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Comparison of Short Axis and Oblique Axis Approaches for Ultrasound Guided Internal Jugular Vein Cannulation

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ABSTRACT: Background: The lateral oblique approach is a novel needle-in-plane technique for ultrasound-guided internal jugular vein cannulation. In this study, our aim is to compare the oblique approach (OAX) with the classical short-axis (SAX) approach for comparing the clinical performance in terms of access time, cannulation attempts, mechanical complications and needle visibility.

Method: Eighty adult patients of 18-65 years needing internal jugular vein cannulation for cancer treatment were divided into 2 groups of 40 (SAX group and OAX group) by assigning them alternatively to each group. IJV cannulation was performed using an ultrasound probe in all patients with either SAX view (n = 40) or the OAX view (n = 40) by an experienced anaesthesiologist.

Results: Access time was 65.27±19.47 seconds in SAX group and 61.95±28.32 seconds in OAX group (P=0.5412). IJV cannulation was successful on first attempt in 36(90%) SAX patients, 31(77.5%) OAX patients. Carotid artery picture noted in 2 cases (5%) in SAX group while in only one case (2.5%) in OAX group (P=0.555). Needle visibility during IJV cannulation in OAX groups was in 35 cases compared with 24 cases in SAX group P=0.0019 which is statistically significant.

Conclusion: Both oblique axis and classic short axis approaches for USG guided IJV cannulation are comparable except better needle visibility with OAX so oblique axis approach may be a suitable alternative to short axis as visibility of needle and guide wire are better.

KEYWORDS:
Cancer; Cannulation; Lateral oblique; Short axis; Ultrasound.

I. INTRODUCTION

[1].Internal jugular venous cannulation is a commonly performed procedure in the operation theatre and in intensive care unit. Traditionally, IJV cannulation is performed using anatomical landmark technique but due to anatomic variation, this may result in a difficult cannulation and mechanical complications like arterial puncture, pneumothorax and hemothorax.

[2,3].But current evidence-based recommendations suggest that USG guidance for central venous access should be used if available as it reduces the chances of complications and increases the safety and quality of central venous cannulation.

[4].Real time imaging with ultrasonography provide visualisation of cannulation needle entering the vein. This reduces the chances of complications.

[5].There are various approaches used for USG-guided IJV cannulation to improve success rate and decrease complications. These are short-axis and long-axis and oblique approaches. Short axis is the most commonly used approach for IJV cannulation in which ultrasound probe is placed along the short axis of the vein to visualize the vein and direct needle placement. It better visualizes IJV and its relation with internal carotid arteries. But its limitation is that it visualizes the needle tip only.

[6].While on the long axis one can visualize better needle path, tip visualisation and the internal jugular vein while relevant anatomical structures cannot be visualized.

[7,8].The oblique-axis approach having the benefit of the both short- and long-axis approach, can visualise both the internal jugular vein and carotid artery and improves both needle and guide wire visibility.

[8,9].Only few studies have compared short axis approach with oblique axis approach for USG guided IJV cannulation.

Our hypothesis is to compare efficacy of oblique axis approach with short axis approach USG guided IJV insertion for better procedure facilitation and reducing procedure related complication.

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This study aims to compare the short axis and oblique axis approaches in USG guided IJV insertion in terms of access time, number of attempts for IJV cannulation, frequency of mechanical complications and needle visibility.

II. MATERIAL AND METHOD

After taking written and informed consent and institutional ethical committee approval, 80 patients of ASA I-III, 18-65 yrs. of age requiring central venous insertion for chemotherapy or major thoraco-abdominal cancer operation were included in our study. Patients with coagulation abnormalities, history of surgery or infection at the insertion site, thrombus in the IJV were excluded from the study. Standard monitors like electrocardiography, pulse oximetry, non-invasive blood pressure were applied in all cases. The position of patient for IJV cannulation was 15 degree Trendelenburg with a slight head rotation to the left side. Right IJV was selected for each case. The ultrasound screen was kept on the same side for better vision of needle advancement. All aseptic precautions were taken for procedure. Skin was prepared with 10% chlorhexidine, then after draping skin was infiltrated with 2% lignocaine at puncture site. We used high frequency linear probe 6-13 MHZ (Fuji film Sonosite, EDGA, USA, 2017 version). This high frequency linear probe and its cable were isolated with sterile transparent cover. In this single-operator technique, the US probe was held with the nondominant hand and the needle was held with the dominant hand for better visualisation of ultrasonographic view and direction of the needle.

