

Comparison between supraclavicular and infraclavicular approaches for subclavian venous catheterization in adults

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Introduction: The subclavian vein access has been the standard recommended approach for central venous catheterization both for short and long-term use. Aim is to compare the supraclavicular and infraclavicular approaches for subclavian venous cannulation in regard to success, attempts required, time taken and complications.

Material and Methods: All patients satisfying the inclusion criteria were placed either in group supraclavicular (S) or group infraclavicular (I) approach for right subclavian vein and 7FrG cannula was cannulated using modified Seldinger technique under general anaesthesia.

Results: Time taken for successful cannulation in Group (S) were 188.96 ± 37.19 seconds and in Group (I) were 299.76 ± 69.712 seconds which was statistically significant with p value of <0.001 . Success of cannulation in Group (S) was 95 %, where as in Group (I) was 92.5%. In Group (S) 85% cannulas were secured in 1st attempt, 10% in 2nd attempt and 5% had failed cannulation. In Group (I) 67.5% were secured in 1st attempt, 25% in 2nd attempt and 7.5% had failed cannulation. Complications in terms of arterial puncture, malposition and pneumothorax were comparable. All these parameters were not statistically significant between the groups with p value >0.05 .

Supraclavicular approach is better than infraclavicular approach in terms of less mean time required for successful cannulation.

Conclusion: Subclavian venous catheterization via the supraclavicular approach is a quicker method of central venous access in anesthesia.

Keywords: Supraclavicular; infraclavicular; subclavian vein

Introduction

Central venous catheter (CVC) insertion is commonly used in critically ill patients and those undergoing major surgery for invasive monitoring technologies and aggressive haemodynamic resuscitation. The subclavian vein (SCV) is the preferred site for CVC insertion because of its large size, lower risk for infection and its ability to provide patient comfort in long-term use.^{1,2}

Since Aubaniac's original description in 1952, subclavian vein catheterization via the infraclavicular approach has become a well-established technique. In 1965 an alternate supraclavicular approach was described by Yoffa

having some distinct advantages over the infraclavicular approach like a well-defined insertion landmark (the clavisternomastoid angle); a shorter distance from skin to vein; a larger target area; a straighter path to the superior vena cava; less proximity to the lung and fewer complications of pleural or arterial puncture. However, it is less often taught and utilized for reasons that are not clear.^{3,4}

Hence this study was to compare supraclavicular and infraclavicular approaches for subclavian venous catheterization

Aim: To compare the supraclavicular and infraclavicular approaches for subclavian venous cannulation.

Objectives:

The purpose of this study was to compare the two techniques regarding:

1. Number of attempts
2. Time required for cannulation
3. Success rate of catheterization
4. Complications associated with the procedure (arterial puncture, malposition, pneumothorax/haemothorax)

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Received: 17/08/2017

Accepted: 20/10/2017

DOI: <http://doi.org/10.4038/slja.v26i1.8269>



Materials and Methods

Patients who needed central venous catheterizations for purposes like fluid management and central venous pressure (CVP) monitoring were given importance. Randomization was done by computer-generated random number tables and divided into two groups Group S and Group I. Written informed consent was taken from all the patients after explaining to them and their attendants about the merits and demerits of the procedure. Patients satisfying the inclusion criteria were enrolled in the study. Study was conducted in M.S. Ramaiah Hospital, MSR Nagar, Bangalore following ethics committee approval from the hospital. Cannulation was performed by two trained anaesthetist with more than 3 years of experience.

Study period: July 2016 to April 2017

Inclusion Criteria

1. ASA Grading I, II, III
2. Medical, surgical and neurosurgical patients
3. Patients requiring CVP monitoring and infusion of vasopressors
4. Patients requiring long-term fluid management in the ICU.

Exclusion Criteria

1. Morbidly obese patients in whom landmarks were difficult to identify
2. Infection at the site of insertion
3. Trauma to ipsilateral neck/clavicle/first rib or deformities
4. Coagulopathy
5. Age < 18 years

Routine investigations such as complete haemogram, bleeding time, clotting time, urine examination, coagulation profile, electrocardiogram and chest X-ray (PA view) were carried out in all patients.

