Original Article

Comparison of central venous catheter in brachiocephalic vein and internal jugular vein for the incidence of complications in patients undergoing radiology

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Abstract

Introduction: Central venous catheter (CVC) is an essential part of modern medical care that delivers the drugs, intravenous fluids, and intravenous feeding to the vein. So far, limited studies have been carried out on the brachiocephalic vein (BCV) in adults. This study aimed to compare the CVC in the internal jugular vein (IJV) and BCV in order to ease of access and incidence of complication such as infectious and mechanical complications. **Materials and Methods:** This clinical trial was performed on 52 patients who underwent BCV and the IJV catheterization. The patients were compared in two groups of IJV and BCV in order to facilitate catheterization and measure the success rate and catheterization-induced complications. The difference between the two groups was analyzed by Independent *t*-test and Chi-square tests. **Results:** Overall, 52 patients underwent intravenous catheterization. The success rate of catheterization in the first attempt was 100%. The problems of catheterization procedure in the IJV group (11.5%) were greater than the BCV group (6.6%). There was no significant difference between the two groups regarding the duration of catheterization, pneumothorax, emphysema, hematoma, arterial puncture, infection, and complete thrombosis, whereas the partial thrombosis in the IJV group (30.76%) was significantly ($P < 0.05$) greater than the BCV group (23.07%). **Conclusion:** Catheterization in both brachiocephalic and the IJV is an appropriate, highly efficient, stable, and safe procedure and ultrasound-guided catheterization is very reliable and safe method.

Keywords: Brachiocephalic vein, catheterization, central vein, internal jugular vein, ultrasound

Introduction

In modern medical centers, about 80% of the patients receive medication, liquids, nutrients, and blood products through the central and peripheral veins during the admission.[1,2]

The central venous access (especially interventional radiology) is of particular importance for managing the patients in the intensive care unit.[3] Central venous catheter (CVC) is a necessary part of modern medical care that allows the delivery of medications, intravenous fluids, intravenous feeding, and hemodialysis. CVC can be used to monitor the hemodynamic changes.[4-6] CVC is sometimes associated with adverse complications, including infectious, mechanical, and thrombotic complications.[6,7] The most common complication due to CVC over 72 h is an infectious disorder that occurs locally in the entrance of the catheter and blood, occurring in 5%–26% of cases.[8]

Given their proper location, high blood flow, and easier access, jugular veins are widely used. In this method, the probability of developing pneumothorax and thrombosis is lower. However, it should be taken into account that these

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Received: 08-03-2019 **Accepted:** 26-03-2019

Access this article online

Quick Response Code:

Website: www.jfmpc.com

DOI: 10.4103/jfmpc.jfmpc_205_19

How to cite this article: Motamedfar A, Gharibvand MM, Jalil A. Comparison of central venous catheter in brachiocephalic vein and internal jugular vein for the incidence of complications in patients undergoing radiology. J Family Med Prim Care 2019;8:3379-82.

catheters cause discomfort in patients, especially when moving the neck. Catheters increase the probability of being infected, compared with the subclavian catheter. On the other hand, access to the subclavian vein is difficult and time-consuming and increases the likelihood of damage to the subclavian artery, pneumothorax, and hemothorax. It should be pointed out that it is less infectious, and it is easier for the patient to tolerate.[9] Given the possible infection and thrombosis following the use of internal jugular veins (IJVs) and subclavian, one has to consider alternatives to reduce these complications.

Therefore, targeting the brachiocephalic vein (BCV) and using ultrasound for the administration of CVC may reduce the incidence of complications associated with catheterization and vascular access.[10] BCV cannulation, supraclavicular procedure, and ultrasound can contribute to this to a great extent, especially in children.[11,12]

Accordingly, this study aimed to compare the placement of central vein catheter in IJV and brachiocephalic in terms of ease of access and incidence of infectious and mechanical complications in the patients at the Radiology Departments of Imam Khomeini Hospital and Ahvaz Hospital in 2018.