The two groups were SAX (short axis) group and OAX (oblique axis) group, 40 patients in each group. The probe is placed in a transverse plane in the neck at the level of the apex of the triangle formed by sternal and clavicular heads of the sternocleidomastoid muscle. Compared to the carotid artery the IJV appears to be large, non-pulsatile, more superficial and easily compressible. Now in SAX the position of the transducer was transverse to the vessel and the needle **(Figure 1, Figure 2)**.

Figure 1: Position Of Needle And Ultrasound Probe In Short Axis Approach

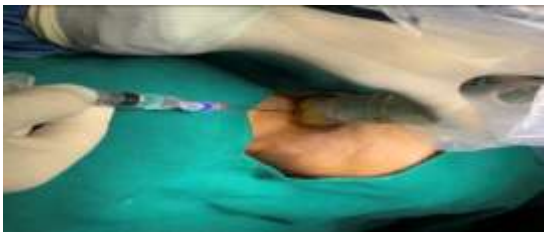

Figure 2: Ultrasonographic View of Needle And IJV In Short Axis Approach

The puncture of the skin was performed exactly in the middle of the probe with an angle of approximately 45° to the skin. In OAX approach (ultrasound view that is halfway between the short-axis and the long-axis view) probe was placed as was placed in SAX approach and then probe was rotated 45◦ clock-wise for right IJV to achieve a lateral oblique orientation with lateral cephalic and medial caudad direction of probe. Now the position

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of the probe is parallel to the needle and oblique to the vessel **(Figure 3, Figure 4)**.

Figure 3: Position of Needle And Ultrasound Probe In Lateral Oblique Approach

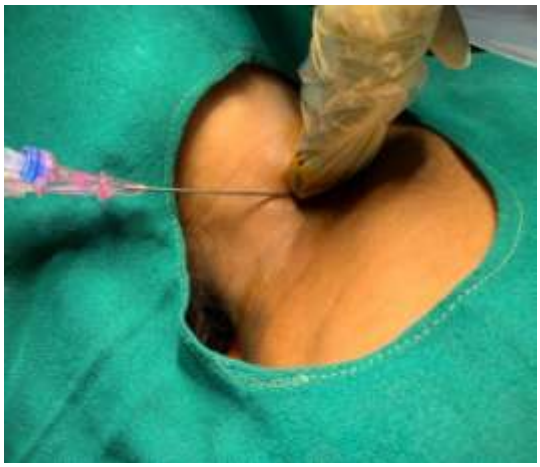
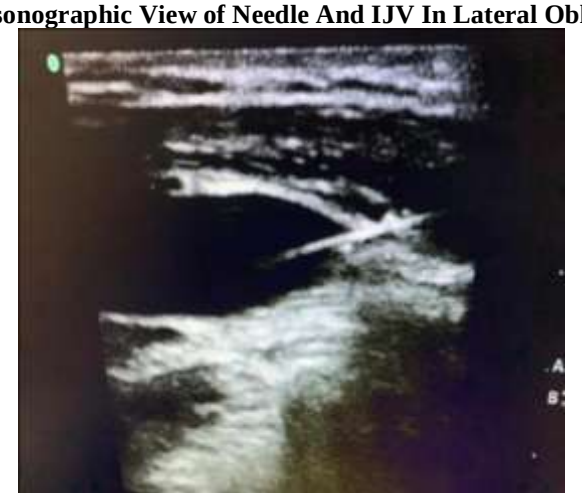


Figure 4: Ultrasonographic View of Needle And IJV In Lateral Oblique Approach



The skin puncture was done with the needle at the lateral cephalic border of the probe, and is advanced medially in plane toward the IJV. This real view allows visualisation of progression of the entire needle and guide wire. As the needle which is attached to a syringe, penetrates the vessel lumen and blood is aspirated the guide wire is introduced through the needle with ultrasound visualization. Once the guide wire is correctly placed the needle is removed and the procedure is completed in both the approaches in traditional way.