Patients were given general anaesthesia with fentanyl 2mcg/kg, propofol 2mg/kg and atracurium 0.5mg/kg and male patients were intubated with 8-8.5mm endotracheal tubes while female patients were intubated with 7-7.5mm endotracheal tubes.

All patients were placed in a 10° head-down position with a rolled towel placed under their shoulders. The head was turned 30° away from

the side of the venepuncture, and the ipsilateral arm was gently pulled towards the knee. Right subclavian vein was selected for cannulation. Subclavian vein was cannulated using 7Fr G cannula using modified Seldinger technique.

Supraclavicular approach (Group S)⁵

The clavicolosternomastoid angle was identified either by asking the patient to raise his/her head or by palpation. Correct identification of this angle is critical to the success of supraclavicular approach. The needle with attached syringe was inserted at the clavicolosternomastoid angle, bisecting it in a direction at an angle of 45°. Needle was advanced behind the clavicle and directed towards the contralateral nipple. (Figure 1)

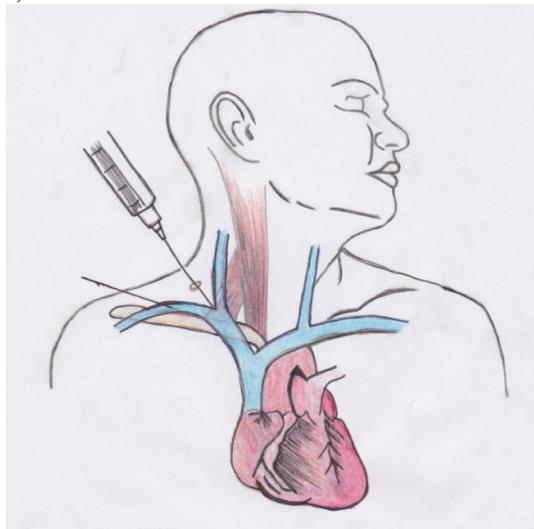


Figure 1: Supraclavicular approach

Infraclavicular approach (Group I)⁶

After identification of the anatomical landmarks, wide preparation of the surgical field, including infraclavicular and jugular area sterilization, was performed. Point of needle entry 1cm below the clavicle at the junction of middle and medial third of the clavicle and directing the needle towards the suprasternal notch. (Figure 2)

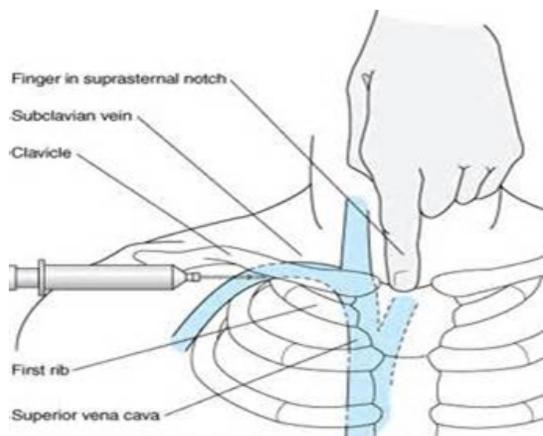


Figure 2: Infraclavicular approach

Parameters which were looked upon are number of attempts required for successful cannulation, time taken for the procedure, correct placement and complications.

Each skin puncture was defined as an attempt and maximum 3 attempts were allowed in either approach and in case of failure, alternate approach (internal jugular) was used for catheterization. Once the needle is taken off the skin it's counted as an attempt. Any further skin puncture is counted as new attempt.

Time taken is calculated in seconds (sec) from the skin puncture to successful placement of cannula.

All successful cannulations were confirmed by post-procedure chest radiography for correct placement and to check for any complications. Any mal positions like cannula tip being in ipsilateral or contralateral internal jugular vein (IJV) or contralateral subclavian were noted. Complications like arterial puncture was noted by bright red color of the blood and pulsatile flow, pneumothorax and haemothorax were visualised by chest x-ray.