Materials and Methods

This clinical trial was performed on 52 patients aged 18–80 years. Patients were randomly divided into two groups (IJV and brachiocephalic).

Once the patients filled out the informed consent, demographic characteristics and BMI of each patient were recorded individually. All of the patients were provided with important information about the condition before the placement of catheter, such as trauma of head and neck edema, variations in anatomy, previous neck surgeries, burns, central venous thrombosis, coagulopathy, and tracheostomy.

In this study, all of the patients who did not have a previous history of catheterization were selected. In addition, all catheterization procedures were performed under local anesthesia, and none of the patients needed sedation. Jugular vein and right BCVs were selected for convenient access.

Then, the standard process of placing CVC was performed as follows:

1. The patient was placed in the supine position, and the patient's neck was bended to the left.
2. The site of the catheter was sterilized using a chlorhexidine or betadine solution, and a special perforated fabric was placed on the site.
3. Then, the guidewire was introduced. After the dilatation, a catheter was inserted using the dilator.
4. Finally, the catheter was fixed using nylon or silk thread.
5. The patient was examined in terms of acute complications.

Analysis

Data were analyzed using SPSS v20 (SPSS Inc., Chicago, IL, USA). Moreover, $P < 0.05$ was considered as the level of significance.

Results

This clinical trial was performed on 52 patients in Imam Khomeini Hospital and Golestan Ahvaz Hospital in 2018. Patients were selected from people who did not have a history of catheterization.

All procedures were performed in an outpatient operating room at the Interventional Radiology Department under local anesthesia. Patients who had expired due to underlying causes were excluded. The patients were divided into two groups of IJV catheter and BCV. Accordingly, catheterization was performed well in all patients. The general characteristics and demographics of patients are shown in Table 1. The duration of the procedure in both groups was examined [Tables 2 and 3]. The duration of cannulation was calculated, considering all factors. The entire duration of the procedure is from local anesthetic to catheter fixation. Patients catheterized via the BCV approach were then compared with those catheterized via the IJV in terms of ease of catheterization, success rate, and complications. Differences between approaches were assessed by univariate analyses and multivariable analysis.

The complications of placing CVC and internal jugular were compared, and a variety of complications were shown for the patients [Table 2]. These complications were divided into three classes: acute (<24 h), subacute (24 h to 3 weeks), and chronic (3 weeks to 3 months).

Table 1: Baseline characteristics of the patient population (*n*=52)

Demographics	Brachiocephalic vein (*n*=26)	Internal jugular vein (*n*=26)
Age (18-80) year	40	36
Weight (kg)	80	78
Body mass index (kg/m^2)	26.2	25.5
Gender		
Male	14 (53.84)	17 (65.38)
Female	12 (46.15)	9 (34.61)

Table 2: Complication and success rates, by insertion site

Parameter	Brachiocephalic vein (*n*=26)	Internal jugular vein (*n*=26)	*P*
Time			
Total	4-5.3 min	3.8-6 min	*P*>0.05
Cannulation	2.2 min±10 s	2 min±7 s	*P*>0.05
Success at first puncture	26 (100)	26 (100)	
Any procedural difficulty	2 (7.69)	3 (11.53)	*P*>0.05
Insertion failure	0	0	
Previous history of catheterization	0	0	

Table 3: Complication after brachiocephalic and internal jugular central venous catheter

Complications	Brachiocephalic	Internal jugular	*P*
Pneumothorax	No complications	No complications	
Hematoma	No complications	1 (3.84) Hematoma	*P*>0.05
Emphysema	No complications	No complications	
Arterial puncture	No complications	No complications	
Infection	2 (7.69)	No complications	*P*>0.05
Need remove the catheter due to complications	No need	No need	
Partial thrombosis	6 (23.07)	8 (30.76)	*P*<0.05
Complete thrombosis	No complications	No complications	

The complications included arterial pancture, pneumothorax, emphysema, hematoma, infections, and chronic complications. Accordingly, partial thrombosis and complete venous thrombosis were examined.