Demographic characteristics (Age, gender, BMI) and indication for central venous catheterisation were noted. Primary data were access time, number of attempts of successful cannulation and complications observed during catheterisation. Secondary outcome was ultrasound guided needle visualisation.

Access time was defined as time from skin puncture, free flow of venous blood aspiration in the syringe and easy insertion of guide wire into puncture vessel.

Successful cannulation was defined as properly placed catheter with free and easy aspiration of venous blood from catheter.

III. STATISTICAL ANALYSIS

Calculation of the sample size was done on the basis of pilot study. To get the clinically relevant difference of 24 (SD) in access time with 0.05 significant level and 80% power, we needed 40 patients in each group. The statistical analysis was carried out using SPSS (version 20, IBM cap. USA) software. Data were presented as mean ± SD, number and percentages. Continuous variables were analysed using unpaired student t test and categorical variables were analysed using chi-

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square test with yate's correction. **p** value < 0.05 was considered as statistically significant.

IV. RESULTS

Our study included total 80 patients. Both the groups were comparable in terms of age, height, weight, BMI and gender. In both the groups right sided IJV cannulation was done **(Table 1).**

Table -1:

Patient Characteristic

Variables		**SAX Group (N=40)**	**OAX Group (N=40)**	**P Value**
Age (Years)		50.35±11.28	46.35±14.20	0.19
Weight(Kg)		58±5.11	55±7.14	0.03
Height (Meter)		155.07±9.10	155±10	0.97
BMI		22±3.5	21±4.8	0.29
Gender (%)	**Male** **Female**	52 48	60 40	0.4916
Visualisation Of Needle (%)	**Easy** **Difficulty**	61.2 38.8	89.5 10.5	0.0019
Indication	**Chemotherapy** **Thoraco-Abdominal Surgery**	11 29	9 31	0.603 0.603

N= number, BMI= Body Mass Index
Data presented as mean, standard deviation, percentage or number
P<0.05 – significant, P< 0.001- highly significant

The first attempt success rate was in 36 patients in SAX group and 31 patients in OAX group. IJV cannulation occurs by second attempt in 4 cases in SAX group while 7 cases in OAX group. While the third attempt cannulation occurs in 2 cases in the OAX group. By conventional criteria this difference is considered to be not significant (p=0.13)(**Table2)**.

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Table-2:
Outcome (Access Time, Number Of Attempts, Complications) Comparison Between Groups During The Procedure

Variables		SAX Group (N=40)	OAX Group (N=40)	P Value
Access Time (Seconds)		65.27 ±19.47	61.95 ± 28.32	0.5412
No. Of Attempt (%)	**1st** **2nd** **3rd**	36 (90%) 4 (10%) 0	31 (77.5%) 7 (17.5%) 2 (5%)	0.13
Complications	**Carotid Puncture** **Hematoma** **Pneumothorax** **Hemothorax**	2 (5%) - - -	1 (2.5%) - - -	0.555

N= Number
Data presented as mean, standard deviation, percentage and number

The mean access time was 65.27±19.47 in SAX group and 61.95±28.32 in OAX group (p=0.5412) which is statistically not significant. (Table 2) Carotid artery picture was noted in two cases (5%) in SAX group while in only one case (2.5%) in OAX group, p=0.555 which is statistically not significant. No other complications were noted like pneumothorax, hemothorax, and hematoma. (Table 2) Needle was visible easily during IJV cannulation in OAX group (89.5% cases) compared with SAX group (61.2% cases) p=0.0019 which is statistically significant. **(Table 1)**

V. DISCUSSION

Real-time USG during IJV cannulation will improve success rate and decreases the incidence of mechanical complications. This recommendation is based on category A, level 1 evidence [10, 11]. As we have availability of USG machine in our institute we have used it for IJV cannulation.

