

Central Venous Catheterization: A Comparison of Procedure Related Early Complications with Internal Jugular Versus Subclavian Routes

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We carried out a study comparing two most commonly used routes of central venous catheterization i.e. internal jugular and subclavian vein as regards their early procedure related complications. Sixty patients of either sex with physical status ASA II, III and IV with weight between, 35-100 kg and age above 18 years were randomly allocated to two groups of 30 each. In group A an internal jugular was used for catheterization while in group B, subclavian vein was used. The complications related to central venous catheterization were looked for a period of 72 hours. 10% patients in group A suffered from various complications while 13.3% of patients in group B experienced complications. Pneumothorax occurred in only one patient in group B, showing that this complication is specific to subclavian route while arterial tap occurred in two patients in group A showing that this complication is specific to internal jugular route. The difference regarding complications between the two routes was not statistically significant. (P value=0.522487).

Key Words: Central venous catheterization, Internal Jugular vein, subclavian vein, procedure related complication,

Although central venous catheterization (CVC) is being done world over for various indications i.e. central venous pressure monitoring, inadequate peripheral veins, intra cardiac pacing (Molina et al 1995)¹, long term intravenous therapy i.e. chemotherapy (Ardalaan & Flores 1995)², haemodialysis, hyperalimentation and cardiopulmonary resuscitation (Dronen et al 1982)³. But like other invasive procedure this procedure is also not complication free. Other than coagulopathy or recent fibrinolytic therapy, relative contraindications may however be site specific. The risk benefit ratio must be weighed for each patient prior to attempting placement of a central venous catheter. The risk of complications increases with the number of pricks (Mansfield et al 1994)⁴. As these two routes for CVC are the most common routes (Skolnick 1994)⁵ we have compared these two routes as for there early procedure related complications are concerned.

Patients and Methods

This was a prospective, randomized study held at Sheikh Zayed hospital complex, after approval from the hospital Ethics committee.

All patients included in this study provided written informed consent. The central venous catheters of Secalon T (Viggo-spectramed Limited) of gauge 16 were used, which are essentially a catheter over needle device. Adult patients over 18 years of age were included, and their weight was between 35-100 kg, patients belonged to both sexes and were from ICU (intensive care unit), operation theatres or the wards but most of the patients belonged to the ICU. Only patients of ASA grading II, III and IV were included. Patients with coagulopathies and on fibrinolytic therapy were excluded. All patients had their X-ray chest and CBC done, which included platelet count and prothrombin time. Blood pressure (BP), pulse, and

respiratory rate were noted before insertion. ECG was monitored throughout the procedure. All catheterizations were performed in the Trendelenbergs position after observing strict antiseptic measures.

The right-sided approach was used. For the subclavian catheterization infra clavicular approach was used while for internal jugular vein the high triangle approach was utilized. After strict aseptic measures, and infiltration of subcutaneous tissue with 2% lidocaine, catheterization was done and the catheter was secured to the chest wall and neck respectively with the help of prolene. The dressing was done by transparent bio occlusive dressing. The correct position of the catheter tip was checked by immediate X-ray chest.

A strict watch was kept for complications for 72 hours after catheterization and a check X-ray chest was taken to check for signs of delayed pneumothorax.

Demographic Profile

A total of sixty patients were randomly assigned in two groups of thirty patients each. Group A had CVC done via right internal jugular while group B comprised of patients in whom CVC was done by right subclavian infra clavicular route. Group A comprised of 56.7% male patients while proportion of males in-group B was 63.3%. Average age in group A was 44.5333 ± 2.9222 years while in group B it was 43.5667 ± 3.070 (pValue=0.820). In group A 19 patients belonged to ICU, 09 were from the theatre while only two were from the wards. While in group B 18 patients were from the ICU, 03 from the theatre and 09 belonged to the wards.

Patient Distribution by Sex

Groups	Male	Female
Group A	17(56.7%)	13(43.3%)
Group B	19(63.3%)	11(36.7%)

Patient Distribution by Age

Groups	Mean \pm Sem	Minimum	Maximum	Median	Mode
Group A	44.5333 \pm 2.9222	20	75	40	40
Group B	43.5667 \pm 3.070	16	80	46	60

All patients were catheterized as elective cases under controlled environment. Two patients in group A had arterial tap but none had haematoma formation. Only one patient in this group had failure of catheterization. Whereas in group B one patient had failure of insertion, the same patient had pneumothorax, which had to be treated by placement of chest tube. Misplacement and coil formation occurred in one patient and there was arterial tap in one patient but no haematoma formation.

Statistical Analysis of Data

Chi-square test with Mental Haenszele test were used to compare the proportion of patients which suffered complications. Students t test was utilized to test the quantitative data (pValue=0.52487) Since p value is large enough to indicate the non significance of the proportion of patients experiencing complications, it is concluded that the complications occurring in each group are statistically not significant when compared with each other.

