

Comparing of Frequent Central Venous Catheter Insertion and Selection Procedure and its Complications

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Abstract

Background: Central venous catheterization is used for several goals in the emergency department. Common sites of insertion of central venous lines are the right and left jugular veins as well as the right and left subclavian veins. The aim of this study was to evaluate the tendency frequency of emergency medicine residents to choose central venous line insertion route and also to determine the post-procedure complications.

Methods: In this descriptive cross-sectional study, all patients who underwent central venous catheterization and were in the emergency ward of the Imam Reza hospital, Tabriz, Iran during March 21, 2015 to September 23, 2015 were included, preferences route of insertion and complications of both right and left jugular and subclavian veins were descriptively analyzed.

Results: Of all the 134 evaluated patients, 54.5% were catheterized in course of shock. 88.1% of patients underwent right jugular vein catheterization and only 4.5% experienced post-procedure complications. In 91.8% of cases, the decision-making was done by the physician and 75.4% of the catheterizations were fulfilled by second-year emergency medicine residents.

Conclusions: The most common route of catheterization was through the right jugular vein. Additionally, the most common complication was hematoma of the insertion site. In most of the cases, decision making was made by the physician and most of the catheterization procedures were fulfilled by second-year emergency medicine residents.

Keywords: Catheterization, Subclavian, Jugular, Central Vein, Complications

1. Background

In the emergency department, during critical situations, Jugular, subclavian, and supraclavicular veins are used as a central vein route that has related difficulties and complications. The central vein route is used for drugs administration, assured IV line in patients who are obese or have low blood pressure, and for assessment of central vein pressure (1). Furthermore, the central vein route is used for TPN administration or some drugs where peripheral veins can't be used for required doses; such as sodium chloride in the dose of higher than 40 mMol/Lit, hyperosmolar saline (2). Central vein is useful for hemodialysis. With all the complicated qualifications mentioned above, central vein catheterization in critical situations is a contest that must be done very quickly and without complication (3).

Ingenuity and experience are needed for reduction during the time of catheterization and its complications. It seems necessary to evaluate factors that can affect and reduce the complications of central vein catheterization (4).

In the study of Orak et al., which was done on the effective factors of the central vein catheterization, doctors and emergency medicine specialists have more than a 3 time

risk for complication of trial for insertion of the catheter. In one study, the procedure of the concurrent sonography is recognized as the most effective way for reduction of complications. In that study, anatomical variations, undetectable (unpalpable) pulse, and patients with coagulopathies are mentioned as factors for a higher rate of complications (5).

In regards to insecure data about the rate of possible complications due to central veins catheterization, the goal of this study is to evaluate the tendency of emergency medicine's specialists and residents in the selection of the central vein and effective factors on it as well as complications of central vein catheterization through descriptive cross-sectional study on the etiology of selection of each of the central vein routes.

2. Methods

This was a descriptive cross-sectional study that includes patients who entered the emergency department of the Imam Reza's hospital from October 1, 2015 until October 1, 2016 as well as have any indication for central vein catheterization. The exclusion criteria for this study

included patients who have an acute bleeding disorder, all patients with a coagulopathy disorder, as well as have any contraindication for catheter insertion. Traumatic patients were also excluded.

After assurance of necessity of central vein catheterization, complications of catheterization and its process were clarified to the patients themselves (if they are conscious) or their attendants. Then, with regards to sterility condition and evaluation of different veins in the viewpoint of appropriateness for catheterization and patients condition, after local anesthesia with lidocaine, central vein catheterization was done. Finally, catheterization of the right jugular vein, left jugular vein, right subclavian vein, as well as left subclavian vein were compared with each other in respect to easygoing and complications.

The data gathering instrument was a researcher made checklist. All data were taken into the SPSS software (SPSS) (version 15, SPSS Inc., Chicago, IL, USA) and descriptive statistical methods were applied.

2.1. Ethical Considerations

In data gathering phase just proceed to augmentation of the designed checklist and then they were evaluated and there was no clinical action on this study's patients. In addition, in this study, there was no inflicted cost for patients and the regional ethical committee verification was accepted.

3. Results

We studied 158 patients that underwent central vein catheterization, however, 24 of them were excluded due to the exclusion criteria. The average age of the patients studied was 60.22 years with a standard deviation of 14.60. The minimum age was a 22-year-old male patient and highest of them was an 89-year-old male patient. In point of the sex ratio, there were 78 male patients (58.2%) and 56 female patients (41.8%).

In view of catheterization indication, 18 of the patients were for hydration (13.4%), 73 of the patients were due to shock (54.5%), and 43 of the patients who had renal failure (32/1%) underwent central vein catheterization.

Patients also studied in the viewpoint of the location of central venous catheter insertion.

Among patients who underwent central vein catheterization and were studied in this research; 118 of them had central vein catheterization through the right jugular vein (88.1%), 6 of them through the left jugular vein (4.5%), 8 of them through the right subclavian vein (6%), and 2 patients through the right femoral vein (1.5%).

