

Original Article

Application of peripherally inserted central catheter via femoral vein for pediatric burns

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Abstract: Aims: To explore the efficacy of peripherally inserted central catheter (PICC) via femoral vein and its complication rates in burns children to provide rationales for providing access for venous infusion. Methods: From January 2014 to December 2015, a total of 48 children with moderate-to-severe burns were recruited and assigned into two groups of PICC (n=24) and peripheral intravenous catheter (PIV). And their efficacies and complication rates were compared. Results: Significant inter-group differences existed in one-time puncture success rate, retention duration and overall complication rates. The specific data of PICC and PIV groups were as follows: one-time puncture success rate (95.8% vs 62.5%, $\chi^2=8.084$, $P<0.01$); retention duration: (24.92 ± 25.41 vs 2.63 ± 1.16 days, $z=5.941$, $P<0.01$); overall complication rate (12.5% vs 58.3%, $\chi^2=11.021$, $P<0.01$). Conclusion: With the advantages of higher one-time puncture success rate, longer retention duration and lower complication rate, PICC via femoral vein is ideally suited for infusion in pediatric burns, especially for those with large-area wound, emergency rescue and long-term therapy.

Keywords: Peripherally inserted central catheter, peripheral intravenous catheter, burns children, intravenous infusion

Introduction

As one common type of pediatric trauma, burn injury occurs in 32%-36% of burn patients [1]. Due to microcirculatory disturbances and a depletion of blood volume, hypovolemic shock is prone to happen within 48 h post-injury. And intravenous infusion should be initiated as soon as possible. An optimal management of burn requires stabilizing vital signs, long-term intravenous infusion and nutritional supports [2]. Venous puncture becomes more difficult because of fluid loss, poor venous filling, edema, skin damage and surface wound. And interrupted and slow infusions have further continued a vicious cycle. Peripherally inserted central venous catheter (PICC) works as a great alternative by deploying catheter tips into superior vena cava or inferior vena cava [3]. Despite its wide clinical usage in adults, it has a disappointing success rate in infants and obese children because of their unique physical, mental

and venous constraints [4]. It has been reported that PICC via femoral vein is efficacious for adults of hemorrhagic shock and critical illnesses. However, there are few reports of children. Our departmental success rate of PICC via femoral vein was as high as 95.8% for children from January 2014 to December 2015. And the clinical outcomes were satisfactory with a low complication rate.

Clinical data

A total of 48 children of moderate-and-severe burns were recruited from January 2014 to December 2015. And they were assigned into two groups of PICC via femoral vein and PIV (n=24 each). Their clinical characteristics are summarized in **Table 1**. Inclusion criteria were children of moderate and severe burns and exclusion criteria the same as PICC contraindications.

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Table 1. Comparison of clinical profiles in PICC and PIV groups

Items	N	Gender		Average age (years)	Burn area (%)
		Male	Female		
PICC group	24	13	11	2.28±1.69	(24.63±18.03)%
PIV group	24	15	9	2.14±1.77	(23.58±13.53)%
T value			-	0.286	0.226
X ² value		0.343		-	-
P value		0.558		0.776	0.822

Table 2. Catheterization outcomes in PICC and PIV groups

Groups	N	One-time puncture success rate (%)	Retention duration (days)
PICC	24	95.8	24.92±25.41
PIV	24	62.5	2.63±1.16
χ ² /Z value		8.084	5.941
P value		0.000	0.000

Methods

Preoperative sedation

For pain relief during puncture, preoperative diazepam (0.3 ml per kilogram of body weight) was intravenously injected. Feeding within 30 min pre-operation was withdrawn for preventing suffocation. Respiratory tract status was assessed before sedation for preventing respiratory depression and apnea. And rescue supplies were prepared.

Catheterization instruments

PICC group: PICC Puncture Kit (Bard Access Systems, Inc, USA) was used. And a 3F catheter model with a length of 60 cm and a lumen dimension of 0.31 ml was selected. *PIV group:* a Jierui 24 G conventional peripheral intravenous catheter (Weigao Holding, China) with a lumen size of 19 mm and a diameter of 0.7 mm.

Puncture methods

PICC group: Firstly a proper vein was selected. Lying in a supine position, the patients had lower extremities in abduction and external rotation so that their knees slightly buckled. And a barb pose of lower body was adopted. Secondly, after sterilization and wearing aseptic gloves, a puncture site was located at 2-3

cm below the midpoint of inguinal ligament and 0.5-1 cm adjacent to femoral pulse. Local anesthesia was induced by a subcutaneous injection of 2% lidocaine 2 ml. The angle between needle and skin was 30-45° and blood oozed out after insertion. Thirdly, puncture needle sheath was retracted. The left front end of sheath was pressed with left hand while a catheter inserted slowly to the preset length by right hand. Blood was withdrawn and insertion succeeded. Parallel withdrawal of guide wire was initiated. After pressing evacuation sheath tip, excess catheter was sliced off, 7-9 cm reserved and catheter fixed. The catheter tip was radiologically located between 10th thoracic and 1st lumbar vertebra. And abdominal organs were spared.

PIV group: After opening catheter package, a cuff was tied above puncture point. And iodine was applied topically for skin disinfection. Upon drying, needle sheath was removed and needle bevel turned upward. Needle was pierced into skin at an angle of 15-30°. Upon a return of blood, the angle of needle was lowered and further advanced for 0.2-0.5 cm. Right hand was used for fixing while needle core was extracted for 0.5-1 cm by left hand. The outer sleeve was inserted entirely into vein and cuff loosened. Finally needle core was withdrawn and fixed with adhesive film.

