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Original Article

Usefulness of Percutaneous Puncture in Insertion of Totally Implantable Venous Access Devices in Pediatric Patients

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Purpose: Totally implantable venous access devices (TIVADs) are commonly used in pediatrics for the administration of chemotherapy, antibiotics, or parenteral nutrition. TIVADs can be implanted using various techniques, including surgical cutdown (SC) and percutaneous puncture (PP). Recently, percutaneous TIVAD became popular in adults, but studies comparing between PP and SC group in pediatric patients are rare.

Materials and Methods: Data were collected and analyzed retrospectively from 23 patients who underwent TIVAD at a single institution between January 2013 and December 2015. We examined the clinical characteristics, insertion techniques, and clinical outcome. We divided the patients into 2 groups and compared PP with ultrasonography and SC using the insertion technique. We compared success rate, procedural time, and the patency rate between the 2 groups.

Results: Eleven TIVADS were inserted using PP, and 12 TIVADs were inserted using SC. No statistically significant difference in characteristics was found between the 2 groups. The procedural time in the PP group was shorter than that in the SC group, but the difference was not statistically significant (P=0.685). During follow-up, 1 patient in the SC group had an occlusion, and 1 patient in the PP group had an infection.

Conclusion: PP of the internal jugular vein with ultrasonography appears to be the method of choice for TIVAD insertion owing to its similar success rate in terms of implantation and complication rate to that in SC, with shorter procedural times in pediatric patients.

Key Words: Vascular access devices, Catheters, Indwelling, Pediatrics

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INTRODUCTION

Since 1982, when the first implantation of a totally implantable venous access device (TIVAD) was performed, the quality of life of patients who required cytotoxic medication infusion and repeated blood sampling has improved [1].

TIVADs are commonly used in adults and pediatric patients for the administration of chemotherapy, antibiotics, or parenteral nutrition. The use of these devices has improved the compliance of pediatric patients [2,3].

TIVADs can be inserted using various techniques, including surgical venous cutdown and percutaneous approaches

[1]. Recently, percutaneous insertion of TIVADs with ultrasonography guidance became popular in adults [4,5].

Previous studies have shown that percutaneous puncture (PP) for TIVAD implantation was more valuable than the surgical cutdown (SC) technique in adults [6]. However, comparative studies between 2 groups in pediatric patients are rare.

The objective of this study was to compare PP and SC in insertion of TIVADs in pediatric patients. We compared primary success rate, procedural time, postoperative complications, and patency rate between the PP and SC groups.

MATERIALS AND METHODS

Data were collected and analyzed retrospectively from 23 pediatric patients who underwent TIVAD implantation in Inha University Hospital between January 2013 and December 2015. We excluded patients implanted under local anesthesia and the subclavian or femoral vein approach.

The data collected included the clinical characteristics (age, sex, and indication for TIVAD) and insertion technique (insertion vein, percutaneous or cutdown method, ultrasonography guidance, or fluoroscopy guidance). We divided the patients into 2 groups and compared between PP and SC by using the insertion technique.

The primary end points were success rate and procedural time, and the secondary end points were patency rate difference between the 2 groups. The clinical success was defined as no functional problem without other complications regardless of catheter tip location right after operation. Technical success was defined as an accurate tip location. The catheter tip location was confirmed either by using chest radiography postoperatively or intraoperative fluoroscopy. The accurate tip location is at the junction between the right atrium and the superior vena cava [1].

We compared perioperative and postoperative complications between the 2 groups. Implantation was performed in both groups by 2 surgeons, respectively. The decisions about insertion method were made by the attending surgeons. All the procedures were performed in the operating room under general anesthesia. In percutaneous approach cases, the insertion vein was accessed using the ultrasonography guided technique. A micropuncture kit (Cook, Bloominton, IN, USA) was used for initial puncture to minimize arterial injury (Fig. 1). The Seldinger technique is used for inserting the catheter. The Celsite Access Ports (B-brown, Bethlehem, PA, USA) was fixed to the pectoral fascia. The pocket was closed with subcuticular and absorbable sutures.

