

Ultrasound-guided internal jugular venous cannulation comparison with palpation technique: Benefits and drawbacks

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ABSTRACT

Background: Catheterization of central venous access has many purposes. It was being done with traditional method. In 2001, the agency for healthcare research and quality (AHRQ) reported that use of USG during central venous access deserved widespread implementation based on the strength of evidence in the literature.

Aim: To compare palpation technique versus the ultrasound-guided technique for internal jugular vein (IJV) cannulation in cardiac surgical patients.

Methods: Four hundred patients who required IJV cannulation were randomly assigned to receive either by palpation technique [n=200] or by ultrasound-guided technique [n=200] in Cardiac setup during last two years. Failed catheter placement, risk of complications, number of attempts and time to successful catheterization and infection rate were observed.

Results: The overall access time, number of attempts for successful placement and complication rates were higher in traditional palpation technique, however infection rate was higher in ultrasound group which probably is related to sterilization. The success rate was comparable between both groups.

Conclusion: Ultrasound guidance improved the success rate in terms of reducing morbidity of IJV cannulation in cardiac patients. Our study indicates that ultrasound guided IJV cannulation requires less time and lower rate of immediate complications.

Keywords: ultrasound, IJV cannulation, cardiac surgery

INTRODUCTION

Catheterization of central venous access has many purposes such as, hemodynamic monitoring in case of cardiac surgeries, fluid, nutrient and drug transfusion, hemodialysis etc. Internal jugular vein, Subclavian vein and femoral vein are the options among which IJV is the preferred one for most of the Anesthesiologists.

In 1978, Ullman and Stoelting described the first use of ultrasound for accessing of central venous line. They used Doppler to localize the skin overlying the IJV.¹ According to authors, this new technique would increase the success rate of IJV catheterization and reduce accidental puncture of the carotid artery as compared with conventional method.¹ It has been suggested that USG guidance could be beneficial in placing catheter, reduction in time with less complications also in those patients in whom central venous access may be more difficult by palpation technique due to any reason.

Our aim is to compare USG guided IJV cannulation in comparison with Palpation method in cardiac set up in terms of number of attempts, time require for the procedure, rate of infection and complications in both groups.

MATERIALS AND METHODS

In this prospective randomized study, 400 patients, who require internal jugular vein cannulation were randomly assigned to receive internal jugular vein cannulation either through palpation technique [n=200] or ultrasound-guided technique [n=200] in Cardiac surgery patients during last 2 years. Institutional ethical clearance was obtained for this study.

Successful placement of catheter was confirmed by Chest x-ray and post-procedure arterial blood gas analysis. Mechanical complications were defined as carotid puncture, pneumothorax, haemothorax, stroke, catheter malposition etc.

In Palpation technique, patient was kept in supine position with head-down. Under strict sterile precaution, local area was anesthetized with Inj, Xylocard 2% with 24 gauge needle. The skin at the top of the triangle of sternal and clavicular head of sternocleidomastoid muscle was stretched. Puncture needle attached with 5 cc syringe with heparinised normal saline was guided at 45 degree angle towards right or left nipple (for right or left IJV respectively). The return of venous blood in syringe indicates entry into the vein. Guide wire was passed and followed by either sheath or catheter was placed and fixed with skin.

In USG guided technique, patient was kept in supine position. Under strict sterile manner, a linear USG probe connected with real-time ultrasound was covered with sterile cover. Standard two dimensional (2D) was used to measure the depth and calibre of IJV, evaluate its patency and compressibility and also to find out any anatomical variation in IJV. If found proper, opposite side IJV was catheterised. Catheterisation was performed under continuous real time ultrasound images obtained by putting the transducer parallel and superior to the clavicle, over the groove between and sternal and clavicular head of the sternocleidomastoid muscle. Once the vein is located, guide wire was passed followed by sheath or catheter was placed.

All 400 patients were analyzed by using Software Graphpad Prism V.6.0. P value < 0.05 is considered as statistically significant.

RESULTS

Demographic characteristics of both group patients are shown in Table 1. Patients of both the groups are comparable (p > 0.05) in terms of demographic details such as age, sex, site of catheterisation, previous catheterisation, any history of previous mechanical complications, untreated coagulopathy, skeletal deformity, compromised respiratory status or any known vascular abnormality.