Statistical methods

Descriptive statistics of access time of catheterisation was analysed and presented in terms of mean with standard deviation. The success rate, number of attempts and complications were summarised in terms of percentage.

Independent T test was used to compare the access time of catheterisation between two groups. Chi square test was used to compare success rate, number of attempts and complications between two groups.

Thakur et al¹, has observed that the mean access time in supraclavicular approach was 4.30 ± 1.02 mins, where as in infraclavicular approach it was 6.07 ± 2.14 mins. In the present study expecting similar results and to get 80% power, 95% confidence level and minimum detectable difference in group as 1.1 min, the study required a minimum of 36 subjects in each group. We considered 40 subjects to avoid drop rates during study.

Results

The mean age in group S was 35.93 ± 9.5 years and group I was 39.53 ± 8.4 years. The mean weight was 65.1 ± 6.9 kgs and 58 ± 6.9 kgs in group S and I respectively. The mean height was 165.1 ± 8.23 cms and 156 ± 10.1 cms in group S and I respectively. Out of 80 patients, 38 were males and 42 were females. In group S, 16 were males and 24 were females. In group I, 22 were males and 18 were females.

The demographic parameters of the patients like age, weight, height and gender in the study were comparable with a p value of > 0.05 . All these were statistically not significant.

In Group S out of 40 patients, in 34 patients (85%) cannulas were secured in 1st attempt, 4 patients (10%) in 2nd attempt and 2 patients (5%) had failed cannulation.

In Group I out of 40 patients, in 27 patients (67.5%) cannula was secured in 1st attempt, 10 patients (25%) in 2nd attempt and 3 patients (7.5%) had failed cannulation. These were not statistically significant with p value of > 0.05 . (Figure 3)

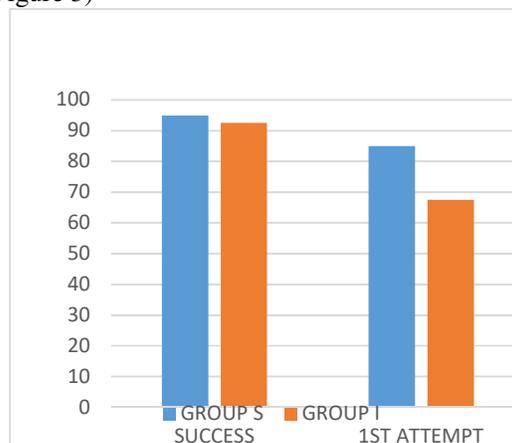


Figure 3: Comparison of success and 1st attempt between two groups S and I in terms of percentage

Time taken for successful cannulation in Group S were 188.96 ± 37.19 seconds and in Group I were 299.76 ± 69.712 seconds which was statistically significant with p value of <0.001 . (Figure 4)

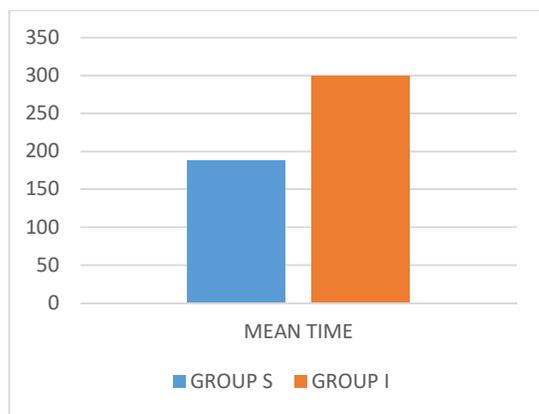


Figure 4: Mean access time between two groups S and I in seconds

Success of cannulation in Group S was 38 out of 40 patients (95 %), where as in Group I was 37 out of 40 patients (92.5%) which was statistically not significant with p value of >0.05 .

Complications in terms of arterial puncture was seen in 2 patients in Group S and 1 patient Group I. Malposition in terms of cannula tip seen in ipsilateral IJV was seen in 3 patients in Group I and none in Group S. Pneumothorax was seen in 1 patient in Group I and none in Group S. All these complications in terms of arterial puncture, malposition and pneumothorax were not statistically significant between the groups with p value >0.05 .

