International Journal of Medical Anesthesiology

E-ISSN: 2664-3774
P-ISSN: 2664-3766
www.anesthesiologypaper.com
IJMA 2020; 3(1): 85-90
Received: 04-11-2019
Accepted: 08-12-2019

Dr. Abhilasha Motghare
Department of Anesthesiology, Seth G.S. Medical College and KEM Hospital, Mumbai, Maharashtra, India

Dr. PrernaPhulkar
Department of Anesthesiology, Seth G.S. Medical College and KEM Hospital, Mumbai, Maharashtra, India

Dr Neerav Kotak
Department of Anesthesiology, Seth G.S. Medical College and KEM Hospital, Mumbai, Maharashtra, India

Dr. RD Patel
Department of Anesthesiology, Seth G.S. Medical College and KEM Hospital, Mumbai, Maharashtra, India

Corresponding Author:
Dr. Abhilasha Motghare
Department of Anesthesiology, Seth G.S. Medical College and KEM Hospital, Mumbai, Maharashtra, India

Prospective, randomised, controlled comparison study between ultrasound guided technique with conventional landmark technique of internal jugular vein cannulation

Dr. Abhilasha Motghare, Dr. PrernaPhulkar, Dr Neerav Kotak and Dr. RD Patel

DOI: https://doi.org/10.33545/26643766.2020.v3.i1b.72

Abstract
Background and Aims: Central venous cannulation is an integral part in management of patients posted for major surgeries. We conducted a prospective, randomised, controlled comparative study to compare conventional landmark technique and ultrasound guided technique for internal jugular vein cannulation. 124 patients were enrolled in the study and were randomized into two groups by computer generated chart into conventional landmark group and the ultrasound group. Outcome measures included the time taken for successful cannulation, number of attempts taken, success/failure rate and the complications.
Results: The skin to vein time for IJV cannulation was 109.10 (±69.533) seconds in the conventional group while in the USG group it was 56.40 (±16.799) seconds (p- value <0.0001). The success rate on first attempt was 71% in the conventional group and 95.2% in the USG group (p- value<0.05). Complications were seen in 17.74% in the conventional group and 4.83% of patients in the USG group.

Keywords: Internal jugular vein cannulation, USG guided, conventional landmark technique

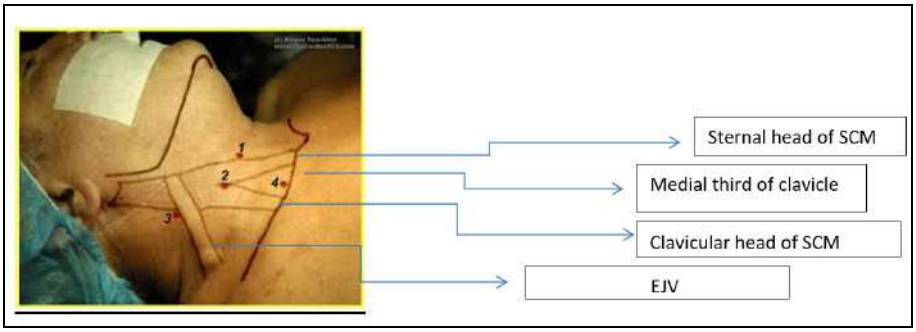
Introduction
Internal jugular vein (IJV) catheterization is commonly used to obtain central venous access for hemodynamic monitoring, long term fluid administration, antibiotics, total parenteral nutrition and hemodialysis. Many techniques for IJV puncture using the anatomical landmark have been described.[1]But the complication rates are higher with the blind procedure. It has been suggested that ultrasound guidance could improve success rate, the number of attempts, and decrease complications [2, 3]. Although the ultrasound method has been favourably compared to the landmark technique, its widespread use has been hampered by the unavailability of equipment, such as the specially designed ultrasound device, and the lack of trained personnel. Cannulation of IJV is usually preferred because of its anatomical position and large diameter in the Trendelenburg position. The purpose of this study was to determine whether ultrasound guidance could improve the success rate, decrease the number of attempts and complication rate of IJV catheterization and decrease the time required for a successful catheterization compared to the landmark technique.