There are three main approaches to USG-guided IJV cannulation, each with their own advantages and disadvantages. In our study we compared short axis and oblique axis approaches for IJV cannulation. The advantages of the classic short-axis view is that it allows better visualization of the internal jugular vein in relation to the internal carotid artery and other anatomic structures so as to avoid accidental arterial puncture, oblique axis plane also has similar advantage. However, in the short-axis view, the needle is visualized as an echogenic point while in the oblique axis view needle and guide wire visibility are better compared to short axis group. We have used lateral oblique approach for IJV cannulation in our study which was introduced by Phelan and Hagerty in which probe position (lateral cephalad and medial caudad) allows easy needle manipulation and position of catheter is also comfortable to the patient [8, 12].

While in medial oblique approach, the oblique position of the probe (cephalad medial end and cauded lateral end) may complicate needle manipulations and redirections because of the mandible [13].

The Lateral oblique approach visualise the entire needle as it enters the IJV so less chances of complications. The advantage of position of US

probe is that it will not interfere with cannulation of needle on the anterior aspect of the neck and the needle can be inserted parallel to the US probe and perpendicular to the US beam, resulting in a clear image of the entire needle [14]. Visibility of entire needle may be the reason for reduction of access time in our study. However, it was not statically significant. Moreover, oblique approach is preferable after gaining experience in visualisation both the needle and the vein together in the ultrasound beam plane.

Carotid artery puncture is the most frequent complication of IJV cannulation because of its close anatomical situation to the IJV. The number of attempts for IJV cannulation was strongly associated with the overall rate of complications.

Miao S. et al[15] in their metanalysis observed that the incidence of carotid artery puncture in the oblique-axis group was significantly lower than that in the short-axis group (RR, 0.13; 95% CI, 0.02–0.70; P =0.02). No significant difference was found in the first attempt success rate and number of attempts between both the groups (mean difference, 0.28; 95% CI, 0.06–0.11) which is similar to our study (p=0.1242).In our study, the rate of carotid artery punctures was 5% with SAX group and 2.5% with OAX group and it is also not statistically significant (p=0.555).

Balaban O et al[9] found that the mean time of catheterization was 52.00±70.18 seconds in the oblique approach group and 40.76±49.30 seconds in short-axis group which is statistically not significant and in study also mean access time was comparable in both the groups. The mean number of attempts for IJV cannulation was 1.21±0.61 in oblique approach and 1.12±0.50 in short-axis group. The results did not differ significantly and are in accordance to our study. There was an improved needle visualisation in the oblique approach group, but this was not proved as statistically significant in their study while in our study visualisation of needle in oblique axis group is easy in 89.5% cases as compared to SAX group which is 61.2%. This difference is highly statistically significant (P=0.0019).

Maitra S. et al[12] in their metaanalysis found no difference in first attempt success rate of IJV cannulation with three approaches with posterior median odds ratio between long axis and short-axis view, oblique-axis and short-axis view, and long-axis and oblique-axis view were 0.67 (0.20, 2.08), 0.92 (0.09, 4.790), and 1.3420 (0.1680, 6.7820), respectively. The incidence of artery puncture and overall success rate of IJV cannulation are comparable in all groups. They conclude that all three approaches for USG-guided internal jugular vein cannulation are comparable and no approach is recommend over other.

Wilson JG et al[8] compared the rates of posterior vessel wall puncture (PVWP) between the short-axis and oblique-axis approaches to US-guided CVC and concluded that Confidence in needle tip location was 3.63 using short axis, and 4.58 using oblique axis (P < 0.001) which is significant. Avoidance of posterior wall puncture with better visibility of entire needle is the biggest benefit of using oblique axis approach for USG guided IJV cannulation.

LIMITATIONS:

Limitation of our study is that evaluation of posterior wall puncture was not done as it is difficult to diagnose and needs an extra ultrasound as well.

VI. CONCLUSION

We conclude that both oblique axis and classic short axis approach for USG guided IJV cannulation are comparable in terms of first attempt success rate, access time and incidences of mechanical complications. So oblique axis approach may be a suitable alternative to short axis as visibility of needle and guide wire is better with OAX group than SAX group.

