

Complications of Central Venous Catheters: Internal Jugular versus Subclavian Routes

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ABSTRACT

Complications of Central venous catheterization is often necessary to treat critical ill patients hospitalized in intensive care units(ICU).However, this procedure can lead to serious and sometimes life threatening complications whether mechanical, infectious, thrombotic. The choice of insertion site can influence the incidence and type of such complications. **Study design:** Cross sectional analytic study. **Place and duration of Study:** Anesthesia department Shaikh Zayed Hospital Lahore. **Methods:** In this study sixty patients of ASA 1-IV, E, and weight between 35 – 100kg, were included. Thirty of those were in group A (internal jugular vein was the route of central venous catheterization), and another thirty in group B (subclavian vein was the route of central venous catheterization).They were randomly allocated into two sub groups A and B by using random table. **Results:** Mean age of the patients was found to be 53.2 ± 14.2 and 45.6 ± 17.6 in group A and group B respectively. There were no significant hemodynamic changes noted. In few cases there were minimum increase in blood pressure and heart rate.16.7% patients from group B developed pneumothorax during 36 hours post-procedure, whereas no patient from group – A developed pneumothorax. **Conclusion:** Appropriate catheter and site selection, sufficient operator experience, careful technique and proper catheter maintenance, and catheter early removal is associated with optimal outcome.

Key Words: Central venous catheter, catheter related infections, internal jugular, and subclavian.

INTRODUCTION

Central venous catheterization (CVC) is being done world over for various indications *i.e.* central venous pressure (CVP) monitoring, inadequate peripheral veins, cardiopulmonary resuscitation (CPR), administration of phlebotic medicine, extremely rapid fluid administration, hyperalimentation, as an adjunct to pulmonary artery catheterization and inotropic support¹.

Central venous access can be achieved by different routes, utilizing femoral, axillary, jugular, subclavian and cubital veins but the routes favored by most centres are the internal jugular and subclavian. All complications and side effects are dependent upon vascular access routes².

Although there is no absolute contraindication to the establishment of central

venous access but this procedure is not without complications^{3,4}. The risk benefit ratio must be weighed for each patient prior to attempting placement of a central venous catheter. Other than coagulopathy or recent fibrinolytic therapy, relative contraindication may however be site specific⁵.

Various complications which may arise are extravasations of fluid arterial tap⁶, haemothorax, cardiac tamponade, hydromediastinum, haemothorax, cardiac tamponade, hydromediastinum, dislodgement and misplacement of the catheter⁷, thrombosis, embolism, knotting of the catheter and catheter related sepsis^{8,9}.

OBJECTIVES

The aim of this study was;

To compare incidence rate of mechanical

complications (up to 36 hours) of central venous catheters of two commonly used routes (internal jugular versus subclavian).

METHODS

After institutional ethics committee approval, 60 ASA 1-IV E, weight between 35-100 Kg, age >18 years patients eligible for this study gave written informed consent. The demographic profile of the patients was compiled (name, age, sex). They were asked about the history of present illness in terms of (symptoms, severity, duration). Exclusion criteria was coagulopathies, fibrinolytic therapy, emphysema. Single and multilumen catheters were used for this study.

Technique

When inserting a catheter, one should use maximal sterile precautions, including mask, cap, a sterile gown, sterile gloves and large sterile drape. This approach will reduce the incidence of catheter related infections. Patient was positioned in Trendelenburg position to decrease the risk of embolism and to distend the vein. I used strict aseptic technique by utilizing sterile gloves, gown, mask, drapes, instruments and accessories, after bactericidal skin preparation 3ml of 2% Xylocaine was injected subcutaneously on insertion site.

Technique used for internal jugular vein cannulation: two heads of the sternocleidomastoid muscle and clavicle form the three sides of triangle, 25 gauge needle was used for local infiltration at the apex of triangle. The internal jugular vein was found by advancing the 25 gauge needle or a 23 gauge needle in heavier patients along the medial border of the lateral head of sternocleidomastoid muscle toward the ipsilateral breast nipple at an angle of 30 degree to skin. Aspiration of venous blood confirms the location. An 18 gauge thin wall needle is advanced along the same path as the locator needle. The needle is removed and pliable silastic catheter is advanced over the wire. The guide wire is removed with thumb placed over the catheter hub to prevent the aspiration of air until the intravenous catheter tubing is connected to it. Then catheter is secured and dressing done.

