



## In-line oblique transducer approach for ultrasound guided cannulation of internal jugular vein.

1. MBBS, FCPS  
Senior Registrar Anesthesia  
Sughra Shafi Hospital, Sahara  
Medical College, Narowal.
2. MBBS, MCPS, FCPS  
Associate Professor Anesthesia  
AIMC/JH Lahore.
3. MBBS, MCPS, FCPS  
Professor Anesthesia  
Hameed Latif Hospital, Lahore.
4. MBBS, FCPS  
Consultant Anesthetics  
Hameed Latif Hospital, Lahore.
5. MBBS FCPS  
Consultant Anesthetics  
Hameed Latif Hospital, Lahore.
6. MBBS, FCPS  
Associate Specialist Anesthesia  
Somerset NHS Foundation Trust  
Taunton, UK.

**Correspondence Address:**

Dr. Liaqat Ali  
Department of Anaesthesia  
Allama Iqbal Medical College,  
Jinnah Hospital Lahore.  
aliliaqatdoc@gmail.com

**Article received on:**

23/10/2020

**Accepted for publication:**

10/02/2021

Ehsan Ahmad<sup>1</sup>, Liaqat Ali<sup>2</sup>, Khalid Bashir<sup>3</sup>, Maryam Inayat<sup>4</sup>, Ayesha Asad<sup>5</sup>, Irfan Liaqat Ali<sup>6</sup>

**ABSTRACT... Objective:** To determine the frequency of successful cannulation of ultrasound assisted inline oblique transducer approach for internal jugular venous cannulation. **Study Design:** Descriptive Case Series. **Setting:** Department of Anesthesia and Intensive Care, Hameed Latif Hospital, Lahore. **Period:** 22-02-2017 to 22-08-2017. **Material & Methods:** In this study the cases were included of both gender and age between 18 to 65 years. Jugular vein was visualized ultrasonographically in an oblique axis and the needle was inserted in the same plane, aligned with the longitudinal axis of the transducer. Success rate was noted. **Results:** The mean age of patients was  $49.94 \pm 10.90$  years, male to female ratio of the patients was 1.9:1. In this study the successful cannulation was observed in 145/155 (93.55%) patients. **Conclusion:** It has been observed in this study that the ultrasound assisted inline oblique transducer approach is successful technique for IJV cannulation.

**Key words:** Central Venous Catheter (CVC), Internal Jugular Vein (IJV), Inline Oblique Axis, Long-axis (LAX), Short-axis (SAX), Ultrasonography.

**Article Citation:** Ahmad E, Ali L, Bashir K, Inayat M, Asad A, Ali IL, In-line oblique transducer approach for ultrasound guided cannulation of internal jugular vein. Professional Med J 2021; 28(3):428-433.

<https://doi.org/10.29309/TPMJ/2021.28.03.6172>

## INTRODUCTION

Insertion of central venous catheter in internal jugular vein (IJV) is a commonly performed procedure in the intensive care units (ICU), during anesthesia in certain surgeries and also in those cases where peripheral lines are difficult to access. In addition to the advantage of providing a large bore venous access, it also aids for hemodynamic monitoring. According to a survey about five million cannulations are done per year in United States.<sup>1-2</sup>

Central venous cannulation can be accessed via various ways and even without image guidance. The choice depends upon the available resources, competency of the performing staff and urgency of the procedure. The routine insertion of central venous line is performed on the basis of anatomical landmarks which is associated with risk of many complications like pneumothorax, multiple venous or arterial punctures causing hematoma, hemodynamic instability, local site infection, pain, vasovagal reflexes etc.<sup>3</sup>

Use of ultrasonography shows surrounding structures like muscles, carotid artery, trachea so we can see exact site of internal jugular vein.<sup>3-4</sup> This image guided approach can avoid a number of the complications that occur with landmark technique.<sup>5-6</sup> The different ultrasound probe positions have been described in literature. Most commonly used probe positions are short-axis (SAX) and long-axis (LAX) views. The SAX probe position can only demonstrate the cross-section of IJV so during procedures only tip or shaft of needle can be seen in the shape of a dot shadow, while the LAX approach shows the longitudinal view of IJV and whole needle can be seen. A new approach is an overlap of both of these approaches as oblique probe position which has the unique property with benefits of both long and short axis views. The oblique ultrasound probe positioning approach seems to be much better option as it allows performing dynamic IJV catheter insertion under ultrasonography. The success rate of cannulation with USG guidance ranges from 85% to 99% of the cases.<sup>7-8</sup> We

conducted a descriptive case series study in 155 patients to determine the success rate with ultrasound guided oblique in-plane approach for internal jugular vein cannulation.

