



ORIGINAL ARTICLE

Comparison of the ultrasonography guided catheterization with the landmark technique in internal jugular vein catheterization.

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ABSTRACT... Objective: To determine the differences in using the ultrasound guided technique as compared to the landmark technique for the cardiac catheterization procedures. **Study Design:** Cross-sectional study. **Setting:** Civil Hospital, Karachi. A Large Tertiary Care Hospital in Karachi, Pakistan. **Period:** November 2018 to November 2019. **Material & Methods:** Patients were divided into two groups, those who underwent catheterization through the landmark procedure and those who had the ultrasound guided procedure done. Various clinical and laboratory investigations were performed and recorded for the patients. The inclusion criteria was all the patients whose complete data was available in our archives, between the ages of 18 and 80 years, and belonging to the ASA Classification I to III, an international normalized ratio (INR) of <1.5 and platelet counts of >50,000 mm³. **Results:** The study population n= 600 patients, the mean age of patients was 65.2 +/- 10.6 years. We did not find any statistically significant differences in the age comparisons of the two groups, having a P-value of 0.3. Similarly, no difference was found in between genders, having a P-value of 0.8. When it comes to the duration of the bypass procedure there was no significant difference, the p value was 0.7. The success rate of the procedure was 89.79% in the landmark group and 98.07% in the ultrasound group, the P-value was significant at 0.04 respectively. **Conclusion:** The ultrasound-guided central venous catheterization is an effective and safer option when compared to the landmark technique.

Key words: Cardiac Surgery, Central Venous Catheterization Landmark Technique, Ultrasonography.

INTRODUCTION

In order to comprehensively monitor the status of a cardiovascular surgery candidate, a procedure known as Central Venous Catheterization (CVC) must be performed. This invasive procedure produces a variety of benefits both in monitoring the status of the patients as well as administering medications and nutrients. It is also used in hemodialysis and hyperalimentation respectively. The most common route of CVC is the internal jugular vein. Other sites where this procedure can be performed are the subclavian vein and the femoral vein.^{1,2} The complications encountered by surgeons and anesthesiologists range from hematomas, hemothorax, mediastinitis, pneumothorax, chylothorax and death. Traditionally the landmark technique is utilized when performing this procedure, where the

physician does the procedure through feel alone. This technique has some inherent failure points that make it susceptible to having post-operative complications.³ This low-cost method is being replaced by the ultrasound guided technique which was pioneered by Legler.^{4,5,6,7}

This method helps the physician to visualize the area and identify any anatomic nuances and provides a continuous observation in addition to being virtually independent of the site selected for the procedure. Studies report fewer complications, needle passes and short time interval of the procedure and catheterization times.⁸ The aim and rationale of this current study is to determine the differences in using the ultrasound guided as compared to the landmark technique for cardiac catheterization procedure and to

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compare the two techniques in terms of success and complication rates.

MATERIAL & METHODS

The type of study is a retrospective cross-sectional review over a period of one year between November 2018 to November 2019. The study was approved by the hospital's ethics committee (MS/GMCHS/SUKKUR/9027). The sampling technique was non probability convenience sampling. The inclusion criteria was all the patients whose complete data was available in our archives, between the ages of 18 and 80 years, and belonging to the American Society of Anesthesiologists (ASA) Classification I to III, an international normalized ratio (INR) of <1.5 and platelet counts of $>50,000 \text{ mm}^3$. All those patients who previously have had a catheter placed, infection at the site of procedure, having underwent a valvular or aortic surgery and patients planning to undergo carotid artery surgery were excluded.

Patients were divided into two groups, those who underwent catheterization through the landmark procedure and those who had the ultrasound guided procedure done. Various clinical and laboratory investigations were performed for the patients. All the patients had ECG, pulse oximetry and blood pressures measured. After the induction of anesthesia and intubation the patients were placed in a supine Trendelenburg position with the head turned towards the opposite side of the site of procedure. The area was first sanitized and the appropriate techniques were used to perform the maneuvers on the respected patient.

Several different data points were analyzed in our study and we used IBM SPSS version 20 to perform those analysis. We recorded the demographic data of all the patients as well as their pre-operative blood profiles, and their anticoagulant intakes. We also evaluated the success of the technique, complications and number of venous entries one. When late onset complications of the procedure was also recorded in the follow up. Mean and standard deviations were used for continuous data frequencies and percentages were used for qualitative data.

Student's t test was performed to compare the quantitative values and chi square test of Fisher's test was used to analyze the Qualitative values. A p value of less than 0.05 was considered to be statistically significant.