We compared the mean by using the nonparametric statistical test due to small sample sizes. McNemar's test and Mann-Whitney test were performed to compare between the 2 groups. We performed Kaplan-Meier method for analysis of patency rate.

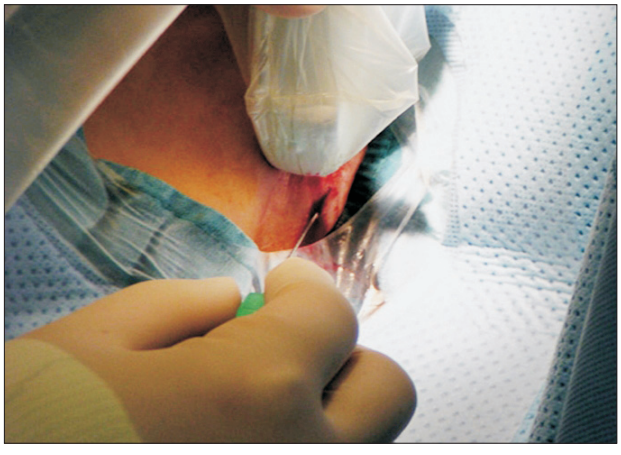

Fig. 1. The micropuncture (Cook, Bloominton, IN, USA) kit was used for initial puncture with ultrasonography.

RESULTS

Eleven TIVADs were inserted by PP; and 12, by SC. No statistically significant difference in the patient characteristics were found between the 2 groups (Table 1).

The procedural time in the PP group (mean, 38.64 minutes) was shorter than that in the SC group (mean, 42.50 minutes), but the difference was not statistically significant (P=0.685). Only the internal jugular vein (IJV) was used only in the PP group. All devices were inserted on the right side in both groups. Fluoroscopy was performed in 8 cases in the PP group during the procedure (Table 2).

Procedure-related immediate complications, such as pneumothorax, hemothorax, and accidental arterial puncture were not observed in both groups. Reposition during

Table 1. Patients' demographic and characteristics

Variable	PP (n=11)	SC (n=12)	P-value
Demographic			
Age (y)	6 (0-16)	4 (0-15)	0.975[b]
Male	4 (36.4)	8 (66.7)	0.356[a]
Indication			0.684[a]
Hematopoietic malignancy	8 (72.7)	7 (58.3)	
Medulloblatoma	2 (18.2)	2 (16.7)	
Nutrition	1 (9.1)	2 (16.7)	
Other	0	1 (8.3)	

Values are presented as median (range) or number (%).
PP, percutaneous puncture; SC, surgical cutdown.
[a]McNemar's test, [b]Mann-Whitney test.

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Table 2. Procedural details

Variable	PP (n=11)	SC (n=12)	P-value
Procedural time (min)	38.64±12.63	42.50±18.89	0.685[b]
Insertion site			0.001[a]
Internal jugular vein	11	9	
External jugular vein	0	3	
Insertion direction			
Right	9 (81.8)	11 (91.7)	0.843[a]
Use of fluoroscopy	8	0	0.001[a]
Technical success rate	9 (81.8)	10 (83.3)	0.912[a]
Clinical success rate	11 (100.0)	12 (100.0)	

Values are presented as mean±standard deviation, number only, or number (%).
PP, percutaneous puncture; SC, surgical cutdown.
[a]McNemar's test, [b]Mann-Whitney test.

