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A Comparative Study on Two Different Approaches (Central and Posterior) for Internal Jugular Vein Catheterization in Surgical Patients by the Traditional Blind Anatomical Landmark Technique

KEYWORDS: catheterization, internal jugular veins, central venous access, complications.

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ABSTRACT

Background: *Central venous catheterization is performed as an elective or emergency procedure. Central venous catheterization is commonly attempted at the internal jugular vein, subclavian vein, femoral vein or armveins using peripherally inserted central catheters. Internal jugular venous catheterization using traditional blind anatomic landmark technique can be done by various approaches namely central or anterior, posterior, high anterior or medial approaches*

Aim: *The aim of the study was to compare the central and posterior approaches in internal jugular venous catheterization by using traditional blind anatomic landmark technique in patients posted for major elective surgeries.*

Materials: *A prospective, randomized comparative study comprising of 60 patients were divided randomly into two groups. Group C underwent internal jugular venous catheterization by central approach using traditional blind anatomic landmark technique. Group P underwent internal jugular venous catheterization by posterior approach using traditional blind anatomic landmark technique. Time taken to perform block, success rate, ease and depth of insertion, occurrance of complications were observed.*

Results: *Time taken to perform block, ease of insertion, success rate were found to be better in posterior approach group when compared to central approach group. Depth of insertion was comparable in both study groups. Complication like carotid artery puncture was found to be more with central approach group when compared to posterior approach group.*

Conclusion: *Posterior approach to internal jugular venous catheterization is better compared to anterior approach to internal jugular venous catheterization because of shorter access time, high success rate and less incidence of complications.*

Introduction:
Central venous catheterization is performed as an elective or emergency procedure. Central venous catheters are used for central venous pressure[1, 2] monitoring, administration of vasopressors, cytotoxic drugs, parenteral nutrition[3], rapid infusion of IV fluids and transfusion of blood and blood products. Central venous access is commonly attempted at the internal jugular vein, subclavian vein, femoral vein or arm veins using peripherally inserted central catheters. Out of which, internal jugular vein is the best route because of its reliability and lower incidence of complications with insertion. Among the various techniques, using anatomical landmarks technique is the standard conventional technique for placing central venous catheters in IJV [(1)].

Aim:
The aim of the study was to compare the anterior and posterior approaches in internal jugular venous catheterization[4, 5] by traditional blind anatomic landmark technique in patients posted for major elective surgeries.

Anatomy of the internal jugular veins:
The internal jugular vein begins at the jugular foramen as a continuation of the sigmoid sinus and drains the skull, brain, superficial parts of face and much of the neck. After receiving tributaries, it joins the subclavian vein to form the brachiocephalic vein on both sides; which further unite to form the superior vena cava. The jugular vein forms a dilatation called the superior bulb at its upper end and the inferior bulb, just above its termination. Above the inferior bulb, the internal jugular vein contains a pair of valves. The internal jugular vein lies posterior to the internal carotid artery in the uppermost part of its course, but later lies lateral to it as it passes down. At the base of the neck, it becomes anterolateral to the common carotid artery and crosses in front of the sub-clavian artery to join the subclavian vein.

Surface anatomy:
The internal jugular vein is represented by a broad band from the ear lobule to the medial end of the clavicle.
Materials and Methods:

This study was done in a prospective randomized manner in Department of Anesthesiology, ISO KGH, Govt. medical college, Omandurar govt. estate, chennai

Selection of Cases: 60 patients of either sex posted for major surgeries aged – 18 to 60 years, weighing 45 to 70 kgs, planned for elective IJV catheterization were included. Patients who does not satisfy inclusion criteria, emergency catheterization, presence of coagulopathy, neck deformities, local sepsis, H/O i.v drug abuse, H/O IJV thrombosis were excluded. After obtaining institutional ethical committee approval, Patients were all evaluated preoperatively and clinically examined. Investigations including biochemical, electrocardiogram, CXR were

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done prior to the assessment. Procedures were explained in detail and written consent was obtained. Patients were randomly allocated into two groups of 30 patients each (Group C and Group P). **GroupC:** 30 patients who underwent internal jugular venous catheterization by central approach using traditional blind anatomic landmark technique. **Group P:** 30 patients who underwent internal jugular venous catheterization by posterior approach using traditional blind anatomic landmark technique.