The technique used for subclavian vein

cannulation: was the infraclavicular approach. Venipuncture generally proceeds without first identifying the vein with smaller gauge finder needle, because the depth of subclavian vein is often beyond the reach of standard 1½ inch 22 gauge needle. The patients were placed in slight head-down position with the arms kept to the side, the head was turned slightly away from the site of venipuncture and the small bedroll was placed between the shoulder blades to expose the infraclavicular area fully, the skin was punctured 2-3cm caudal to the mid point of the clavicle, far enough from its inferior edge to avoid downward angulation of the needle as it is walked under the posterior surface of the clavicle. The needle tip is directed towards the suprasternal notch which was identified by the fingers of other hand. Once the subclavian vein is punctured, catheterization proceeded in the same manner to that described for internal jugular vein catheterization. The investigations, pre-procedure (CBC, ECG), immediately after procedures like (x-ray chest for the development of pneumothorax, hemothorax) were carried out. Strict watch was kept on ECG monitor, blood pressure and pulse rate as well as respiratory rate during the procedure. Clinical outcome of the procedure in terms of complications will be recorded. All the information was collected through a specially designed Performa.

The final outcome of each procedure was associated with route of central venous cannulation. If there was any association, it was tested for significance by applying chi square test as the data was qualitative in nature (Tables 1, 4, 5), as the data was qualitative in nature (type of complications), McNemar test as we want to test the difference between the paired proportions (Tables 2, 3).

RESULTS

Total 60 patients were enrolled for the study. Out of these, in 30 patients, internal jugular vein (Group A) was the route for central venous cannulation and in other 30 patients, subclavian vein (Group B) was the route for central venous cannulation.

The proportion of ASA-11 was 3.3%, 111 was 30.0%, 1V 56.7% and E was 10.0% in group A. In

group B proportion of ASA 111, 1V and E were 20.0%, 56.7%, 2.3%, respectively (Table 1).

While studying the comparison of ECG findings prior and during the procedure in group A, 28 patients(93.3%) have normal ECG preprocedure while during the procedure 26 patients (87.7%) have normal (Table 2). ECG findings prior and during the procedure, in group B, 29 patients(96.7%) had normal ECG preprocedure while during the procedure 26 patients(86.7%) had normal(Table 3).The shifting of patients from normal to abnormal ECG was recorded as 2/28 in group A and 3/29 from group B. It was compared by using Z-Test for proportion and P-value of 0.667 was reported. Which shows there is no significant difference of shifting from normal to abnormal in both procedures.

Table 1: ASA grades.

ASA grades	Internal jugular (Group A)		Subclavian (Group B)	
	No.	%	No.	%
Grade I	1	3.3	-	0
Grade III	9	30.0	6	20.0
Grade IV	17	56.7	17	56.7
Grade E	3	10.0	7	23.3
Total	30	100.0	30	100.0

P value = 0.362

Key: ASA = American Society of Anesthesiologist

Table 2: Comparison of ECG findings between pre-procedure and during procedure (internal jugular)

Pre-procedure	During procedure		%
	Normal	Abnormal	
Normal	26	2	93.9%
Abnormal	0	2	6.7%

McNemar P value = 0.50

During study, arterial puncture occurred in 6 patients (20.0%) from group A they developed haematoma after accidental carotid artery puncture and 1 (3.3%) patient from group B developed haematoma after subclavian artery puncture. Results were statistically significant (P =0.04) (Table 4).

In this study , 5 patients (16.7%) from group

B developed pneumothorax and during 36 hours post procedure no patient from group A developed pneumothorax. Statistically significant results were found.(P = 0.020) (Table 5).