REFERENCES

[1]. Denys BG, Uretsky BF. Anatomical variations of internal jugular vein location: impact on central venous access. Crit Care Med. 1991; 19(12):1516–9.PMID: 1959371.

[2]. Janssen C, Brkljacic B, Hockey M, Ignee A, Piscaglia F, Radzina M, Sidhu PS, Dietrich CF. EFSUMB Guidelines on Interventional Ultrasound (INVUS). Part VI—Ultrasound-Guided Vascular Interventions. Ultraschall Med. 2016; 37:473–6.PMID: 26515965.

[3]. Lamperti M, BodenhamAR, Pittiruti M et al. International evidence-based recommendations on ultrasound-guided vascular access. Intensive Care Med 2012; 38: 1105 – 17) PMID: 22614241.

[4]. Agarwal A, Singh DK, Singh AP. Ultrasonography: A novel approach to central venous cannulation. Indian J Crit Care Med. 2009; 13:213–6.PMCID: PMC2856149.

[5]. Shrestha GS, Gurung A, Koirala S. Comparison between long- and short-axis techniques for ultrasound-guided cannulation of internal jugular vein. Ann Card Anaesth. 2016; 19(2):288-292. doi:10.4103/0971-9784.179629.

[6]. Liu C, Mao Z, Kang H, Hu X, Jiang S, Hu P, Hu J, Zhou F. Comparison between the long-axis/in-plane and short-axis/out-of-plane approaches for ultrasound-guided vascular catheterization: an updated meta-analysis and trial sequential analysis. TherClin Risk Manag. 2018 Feb 20; 14:331-340. doi: 10.2147/TCRM.S152908.

[7]. Wilson JG, Verona KM, Stein JC, Wang R. Oblique-axis vs. short-axis view in ultrasound-guided central venous catheterization. J Emerg Med. 2014; 47:45–50.PMID: 24685453.

[8]. Phelan M, Hagerty D. The oblique view: an alternative approach for ultrasound-guided central line placement. J Emerg Med. 2009; 37:403-8.PMID: 18829208.

[9]. Balaban O, Aydın T, Musmul A. Lateral oblique approach for internal jugular vein catheterization: Randomized comparison of oblique and short-axis view of ultrasound-guided technique. North ClinIstanb 2020; 7(1):11–17.PMCID: PMC7103737

[10]. Troianos CA, Hartman GS, Glas KE, Skubas NJ, Eberhardt RT, Walker JD, Reeves ST; Councils on Intraoperative Echocardiography and Vascular Ultrasound of the American Society of Echocardiography. Guidelines for performing ultrasound guided vascular cannulation: recommendations of the American Society of Echocardiography and the Society of Cardiovascular Anesthesiologists. J Am SocEchocardiogr. 2011 Dec; 24(12):1291-318. doi: 10.1016/j.echo.2011.09.021.

[11]. Lau, CS. Ultrasound-guided central venous catheter placement increases success rates in pediatric patients: a meta-analysis. PediatrRes 2016; 80: 178–184.PMID: 27057741.

[12]. Maitra S, Bhattacharjee S, Baidya DK. Comparison of long-, short, and oblique-axis approaches for ultrasound-guided internal jugular vein cannulation: A network meta-analysis. J Vasc Access. 2020 Mar; 21(2):204-209. doi: 10.1177/1129729819868927.

[13]. Dilisio R, Mittnacht AJ. The "medial-oblique" approach to ultrasound-guided central venous cannulation-- maximize the view, minimize the risk. J CardiothoracVascAnesth. 2012; 26:982–4.PMID: 22683157.

[14]. Rabindranath KS, Kumar E, Shail R, et al. Use of real-time ultrasound guidance for the placement of hemodialysis catheters: a systematic review and meta-analysis of randomized controlled trials. Am J Kidney Dis 2011; 58:964-70. [Crossref] [PubMed] PMID: 22099570

[15]. Miao S, Wang X, Zou L, Zhao Y, Wang G, Liu Y, Liu S. Safety and efficacy of the oblique-axis plane in ultrasound-guided internal jugular vein puncture: A meta-analysis. J Int Med Res. 2018 Jul;46(7):2587-2594. doi: 10.1177/0300060518765344.