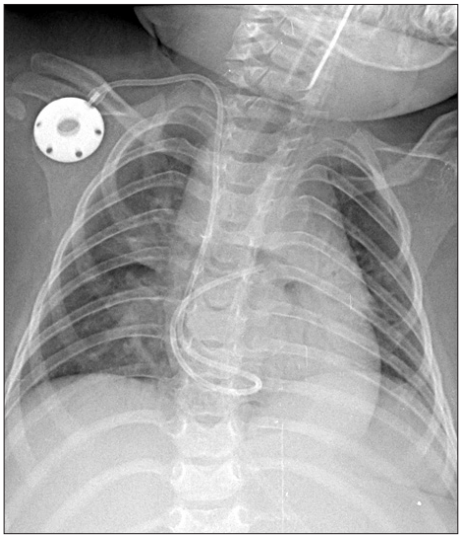

Fig. 2. This postprocedural chest anterior-posterior shows the misplaced catheter tip with no functional problem.

insertion was observed in 4 cases (2 in the PP group and 2 in the SC group) for the misplaced catheter tip (Fig. 2). However, no functional problem was found before the reposition. Accordingly, the clinical success rate was 100% in both groups. However, the technical success rate was not 100.0% because of 4 malposition cases. No statistically significant differences in technical success rate and clinical success rate were found between the 2 groups (Table 2).

The median catheter days was 423 days (range, 62-782 days). During this period, 1 patient in the SC group had an occlusion and 1 patient in the PP group had an infection. However, no statistically significant difference in patency was found between the 2 groups (log rank=0.786) (Fig. 3).

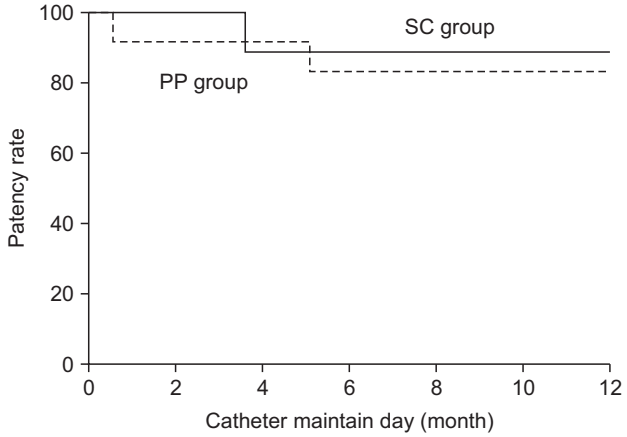

Fig. 3. This shows the patency rate of TIVADs. There is no difference between PP and SC groups. TIVAD, totally implantable venous access devices; PP, percutaneous puncture; SC, surgical cutdown.

DISCUSSION

After the first TIVAD insertion, TIVADs have changed the care of patients who require long-term intravenous therapy, especially pediatric patients [1-3]. Several previous studies have compared the usefulness of PP and SC in the insertion of TIVADs in adults. No significant difference in complication rate was found between the insertion technique groups in adults, except for procedural time. However, the open approach is more frequently used in pediatric patients [1]. Thus, studies comparing between PP and SC group in pediatric patients are rare.

For procedural time, no statistically significant difference was found between the 2 groups. However, dissection of the jugular vein in the PP group was not necessary, unlike in SC. So that, percutaneous approach in insertion TIVADs is useful in difficulty of dissection, such as patients with obesity, pervious incision and small caliber of vein [4,5].

Thus, we expect that the procedural time of the percutaneous approach group will be statistically significantly shorter than that of the SC group in further studies on adults.

In our study, PP group in the insertion of TIVADs has similar primary success rate, procedural time, postoperative complications and patency rate comparing SC group. However, this study has several limitations. We had a small number of cases. Thus, we could not obtain statistically meaningful data about complications. For more reproducible results, further study is needed to accumulate more cases. In addition, other access sites besides the jugular vein should be considered.

Although using fluoroscopy has the disadvantage of ex-

posing the patient to radiation, it is safer owing to the tracing needle puncture, catheter advancement, and tip location in real time. It makes measurement of the appropriate catheter length easier. In our study, 1 case had a revision due to the catheter length after the initial insertion. Intraoperative fluoroscopy during TIVAD insertion should be compared in further study.

In conclusion, in summary, PP of the IJV with ultrasonography guidance appears to be the method of choice for TIVAD insertion owing to the similar success rate in terms of implantation and complication rates to that in SC, with shorter procedural times in pediatric patients.

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