Discussion

The supraclavicular approach seems to be more comfortable than the jugular approach in a conscious patient. It will be of helpful, where the right jugular approach could be associated with cerebral perfusion pressure reduction, intracranial pressure elevation, and venous stasis like in neuroanesthesia. This method can be used successfully and relatively safely by inexperienced as well as experienced physician as a primary or alternative technique when other catheterization sites are not available.⁶

Success of cannulation in our study revealed, in Group S 95%, where as in Group I was 92.5% which was statistically not significant with p value of >0.05 . This was consistent with study done by Durrani et al⁴ where the overall success

rate was 96.4% in supraclavicular group and 91.1% in infraclavicular group. Success rate is comparable and in more than 90%, giving an opinion that both the approaches can be utilised when considering for subclavian venous cannulation.

Our study showed that in Group S 85% of cannulas were secured in 1st attempt, 10% in 2nd attempt and 5% had failed cannulation. In Group I, 67.5% were secured in 1st attempt, 25% in 2nd attempt and 7.5% had failed cannulation. These were not statistically significant with p value of >0.05 . This was comparable with Prasad et al⁵ study which had 72% of the catheterizations done in first attempt, 28% done in 2nd attempt and 12% had failed cannulation. Slightly high failure rate seen in Prasad et al study were due to several causes like unable to locate the vein, arterial puncture, difficulty in the threading the guide wire, catheter entering into ipsilateral IJV. In our study failure rates were only due to inability to locate vein.

Time taken for successful cannulation in Group S were 188.96 ± 37.19 seconds and in Group I were 299.76 ± 69.712 seconds which was statistically significant with p value of <0.001 . Thakur et al¹, observed that the mean access time in supraclavicular approach was 4.30 ± 1.02 mins, whereas in infraclavicular approach it was 6.07 ± 2.14 mins.

Our study results are also in consistent with the above studies in terms of comparison of approaches in regard to mean access time for cannulation. But in our study the time taken for supraclavicular group was much less compared to other studies, indicating that supraclavicular approach by an experienced anaesthesiologist is the easiest and fastest way of central venous cannulation. So, it might be of great help during emergency and crisis situations.

Complications in terms of arterial puncture was seen in 1 patient in group S and 3 patients in group I. Malposition in terms of cannula tip seen in ipsilateral IJV was seen in 3 patients in group I. Pneumothorax was seen in 1 patient in group I. All these complications in terms of arterial puncture, malposition and pneumothorax were not statistically significant between the groups with p value >0.05 . The supraclavicular line offers another approach that appears at least as safe and possibly easier to perform with less misplacement than more frequently used lines.⁷

But these complications are of clinical significance, signifying supraclavicular group fares better than infraclavicular group in regard to complications. Complications in other studies like Pathiraja et al⁸, Aziz et al³ and Hussain et al² were comparable with our study.

Ultrasound guidance reduces time to venous cannulation and reduces risk of complications during central venous access.⁹ Ultrasound is frequently used for placement of central venous catheters in the internal jugular and femoral veins but less commonly used in subclavian venous access, perhaps due to poor visualization of the vein from acoustic shadowing from the overlying clavicle.¹⁰

Our institute had limitations for ultrasound use in our study. Probably by using ultrasound, the success rate would have improved further and complications would have been fewer.

Supraclavicular approach for subclavian vein is a comparable approach when compared to infraclavicular approach in terms of successful cannulation, number of attempts and complications like arterial puncture, malposition, pneumothorax and haemothorax. Supraclavicular approach is better than infraclavicular approach in terms of less mean time required for successful cannulation.

Conclusions

Supraclavicular approach is a faster way of cannulation of subclavian vein and is of great help during emergency situations when compared to infraclavicular approach. It can be an easy cannulation technique for the experienced physician and can be useful as an alternative to traditional approaches. Clinically complications rates are less in supraclavicular group as compared to infraclavicular approach.

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