

# ANATOMIC CONSIDERATION IN PLACEMENT OF CENTRAL VENOUS CATHETERS: A CADAVERIC STUDY :- COMPARISON OF SUPRACLAVICULAR ANTERIOR AND POSTERIOR INTERNAL JUGULAR VENOUS APPROACH

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## ABSTRACT

A comparison of Central venous catheterization (CVC) of the superior vena cava via the anterior and posterior internal jugular venous approach was done. Anterior approach required insertion of needle into the apex of Sedillot's triangle, The distances from the apex of Sedillot's triangle to the ipsilateral sternoclavicular joint was also measured. For posterior approach needle was inserted at a point one-third of the distance along the line between the sternal head of the clavicle and the mastoid process, just lateral to SCM. Subsequently the area was dissected to note the position of needle. Results indicate that on the right, the needle was inserted into the IJV in 93.75% & 87.50% of the cases in anterior and posterior approach respectively, whereas on the left, the needle entered the IJV in 75.00% of the cases in both approaches. Distance between sternoclavicular joint and apex of Sedillot's triangle was  $42.56 \pm 8.47$ mm &  $40.94 \pm 11.65$ mm on the right and left, respectively. It was concluded that the anterior IJV approach is better technique with success more on the right side.

**Key words:-** Central venous catheterization (CVC), Internal Jugular Vein(IJV), Sedillot's triangle, sternocleidomastoid (SCM).

## INTRODUCTION

Central venous catheterization (CVC) is a common practice amongst surgeons, anesthesiologists and emergency room physicians, during the preparations for major surgical procedures such as open-heart surgery, as well as, for intensive care monitoring, and rapid restoration of blood volume (Chudhari et al., 1998)<sup>1</sup>. Apart from the ability to serve as a means for total parenteral nutrition, administration of drugs and fluids, and allowing for invasive monitoring of cardiac parameters (Luckraz, 2003)<sup>2</sup>, the CVC is also a helpful technique for the administration of chemotherapy drugs over a prolonged period without the associated complications, such as thrombosis or sepsis. In these prolonged cases, a completely implantable system is the best solution for chemotherapy administration (Costantini et al., 1997)<sup>3</sup>.

The percutaneous internal jugular approach was developed by (Dr Ian English et al. in 1968)<sup>4</sup> for central venous pressure monitoring and intra-

operative and post-operative fluid infusion at The Brompton Hospital, London. Branthwaite and Bradley (1968)<sup>5</sup> reported the use of the Seldinger technique to introduce fine-bore cannulas fitted with thermistors via the internal jugular vein. Aubaniac (1952)<sup>6</sup> first introduced the concept of using the infraclavicular subclavian vein as a site for venepuncture.

A sound understanding of anatomy plays a vital role in the safe and successful performance of clinical procedures (American Association of Clinical Anatomists (AACA, EAC), 1999;<sup>7</sup> Cottam, 1999;<sup>8</sup> Boon et al., 2001)<sup>9</sup>. Complications that occur can often be related to a lack of understanding or misunderstanding of the anatomy essential to that specific procedure (AACA, EAC, 1999)<sup>7</sup>. A lack of anatomical knowledge can also prolong a procedure, which will inevitably lead to increased morbidity and mortality (Beahrs et al., 1986;<sup>10</sup> Graney, 1996)<sup>11</sup>.

Competency to perform clinical procedures only exists when a practitioner has sufficient knowledge and manual skills required to perform the procedure safely and successfully. Competency is especially important when failure of the procedure could result in complications or cause patient discomfort (Miller, 1997)<sup>12</sup>. The performance of any clinical procedure needs a certain level of competency in order to be performed safely, effectively, and with few

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complications. The Association of American Medical Colleagues (1998)<sup>7</sup> state that before graduation, a student should be competent to perform certain routine technical procedures, which amongst others includes inserting an intravenous catheter. Hence this study was done to find a safer approach for C.V.C.