Materials Used:
Autoclaved tray with Sterile towel, Gally pots with swabs, Sponge holding forceps, 25G hypodermic needle, A set of 7G triple lumen central venous catheter of length 20 cm, Stopclock

Preparation:
Anaesthesia machine, suctioning equipment, emergency intubation cart, manual resuscitation bag with mask and reservoir were kept ready. Standard monitoring was done. After obtaining intravenous access, premedicated with inj. midazolam 0.05 mg/kg and inj. morphine 0.1 mg/kg iv. Oxygenation with face mask 6 L/min was given. Patients were positioned in 15 degree trendelenberg position with a small bedroll between the shoulder blades, head turned slightly to the contralateral side, arms kept by the side of the body. Technique was done under strict aseptic precaution with LA infiltration.

Technique of IJV catheterization
Group C :
IJV catheterization[6,7] using central approach was done. Right IJV is preferred. The operator stood at the head end of the patient. The triangle formed by the two heads of sternocleidomastoid muscle (Sedillot's triangle) was palpated.The carotid artery pulsation was felt 1 to 2 cm medial to this point, beneath or just medial to the sternal head of sternomastoid muscle. With slight or no pressure on the carotid artery with the left hand, the 22 G 1 $_{1/2}$ inch finder needle mounted on a 5 ml heparin saline loaded syringe was inserted with the right hand at the apex of the triangle at a 30 to 45 degree angle with the frontal plane, directed at the ipsilateral nipple. On advancing the needle steadily with constant back pressure, venipuncture occured within 3 to 5 cm, demonstrated by the free aspiration of dark venous blood. After noting the direction and depth of the needle finder needle was withdrawn. The 18G needle mounted on a 5ml heparin saline loaded syringe was introduced in the identical plane and venipuncture was attempted in the same direction and depth. Venipuncture was demonstrated by free aspiration of dark venous blood. The syringe was removed during expiration or valsalva maneuver and hub occluded with a finger after securing the needle in place with one hand. The J tip of the guide wire was then inserted freely upto 20cm at which point the 18G needle was withdrawn. With the guidewire in place, 90 degree stab incision was made at the skin entry site to facilitate passage of the vessel dilator. The dilator was inserted down the guide wire to the hub, ensuring the stability of the guidewire. The dilator was then withdrawn and gauze was used at the puncture site to control oozing and prevent air embolism. The triple lumen catheter was then inserted over the guide wire ensuring that the guide wire protrudes from the distal human hub before the catheter tip penetrates the skin. The catheter was then advanced 15 to 17 cm into the vein , the guide wire was withdrawn and the distal lumen was capped. The catheter was sutured securely.

If first attempt was unsuccessful, the operator should reassess the patient position , landmarks and techniques. Subsequent attempt was directed slightly laterally or medially to the initial thrust after reassessment of the carotid artery position. If venipuncture[8] did not occur with 18G needle after insertion up to a depth of 0.5 cm more than that of a successful finder needle insertion in the same direction or inability to locate the IJV with 18G needle for more than 30 sec, the attempt was considered a missed attempt. The 18G needle was withdrawn to the skin and a fresh attempt was done. If venipuncture was unsuccessful or cannulation was unsuccessful after 3 consecutive attempts with 18G needle or if the operator was unable to cannulate for more than 30 minutes or the development of significant hematoma (>2 cm in any direction) due to artery puncture, it was defined as failure[9]. Failure was followed by an attempt to cannulate the left IJV if significant hematoma was present following the arterial puncture.