The average days of using CV-line catheter in the BCV and the IJV were 13 and 18 days, respectively. The catheter was then removed in all cases because the treatment was over and there was no need for a catheter.

Discussion

In previous studies, IJV and subclavian vein have been used for catheterization in infants and adults. It should be kept in mind that patients do not feel comfortable to use these catheters, especially when moving the neck. On the other hand, access to the subclavian vein is difficult and time-consuming. It may also increase the likelihood of damage to the subclavian artery, pneumothorax, and hemothorax, although it is less infectious and it is easier for the patient to tolerate.[13,14]

In many cases, the use of BCVs is essential as a substitute for other central venous organs in many emergency patients, especially infants. So far, limited studies have been carried out on catheterization in BCVs in adults.[15]

Given the acute and chronic complications of catheterization in central veins, such as IJV, femoral vein, and subclavian vein, this study aimed to evaluate the use of CVC in brachiocephalic in terms of ease of catheterization, success rate, and complications.

The results showed that the use of CVC in BCV is an appropriate strategy since it is capable of reducing chronic and acute complications of catheterization.

Approximately 6 million CVCs are placed annually in European countries and the United States. Accordingly, IJVs, subclavian veins, and femoral veins are prioritized as the main targets.[16]

The catheterization process showed that BCV has several advantages over the IJV in terms of anatomy. The BCV tissue is thinner and has a greater lumen. More importantly, it is easily detected by ultrasound. On the other hand, it does not overlap with carotid arteries and brachiocephalic arteries.

In addition, the catheter entrance is distant from the naso-buccal area and the probability of being infected with oropharyngeal floor is reduced. Accordingly, the patient is unlikely to feel pain in the neck.[17-19]

In this study, in both branchiocephalic and internal jugular vein catheterization, acute complications, (<24 h) including arterial pancture, pneumothorax, and emphysema were not observed in any of the patients.

Subacute complications (from 24 h to 3 weeks) included hematoma and infections; however, hematoma was observed in the IJV group. There was no need to remove the catheter in any cases. Chronic complications (from 3 weeks to 3 months) included partial thrombosis and complete venous thrombosis. Partial thrombosis was observed in both BCV and IJV.

Similarly, Habas *et al.* examined the complications of CVC administration in BCVs compared with other veins. They showed that the level of infection and thrombosis in the BCV was less than the jugular and subclavian vein catheters.[11] Moreover, Oulego-Erroz *et al.* investigated the use of CVC in BCV. They did not find any complications due to catheter administration in the BCV during and after the cannulation. Researchers argued that this method was efficient, accessible, and safe.[20]

Similarly, Di Nardo *et al.* introduced left BCV cannulation as a safe and low-risky method.[21] Beccaria *et al.* suggested that BCV can be an appropriate alternative to cannulation in other central veins.[15]

Thompson *et al.* suggested the use of BCV for central venous access in short-term admissions.[22]

Jordan *et al.* compared the use of central vein catheter in BCVs with IJV and subclavian vein. They showed that the complications of CVC administration, including infections (<5%) and thrombosis, were reduced in BCV compared with two other groups.[12]

In this study, infection was observed in two patients. However, there was no significant difference between the IJV and BCV in terms of the level of infection.

Other parameters such as the duration of cannulation and the acute and subacute complications were similar in both groups.

Conclusion

The results showed that the ease of catheter placement in the BCV and the incidence of acute and chronic complications in

this vein were similar to that of the IJV. On the other hand, given the fact that ultrasound is a very reliable and safe method, the ultrasound-guided catheterization in BCV can be regarded as an alternative method.

Financial support and sponsorship

Nil.

Conflicts of interest

There are no conflicts of interest.

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