Observations

The following parameters were recorded: a) one-time puncture success was defined as one-time needle success without overt subcutaneous vascular action; b) retention duration: between the days of puncture and extubation; c) complications including catheter-related infections and mechanical complications such as phlebitis, catheter blockage and thrombosis.

Statistical analyses

Data processing was performed with SPSS18.0 statistical software. The quantitative data were expressed as mean ± standard deviation ($\bar{x} \pm s$). For inter-group mean comparison, independent sample t test was used for normal distribution and Wilcoxon's rank-sum test for non-normal distribution. Percentage was used for describing the numerical data. And χ^2 test was used for

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Table 3. Comparison of complications in PICC and PIV groups

Groups	N	Phlebitis	Catheter obstruction	Infusion leakage	Dislodged catheter	Puncture site infection	Blood thrombosis	Overall rate
PICC	24	0	2	0	1	0	0	3 (12.5%)
PIV	24	0	6	5	3	0	0	14 (58.3%)
χ^2 value			1.350*	3.572*	0.273*			11.021
P value		1.000	0.245	0.059	0.602	1.000	1.000	0.001

*Corrected χ^2 value.

comparing composition ratios. And $P \leq 0.05$ was deemed as statistically significant.

Results

Catheterization outcomes

One-time puncture success rate was 95.8% in PICC group and it was significantly higher than 62.5% in PIV group ($P < 0.01$). And average retention duration was higher in PICC group than that in PIV group (24.92 ± 25.41 vs 2.63 ± 1.16 days). Refer to **Table 2**.

Complications

In PICC group, complications occurred in 3 patients with an incidence rate of 12.5%. And there were catheter obstruction ($n=2$) and dislodged catheter ($n=1$); while in PIV group, there were 14 complicated cases with an incidence rate of 58.3%. And there were catheter obstruction ($n=6$), dislodged catheter ($n=3$) and infusion leakage ($n=5$). The inter-group difference was statistically significant ($P < 0.01$, **Table 3**).

Discussion

Application advantages of inserting PICC via femoral vein

In clinical practice, PIV has been the most common venue for venous infusion. However, as compared with adults, thin and tiny peripheral veins of children are more susceptible to leakage and even tissue necrosis. Therefore PIV is not suited for a long-term infusion of hyperosmotic fluids and drugs in children [7]. Furthermore, retention duration of PIV is relatively short so that it brings more pains of repeated puncture for long-term infusion. Therefore deep vein insertion has enjoyed wider and wider applications in pediatric infusions. At present, deep venous insertions of PICC and CVC are widely employed and both are technically ma-

ture [8]. However, inserting CVC has been commonly adopted for young children. And the arrival of inserting PICC is relatively recent [9]. Even for inserting PICC, the most common puncture site is also upper extremity vein. In the present study, inserting PICC via femoral vein was employed for pediatric burns. And the one-time puncture success rate of 95.8% was obviously higher than 62.5% in PIV group. And the difference was statistically significant ($P < 0.01$). Inserting PICC via femoral vein is ideal for pediatric burns. The reasons are as follows: a) skin is more easily exposed and thus more fragile at upper extremity vein than inguinal femoral vein; b) even if structurally intact, upper extremity veins of small children are relatively thin with numerous branches and small angles. Because of frequent location variations, insertion is rather difficult. In comparison, femoral vein has a thicker lumen, fewer venous valves and a less tortuous course so that it is easier for a successful puncture than upper extremity veins. Furthermore, the surrounding area of femoral vein is devoid of important structures. Due to a great distance away from heart, inserting has a relatively higher safety rate. With a successful puncture, catheter is consistently delivered into inferior vena cava. And there is a lower occurrence rate of ectopic displacement.

Comparisons of retention durations and costs

In the present study, the retention durations of PICC and PIV groups were 24.92 ± 25.41 and 2.63 ± 1.16 days respectively. And the inter-group difference was statistically significant ($P < 0.01$). For large-area critical pediatric burns, establishing one or two venous access paths promptly and timely is of vital importance for replenishing fluid, blood components and albumin colloids to maintain an effective volume of circulatory blood. However, puncture is rather problematic for these patients due to a sharp reduction in effective circulatory blood volume

within a short time and a collapse of peripheral blood vessels. Even puncture is successfully, a sustained and effective access path has often failed to fulfill the requirements of emergency rescue [10]. And inserting PICC via femoral vein allows a direct injection into inferior vena cava and a rapid blood flow enables a rapid onset of pharmaceutical effects. And it has avoided the stimulations and injuries of peripheral veins and local tissues by parenteral nutrition fluids, hyperosmotic drugs and vasoactive agents. And retention duration might be up to 1 year. It could fulfill the requirements of emergency rescue and long-term infusion. After locally applying Comfeel® hydrocolloid, there was an improvement of leakage. In both groups, dislodged catheter was probably related with individual hyperactivity, non-intentional pulling and dressing immobilization, etc. The experiences and lessons were summarized and the relevant health knowledge drills of patients and relatives strengthened. The phenomenon of catheter loosening was minimized. After insertion, the patients were routinely directed and assisted during extremity functional exercises. There was no instance of thrombosis. Another complication of PICC was catheter-associated infection. However, none of them developed systemic or local infection. In short, except for dislodged catheter (n=1), all other insertions were maintained until the conclusion of treatment. All children were cured and discharged without any severe complication.

In summary, inserting PICC via femoral vein is both safe and effective for pediatric burns and it offers the advantages of a high one-time success rate and fewer complications. Thus a conveniently accessed path has been provided for emergency rescue, long-term infusion and blood sampling.

Disclosure of conflict of interest

None.

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