Archives of Anesthesiology and Critical Care (Autumn 2022); 8(4): 325-329.

Available online at http://aacc.tums.ac.ir

Research Article

A Comparative Study of Internal Jugular Vein Cannulation under Ultrasound Guidance Using Short Axis or Long Axis View Approach

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ARTICLE INFO

Article history:
Received 01 February 2022
Revised 23 February 2022
Accepted 08 March 2022

Keywords:
Internal jugular vein;
Ultrasound;
Venous cannulation;
Scanning axis

ABSTRACT

Background: Anaesthesiologists most commonly perform the procedure of internal jugular vein cannulation(IJV) in emergency and also in elective cases. With the use of ultrasound guidance placement of guide wire and catheter into the internal jugular vein has been made easy, safe and with less complications.
Aims: The aim of the study was to compare IJ vein cannulation under ultrasound guidance with respect to Short and Long axis (SA and LA) view approaches.
Methods: Patients who may require central venous cannulation for undergoing surgery and will be in intensive care unit were randomized using computer generated randomization for ultrasound guided cannulation into one of short axis and long axis (SA and LA) approaches group. Success rate of first pass, number of needle attempts made, guide wire insertion time, catheter placement time and complications were noted for each procedure.
Results: Successful cannulation of IJV was achieved in all the patients. Significant results were not noted among the two groups with respect to demographic profile of the patient, catheter placement time, rate of carotid artery puncture. Whereas a significant result was noted in terms of success rate of first pass (97% in SA v/s 53% in LA, P-0.0001), number of needle attempts (mean of 1.05±0.18 in SA v/s 1.55±0.68 in LA, P-0.0001), guide wire insertion time (mean of 43.20±5.64 in SA v/s 74.83±39.36 in LA).
Conclusion: We conclude from the above study that short axis view approach is better with respect to success rate of first pass, number of needle attempts and guide wire insertion time than long axis view approach for internal jugular vein cannulation under ultrasound guidance.

Internal jugular vein cannulation is performed to gain central venous access for which various approaches which are safe were attempted. Internal jugular vein cannulation was done by anaesthesiologist using surface landmark technique. This central venous cannulation is needed in major surgeries and in patients of critical care unit patients where haemodynamic monitoring is required apart from other purpose such as administration of chemotherapeutic drugs, total parentral nutrition and institution of inotropic drugs for haemodynamic support, central venous oxygen saturation, etc [1].

In conventional technique external surface landmarks were used for the cannulation of internal jugular vein in the expected course of the vein [2]. Anatomical variations of the vein, deformities of the neck may increase the difficulties of the cannulation of IJV in surface landmark

The authors declare no conflicts of interest.
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technique which may lead to unintended complications [3]. The complications were even more in patients having associated coagulopathy.

The success of surface landmark technique of IJV cannulation depends on site of cannulation and patient position. With this surface landmark technique, the incidence of complications, attempts and duration required for cannulation of vein will be more and this may also add to the non-cooperation of patients. So to avoid such complications many other techniques were tried for the cannulation of internal jugular vein. Among one such approaches are the ultrasound guided internal jugular vein cannulation [4]. With this technique ultrasound imaging of the vessels were used to cannulate them with its relationships to surrounding landmarks. With the use of ultrasound guidance the complications encountered were less and the patients being cooperative for internal jugular vein cannulation and insertion of catheter. Complications that may arise during the surface landmark technique of cannulation which include carotid artery puncture, pneumothorax, nerve injury can be minimized with ultrasound guided technique. In clinical practice use of the ultrasound guidance will help for the safe and reliable placement of the catheter into the internal jugular vein in emergency, elective and difficult cases [5]. Many studies were done previously where they have compared surface land mark technique with the ultrasound guided method for IJV cannulation.

The orientation of the internal jugular vein in the ultrasound image will be either short axis (cross-sectional view) or long axis (longitudinal view) [6]. Our study was undertaken which compares the cannulation of internal jugular vein under ultrasound guidance with respect to short axis view and long axis view in terms of success rate of first pass, number of needle attempts, guide wire insertion time, catheter placement time and complications.