Group P:
Posterior approach for IJV was done. External jugular vein was used as the surface landmark.A 22 G 1 1/2 inch finder needle mounted on a 5 ml syringe was first used to locate the IJV.The needle was introduced 1 cm dorsally to the point where the EJV crosses the posterior border of the sternocleidomastoid muscle or 5 cm cephalad from the clavicle along the clavicular head of the sternocleidomastoid muscle.The needle was directed caudally and ventrally towards the suprasternal notch at an angle of 45 degrees to the sagittal plane with 15 degree upward angulation. The needle was steadily advanced with constant back pressure and venipuncture at 5 to7 cm.

When venipuncture occurred with the finder needle demonstrated by the free aspiration of dark venous blood, the operator made a note of the direction and depth of the needle before withdrawing the finder needle. The 18G thin wall needle mounted on a 5ml heparin saline loaded syringe was introduced in the identical plane and venipuncture was attempted in the same direction and depth. Once venipuncture occurred, free aspiration of dark venous blood was demonstrated. The procedure was continued in the same manner as described in central approach.

Parameters Observed:
Time taken to locate IJV with pilot needle, time taken to locate IJV with 18G needle, number of attempts required to successfully cannulate the IJV with 18G needle, number of attempts required to successfully insert the guide wire[10], total access time, failure to cannulate the IJV, depth of cannulation. Acute complications like carotid artery puncture[11], hematoma[12] were observed. Post operatively, local swelling , redness, pain, infection, limitation of neck movements, catheter kinking, catheter dislodgement were noted. X-ray chest was taken postoperatively to check catheter position radiologically[13]

Observation and results:
All the parameters were observed and interpreted.

The distribution of demographic profile like age, sex, weight was found to be equal and comparable among the two study groups.

Table 1 : Time taken with pilot needle to locate IJV :

Group	N	Mean (sec)	SD	p Value
C	30	10.57	2.208	P = 0.005
P	30	9.17	1.367	

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Group P required considerably less time(9.17 ± 1.367 sec) to locate the IJV with pilot needle when compared to Group C (10.57 ± 2.208 sec) which was statistically significant.

Table 2: Time taken with the 18 G needle to locate IJV :

Group	N	Mean (sec)	SD	p value
C	30	11.90	1.539	0.000
P	30	9.43	1.455	

Group P required (9.43 ± 1.455 sec) considerably less time to locate the IJV with 18G needle when compared to Group C (11.90 ± 1.539 sec) which was statistically significant.

Table 3 : The number of attempts required with 18 G needle to successfully cannulate IJV :

Group	Number of patients cannulated at			
	1st attempt	2nd attempt	3rd attempt	4th attempt
C	21 (70%)	6 (20%)	2 (6.7%)	1 (3.3%)
P	26 (86.7%)	4(13.3%)	0%	0%

p = 0.057

In Group P, 26 patients were catheterized at first attempt, 4 patients required 2 attempts. In Group C, only 21 patients were catheterized at first attempt,6 patients required 2 attempts, 2 patients required 3 attempts and 1 patient required 4 attempts (which was a case of failure to cannulate). The difference was statistically significant .

Success rate at first attempt :

Group P = 26/30 = 86%

Group C = 21/30 =70%

Group P had 86% success rate at first attempt where as in Group C, success rate at first attempt was only 70 % and this was statistically significant.

There was no statistically significant difference in the number of attempts for successful guide wire insertion with successful first attempt in 28 (93%) patients in group C compared to 27 (90%) patients in group P.

Table 4 : Total access time (in sec)

Group	N	Mean (sec)	SD	p Value
C	30	299.67	80.598	0.000
P	30	244.63	11.291	

Group P required less time for central venous access (299.67 ± 80.598 sec) when compared to Group A (244.63 ± 11.291 sec).There was a statistically significant. difference in the total access time among the two groups.