We conducted this study to find out the success rate of newly described ultrasound guided oblique in-line approach as advantage of this technique is that it can show us both carotid artery and internal jugular vein along with view of full length needle which seems to be more safe and appropriate.

## OBJECTIVE

To determine the frequency of successful cannulation of ultrasound assisted inline oblique transducer approach for internal jugular venous cannulation.

## MATERIAL & METHODS

We carried out this descriptive case series study at Hameed Latif Hospital, department of Anesthesia and Intensive Care Lahore during 22-02-2017 to 22-08-2017, 155 cases were enrolled via non probability consecutive sampling according to following criteria.

### Inclusion Criteria:

1. Both gender
2. Aged 18-65 year

### Exclusion Criteria

1. Signs of Infection at insertion site
2. Any swelling or subcutaneous hematoma at or around the insertion site.
3. History of any Cather or cannula insertion in IJV in past 3 days.
4. Past history of surgical intervention around needle insertion site.
5. Severe coagulopathy; INR  $>1.8$  or platelet  $<50,000$
6. Subcutaneous emphysema

After all the aseptic measures the IJV was ultrasonographically visualized in an oblique axis at 45 degree angle by using linear probe in between SAX and LAX (Picture 1). The needle was inserted in the longitudinal axis of the transducer in the same ultrasound plane, with a negative pressure. With oblique probe position, the view

of carotid artery and internal jugular vein was seen on ultrasound screen (Picture 2). Vein was confirmed as collapsible vascular structure with probe pressure. Aspiration of free flow venous blood in the needle was observed with aspiration. Guide wire was inserted after confirming tip of needle in IJV with ultrasound (Picture 3). Then guide wire was confirmed in IJV with ultrasound and labeled as successful cannulation. After that triple lumen central venous catheter was inserted, fixed and dressing was applied. The time taken (seconds) from the Seldinger needle inserted into skin to the moment the guide wire was passed in IJV and confirmed with ultrasound was noted and labeled as cannulation time. Then remaining process of central venous catheter insertion was done under standard protocol. Cannulation time within 180 second was considered as successful cannulation.

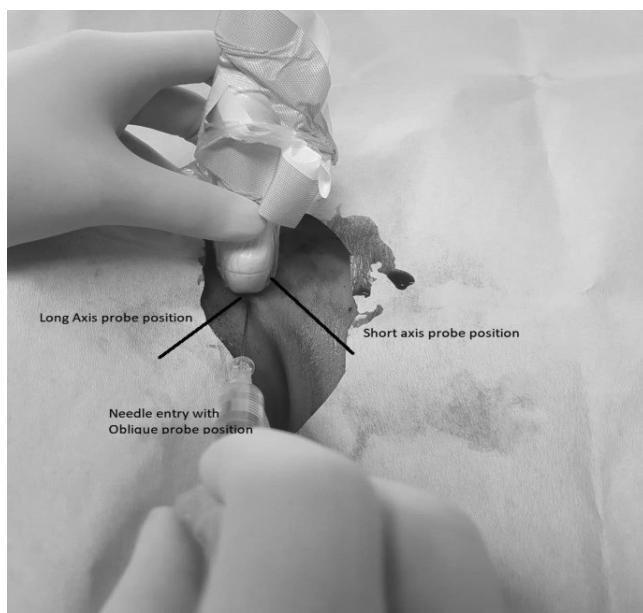
### Statistical Analysis

SPSS 21.0 was used for data analysis. Effect modifiers were stratified. For quantitative variables, independent sample t test was used while for qualitative variables chi square was used. Post stratification p value  $\leq 0.05$  was considered as significant.