Materials and Methods
After approval from the departmental review board (DRB) and institutional Research Ethics Committee and written informed consent from the subject, 124 subjects (obtained by Fischer Exact Test) posted for major and supra major surgery in the operation theatre (OT) of a tertiary care hospital were enrolled in this study. Routine monitors were attached (ECG, heart rate, non-invasive blood pressure, and pulse oximetry) in the OT and intravenous access was established. Patients were randomly allocated either for USG guided central venous canulation or conventional landmark method for central venous cannulation. Patients were given general anaesthesia. Patients were premedicated with Inj. Ramosetron 0.3 mg and Inj. Ranitidine 50 mg IV, Ringer lactate was started. Patients received sedation - Inj. Midazolam 0.03 mg/kg IV and Inj. Buprenorphine 2 microgram/kg. After preoxygenation, a standardized general anaesthetic regime was employed, consisting of Inj Propofol 2mg/kg and Inj Vecuronium 0.1 mg/kg, with intraoperative non-opioid analgesia Inj Paracetamol 15-20 mg/kg.

Anaesthesia was maintained with 50% mixture of oxygen and nitrous oxide and Sevoflurane to maintain MAC 1.

We used the anterior approach for conventional landmark technique in this study. [Photo1].

Sedillot's triangle was identified. The carotid artery was palpated and retracted towards the midline. The needle was inserted at the apex of the triangle with bevel facing up, and the needle advanced towards the ipsi-lateral nipple, at 45 degrees angle with the skin surface. If the vein was not entered at the depth of 5cm, the needle was drawn back and advanced in a more lateral direction. Seldinger technique was utilized for venous cannulation.



1. Sternal head of sternocleidomastoid
2. Clavicular head of sternocleidomastoid
3. External jugular vein
4. Superior border of medial third of clavicle

Photo 1: Landmarks for anterior approach of internal jugular vein cannulation

For ultrasound guided technique, the neck area was painted and draped under all aseptic precautions. Linear probe (frequency 5-16 Hz) was used. Ultrasound probe connected to ultrasound unit, lignocaine jelly applied over it and covered with sterile polydrape. The plane of the ultrasound image may be oriented relative to the vessel in the short (out-of-plane) or long (in-plane) axis. In a short-axis view, the image plane is perpendicular to the course of the vessel and to the needle (needle is "out of plane"). The vessel appears as an anechoic circle on the screen with the needle visualized as a hyperechoic point in cross section. In a long-axis view, the image plane is parallel to the course of the vessel (needle is "in plane"). The image should show the course of the vessel across the screen and the shaft and point of the needle as it is advanced.

In this study, we were seeing the vessels in the short axis view. Tip of the cannula was seen inside the circular shadow. On Doppler ultrasound, the carotid artery was encoded in red and shows flow towards the transducer. The internal jugular vein seen in blue, with flow away from the transducer [Photo 2]. Best view was obtained and the probe was fixed.

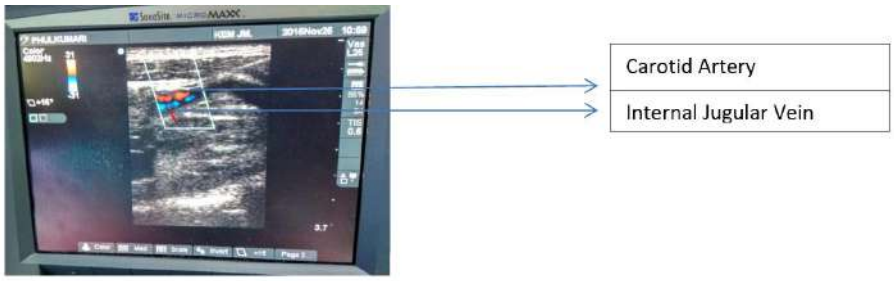


Photo 2: Doppler ultrasound showing the carotid artery (red) and internal jugular vein (blue)

Ultrasound imaging through Sedillot's triangle would demonstrate the carotid artery and the internal jugular vein as two sonoluscent circles [Photo 3].

Carotid artery: Round in cross section, pulsatile, not compressible with pressure

Internal Jugular Vein: Irregular, varies in size with respiration, easily compressible

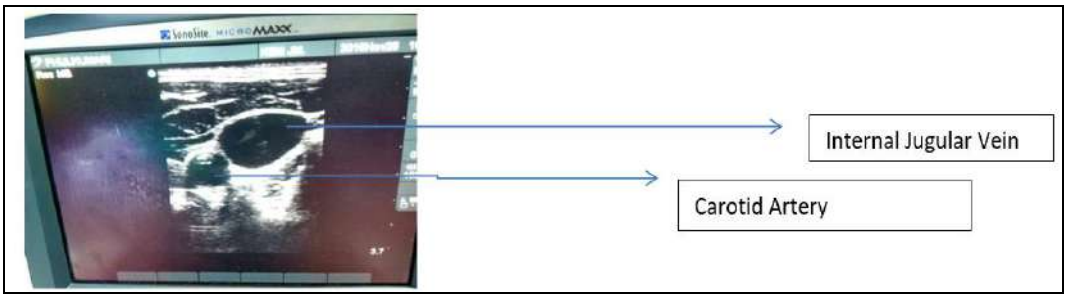


Photo 3: Short axis view on the ultrasound showing the internal jugular vein (left) and carotid artery (right)

2.1 Parameters noted in the study

Duration: Duration being divided into T1 and T2.

