheter leak, were obviously decreased in experimental group (Table 3, $P < 0.01$).

Discussion

Needle head of PICC catheterization in puncture was thick, and local injury was big. Therefore, after chemotherapy, tumor patients tended to have arrest of bone marrow and obstacles of coagulation function, and they have bleeding tendency [8]. There are various factors of bleeding after PICC catheterization at the puncture sites, such as compression, stress and loading of the operated limbs, frequent movement. After PICC catheterization, blood effused from the puncture sites along the catheter which could be seen by patients, which lead to uneasiness and discomfort and cause mental pressure of patients, and thus affected application of tubes [6]. In the present study, bleeding of patients was above class II, and surgical dressing was changed for many times in 1 week. Because of the repeated surgical dressing, the puncture sites were stimulated and wound was not healed, which lead to chances of bleeding.

Alginate dressing is an organic acid extracted from brown algae, and also a cellulose insoluble polysaccharide [9]. Alginate dressing is produced by transforming the insoluble polysaccharides into a calcium salt in the preparation process [10, 11]. It can change insoluble alginate calcium into soluble sodium alginate by ion exchange when it contacts with the wound fluid, and it can release calcium. Alginate dressing has extreme strong absorbance ability, and it can absorb almost 20 times fluid of its weight, which assures the moisture environment of wound healing, and extends dressing time, and in the meantime it can make the autolysis of necrotic tissue in the wound. Furthermore, calcium ion of alginate can form a reticular layer of gel at the wound surface which is helpful in enhancing haemostasis [7, 12]. Therefore, Alginate dressing was used in local haemostasis after surgical operation and haemostasis of burning skin implantation in recent years, which uses characteristics of haemostasis, absorbing bleeding, keep moisture environment of cut surface to enhance wound healing.

The data in the present study showed that bleeding prevalence was lower in 48 h after PICC catheterization at the puncture point with alginate dressing for local

Fig. 2 Dressing change times in 1 week in both groups. **a** Dressing change times in both groups. **b** Average dressing change times. * $P < 0.05$, ** $P < 0.01$ represent experiment group compared with control group, respectively

Fig. 3 Correlation analysis between severity of hemorrhage and dressing times per week

Table 3 Local puncture point infection case and incidence of catheter leak were recorded and compared between the two groups (cases)

Group	Cases	Low-grade infection	Intermediate-grade infection	Severe-grade infection
a. Infection case of the two groups				
Experiment group	30	1**	0	0
Control group	30	11	1	0
Group	Cases	Low-grade catheter leak	Intermediate-grade catheter leak	Severe-grade catheter leak
b. Catheter leak case of the two groups				
Experiment group	30	3	2**	1
Control group	30	5	11	4

Note compared with control group

* $P < 0.05$, ** $P < 0.01$

compression hemostasis than that of gauze local compression of hemostasis, indicating that alginate dressing has more rapid hemostatic effects. In the meantime, long-term

hemostatic effects of alginate dressing in 48–72 h are better than that of small gauze, suggesting that alginate dressing enhances quick healing of puncture wounds to attain long-term hemostatic effects. Moreover, infection rate of puncture point and incidence of catheter leak were simultaneously reduced in the test group. Therefore, after PICC catheterization, application of alginate dressing in preventing bleeding not only reduces pain of patients incurred by PICC catheter local bleeding and the patient's medical expenses, but also reduces time and energy of nurses in changing alginate dressing, and decreases workload of the nursing staffs. Alginate dressing is worth wide application. However, it remains to be investigated how to prevent and treat phlebitis, pipe blockage and other complications induced by alginate dressing.

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Conflict of interest We declare that we have no conflict of interest.

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