### OBJECTIVE

- 1) To ascertain the frequency in which the Internal Jugular Vein is entered when inserting a needle into the apex of the Sedillot's triangle [Anterior Supraclavicular Internal Jugular Venous approach] and through the Posterior Supraclavicular Internal Jugular Venous approach.
- 2) To determine the distance of the apex of the Sedillot's triangle, from ipsilateral Sternoclavicular joint.
- 3) To compare both Anterior and Posterior Supraclavicular Internal Jugular Venous approach.

### MATERIALS & METHODS

This study was conducted on the cadavers available for dissection in Department of Anatomy, Subharti Medical College, Meerut. Dissections were conducted on 16 adult cadavers, all male, in the dissection room of the Department of Anatomy. 18G needle was used for the purpose of puncturing the veins. The length of the needle 70 mm and the length of the guidewire 50cm. Portable X-Ray machine was used for the purpose of taking out radiographs. Digital caliper was used for the purpose of taking various measurement (accuracy  $\pm 0.05\text{mm}$ ).

### TECHNIQUES FOR CATHETERIZATION

The total number of necks dissected on both the left and right sides were 16 in number. Dissections were performed, with the head in a neutral position, cadaver in supine position, without a block between the scapula

### ANTERIOR INTERNAL JUGULAR VENOUS APPROACH

- 1) Introduce the needle into the apex of the triangle (figure A) formed by the sternal and clavicular heads of SCM and the clavicle (Sedillot's triangle).
- 2) Direct the needle inferiorly, parallel to the saggital plane, 3045o posterior to the frontal plane. The needle is advanced inferiorly and

slightly laterally towards the anterior end of the first rib behind the clavicle. (fig.A-1)

- 3) Slowly advance the needle & then dissect out the area to locate the position of the needle and visualise the corresponding area.
- 4) Insert the guidewire through the same opening as that of the needle & advance the guide wire as far as it goes.
- 5) Then obtain a X-ray chest A-P View with guide wire in position.

### POSTERIOR INTERNAL JUGULAR VENOUS APPROACH

- 1) A point one-third of the distance along the line between the sternal head of the clavicle and the mastoid process, just lateral to SCM (figure B).
- 2) Introduce the needle at an angle of 3040o to the skin, deep to SCM and advance inferiorly and medially toward the suprasternal notch until entering the IJV at a depth of 23 cm. (fig.-B-1)
- 3) Then the corresponding area dissected out to note the position of the needle and visualize the area.
- 4) Then the guide wire is inserted into the vein through the same opening as that created by the needle & advanced as far as possible.
- 5) Then X-ray chest A-P view done with the guide wire in position to identify the position of it.

### DISSECTION PROCEDURE

An incision was made in the midline from the thyroid cartilage to the sternal notch. Two lateral skin incisions were then made over both the clavicles. The skin flaps were reflected laterally to expose SCM. Sedillot's triangle as well as its apex was located between the sternal and clavicular heads of SCM. A needle was inserted perpendicular to the table into the apex of Sedillot's triangle and lodged securely. Another needle was inserted into the most superior aspect of the sternoclavicular joint and the distance from this bony landmark to the apex of Sedillot's triangle was measured using a digital caliper (accuracy  $\pm 0.05\text{ mm}$ ). The sternal and clavicular heads of SCM were then removed along with the remaining fascia without disturbing the vessel wall to expose the IJV.