Where T1 for the conventional landmark technique is the duration from entry of 22G needle to backflow of venous blood, and for the ultrasound guided technique it is duration from the entry of Y- cannula to backflow of venous blood.

T2 is the duration for introduction of guide-wire to where the free flow of blood is confirmed in all three ports for both the techniques.

Number of attempts: Using the conventional landmark technique, maximum three attempts would be performed, if unable to cannulate in 3 attempts then one attempt would be performed by using the USG guided technique (crossover). Using the USG guided technique, maximum three attempts would be performed, if unable to cannulate in three attempts then one attempt would be performed by using the conventional landmark technique (crossover).

If failed with crossover on the right side, one attempt of crossover would be taken on the left sided vein. If unable to canulate the vein after all these attempts, then the procedure would be abandoned and taken as Failure. Standard care would be taken by peripheral access in such a scenario.

Note: Attempt being defined as the introducer needle's entry into the skin and its removal from the skin.

Success rate defined as identification of the internal jugular vein and placement of the central venous catheter. Unsuccessful catheterizations are predominantly due to inability to locate the vein in conventional landmark technique and inability to pass the guide-wire in the ultrasound guided group.

3. Results

Table 1: Duration in two groups

Comparison among the study group for duration T1 (seconds)						
		Conventional (N = 62)	**USG (N=62)**	**Total (N=124)**	**Normality # P-Value**	**P-Value**
T1 Duration (Second)	n	62	60	122	< 0.0100	<.0001*
	Mean	109.10	56.40	83.18		
	Median	87.50	57.00	60		
	SD	69.533	16.799	57.226		
	Min	40	28	28		
	Max	305	142	305		

# indicates Normality P-value based on Shapiro-Wilk test.
* indicated P-value calculated based on Wilcoxon Rank Sum.

Comparison among the study group for duration T2 (seconds)						
		Conventional (N = 62)	**USG (N=62)**	**Total (N=124)**	**Normality # P-Value**	**P-Value**
T2 Duration (Second)	n	62	62	124	< 0.0100	0.0863*
	Mean	239.24	230.60	234.92		
	Median	240.00	236.00	239		
	SD	27.158	25.624	26.651		
	Min	179	120	120		
	Max	295	284	295		

# indicates Normality P-value based on Shapiro-Wilk test.
* indicated P-value calculated based on Wilcoxon Rank Sum.

Table 2: Distribution of attempts in two groups

Distribution of Attempts			
Attempt No.		**Conventional (N = 62)**	**USG (N=62)**
1st	Success		
	Frequency	44	59
	Percentage	71	95.2
	Failure		
	Frequency	18	3
	Percentage	29	4.83
2nd	Success		
	Frequency	12/18	1/3
	Percentage	66.66	33.33
	Failure		
	Frequency	6/18	2/3
	Percentage	33.33	66.66
3rd	Success		
	Frequency	4/6	0/2
	Percentage	66.66	0
	Failure		
	Frequency	2/6	2/2
	Percentage	33.33	100

Table 3: Comparison among the study group for number of attempts

Comparison among the study group for average number of attempts						
		Conventional (N = 62)	**USG (N=62)**	**Total (N=124)**	**Normality # P-Value**	**P-Value**
No of Attempts	N	62	62	124	< 0.0001	0.0005*
	Mean	1.39	1.08	1.23		
	Median	1.00	1.00	1		
	SD	0.662	0.375	0.557		
	Min	1	1	1		
	Max	3	3	3		

# indicates Normality P-value based on Shapiro-Wilk test.
* indicated P-value calculated based on Wilcoxon Rank Sum.

Table 4: Comparison among the study group for Success Rate

	Conventional (n =62)	**USG (n=62)**	**Total (n=124)**
Frequency	60	60	120
Percentage	96.8	96.8	96.8
Frequency	2	2	4
Percentage	3.2	3.2	3.2

* indicated P-value calculated based on Fisher Exact Test.

