

# COMPARISON OF SUPRACLAVICULAR VERSUS INFRACLAVICULAR SUBCLAVIAN VENOUS CATHETERIZATION IN A TERTIARY CARE HOSPITAL

Haq Dad Durrani,<sup>1</sup> Khalid Javed Butt,<sup>1</sup> Sairah Sadaf,<sup>1</sup> Muhammad Anwer Rehan,<sup>1</sup> Abdul Majid,<sup>1</sup> Alina Umar,<sup>1</sup> Zeeshan Khan,<sup>1</sup> Imran Ahmed<sup>1</sup>

## ABSTRACT

**Background:** Central venous catheterization (CVC) is an important intervention in critically ill patients for venous access of various emergency measures. **Objective:** The objective of this study was to compare supraclavicular approach of subclavian vein catheterization with the traditional infraclavicular approach in terms of success rate, number of attempts, insertion time for catheterization & complications. **Patients & Methods:** Place of Study: Department of Anesthesiology, ICU and Pain Management, Sheikh Zayed Hospital, Rahim Yar Khan, Pakistan. Duration of Study: 1<sup>st</sup> January to 31<sup>st</sup> October, 2012. Study design: This was a quasi-experimental study, 112 patients requiring central venous catheterization (CVC) were divided into two groups (56 patients in each): supraclavicular (Supra) or infraclavicular (Infra) Central Venous Catheterization. Statistical analysis was done using SPSS 16. Success rate, number of attempts, insertion time and complications were noted for each group. **Results:** The overall success rate was 96.4% (54 out of 56) in supra group and 91.1% (51 out of 56) in infra group. Mean insertion time for catheterization was significantly less in supra 5.00±2.154 minutes than in infra 7.35±2.560 minutes group (p=0.000). Mean number of attempts in locating the vein with 10 ml syringe was significantly less in Supra group (1.06±0.463) than infra group 1.27±0.603 (p=0.50). Mean number of attempts in locating the vein with proper needle was less in supra group (1.11±0.372) than infra group (1.29±0.576). There was one malposition in each group. **Conclusion:** The results of this study reflected that Supraclavicular approach is relatively rapid, has higher success rate, lower number of attempts and equal incidence of malposition compared with infraclavicular approach. More studies are suggested to establish these facts.

**Keywords:** Central venous catheterization, Supraclavicular, Infraclavicular

## INTRODUCTION

Central venous catheterization (CVC) is an important intervention in critically ill patients for venous access in volume resuscitation, administration of hypertonic and irritant substances, parental nutrition, hemo-dialysis, trans-venous cardiac pacing, and measurement of central venous pressure.<sup>1</sup> Various sites of Central Venous Catheterization include right and left sided external jugular, internal jugular, subclavian and femoral veins. Benefits of Subclavian vein remains paramount in aspects of lesser risk of catheter related infection,<sup>2</sup> long & short term use, patient comfort & line security.<sup>3</sup> Aubaniac's introduced infraclavicular subclavian vein catheterization in 1952.<sup>4</sup> Subsequently various insertion points and angles have been described. Central Venous Catheterization has always been

fraught with complications e.g. hemothorax, pneumothorax or arterial puncture. Because it is performed blindly, this has always given impetus to search for safer & easier route. In 1965, Yoffa described an alternative (Supraclavicular) approach to subclavian vein.<sup>5</sup> Although this approach has better & easily accessible landmarks, yet taught & practiced less often for unknown reasons.<sup>2</sup> Moreover, this technique causes less interruption during laprotomy, cardiac surgery and even during CPR.<sup>6,7,8</sup> However, Yoffa himself pointed out the difficulties of this technique. In 5% cases, clavicle is situated lower than usual in relation to rib.<sup>5</sup> Failure to adhere the instructions for angles may result in arterial puncture, pneumothorax or hemothorax.<sup>5</sup> Our objectives were to enlighten reasonably less risky technique in terms of over all success rate, 1<sup>st</sup> attempt success, number of attempts in locating vein with 10 ml syringe & with proper cannula, time for insertion of catheter and complications including arterial puncture, hemothorax, pneumothorax, hematoma and malposition of the tip of the catheter.

1. Department of Anesthesiology & ICU, Sheikh Zayed Medical College, Rahim Yar Khan, University of Health Sciences, Lahore.