The position of the needle was subsequently confirmed to be either in the IJV (this was considered to be a "hit") or, if not in the IJV (this was considered to

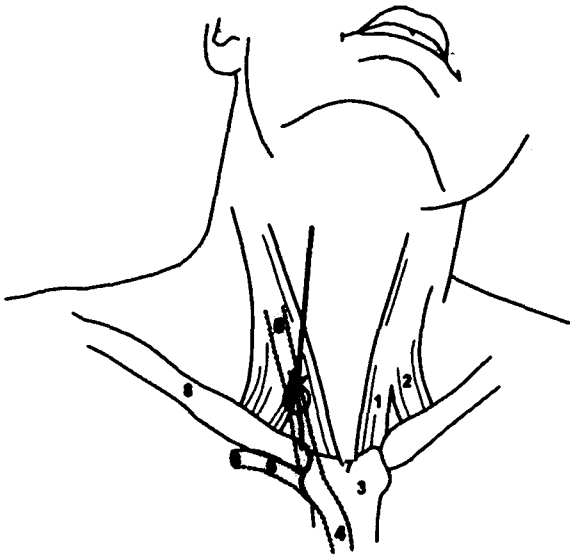


Figure A :- Surface Anatomy Of The Neck Indicating The Procedure For Inserting A CVC Into The IJV Via The Anterior Approach.

- (1) Sternal Head of SCM muscle.
- (2) Clavicular Head of SCM muscle.
- (3) Manubrium .
- (4) Right Brachiocephalic Vein.
- (5) Right Subclavian Vein.
- (6) Right Internal Jugular Vein
- (7) Sternal Notch
- (8) Clavicle

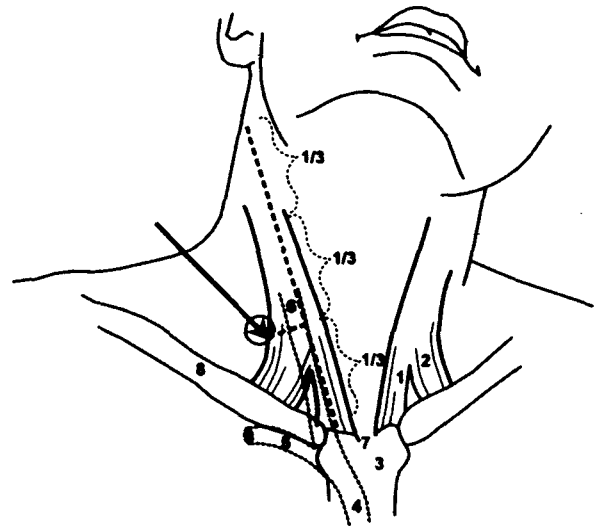


Figure B :- Surface Anatomy Of The Neck Indicating The Procedure For Inserting A CVC Into The IJV Via The Posterior Approach.

- (1) Sternal Head of SCM Muscle.
- (2) Clavicular Head of SCM Muscle.
- (3) Manubrium.
- (4) Right Brachiocephalic Vein.
- (5) Right Subclavian Vein.
- (6) Right Internal Jugular Vein.
- (7) Sternal Notch.
- (8) Clavicle.