Table 5: Distribution of complications

	Distribution of complications		
Complications		**Conventional (N = 62)**	**USG (N= 62)**
Carotid puncture	Frequency	9	1
	Percentage	14.5	1.6
Hematoma	Frequency	9	0
	Percentage	14.5	0
Multiple unsuccessful attempts	Frequency	2	2
	Percentage	3.22	3.22
Nil complications	Frequency	51	59
	Percentage	82.3	95

4. Discussion

There have been several studies conducted to compare the ultrasound and the landmark technique for internal jugular vein cannulation. In our study, we compared the parameters like duration, number of attempts, success/failure rate and complications for IJV cannulation using the landmark technique and ultrasound guided technique. We found that the mean (±SD) duration of T1 (skin to vein time) in the conventional group was 109.10 (±69.533) seconds; while that in the USG group was 56.40 (±16.799) seconds. Using the Wilcoxon Rank sum test a p-value of <0.0001 was obtained. Since the p-value is <0.05, there was a statistically significant difference between the T1 duration of the two groups. So the T1 in conventional group is more than the ultrasound group with p value being statistically significant (p value <0.0001). There have been several other studies (Denys BG *et al*, Teichgraber UK *et al*, Adam H Miller *et al*, Turker *et al*, Shah *et al*) [4, 5, 6, 7, 8]. That have taken into account the skin to vein time for IJV cannulation and values of our study are comparable with the studies showing that ultrasound helps in reducing the skin to vein time. The above-mentioned studies have noted either the skin to vein time or the entire period required for a successful insertion of the central venous catheter. However, in our study, we divided the entire period for successful internal jugular vein cannulation into the skin to vein time (T1) and the duration for introduction of guide-wire to free flow of blood (T2). The mean (±SD) duration of T2 in the conventional group was 239.24 (±27.158) seconds; while that in the USG group was 230.60 (±25.624) seconds. Using the Wilcoxon Rank sum test a p-value of 0.0863 was obtained. Since the p-value is greater than 0.05, there is no significant difference between the T2 duration of the two groups. In our study, the mean no. of attempts for both the groups i.e. conventional as well as USG group was 1 with a range of 1-3. Using the Wilcoxon Rank sum test, a p-value of 0.0005 was calculated that indicated a significant difference among the average number of attempts between the two study groups. In our study, of the 62 patients in each group, 71% in the conventional group (44 patients) were successfully cannulated in the first attempt whereas 95.2% in the USG group (59 patients) were successfully cannulated in the first attempt showing that the success rate in the first attempt was higher with the USG group. Those that failed were subjected to the second attempt. In the conventional group, 18 patients who failed to be cannulated in the first attempt were subjected to second attempt, out of which 12 patients (66.66%) were successfully cannulated in the second attempt. In the USG group, three patients were subjected to second attempt but only one was successfully cannulated (33.33%). The patients who failed in the second attempt were subjected to the third attempt. In the conventional group, 6 patients were subjected to third attempt, out of which four were successful (66.66%). In the USG group, two patients were subjected to the third attempt –turned out to be unsuccessful. The two patients who failed in the third attempt of conventional group were subjected to the USG rescue. Both turned out to be a success. The two patients

who failed in the USG group were subjected to conventional group. Cannulation was unsuccessful with conventional group as well. Then one attempt was given to cannulation of the left sided internal jugular vein, that attempt too failed. So the procedure was abandoned and the surgery was carried out with wide bore peripheral line. In the attempts that failed with ultrasonography, the vein could be localized but there was difficulty in cannulating the guidewire. Hence the results of our study are in accordance with all several other studies (Kosky EM *et al*, Denys BG *et al*, Shrestha *et al*, Mallory DL *et al*) [9, 11, 4]. Indicating that USG reduced the number of attempts for successful internal jugular vein canulation when compared with conventional landmark technique. In our study, USG helped improve the success rate of IJV cannulation in support of all other studies (Mallory DL *et al*, Denys BG *et al*, Shrestha *et al*) [11, 4, 10]. In our study, of the 62 patients in each group, in the conventional group, there were 18/62 failures (29%) in the first attempt whereas in the USG group, 3/62 failures (4.83%) in the first attempt showing that the failure rate in the first attempt was less with the USG group. Those that failed were subjected to the second attempt. In the conventional group, 18 patients who failed to be cannulated in the first attempt were subjected to second attempt, out of which 6/18 patients (33.33%) failed to be cannulated in the second attempt. In the USG group, 3 patients were subjected to second attempt but 2/3 patients failed to be cannulated (66.66%). The patients who failed in the second attempt were subjected to the third attempt. In the conventional group, 6 patients were subjected to third attempt, out of which 2 failed (33.33%). In the USG group, 2 patients were subjected to the third attempt –turned out to be unsuccessful. Our study was comparable with the study conducted by Shrestha *et al.* [11] and (the p value< 0.05) was statistically significant showing that the failure rate on first attempt was low with use of ultrasound. In our study, in the conventional group, 14.5% patients had carotid puncture, 14.5% patients had hematoma, 3.22% patients had multiple unsuccessful attempts (inability to cannulate the guidewire) while 82.3% patients had no complications. In the USG group, 1.6% patients had carotid puncture, 3.22% patients, the guidewire could not be cannulated while 95% had no complications. 11 patients had complications in the conventional group and 3 patients in the USG group. Failure with the technique was due to inability to cannulate the guidewire. There were more number of complications with the conventional technique than the ultrasound guided technique and values of our study are comparable with several other studies (p value< 0.05) making it statistically significant.