There were 34 (32.9%) patients who were also studied in the viewpoint of having an ultrasonography for

catheter insertion. A total of 10 (7.5%) of them underwent ultrasonography before catheterization due to finding the vein's path, and 24 (17.9%) patients underwent ultrasonography after the first try for catheterization (due to the fact that they were unable to find the veins pathway). The overall rate of complication occurrence among the patients was 4.5%, which occurred in 6 patients. Between these complicated patients, 4 of them got hematoma (3%), 1 of them got pneumothorax (0.7%), and 1 got problematic catheterization.

It was studied in respect to parting of complications occurring in regards to the location of catheter insertion. Between patients who underwent subclavian catheter insertion, 2 of them (25%) had a hematoma of the catheter insertion site. Among these patients, 1 of them got pneumothorax (12.5%) and in 1 of them the catheterization failed (12.5%).

Between 6 patients who had a central vein, and catheterization was done from the left jugular vein, 2 of them (33.33%) got hematoma of the site of catheter insertion.

The indication of central vein catheterization in 123 patients was the decision of the attending physician (91.8%). Among the studied patients, 3 of them underwent central vein catheterization due to the patient's condition (2.2%) and 8 (6%) of the patients underwent central vein catheterization due to being unable to get an IV line from peripheral veins.

In this research, patients studied factors that depend on the physician who inserts the catheter.

For all studied patients, 73 of them underwent a central venous catheter in the first half of shift work (54.47%), which had 1 case of pneumothorax and 2 of hematoma. A total of 61 patients underwent central vein catheterization in the second half of the physicians work shift (45.52%), which had 2 cases of hematoma and 1 case of difficult catheterization.

Among all catheterizations, 77 cases were during the day shift (57.46%), which had 1 case of pneumothorax and 1 of hematoma in point of complications.

A total of 57 cases of catheterization were done during the night shift (42.53%), 3 cases of hematoma, and 1 case of difficult catheterization.

Physicians who did the catheterizations: First-year residents in 19 cases (14.2%), 2nd residents in 101 cases (75.4%), 3rd residents in 11 cases (8.2%), and attending physician in 3 cases (2.2%).

In the viewpoint of complications in each group: there were 2 cases of hematoma in 1st year residents group (1.5%), 1 case of difficult catheterization, 1 case of pneumothorax as well as 1 case of hematoma in 2nd year residents group (2.25%), and 1 case of hematoma in 3rd year residents group

(0.7%) (Table 1).

Patient-related factors involved in catheterization such as short neck and obesity were present in 58 patients and complications including 1 case of difficult catheterization, 1 case of pneumothorax, and 1 case of hematoma had been reported.

Other patient-related factors were in cooperation of patients with a physician and continuous movements that were reported in 23 patients among whom 2 cases of hematoma have been reported. The other factor was neck mobility that has been reported in 8 patients.

4. Discussion

The present study showed that the highest type of central vein catheterization in Imam Reza medical research and training hospital were done through the jugular vein in between the right jugular vein appropriating 88.1% of patients. Most of them were done in patients who went through a shock by 2nd-year residents in day shifts.

In one study that proceeded to the evaluation of central venous catheter complications through each anatomical location, it was reported that the highest preference for central vein catheterization in the emergency department was a femoral vein (4).

Regarding some of the complications of catheterization, part of the researchers represent that infection of the site of catheter insertion can be prevented by Subcutaneous Tunneling (6).

The present study showed that the overall and cumulative complication of the process was almost 4.5% and hematoma of the catheter insertion location was the prevalent complication (3%). This is while other researchers reported this value between 0.3% - 12%. This rate shows that complications that occurred in this study is significantly lower than the average rate and it is obvious that there are lower risks of complication occurrence than other researchers (7, 8)

Indeed, the significant point in this case is that in the researchers mentioned above, the process of catheterization had been done by the attending physicians, however, in this study, most cases of central vein catheterizations had been done by residents (4).

Like the findings of some researchers that have been done in this field, it shows that the prevalence of infections due to catheterization is one of the important complications of this procedure and therefore, the exact evaluation of this complication seems necessary (4).

According to that, patients who were studied in this research only entered this study from the emergency department and therefore, computation of the rate of the catheter infection or infection of the catheter location in

long-lasting time isn't possible and just acute complications were evaluated in this research.

Results and finding of the present study showed that incidence of complications in central vein catheterization thorough subclavian veins is significantly high and the prevalence of complication reaches to 33%. Furthermore, in the central vein catheterization through subclavian vein, hematoma of the location of catheter insertion is the most common complication (25%).

The central vein catheterization through the subclavian vein has complications itself and can't be denied or disregarded, however, it should be noted that presumably due to the low number of cases of catheter insertion from this anatomical location, the basis of experience and ingenuity of residents isn't adequate.