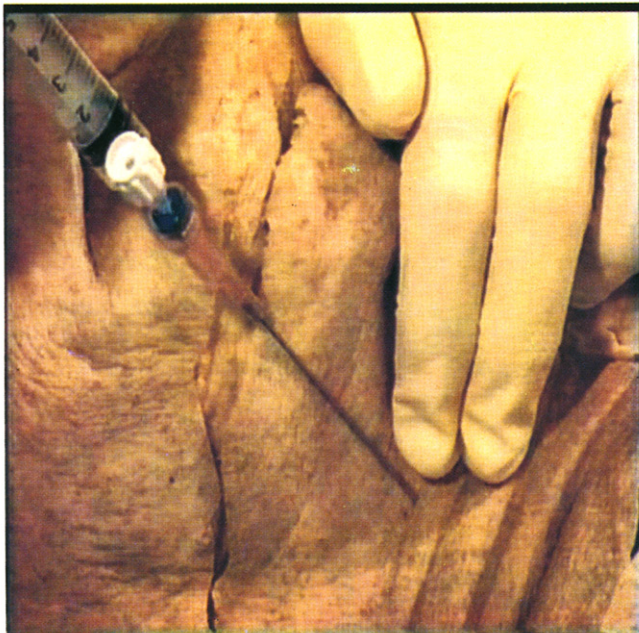
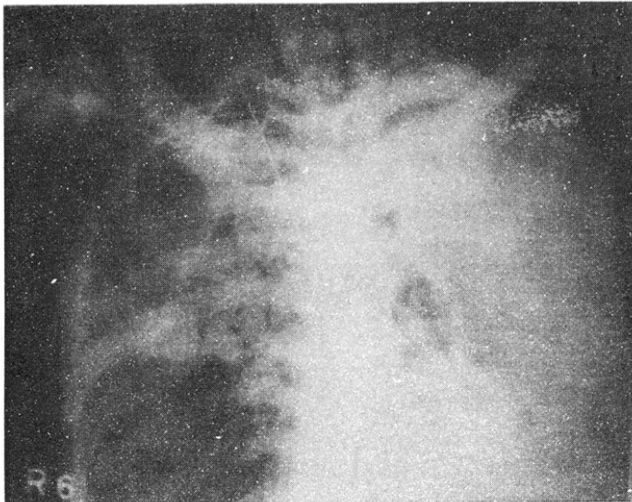


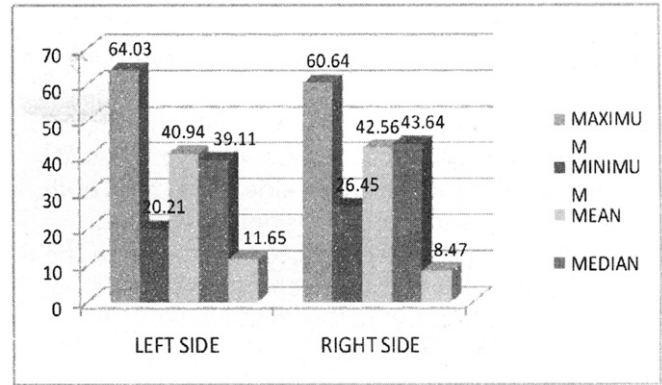
Fig A-1. The Procedure For Inserting A CVC Into The IJV Via The Anterior Approach.



Fig B-1. The Procedure For Inserting A CVC Into The IJV Via The Posterior Approach.



Radiograph (PA view) showing canula in IJV



Graph- 2 COMPARISON OF RESULTS OF MEASUREMENTS OF THE DISTANCE OF IPSILATERAL STERNOCLAVICULAR JOINT TO THE APEX OF SEDILLOT'S TRIANGLE (mm), ON BOTH LEFT AND RIGHT SIDE

**RESULTS :**

- This study was conducted on a sample of 16 adult cadavers. All the cadavers were male.
- In the anterior Internal Jugular Venous (IJV) approach there was only one "miss" on the right side and four "misses" on the left side (graph-1).
- In the posterior Internal Jugular Venous (IJV) approach there were two "misses" on the right side and four "misses" on the left side (graph-1).
- The mean distance of apex of Sedillot's triangle on both right & left sides are 42.56mm and 40.94mm respectively (graph-2).