Methods

The approval for the study was obtained from Institutional ethical committee (IEC NUMBER: AIMS/IEC/2080/2020). Those adult patients posted for surgery and who may require intensive care unit requiring central venous cannulation were included in the study. A written informed consent was obtained. Exclusion criteria of the study being patient with coagulopathy whose (International Normalized Ratio>1.5 and platelet count <50,000/cumm), age of the patients <18 years, infection at the site, patients not willing or uncooperative. A pilot study was conducted to determine the sample size required for the study, taking sample size of 5 in each group before the study being started. With the help of pilot study sample size was obtained as 30 in each group being calculated with 80% power and 5% significance level using G*power 3.1 software. Patients who were enrolled in the study were randomized into one of the groups by computer generated random number table. Patients who were assigned to group S will undergo internal jugular vein cannulation in Short Axis (SA) view ultrasound guided approach. Patients belonging to Group L will undergo internal jugular vein cannulation in Long Axis (LA) view ultrasound guided approach. The internal jugular vein cannulation will be performed using Seldinger technique in all patients.

In all the patients internal jugular vein cannulation will be performed by principal investigator of the study who has experience in IJV cannulation using surface landmark technique and also in ultrasound guided technique of IJV cannulation. An assistant who is not aware of the group allocation, objectives and outcome of the study will record the data such as success rate of first pass, number of needle attempts, guide wire insertion time, catheter placement time and complications. Under aseptic precautions ultrasound linear probe of 12MHZ was used to do the procedure. On this probe a sterile water based jelly was administered then it was covered by a sterile cover, the air between the cover and the probe was removed. Then again sterile jelly was administered over the probe over the cover for skin contact this improves the quality of the image.

Under aseptic precautions the procedure was done with the help of an assistant who was assisting throughout the procedure. The patients were placed in 30º head down position (Trendelenburg position) and the head is rotated to the opposite side of the side chosen for cannulation. The site of cannulation was sterilized with chlorhexidine solution. The whole area was covered with a sterile drape leaving the required area exposed. Cannulation of the internal jugular vein was done with Seldinger's technique (ie catheter over guidewire) under ultrasound guidance. After the insertion of the catheter it was fixed to the skin by sterile sutures. A transparent adhesive dressing (Tegaderm) was applied over the catheter insertion site. Date of insertion was mentioned on a sterile label. Complications that may occur after insertion of the catheter was monitored and managed. A check X-ray was done post insertion of the catheter to confirm the position of the catheter tip.

Group S

In this group IJV cannulation was done using ultrasound guidance in Short Axis(SA) view approach. In this view right IJV was viewed by placing the ultrasound probe perpendicular to the direction of the vein at the level of the cricoid's cartilage. Cross section view of the IJV and carotid artery were visualized in the monitor (Figure 1). Keeping the IJV focused in the center of the screen, at an angle of 45º a syringe with needle attached was advanced with gentle aspiration in out of plane to the probe. Entry into the vein can be seen as the needle indenting the wall of the vein, which can also be confirmed by aspiration of venous blood in to the syringe. The guidewire is then passed which can be visually confirmed by the short axis view (Figure 2). After confirmation catheter was passed and secured.

Figure 1- Cross section view of the internal jugular vein (vertical arrow) and carotid artery (asterisk) in Short Axis view

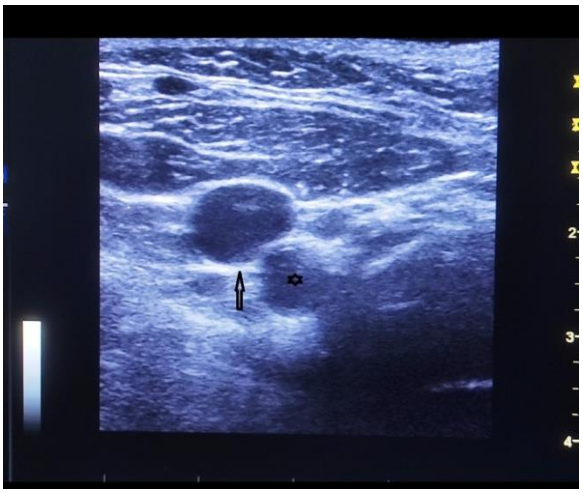
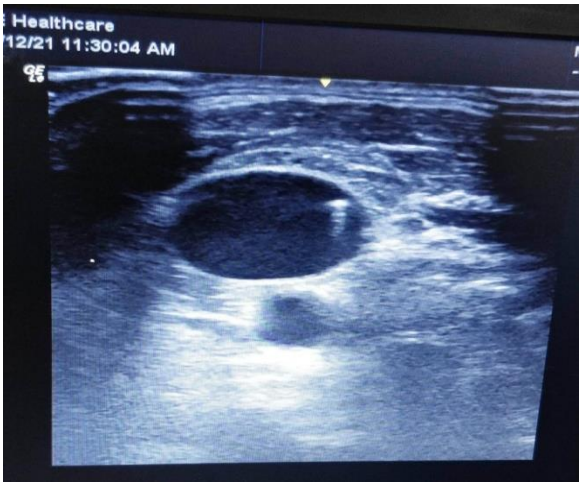