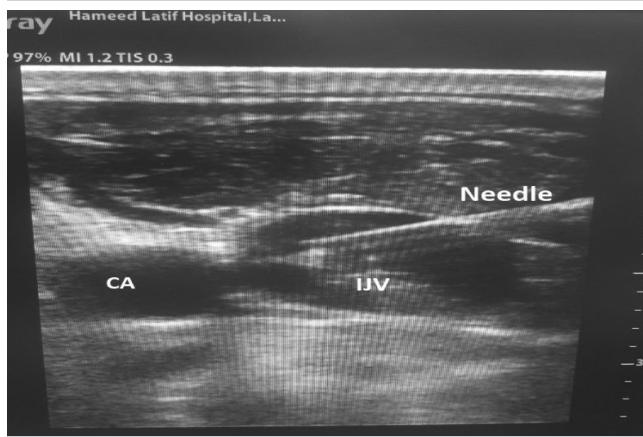
## RESULTS

We enrolled total 155 cases in our study. The mean age of the patients was  $49.94 \pm 10.90$  years with mean value of BMI was  $25.06 \pm 5.50$  kg/m<sup>2</sup> (Table-I). Out of these 103 (66.45%) patients were male and 52 (33.55%) patients were females. Left side cannulation was noted in 27 (17.42%) patients and right side cannulation was noted in 128 (82.58%) patients. (Table-II). In this study the successful cannulation was observed in 145 (93.55%) patients as in Figure-1 and mean cannulation time of the patients was  $1.52 \pm 1.072$  minutes (Table-I). Regarding age and gender, no significant difference in terms of cannulation success rate was seen as shown in Table-III and IV with p value of 1.0 each. Successful cannulation seen in 60 out of 63 cases with normal BMI and 85 out of 92 with abnormal BMI with p-value=0.74 as in Table-V. Cannulation was successful in all 27 cases with left sided approach and 118 out of 128 with right sided attempt with p value=0.21 as

shown in Table-VI.



Picture-1. Oblique probe position.



Picture-2 In-line needle view in IJV.

Variables	Mean $\pm$ SD	Range
Age (years)	49.94 $\pm$ 10.90	25-65
Height	5.55 $\pm$ 0.29	4.9-6.3
Weight	77.11 $\pm$ 20.61	29-150
BMI ( $\text{kg}/\text{m}^2$ )	25.06 $\pm$ 5.50	11-40
Mean cannulation time	1.52 $\pm$ 1.07	0.4-5

Table-I. Study variables (n= 155)

Variables		Number	%
Gender	Male	103	66.45
	Female	52	33.55
Side of cannulation	Right	128	82.58
	Left	27	17.42

Table-II. Gender and side of cannulation



Picture-3. Guide wire in IJV.

### Successful Cannulation

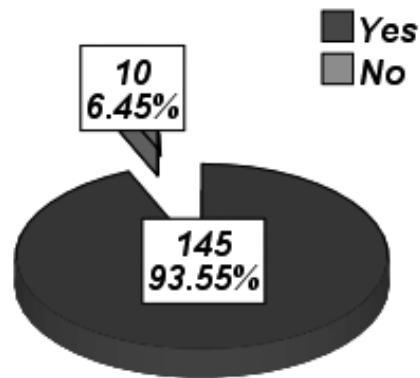


Figure-1. Successful cannulation.

	Successful Cannulation		Total
	Yes	No	
Age (years)	$\leq 50$	73	5
	$> 50$	72	5
Total		145	10
155			

Table-III. Comparison of age with successful cannulation  
p-value = 1.0

		Successful Cannulation		Total
Gender	Male	Yes	No	
Female	49	3	52	
Total	145	10	155	

**Table-IV. Comparison of gender with successful cannulation  
p-value=1.0**

		Successful Cannulation		Total
BMI	Normal	Yes	No	
Abnormal	85	7	92	
Total	145	10	155	

**Table-V. Comparison of BMI with successful cannulation  
p-value = 0.74**

		Successful Cannulation		Total
Side of cannulation	Left	Yes	No	
Right	118	10	128	
Total	145	10	155	

**Table-VI. Comparison of side of cannulation with successful cannulation  
p-value=0.21**

## DISCUSSION

Central venous catheter (CVC) placement is needed during anaesthesia, venous access and for the care of critically ill patients for different indications. In USA, on average >5 million central venous catheter are passed every year. In spite of this magnitude of number of procedures performed, the complications rate is still too high 5% to 19%. Ultrasound guided insertion of these catheter leads to decrease in complications and better success rate but there is no standard technique with minimum complications and maximum success rate. So more evidence is required about the most reliable ultrasound guided approach for CVC insertion.<sup>19</sup>