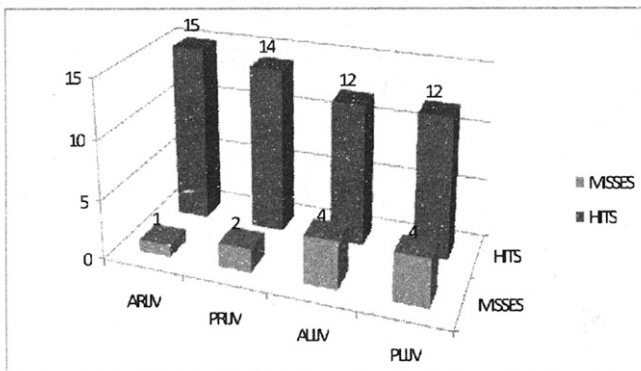
**DISCUSSION**

The results confirm that it is much safer and easier to place a central venous catheter into the IJV on the right side with success rate of 93.75% and 87.50% for anterior and posterior approaches on right side respectively, whereas the success rate for anterior and posterior approach of IJV on left side was 75.00% in each case. Hence overall success rate in right side approach of IJV is greater in comparison to left side. Also the success rate through anterior approach on right side was greater as compared to left side with one "miss" on the right side and four "misses" on the left side. The result is consistent with the findings of Botha et al. (2006)<sup>13</sup> who reported the success of anterior approach of IJV on right and left side as 97.14% & 78.79% respectively. A miss could possibly lead to puncturing the Common Carotid Artery (CCA), especially if the needle passed medial to the IJV.

The results suggest that the mean diameter of IJV is slightly more on the right side ( $16.61 \pm 4.26$  mm) as compared with the left side ( $15.92 \pm 3.51$  mm) with 95% confidence interval for the actual mean 14.34 to 18.88mm on right side & 14.05 to 17.78mm on the left side with p value < 0.001 for both.

The distance of apex of Sedillot's triangle from the most superior aspect of sternoclavicular joint of same side is  $42.56 \pm 8.47$ mm on the right side and  $40.94 \pm 11.65$ mm on left side, with 95% confidence interval of actual mean is between 38.05 and 47.07mm on the right & between 34.74 and 47.15mm on the left with p value < 0.001.

Besides this the 3 "misses" (1 ant. & 2 post.) of right IJV there was no corresponding "miss" on the left side.



Graph-1 :- RESULTS OF SUCCESS (HITS) & FAILURE (MISSES) OF VENOUS PUNCTURE THROUGH VARIOUS APPROACHES

- HIT Successful insertion of needle in vein
- MISSES Failure of insertion of needle into vein
- ARIJV Ant. Right IJV approach
- PRIJV Post. Right IJV approach
- ALIJV Ant. Left IJV approach
- PLIJV Post. Left IJV approach

Likewise 8 "misses" (4 ant. & 4 post.) on left side there was no corresponding "miss" on the right side.

Also on the right IJV approach either anterior approached missed or posterior approach "missed" and never both, whereas on left side in one case both anterior and posterior approaches both "missed".

A proposed step-by-step procedure for use in the anterior approach for the catheterization of the IJV has been described by Bazara and Harlan (1981)<sup>14</sup>, Edwards and Morgan (1989)<sup>15</sup>, and Chudhari et al. (1998)<sup>1</sup>.

The surface anatomy of the IJV is represented as a broad band from the ear lobe or mastoid process to the medial aspect of the clavicle. Usually the IJV lies posterior to the CCA in the upper part of the neck, but lateral to the CCA as it passes inferiorly (Chudhari et al., 1998)<sup>1</sup>. The IJV lies between the SCM muscle and the cervical pleura. The results support the well known fact that placement of a Central Venous Catheters (CVC), using the anterior approach, into the right IJV is safer than placement into the left IJV. This is mainly due to the position of the right IJV lying immediately posterior to the apex of Sedillot's triangle.

Luckraz, 2003<sup>2</sup> and Schummer et al., 2003<sup>16</sup> stated that although the relation of the IJV varies, the use of the apex of Sedillot's triangle combined with the use of ultrasound could lower the risk of puncturing the wrong vessel, whilst malpositioning of the catheter could greatly be reduced.

Conz et al., (1997)<sup>17</sup> showed that the exact location, size, and patency of the IJV can be determined with the use of ultrasonography and this can reduce possible complications.

## CONCLUSION

From this study and the accompanying results, it can be concluded that the anterior IJV approach for CVC seems to be a reliable technique from an anatomical point of view when compared with posterior IJV approach. The overall success rate is more for the right sided anterior IJV approach.

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