**Correspondence:** Dr. Haq Dad Durrani, Department Of Anesthesiology & ICU Sheikh Zayed Medical College, Rahim Yar Khan (Pakistan)

**Email:** drhaqdad@szmc.edu.pk  
**Phone:** 0308-7598502

## PATIENTS AND METHODS

This Quasi experimental study was performed in Department of Anesthesiology, Intensive Care & Pain Management, of Sheikh Zayed Medical

College/Hospital, Rahim Yar Khan, Pakistan from 1st January to 31<sup>st</sup> October 2012. After getting permission from hospital ethical committee, 112 patients of age 12 to 70 years, of requiring (CVC) were selected without any gender discrimination. Patients having infection or anatomical abnormality of the area adjoining insertion site e.g. fracture of clavicle, or bleeding/clotting disorders were observed for excluded. 56 patients were allocated to supraclavicular (SUPRA) group and 56 to infraclavicular (INFRA) group by draw. All the procedures were performed by anesthesiologists with more than 6 years of experience. 38 right sided and 18 left sided catheterizations were done in infra group. 13 right sided and 43 left sided catheterizations were done in supra group. Both the groups were observed for time taken for catheterization, number of attempts in locating vein with 10 ml syringe, number of attempts in locating vein with proper needle, success or failure of procedure and any complications associated with procedure. Maximum 3 attempts were allowed in either approach.

Informed consent was taken from the patient or next of kin, if he was unconscious. Proper scrubbing, wearing gloves, mask and caps, along with an assistant were done. A wide area extending from jaw to nipple (if not interfering surgery), was prepared on the insertion side.

In supra group, we identified the lateral border of clavicular head of sternocleidomastoid at its junction with clavicle. It makes an angle of almost 90° with the clavicle. 2ml 1% lignocaine was infiltrated at the junction of lateral head of sternocleidomastoid and clavicle. A 10 ml syringe was used to pierce the skin at an angle of 45° (almost bisecting 90° angle) to the sagittal plane, and 15° forwards to the coronal plane, towards contra lateral nipple with constant negative pressure to aspirate blood.

In infra group, 10 ml syringe was used to pierce the skin just below the junction of medial and middle third of clavicle. 3-4 ml 1% lignocaine was infiltrated. A constant negative pressure was applied directing towards opposite shoulder until blood was aspirated. Central venous cannula was passed in the direction located with 10 ml syringe. After aspiration of blood, syringe detached and thumb applied over cannula to prevent air embolism. In both groups, bevel was cauded

(facing towards foot of patient). Guide wire passed through cannula and then cannula removed. Dilator threaded over guide wire and with gentle rotation passed into vein and then dilator removed. Catheter railroaded over guide wire. Guide wire removed. Aspiration through catheter done and drip attached. Constant free flow of drip checked and drip placed lower down to check the free back flow of blood. Stitching of catheter done with skin.

All successful catheterization were confirmed by X-Ray Chest. Data was analyzed by SPSS version 16. for descriptive and inferential statistics. The chi square test was used for comparing qualitative variables, while  $P \leq 0.05$  was considered significant.

## RESULTS

There were 34 males and 22 females in infraclavicular group, and 33 male and 23 females in supraclavicular group, the differences were not statistically significant. ( $P=0.847$ ). The mean age of the patient in infra group was  $39.95 \pm 17.47$  years and in supra group was  $38.14 \pm 1.73$  years, the differences were not statistically significant ( $p=0.637$ ). In supra group, right side catheterization was attempted in 13 patients and left side in 43 patients. In infra group, right side catheterization was attempted in 38 patients and left side in 18 patients.

Although 46 patients in supra group and 28 patients in infra group were mechanically ventilated {the difference was statically significant ( $P=0.001$ )}, yet we did not notice any pneumothorax in either group.

The overall success rate was higher in supra clavicular approach (54 out of 56 i.e, 96.4%) than infraclavicular group (51 out of 56 i.e, 91.1%) but the differences were not statistically significant ( $p$ -value = 0.242).

Higher success with first attempt was in supra clavicular approach 49 (87.51%) than in infraclavicular approach 39(69.64%), but not statistically significant.  $P=0.157$

Mean number of attempts locating with 10 ml syringe was significantly less in Supraclavicular group ( $1.06 \pm 0.463$ ) and than infraclavicular group ( $1.27 \pm 0.603$ ).  $P$  value  $< 0.05$

Mean number of attempts locating with proper cannula in supraclavicular group was  $1.11 \pm 0.372$  and in infraclavicular group was  $1.29 \pm 0.576$ . The difference was not statistically significant ( $P=0.137$ ).