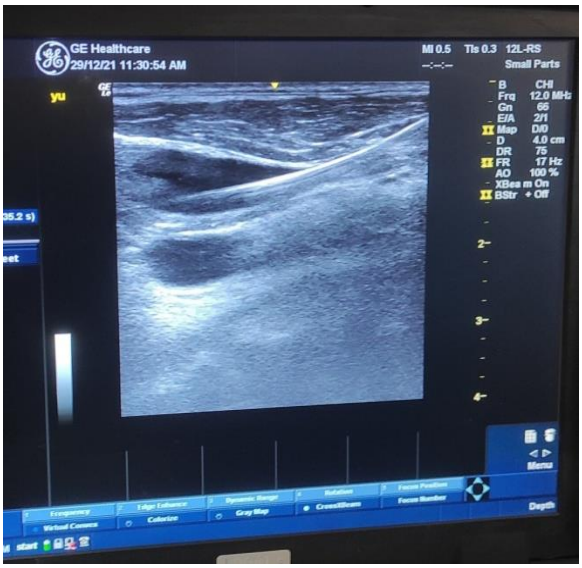
Figure 2- Position of guide wire inside internal jugular vein short axis view



Group L

In this group IJV cannulation was done using ultrasound guidance in Long Axis (LA) view approach. In this view right IJV was viewed with the ultrasound probe being placed perpendicular to the direction of the vein at the level of cricoid cartilage. Cross section view of the IJV and carotid artery were visualized in the monitor. Keeping the IJV focused in the center of the screen, probe of the ultrasound is rotated to 90º to obtain the longitudinal view of the IJV. At an angle of 45º a syringe with needle attached was advanced with gentle aspiration in plane to the probe. The entire length of the needle can be seen as it enters the IJV. Entry into the IJV can also be confirmed by aspiration of venous blood into the syringe. The guidewire is then passed and the position of which can be visually confirmed by the Long Axis view (Figure 3). After confirmation catheter was passed and secured.

Figure 3- Position of guide wire inside internal jugular vein Long Axis view



Parameters observed

Success rate of first pass

It is the success rate of cannulation of IJV in single needle attempt.

Number of needle attempts

It is the number of times/attempts taken for successful cannulation of IJV.

Guide wire insertion time

It is the time taken from the entry of the needle to the ultrasound confirmation of presence of guide wire within the vein.

Catheter placement time

It is the time taken from the ultrasound confirmation of presence of guide wire within the vein to the successful aspiration of venous blood from the catheter.

Rate of carotid artery puncture

It is the rate of puncture of the carotid artery.

Statistical analysis

Analysis of the categorical variables were done using chi-square test and analysis of continuous variables were done using independent T test. A type I error of 0.05 was considered while analyzing the data.

Results

With respect to demographic profile of age, gender and weight no statistical significance were found between the two groups making the two groups comparable and similar.

Success rate of first pass

The success rate of first pass was 97% in group S and 53% in group L. The p value (p=0.0001) showing a significant relation between the two groups (Table 1).

Table 1- Success rate of first pass

Success rate of first pass	Short Axis view		Long Axis veiw	
	No	%	No	%
Yes	29	97	16	53
No	1	3	14	47
Total	30	100	30	100
Value of Chi square	14.03			
P value	0.0001 (Significant)			

Number of attempts

Successful cannulation of IJV was done in single attempt in 29cases (96%) and required 2 attempts in 1 case (4%) in Short axis view. Whereas it took single attempt in 16 cases (54%), 2 attempts in 11 cases (36%) and 3 attempts in 3 cases (10%) in Long axis view. Chi square tests were applied and was found that statistically significance with p value (p=0.0001) was found between the two groups (Table 2 and 3).

Table 2- No of needle attempts

No of Needle attempts	Short Axis view		Long Axis veiw		Total	
	No	%	No	%	N	%
Once	29	96	16	54	45	75.00
Twice	1	4	11	36	12	20.00
Thrice	0	0	3	10	3	5.00
Min	1		1		1	
Max	2		3		3	
Chi-square Value	14.09					
P value	0.0001 (Significant)					

Table 3- Mean no of needle attempts

	Short Axis view	Long Axis view
Mean	1.05	1.55
Sd	0.18	0.68
t-Value	3.16	
P value	0.0001 (Significant)	

Guide wire insertion time

The mean time required for the insertion of the guide wire was 43.20 seconds with standard deviation of 5.64 in Short axis view group. As compared to Long axis view group where the mean was 74.83 seconds with standard deviation of 39.36. Statistical significance with p value(p=0.0001) was found between the two groups (Table 4 and 5).