In the viewpoint of timing (physician-centered) of the catheterization, among all studied patients, 73 of them was in the 1st half of their work shift (54.47%) as well as 61 of them in the second half of their work shift and furthermore, 77 patients in the day shift (57.46%) and 57 patients in the night shift (42.53%) underwent catheterization.

Physicians who inserted the patients' catheterizations, in 19 cases, were 1st year residents (14.2%), in 101 cases were 2nd year residents (75.4%), in 11 cases were 3rd year residents (8.2%), and in 3 cases were attending physicians (2.2%). In the Barberra et al. study, it was reported that inserting the catheterization by a proficient physician significantly had reduced the complications of the procedure and on the other hand, emphasized to continuous training and active catheterization to the physicians (9).

In the viewpoint of time-related factors, among all studied patients, 73 of them underwent central vein catheterization in the first half of the work shift (54.47%), which includes 1 case of pneumothorax and 2 cases of hematoma. Furthermore, catheterization had been done for 61 patients in the second half of the work shift (45.53%) had 2 cases of hematoma and 1 case of difficult catheterization in point of complications.

Through all catheterizations, 77 patients underwent the procedure during the day shift (57.46%) had 1 case of pneumothorax and 1 case of hematoma in point of complications. In addition, 57 patients who underwent the procedure during the night shift (42.53%) had 1 case of difficult catheterization and 3 cases of hematoma.

Physicians who inserted the patients' catheterizations, in 19 cases, were 1st year residents (14.2%), in 101 cases were 2nd year residents (75.4%), in 11 cases were 3rd year residents (8.2%) and in 3 cases were attending physicians (2.2%). In point of complications in each group: there were 2 cases of hematoma in the 1st year residents group (1.5%), and 1 case of difficult catheterization, 1 case of pneumothorax as well as 1 case of hematoma in 2nd year residents group

Table 1. Complications in Each Group

Anatomical Location	Hematoma	Pneumothorax	Unsuccessful Catheterization	Amplitude and Percent
Left jugular vein	2	0	0	33.33%
Right jugular vein	0	0	0	0%
Right subclavian vein	2	1	1	50%
Right femoral vein	0	0	0	0%
Amplitude	4	1	1	

(2.25%), and also 1 case of hematoma in 3rd year residents (0.7%).

In the study done by Puri et al., central vessels, catheterization complications were evaluated in critically ill patients prospectively. In that research, there were 210 enterprises of catheterizations on 116 patients. In 80 patients, central vein catheterizations had been done, 71 patients with pulmonary artery, and in 59 patients arterial catheterization. In all cases, except 7, percutaneous catheterization had been done. Patients who had central vein catheterization in 3.7% of cases, pulmonary artery catheterization in 10% of cases, and other patients in 13.5% of cases catheterization complications had been reported. Authors conclude that catheterization with significant complications correlates with patients' recovery process (10-12).

Patient-related factors that contribute in catheterization such as short neck and obesity was seen in 58 patients, which was 1 case of difficult hematoma, 1 case of pneumothorax, and 1 case of hematoma had been reported (2.25%). Among other patient-related factors, incorporation of a patient with a physician who inserts the catheter and continuous movements that reported in 23 patients among whom 2 cases of hematoma have been reported (1.5%). Other patient-related factors are which were related to neck motility. There was impaired neck motility in 8 patients and 1 case of hematoma was reported (0.07%).

Another study done by Fergosene et al. proceeded to the evaluation of patient-physician cooperation factors, domination degree of a physician who inserts the catheter, and patient factors. In that research, they studied 118 patients who underwent a central vein catheterization. Through that, authors concluded that complications of catheterization had a significant correlation with patient cooperation ($P = 0.00$), tiredness of the individual who inserted the catheterization ($P = 0.02$), the existence of patients unfavorable physical condition such as obesity ($P = 0.04$) (13).

4.1. Conclusion

According to findings of the present study and discussion regarding the patient's catheterization: the major-

ity of patients who almost underwent a catheterization through the right jugular vein, which is undoubtedly an easy access to that vein, ability to do ultrasonography in case of catheterization failure and training are effective factors. Near one-third of patients underwent an ultrasonography for implementation of the catheter insertion.

Among complications of catheterization, in both jugular and subclavian veins, hematoma of the location of the catheter is the most reported complication. With do attention to the timing of the gathered data, the majority of physicians who do the patient's catheterization were 2nd residents, which had the most reported complications. This is while the catheterizations done by the attending physicians were uncomplicated. In regards to the descriptive nature of this study, the central vein catheterizations complications in which group is higher aren't able to be defined. Overall reported complications rate in this study (4.5%) is lower than the results reported in other accomplished studies (0.3% - 12%), which indicates effective training on this field in the emergency department.

4.2. Limitation and Recommendation

More researchers should be done in other hospitals of the country for use of direction of integration and concordance of catheterization-related planning and preparation of related guidelines. Through this study, the acute complications of central vein catheterization were evaluated. It is recommended to do extended studies in regarding long-term complications of each of central veins catheterization.

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