5. Conclusion

All anesthesiologists should be encouraged to teach, train, and practice the basic skill of central venous cannulation by landmark technique. Although the ultrasound guidance does not appear to be imperative in all patients, it should be used as a part of training wherever the facility is available so that it can be used as a backup in difficult situations. USG is a relatively more expensive technique, requires some duration of setting up, and definitely has a learning curve and also not easily available everywhere. IJV canulation with landmark technique is highly successful with minimal complications in the adult patients. Basic training of cannulating the IJV by landmark technique should be imparted to all the trainees as ultrasound may not be available in all locations. So inference from our study would be mastery over both the techniques and use of USG in difficult cannulations.

6. References

1. Turker G, Kaya FN, Gurbet A, Aksu H, Erdogan C, Atlas A *et al*. Internal jugular vein cannulation: an ultrasound-guided technique versus a landmark-guided technique. Clinics. 2009; 64(10):989-992. doi:10.1590/S1807-59322009001000009.
2. Randolph AG, Cook DJ, Gonzales CA, Pribble CG. Ultrasound guidance for placement of central venous catheters: a meta-analysis of the literature. Crit Care Med. 1996; 24(12):2053-2058. http://www.ncbi.nlm.nih.gov/pubmed/8968276. Accessed December 9, 2016.
3. Bond DM, Champion LK, Nolan R. Real-time ultrasound imaging aids jugular venipuncture. Anesth Analg. 1989; 68(5):700-701. http://www.ncbi.nlm.nih.gov/pubmed/2655499. Accessed December, 2016, 9.
4. 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):1557-1562. http://www.ncbi.nlm.nih.gov/pubmed/8491011. Accessed December, 2016, 9.
5. Teichgräber UK, Benter T, Gebel M, Manns MP. A sonographically guided technique for central venous access. Am J Roentgenol. 1997; 169(3):731-733. doi:10.2214/ajr.169.3.9275887.
6. Miller AH, Roth BA, Mills TJ, Woody JR, Longmoor CE, Foster B *et al*. Ultrasound guidance versus the landmark technique for the placement of central venous catheters in the emergency department. Acad Emerg Med. 2002; 9(8):800-805. http://www.ncbi.nlm.nih.gov/pubmed/12153885. Accessed December, 2016, 9.
7. Turker G, Kaya FN, Gurbet A, Aksu H, Erdogan C, Atlas A *et al*. Internal jugular vein cannulation: an ultrasound-guided technique versus a landmark-guided technique. Clinics (Sao Paulo). 2009; 64(10):989-992. Doi:10.1590/S1807-59322009001000009.
8. Ultrasound-guided internal jugular venous cannulation comparison with palpation technique: Benefits and drawbacks.
9. Koski EM, Suhonen M, Mattila MA. Ultrasound-facilitated central venous cannulation. *Crit Care Med*. 1992; 20(3):424-426. http://www.ncbi.nlm.nih.gov/pubmed/1541105. Accessed December, 2016, 9.
10. Shrestha BR, Gautam B. Ultrasound versus the landmark technique: a prospective randomized comparative study of internal jugular vein cannulation in an intensive care unit. JNMA J Nepal Med Assoc. 2011; 51(182):56-61. http://www.ncbi.nlm.nih.gov/pubmed/22916513. Accessed December, 2016, 9.
11. Mallory DL, McGee WT, Shawker TH *et al*. Ultrasound guidance improves the success rate of internal jugular vein cannulation. A prospective, randomized trial. Chest. 1990; 98(1):157-160. http://www.ncbi.nlm.nih.gov/pubmed/2193776.

Accessed December, 2016, 9.
12. Tempe DK, Virmani S, Agarwal J, Hemrajani M, Satyarthy S, Minhas HS *et al*. The success rate and safety of internal jugular vein cannulation using anatomical landmark technique in patients undergoing cardiothoracic surgery. Ann Card Anaesth. 2013; 16(1):16-20. doi:10.4103/0971-9784.105364.