Group C had a failure rate of 16.7% when compared to Group P (0%).The difference was statistically significant(p = 0.052)

Carotid artery puncture rate was 20% in Group C compared to 0% in Group P. The difference was found to be statistically significant(P = 0.024)

Most of the arterial punctures were followed by hematoma formation. Hematoma formation rate was 16.7% in Group C compared to 0% in Group P. This difference was statistically significant (p = 0.052)

The depth of cannulation in Group P was (14.767 ± 0.7176 cm) compared to (14.797 ± 0.6965 cm) in group C. There was no statistically significant difference among the two study groups. (p=0.870)

Discussion:

In our study, we compared central approach for internal jugular venous catheterization with the posterior approach; by analyzing the time taken to perform block, ease of insertion, success rate and occurrence of complications in 30 patients each. Brink man et al proposed that point of entry in the posterior approach was higher up in the neck, providing a longer length of vein for catheterization and also reduces the incidence of complications like hemothorax, carotid puncture and pneumothorax.

In our study, there was a significant reduction in the time required to locate internal jugular vein with both the pilot needle and 18G needle in posterior approach group compared to the central approach group. Chaudhuri et al also demonstrated significant reduction in accessing IJV. In our study, the number of attempts with the 18 G needle to cannulate the IJV was analysed. In the posterior approach group, 26 patients were cannulated at first attempt, 4 patients required 2 attempts. in contrast to central approach group where 21 patients were cannulated at first attempt, 6 patients required two attempts, 2 patients required three attempts and one patient required four attempts(which was a case of failure to cannulate). The number of attempts included missed attempts in which inadvertent artery puncture occurred and attempts in which IJV was hit but cannulation could not be done because of needle tip displacement. The difference was found to be statistically significant (p = 0.057) .With this, the success rate at first attempt for posterior approach group was 86% and only 70% for central approach group. There was no significant difference in the guide wire insertion successfully at first attempt which was 93% patients in posterior approach group and 90% patients in central approach group. In the present study, the access time was less for posterior approach (244.63 ± 11.291 sec) when compared to the central approach group (299.67 ± 80.598 sec).There was no considerable delay due to missed attempts, inadvertent artery puncture, compression of the artery following puncture, hematoma obscuring the anatomy and failure of cannulation.The difference in the total access time of the two groups was found to be statistically significant (p = 0.000). The vertical distance from the cricoid cartilage level to the skin puncture site and the length of the catheter from the skin puncture site to the atriocaval junction are noted. The sum of these two was the depth of cannulation. There was no significant difference with respect to the depth of cannulation among the two study groups. Failure was defined as the process during which cannulation was unsuccessful after three consecutive attempts with 18 G needle or if more than three attempts were required for successful guidewire insertion or if the operator was unable to cannulate for more than 30 minutes or the development of significant hematoma (>2 cm in any dimension) due to artery puncture. The failure rate was significantly increased in central approach group(16.7%) when compared to the posterior approach group (0%) with (p = 0.052).Most common complication observed was carotid artery puncture. Most of which was followed by hematoma formation.

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In the present study,carotid artery puncture occurred in 20% of the cases in central approach group where as there was none in posterior approach group (0%).p value was 0.024.Hematoma formation rate was about 16.7% in central approach group where as none in posterior approach group(0%) with p value 0.052.This difference was found to be statistically significant. Occurrance of these complications were seen commonly in obese and short necked individuals.

Wisheart et al reported a case of injury to the ascending cervical artery by the lateral approach which led to lateral hemothorax, extrapleural hematoma.

Brown et al recorded chronic hematoma in a patient following percutaneous IJV cannulation, requiring surgical removal.

Conclusion:

We conclude that the posterior approach to internal jugular venous catheterization is better compared to anterior approach to internal jugular venous catheterization because of shorter access time (time taken to locate with the pilot needle, time taken to locate with 18 G needle and total access time), reduced failure rate and lower incidence of complications.

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