Discussion

During the last 30 years the CVC has superseded venous cannulation through peripheral routes as an access to the central venous system. CVC like other clinical procedures, is however not free from complications. Amongst the more common and more serious ones are arterial puncture, pneumothorax, hydrothorax, cardiac tamponade, and misplacement of the catheter. In group A we had two arterial taps but no haematoma formation. There was one case of failure to pass the catheter, in which after 3 unsuccessful attempts to pass the catheter, the procedure was abandoned and after a while patient was catheterized via the subclavian route. In group B there was one case of failure to pass the catheter and the same patient was found to have pneumothorax of the same side and chest tube had to be inserted to drain the pneumothorax. Other than these complications there was one case of misplacement of the catheter tip to the internal jugular vein, which was found out on X-ray chest. There was one case of arterial tap, which did not result in any haematoma formation. The rate of complication in group A showed that failure to cannulate accounted for 3.33% and arterial tap, accounted for 6.66% where as over all complication rate was 30%. There were however no serious complications such as pneumothorax.

In group B overall complication rate was 13.3% out of which pneumothorax occurred in 3.33% and arterial tap, misplacement, and failure to cannulate 3.33% each. These rates are similar to those for this procedure in other studies quoted below. Our rate of success in cannulation of IJV and SCV is 96.7% which is similar to that reported by Snajder

et al (1985).⁶ Sanches (1990)⁷ reports the failure rate to be 7.5%. Other studies for SCV (infraclavicular approach) report the success rate to be 95.5% (Mogil et al 1967)⁸ Davidson (1963)⁹ reports 94% success, while James and Myers (1973)¹⁰ reported the rate of success (for supraclavicular approach) to be 94%. The success rate for IJV catheterization ranges from 75% (Johnson 1978)¹¹ to 99.5% reported by Goldfrab (1982)¹² English et al (1969)¹³ reported a failure rate of 5.2% The success rate reported in our study is 96.7%, as the number of attempts were less than three in most of the cases, where as it has already been mentioned that the rate of success decreases with the number of attempts (Mansfield et al 1994).⁴

There was no incidence of pneumothorax in group A while only one patient developed pneumothorax in group B and the patient who developed this complication was the same in which attempted CVC had already failed. Pneumothorax was suspected when during third attempt at cannulation air was aspirated from the syringe attached to the catheter device and the patient suddenly developed hypotension i.e. 110/70 before insertion to 70/nil during the procedure.

The pneumothorax was managed by chest tube placement which was connected to an under water seal. The patient recovered fully. Incidence of pneumothorax reported by Mihm and Rosenthal (1992)¹⁴ varies from 0% to 6%, more with the experience of the operator rather than any other factor (Bernard and Stahl 1971)¹⁵ It was seen that incidence of pneumothorax was much less with the IJV route. The comparative high risk of pneumothorax with SCV catheterization is because parietal pleura is in contact with poster-inferior side of SCV.

The incidence of pneumothorax with IJV reported by Martin et al (1990)¹⁶ was 0.01%. In another report it was 0.2% English et al (1969),¹³ In this report a very low triangular approach was used whereas we used a high triangle approach in which point of entry was at the level of cricoid cartilage. In group B we had 3.33% rate of this complication i.e pneumothorax. Matthews and Worthley (1982)¹⁷ reported 3.95% incidence of this complication in right sided infraclavicular approach for subclavian vein catheterization. Sanches et al (1990)⁷ reported the incidence to be 1%. The percentage of 3.33% in our study can be attributed to the fact that the number of patients was very small.

The incidence of arterial puncture was 6.66% in group A and 3.33% in group B. The most common reported complication of IJV cannulation is arterial tap with or without haematoma formation (Defalque 1974).¹⁸ In our study the percentage of arterial tap was 6.66% in group A which conforms to the incidence reported in other studies. Mihm and Rosenthal (1992)¹⁴ reported the incidence to be on the average 0.2%, but the range is 0-30% with different techniques. In another study by (Boulanger in 1976) cited by Rosen et al (1992)¹⁹ the incidence of carotid tap was 0.2%.

Prince et al reported the highest percentage of this complication i.e 7.5%. This high incidence is most

probably due to the fact that the number of patients was small and most of the patients were children. . Another report by Hall and Geefhussen (1977) ²⁰ shows the incidence to be 3.33% but this too was a study in which most of the population were children aged between 02 weeks to 09 years. However the incidence reported in our study is 3.33% for SCV catheterization which is much less than the incidence of the same complication in the IJV cannulation. Davidson et al (1963)⁹ reported 03% arterial taps whereas Mogil reported 1.3%. Another study reported still lower incidence (0.1%). The results of our study also confirm that IJV route has more chances of arterial tap i.e. 6.6% compared with 3.33% in SCV catheterization

Table: Complications

Groups	Pneumothorax	Failure	Misplacement	Arterial tap
Group A	0	1	0	2
Group B	1	1	1	1
Total	1	2	1	3

p Value= 0.522487

Conclusions

It is concluded from the results of our study comparing the two most commonly used routes i.e. SCV and IJV for CVC that, there is no statistically significant difference between the two groups as far as overall complication rates are concerned.

As far as pneumothorax is concerned which is a major complication, we found out that IJV route is definitely much safer as compared to the SCV route

It is also clear that various complications are site specific, the pneumothorax is commoner with the SCV route whereas arterial tap is commoner with the IJV route. Like all clinical procedures the incidence of complications decreases with increasing experience. A smaller patient population also magnifies the rate of complications.

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