**Table I: Comparison of success in number of attempts between supra and infra groups.**

Attempts	Approaches n (%)		Total	p- value
	Supraclavicular (n=56)	Infraclavicular (n=56)		
1	49(87.51%)	39(69.64%)	88(78.57%)	P=0.157
2	04(07.14%)	09(16.07%)	13(11.61%)	
3	01(01.78%)	03(05.36%)	04(3.57%)	
unsuccessful	02(3.57%)	05(08.93%)	07(6.25%)	

**Table II: Comparison of successful attempts with finder needle (10ml syringe)**

Number of Attempts (Mean ± SD)			
Supraclavicular approach n=56	Infraclavicular approach n=56	Total N=112	p-value
1.06±0.463	1.27±0.603	1.16±0.463	0.050

**Table III: Comparison of successful attempts with proper needle (Central Venous Cannula)**

Number of Attempts (Mean ± SD)			
Supraclavicular approach (n=56)	Infraclavicular approach (n=56)	Total N=112	P - value
1.11±0.372	1.29±0.576	1.20±0.488	0.137

The mean insertion time for catheterization was significantly less in supraclavicular group ( $5.00\pm 2.154$ ) than infraclavicular group ( $7.35\pm 2.560$ ) ( $p=0.000$ )

**Table IV: Comparison of insertion time for catheterization in successful attempts**

Insertion time in minutes (Mean±SD)			
Supraclavicular approach (n=54)	Infraclavicular approach (n=51)	Total (n=105)	P- value
5.00±2.154	7.35±2.560	6.14±2.629	0.000

Malposition was identified in one patient of each group. In supraclavicular group, catheter was passed to ipsilateral axillary vein. In infraclavicular group catheter was passed into ipsilateral internal jugular vein.

None of the complications including, hematoma, arterial puncture, pneumothorax or hemothorax was observed in any patient of either group. Regarding complications, the differences were not significant between two groups.

## DISCUSSION

The results of our study indicated that supraclavicular approach was a quicker & more successful approach in terms of locating the vein with finder needle of 10 ml syringe and the mean insertion time of catheterization. Up to now, only few comparisons of supra & infra groups have been published and our study results are also in accordance with the previous study. We used original Yoffa technique<sup>5</sup> & used left side in most of supraclavicular cases because Yoffa recommended left side for right handed persons. Moreover, during surgical procedure under anesthesia, right side is occupied by endotracheal tube, breathing circuit and its support. However, there is a potential risk of injury to thoracic duct during cannulation to left side. Overall success rate of catheterization in previous studies ranged from 84.5% to 98% in supra group and 80-98% in infra group, hence the difference between 2 groups remained statistically insignificant. We found overall success 96.4% in supra group and 91.1% in infra group which also was not statistically significant difference.

First attempt success was significantly higher in infra group in a study on patients undergoing open cardiac surgery by Kocum et al,<sup>6</sup> being 88% in infra group and 61% in supra group. These results are contrary to our results in which 1<sup>st</sup> attempt success rate was higher with supra group being 87.5% and in infra group being 69.64%. However, the statistical analysis showed the difference to be insignificant.

The mean number of attempts in locating the vein with finder needle was less in supra group than in infra group, with p value of less than 0.05. In our study, the mean number of attempts in locating the vein with proper needle was less in supra group than in infra group. Kocum<sup>6</sup> had lesser number of attempts in infra group. Hussain Safdar<sup>7</sup> found significantly lesser number of attempts in supra group.

The mean time for insertion of central line was significantly less in supra group than in infra group ( $p=0.000$ ) in our study. This is in contrast with Kocum et al,<sup>6</sup> where mean insertion times were comparable in both approaches. This probably was because their study was conducted at cardiac surgery set up and their system would have been well versed with infra approach. Malposition was detected significantly higher in infra group by *Dronen et al*,<sup>8</sup> in which they detected malpositioning or kinking of

the catheter significantly higher with the infraclavicular technique (26%) versus (7%) in the supraclavicular group and *Sterner et al.*,<sup>9</sup> who discovered incidence of catheter malpositioning was significantly higher in the infraclavicular group (9%) vs. (0.5%) in the supraclavicular group. The remaining 3 authors did not find significant difference between 2 approaches and so was case with our study. The possible reasons include they did not mentioned that bevel was kept caudad while threading guide wire. As they catheterized all patient during CPR (*Dronen*<sup>8</sup>) or in Emergency (*Sterner*<sup>9</sup>), so direction of bevel might not be consideration at those moments.

In all of these five previous comparative studies incidence of pneumothorax, hemothorax, arterial puncture were not statistically different between 2 approaches. We also got the similar results. In our study, 46 patients in supra group and 28 in infra group were mechanically ventilated but we did not encountered any pneumothorax, hemothorax or arterial puncture. Tomasz Czarnick<sup>10</sup> applied supraclavicular catheterization in 370 mechanically ventilated patients and encountered very low complication rate (1.7%).

## CONCLUSION

The result of this study reflected that supraclavicular approach is relatively rapid, has relatively higher success rate, lower number of attempts and equal incidence of malposition compared with infraclavicular approach. More studies are suggested to strengthen the pavement for supraclavicular approach as relatively safer catheterization technique for subclavian vein.

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