In patients with hemodynamic instabilities and especially in patients with hypovolemia the central venous access is difficult and ultrasound imaging

is required to guide for cannulation in the internal jugular vein. Furthermore, in such situation the IJV has the tendency of easily collapsing with both LAX and SAX and thus rendering a limited approach. However, with oblique-axis internal jugular vein can be visualized without being collapsed as the ultrasound probe can be maneuvered easily.<sup>9-11</sup> In addition, this method provides for optimal ultrasonographic view of the IJV along carotid artery. The tip of needle is visualized on the ultrasound screen as it advances. Then we can see whole needle in length along the tip of needle so we can ensure that needle is not going towards any unwanted structure then it enters into IJV.

In our study the mean cannulation time of ultrasound assisted inline oblique transducer approach for IJV was  $1.52 \pm 1.072$  minutes and this technique was successful in 145 (93.55%) patients. These results were also supported by the results of the previous studies.

A study by Mehdi Fathi et al presented that successful cannulation was seen in 98.7% in blind attempt group using various landmarks and 99.4% in the USG group. According to their study the mean time taken to cannulation was 46.05 and 45.46 seconds in both groups respectively which was shorter than our study. Success rate with ultrasound-guidance is comparable with our study while the difference in time taken can be explained by the fact that procedure was performed by residents and using inline oblique transducer approach.<sup>12</sup>

In another comparative randomized control trial of ultrasound guided versus landmark technique, Denys et al reported a success rate of 100% and 88 respectively. Which again favors of our results, advocating incorporation of ultrasound guidance during central venous cannulation.<sup>13</sup>

Ray BR et al also used USG guidance and denoted the success rate in 90.83% in terms of cannulation.<sup>14</sup> In another randomized trial they compared USG with no image guidance and the success rate was seen in 92% as compared to 44% with no image guidance in the first attempt.<sup>15</sup>

In another study, the success rate was 100% with USG guidance in patients on ventilators.<sup>16</sup> Similar was seen by the studies done by Chuan et al and Batlori et al where this success was seen in 100% and 96.4% of the cases where the latter used the oblique technique and the first attempt success rate was highest.<sup>7,18</sup>

In a meta-analysis regarding the success rate and complications of the oblique-axis plane, it was demonstrated that ultrasound guided IJV cannulation with oblique-axis plane may also reduce the chances of carotid artery puncture.<sup>18</sup> The in-line oblique-axis technique provide the advantages of the both SAX and LA approaches in one ultrasound guided view. Once mastered, it is likely that with inline oblique axis probe position allowing for visualization of both the carotid artery and IJV while observing the needle advancement into the vein would minimize the risk of many complications associated with CVC insertions.<sup>19</sup>

We did not note number of attempts for successful cannulation which is limitation of our study and our study is observational. More randomized controlled trials are needed to establish best approach for CVC insertion with focus on success rate, number of attempts and complications comparing different techniques.

There is no conflict of interest of any author or institution.

## CONCLUSION

It has been observed in this study that the ultrasound assisted inline oblique transducer approach is successful technique for IJV cannulation.