Table 3: Comparison of ECG findings between pre-procedure and during procedure (Subclavian)

Pre-procedure	During procedure		%
	Normal	Abnormal	
Normal	26	3	96.7%
Abnormal	0	1	12.3%
Percentage	86.7		13.3

McNemar P value = 0.50

Table 4: Distribution of cases by arterial puncture

Arterial puncture	Internal jugular (Group A)		Subclavian (Group B)	
	No.	%	No.	%
Yes	6	20.0	1	3.3
No	24	80.0	29	96.7
Total	30	100.0	30	100.0

P value = 0.044 (significant)

Table 5: Distribution of cases by pneumothorax

Pneumothorax	Internal jugular (Group A)		Subclavian (Group B)	
	No.	%	No.	%
Yes	-	-	5	16.7
No	30	100.0	25	83.3
Total	30	100.0	30	100.0

P value = 0.020 (Significant)

DISCUSSION

Insertion of a central venous catheter is a common occurrence in hospital practice. It can be placed either as the part of any surgical procedure or at some other time as a separate procedure. Most CVP are sited without significant complications or difficulty but potential for serious complications is well known.

Various studies are already performed to investigate the route, which has minimum chances

of complications and simple to perform.

My study was designed to compare the complications of central venous catheters: internal jugular versus subclavian routes.

In this study patient's characteristics including, age, sex, history of present illness, ASA, monitoring (ECG, blood pressure, pulse, saturation of arterial oxygen). Investigations, coagulation profile preprocedure, X-ray chest (immediately and during 36 hours) were evaluated. Strict watch was kept on ECG, pulse rate, blood pressure and respiratory rate during the procedure and clinical outcome was recorded.

Patients of both sexes, ASA I, II, III, IV, E, age > 18 years, weight between 35 – 100 kg were included in this study. Patient with any coagulopathy / on fibrinolytic therapy or emphysematous were excluded from study.

In this research, I used single, double, triple lumen catheters but it was observed that number of lumen do not affect the incidence of mechanical complications. Some old studies have also shown that number of Lumina have no effect on the rate of catheter related complications¹⁰.

During study, I observed, pre-procedure, 28 patients from group - A and 29 patients from group - B have normal ECG. During procedure 13.0% patients from group - A, and 13.3% from group - B have shown arrhythmias on ECG. Some previous studies have also shown arrhythmias with CVC insertion depth. CVC malposition has been associated with perforation, arrhythmias, venous thrombosis.

In my study no case of venous perforation, venous thrombosis was found. During the procedure arrhythmias occurred but no serious consequences of arrhythmias were seen. Arrhythmias disappeared after guide wire withdrawal. Previous studies have also shown small percentage of symptomatic arrhythmias such as heart block and even sudden death^{11, 12}.

Arterial puncture which is another mechanical complication of central venous catheterization occurred in 20% of patients from group - A and 3.3% of patients from group - B. During study, I identified arterial puncture by pulsatile flow and bright red colour of blood. These findings might not be seen in hypotensive or marked

desaturated patients.

In my study, there were significantly more arterial puncture with internal jugular route than the subclavian route. Some other studies have also shown increased chances of carotid artery puncture via internal jugular route than subclavian artery puncture via subclavian route^{13, 14}.

Haemothorax, haematoma can occur due to inadvertent arterial injury which can lead to severe consequences¹⁵. In my study no case of haemothorax / haematoma was found.

In present study pneumothorax did not occur in patients of group - A (internal jugular) while in group - B (subclavian), 5 cases (16.6%) of pneumothorax were studied. The first indication of the trouble may be a decreasing oxygen saturation, hypotension or difficulty with breathing. These results are comparable with the study of Takeyama et al^{16, 17}.

In my study, pneumothorax occurred 2-3 hours after the procedure that manifested with difficulty in breathing, decreased chest movement and reduced breath sounds on the affected side. Other studies have shown lower incidence of pneumothorax with internal jugular route of catheterization as compared to subclavian route^{18, 19}.

CONCLUSION

In the view of current study, it is concluded that on ways to improve on the safety of central venous access. Internal jugular route is better choice than subclavian route.

Although internal jugular and subclavian catheterization carry similar risk of mechanical complication, but subclavian vein catheterization is more likely to be complicated by pneumothorax. Internal jugular route is simpler and easier and associated with fewer complications.

Knowledge about anatomical landmarks and expertise are the other aspects of clinical practice which should be addressed to minimize the complications.

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