Table 4- Guide wire insertion time in seconds

No of Needle attempts	Short Axis view		Long Axis view				
	Mean	Sd	Mean	Sd	T value	Df	P value
once	41.26	4.16	57.50	6.88	9.66	42	0.0001
Twice	71	0	68.91	5.24	0.016	10	0.98(NS)
Thrice	-	-	172.0	71.0	-	-	-
Total	43.20	5.64	74.83	39.36	4.440	59	0.0001

Table 5- Mean guide wire insertion time in seconds

	Short Axis view	Long Axis view
Mean	43.20	74.83
Sd	5.64	39.36
T value	4.440	
P value	0.0001 (Significant)	

Catheter placement time

The mean time required for catheter placement was 71.80seconds with standard deviation of 5.43 in short axis view group. The mean time required for catheter placement was 70.67seconds with standard deviation of 4.65 in long axis view group. The p value (p=0.401) shows no statistical significane between the two groups (Table 6).

Table 6- Catheter placement time in seconds

	Short Axis view	Long Axis view
Mean	71.80	70.67
Sd	5.43	4.65
T value	1.12	
Significant	0.401 (Not Significant)	

Rate of carotid artery puncture

In short axis view group there were no case of carotid artery puncture (0%).In long axis view group carotid artery puncture occurred in 3 cases (10%).Chi square test was applied which shows a p value(p=0.09) showing no significant relation between the two groups (Table 7).

Table 7- Carotid artery puncture

Carotid Artery Puncture	Short Axis view		Long Axis view		Chi-square	P value
	N	%	N	%		
No	30	100	27	90.0	3.18	0.09
Yes	0	0	3	10.0		Not Significant

Discussion

Internal jugular vein cannulation related complications have been reduced since the advent of ultrasound in clinical practice. The number of needle attempts have been reduced and success rate of first pass is increased with the use of ultrasound guidance for IJV cannulation [6]. Under ultrasound guidance IJV cannulation can be done in two approaches i.e., Short Axis view (cross sectional view) or Long Axis view (longitudinal view) [9-10].

Our study compares the cannulation of internal jugular vein with respect to Short Axis view and Long Axis view approaches.

With respect to demographic profile of age, gender and weight no statistical significance were found between the two groups making the two groups comparable and similar.

Many studies were conducted previously which showed significant results between short axis view and long axis views in terms of success rate of first pass and complications. Among the two approaches short axis view showed better results in terms of success rate of first pass and with lesser complications [7].

While considering the previous studies we decided to test the hypothesis made such that short axis view approach is better than long axis view for IJV cannulation under ultrasound guidance in terms of success rate of first pass, number of needle attempts, catheter placement time.

A statistically significant result with success rate of first pass of 97% in short axis view and 53% in long axis view was found in our study. These results are similar to the studies done by Chittoodan et al [8] whose study showed first pass success rate was 98% in the short axis view and 76 % in long axis view. But theoverall success rate were said to be 100% in both the groups.

Our study showed the mean number of needle attempts was 1.05 with standard deviation of 0.18 in short axis view as compared to 1.55 with standard deviation of 0.68 in long axis view which was found to be statistically significant similar results were found to be in study done by Chittoddan et al.

Our study showed the mean guide wire insertion time was 43.20 with standard deviation of 5.64 in short axis view as compared to 74.83 with standard deviation of 39.36 in long axis view which was found to be statistically significant and the results were similar to the study done by Chittoddan et al [8], Blaivas et al [7].

Our study showed the mean catheter placement time was 71.80 with standard deviation of 5.43 in short axis view as compared to 70.67 with standard deviation of 4.65 in long axis view these results were found to be statistically not significant.

Rate of carotid artery puncture in our study was about 10% in long axis view approach as compared to short axis view approach where no carotid artery puncture occurred (0%).The relation between the two groups was statistically not significant. In long axis view approach more hand eye coordination is needed for IJV cannulation, so the carotid artery puncture rate is more than short axis view approach. This results were similar to the results obtained by Chittoodan et al [8].

In this study an assistant who is not aware of group allocation, objectives and outcome of the study will record the data parameters to minimize bias.

Conclusion

From the study conducted we conclude that short axis view approach is better with respect to success rate of first pass, number of needle attempts and guide wire insertion time than long axis view approach for internal jugular vein cannulation in adults under ultrasound guidance.

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