**Copyright© 10 Feb, 2021.**

## REFERENCES

1. Tammam TF, El-Shafey EM, Tammam HF. **Ultrasound-guided internal jugular vein access: comparison between short axis and long axis techniques.** Saudi Journal of Kidney Diseases and Transplantation. 2013; 24(4):707.
2. Sofi K, Arab S. **Ultrasound-guided central venous catheterization in prone position.** Saudi journal of anaesthesia. 2010; 4(1):28.
3. Cavanna L, Civardi G, Vallisa D, Di Nunzio C, Cappucciati L, Bertè R, et al. **Ultrasound-guided central venous catheterization in cancer patients improves the success rate of cannulation and reduces mechanical complications: A prospective observational study of 1,978 consecutive catheterizations.** World journal of surgical oncology. 2010; 8(1):91.
4. Riaz A KSaSF. **Ultrasound guided internal jugular venous cannulation: Comparison with Land-Mark Technique** Journal of the College of Physicians and Surgeons Pakistan. 2015; 25 (5):315-9.
5. O'leary R, Ahmed S, McLure H, Oram J, Mallick A, Bhambra B, et al. **Ultrasound-guided infraclavicular axillary vein cannulation: A useful alternative to the internal jugular vein.** British journal of anaesthesia. 2012; 109(5):762-8.
6. Troianos CA, Hartman GS, Glas KE, Skubas NJ, Eberhardt RT, Walker JD, et al. **Guidelines for performing ultrasound guided vascular cannulation: Recommendations of the American Society of Echocardiography and the Society of Cardiovascular Anesthesiologists.** Journal of the American Society of Echocardiography. 2011; 24(12):1291-318.
7. Batllori M, Urra M, Uriarte E, Romero C, Pueyo J, López-Olaondo L, et al. **Randomized comparison of three transducer orientation approaches for ultrasound guided internal jugular venous cannulation.** BJA: British Journal of Anaesthesia. 2015; 116(3):370-6.
8. Panebianco NL, Fredette JM, Szyld D, Sagalyn EB, Pines JM, Dean AJ. **What You See (Sonographically) Is What You Get: Vein and patient characteristics associated with successful ultrasound-guided peripheral intravenous placement in patients with difficult access.** Academic Emergency Medicine. 2009; 16(12):1298-303.
9. Phelan M, Hagerty D. **The oblique view: an alternative approach for ultrasound-guided central line placement.** The Journal of emergency medicine. 2009; 37(4):403-8.
10. Ho AM-H, Ricci CJ, Ng CS, Critchley LA, Ho AK, Karmakar MK, et al. **The medial-transverse approach for internal jugular vein cannulation: An example of lateral thinking.** The Journal of emergency medicine. 2012; 42(2):174-7.
11. Lorchirachoonkul T, Ti LK, Manohara S, Lye ST, Tan S-A, Shen L, et al. **Anatomical variations of the internal jugular vein: implications for successful cannulation and risk of carotid artery puncture.** Singapore medical journal. 2012; 53(5):325-8.

12. Fathi M, Izanloo A, Jahanbakhsh S, Gilani MT, Majidzadeh A, Benhangi AS, et al. **Central venous cannulation of the internal jugular vein using ultrasound-guided and anatomical landmark techniques.** Anesthesiology and pain medicine. 2016;6(3).
13. Denys BG, Uretsky BF, Reddy PS. **Ultrasound-assisted cannulation of the internal jugular vein. A prospective comparison to the external landmark-guided technique.** Circulation. 1993; 87(5):1557-62.
14. Ray BR, Mohan VK, Kashyap L, Shende D, Darlong VM, Pandey RK. **Internal jugular vein cannulation: A comparison of three techniques.** Journal of anaesthesiology, clinical pharmacology. 2013; 29(3):367.
15. Gualtieri E, Deppe SA, Sipperly ME, Thompson DR. **Subclavian venous catheterization: Greater success rate for less experienced operators using ultrasound guidance.** Critical care medicine. 1995; 23(4):692-7.
16. Fragou M, Gravvanis A, Dimitriou V, Papalois A, Kouraklis G, Karabinis A, et al. **Real-time ultrasound-guided subclavian vein cannulation versus the landmark method in critical care patients: A prospective randomized study.** Critical care medicine. 2011; 39(7):1607-12.
17. Chuan WX, Wei W, Yu L. **A randomized-controlled study of ultrasound prelocation vs anatomical landmark-guided cannulation of the internal jugular vein in infants and children.** Pediatric Anesthesia. 2005; 15(9):733-8.
18. Shuai Miao, Xiuli Wang, Ye Zhao. **Safety and efficacy of the oblique-axis plane in ultrasound-guided jugular vein puncture: A meta-analysis.** J. Int Med Res. 2018 Jul; 46(7): 2587-2594.
19. Takeshita J, Nishiyama K, Fukumoto A, et al. **Combined approach versus 2 conventional approaches in ultrasound-guided central venous catheterization: A randomized controlled trial.** J Cardiothorac Vasc Anesth 2019; 33:2979–84.

#### AUTHORSHIP AND CONTRIBUTION DECLARATION

Sr. #	Author(s) Full Name	Contribution to the paper	Author(s) Signature
1	Ehsan Ahmad	Data collection.	
2	Liaqat Ali	Manuscript writing.	
3	Khalid Bashir	Review of manuscript.	
4	Maryam Inayat	Conduct of procedure.	
5	Ayesha Asad	Conduct of discussion.	
6	Irfan Liaqat Ali	Data analysis.	