RESULTS

The total study population was $n= 600$ patients, the mean age of the patients was 65.2 ± 10.6 years. We did not find any statistically significant differences in the age comparisons of the two groups, having a P-value of 0.3. Similarly, no difference was found in between genders, having a p value of 0.8. When it comes to the duration of the bypass procedure there was no significant difference, the P-value was 0.7. The success rate of the procedure was 89.79% in the landmark group and 98.07% in the ultrasound group, the P-value was significant at 0.04 respectively. The rest of the demographic variables are provided in Table-I. Whenever the procedure of catheterization failed with using the right or left side of the internal jugular vein catheterization a femoral vein catheterization was performed. When it comes to blood profile and use of anticoagulant and antiaggregant medications there was no statistically significant difference. In terms of complications of catheterization $n= 13$ patients in the ultrasound group and $n= 95$ patients in the landmark group had complications. The details of the complications are provided in Table-I. The p values for the complications are as follows, hematoma (p value= 0.03), hemorrhage (p value= 0.05), pneumothorax (p value= 0.01) mispositioning of the catheter (Not significant), punctured carotid artery (p value= 0.01). Of the patients having a hematoma, the hematoma resolved in all the ultrasound guided patients while it only resolved for 66.66% of the patients spontaneously in the landmark group. One of the patients had to undergo exploration procedure to resolve the hematoma. The patients with carotid artery puncture did not develop any late complications. All the patients who had pneumothorax were observed and had radiographic investigations done and all of them resolved the pneumothorax with treatment.

Variable	Ultrasound Guided Group n= 208	Landmark Group n= 392
Age in years	64.5 +/- 10.4	65.8 +/- 10.5
Gender		
Male	117 (56.25%)	212 (54.08%)
Female	93 (44.71%)	180 (45.92%)
Number of successful procedures**	204 (98.07%)	352 (89.79%)
Total duration of bypass procedure in minutes	186.4 +/- 42.6	199.2 +/- 37.4
Site of catheterization		
Right internal jugular vein	198 (95.19%)	337 (85.96%)
Left internal jugular vein	10(4.80%)	23 (5.86%)
Complications		
Hematoma	5	28
Hemorrhage*	0	5
Mispositioning of Catheter	8	26
Pneumothorax	0	13
Carotid Artery Puncture	0	23
Total	13 (6.25%)	95 (24.23%)

Table-I. Demographic and other variables of the two population groups.

ACT= Activated clotting time, INR= International normalized ratio

*Requiring intervention

**Statistically significant

DISCUSSION

In our study there were total 18% complications of the catheterization, with 6.25% complication rate in the ultrasound guided group and 24.23% complication rate in the landmark group. Showing a significantly less number of complications when the ultrasound guided technique is used having a p value of 0.0001 respectively. In our literature review we found that currently reported rates of mechanical complications for central vein catheterization was between 5% to 19%, infectious complication rates were 5% to 26% and thrombotic complications were between 2%

and 26% respectively.^{9,10,11} Some of the factors which affect the outcome of the procedure are, Cachexia, Scarring, co-morbid diseases, obesity and the experience of the physician performing the procedure.^{12,13,14} The ultrasound guided catheterization has multitude of benefits as it provides a better appreciation for the patients anatomy, used in ICU settings it is known to reduce the procedures complications.¹⁵ Our results also support the use of the ultrasound guided technique of catheterization.

The success rate of the landmark method in our study population was approximately 90%, other studies have reported a success rate between 85% and 99%.^{16,17} The complication of carotid artery puncture using this method in our study population was 5.86% and in literature studies have reported a complication rate of carotid artery rupture between 3% and 6% respectively.¹⁷ Five patients in the ultrasound guided group had a palpable hematoma post procedure which resolved itself. However, careful monitoring of the hematoma was done to ensure resolution with minimal complications. The cause of this hematoma could be the concomitant use of antiaggregant and anticoagulants in these patients. Mispositioning of the catheter is also an important complication. In our study 8 patients in the ultrasound group and 26 patients in the landmark group had mispositioning of their catheters. The malposition observed were either the catheter being location in the subclavian vein, jugular vein or rotating in the vein outside the right atrium. In terms malposition both the procedure had similar outcomes. Furthermore, when studies looked at the impact of physician performance on the outcome of catheterization they observed that there were reduced complications with the ultrasound guided method regardless of the experience of the physician performing the procedure.^{17,18} The ultrasound method eliminates various minor issues that the physician might encounter such as jugular vein anomalies, collapsed veins and carotid beat making the procedure difficult among others. In developing countries especially Pakistan, the cost of a procedure is often the main consideration for physicians and patients alike. Overall the

ultrasound guided methods requires an initial investment to be made to obtain the ultrasound machine and accessories, however in the long run the decreased complications and faster speed of the procedure makes it a cost effective option.^{19,20} We also had some limitations in our study. First of all the two groups compared did not have an equal number of patients. This was so as in our institute there is a limited capacity to perform ultrasound guided procedures, however we feel that the results are significant enough to help make the physicians make a smarter decision when it comes to choosing the method of catheterization.

CONCLUSION

The results of our study show that the ultrasound-guided central venous catheterization is an effective and safer option when compared to the landmark technique.






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