Table. 1: Demographic profile

DEMOGRAPHIC CHARACTERISTICS	ULTRASOUND GROUP (N=200)	PALPATION GROUP (N=200)	P VALUE
Age (years)	57.4 ± 9.9#	58.1 ± 10.2#	p>0.05
Sex (M/F)	119/81	123/77	
Site of Catheterisation (Right/Left)	190/10	174/26	
BMI (kg/m2)	23.9 ± 5.2#	23.4 ± 4.9#	p> 0.05
Previous Catheterization	5 (2.5%)	6 (3%)	p> 0.05
Previous Difficult Catheterization	3 (1.5%)	3 (1.5%)	p> 0.05
Previous mechanical complications	0 (0%)	1 (0.5%)	p> 0.05
Known vascular abnormality	2 (1%)	3 (1.5%)	p> 0.05
Untreated coagulopathy	3 (1.5%)	1 (0.5%)	p> 0.05
Skeletal deformity	4 (2%)	4 (2%)	p> 0.05
Previous episode of stroke	1 (0.5%)	1 (0.5%)	p> 0.05
Compromised respiratory status	6 (3%)	4 (2%)	p> 0.05

P > 0.05 – Non significant, p < 0.05 – Significant, # mean ± SD

In ultrasound group all except 3 patients underwent successful catheterisation. While those 3 patients with prior catheterisation or previous difficult catheterisation was found thrombus in ultrasound. So they were cannulated with USG on opposite side. While in palpation group, 3 patients were converted into ultrasound group. That is mainly because of thrombus were found in USG in 1 cases out of 3 and remaining 1 were found with anatomical variation, while 1 had large left SVC. Due to this reason palpation method failed. In accordance with this, we have used 2D echo images in transverse (Figure 1) and longitudinal axis (Figure 2).



Fig.1



Fig.2

Outcome measures are compared in both the groups in Table 2.

Table.2. Outcome measures in both the groups

OUTCOME MEASURES	ULTRASOUND GROUP(N=200)	PALPATION GROUP (N=200)
Access Time (seconds)*	19.6 ± 13.2	68.3 ± 43.4
Number of Attempts	1.17 ± 0.14	1.36 ± 0.21
Success rate	200 (100%)	190 (95%)
Carotid Puncture	1 (0.5%)	11 (5.5%)
Hematoma	0 (0%)	5 (2.5%)
Hemothorax	0 (0%)	1 (0.5%)
Pneumothorax	0 (0%)	4 (2%)
Catheter Tip - Blood culture#	0 (0%)	2 (1%)
Catheter Malposition	0 (0%)	1 (0.5%)

* Access time was considered as time to locate the IJVs

#Catheter tip – blood culture was done in suspected cases

Access time and number of attempts is significantly low in Ultrasound group as compared to palpation group ($p < 0.05$). 100% success rate in ultrasound group was observed while in palpation group it is 95%. No complication was encountered in ultrasound group such as carotid puncture, hematoma, haemothorax, pneumothorax while it is 5.5%, 2.5%, 0.5%, and 1% respectively in palpation group which is also statistically significant ($p < 0.05$).

DISCUSSION

Previous studies demonstrated that mechanical complications are commonly occurred in 0-6.6% of patients, while infectious complication in 5-26%, and thrombotic complications in 2-26%.^{2,3} These complications rate increase with anatomical malformation, previous difficult cannulation, patient already in cardiac arrest or unconscious state.^{4,5,6} In our study, complication rate is comparably very low.

Real time ultrasound guided IJV cannulation improves the success rate and reduce the complications rate.^{5,7,8} Our study also demonstrates the effectiveness of using ultrasound in IJV cannulation to reduce mechanical complications. Using palpation technique, we demonstrated 95%

of patients underwent successful cannulation which is also in accordance with other studies which showed documented success rate of blind IJV cannulation ranging from 85-99%.^{7,8,9}

While in USG guided group, we found 100% success rate which is almost similar in other studies.¹⁰ We had only 1 patient with carotid puncture that is mainly because IJV is located above the artery rather than being on lateral. So to prevent carotid puncture in such cases sideways perpendicular approach is beneficial.¹¹

Repeated puncture attempts lead to increase chance of colonization of microorganisms, IJV carries higher rate of infection in comparison with Subclavian or femoral cannulation.^{12,13,14} Infection rate due to indwelling catheter is about 5.3/ 1000 cases which is comparable with our study.¹⁵ Indwelling catheter has been reported to cause arrhythmias in 0.9% of patients.¹⁶ However, this was not encountered in our study in both the groups.

CONCLUSION

USG guided IJV cannulation minimises time, number of attempts and complications as compared with palpation method. Provided the facility is available it is the method of preference.

AUTHOR NOTE

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