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Ultrasound Guided Measurement of Change in Right Internal Jugular Vein Diameter in Various Body Positions - An Observational Study.

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ABSTRACT
INTRODUCTION :*The right internal jugular vein is most commonly preferred for securing central venous access. The traditional method of using anatomic landmarks to guide cannulation of right internal jugular vein have yielded various rates of successful access and complications. Thus, ultrasound has been applied to describe the anatomy of the IJV and to evaluate various techniques for percutaneous cannulation. However this facility may not be available in many centres because of the cost. Hence this study is conducted to identify the ideal posture in landmark guided RIJV cannulation.*
OBJECTIVE :*The objective of our study is to establish the optimal position resulting in the largest RIJV diameter, thereby increasing the first pass success rate of IJV cannulation.*
METHODS :*An observational study was conducted in 100 volunteers in the Department of Anaesthesiology, CMCH Coimbatore after obtaining approval from the Institutional Ethical Committee. Patients with ASA group I & II, of either sex and in the age group of 20-50 years were included in the study. A 2D Ultrasonography machine 7.5 MHz, was used to measure the lateral diameter of RIJV in different body positions,4 cm lateral to the cricoid cartilage. The variation in the diameter of RIJV was observed in supine with head on the table, supine with head on the pillow, 15^{o}Trendelenburg along with head on a pillow and 15^{o}Trendelenburg with head on a pillow along with palpation of carotid artery.*
RESULTS :A*ll the 100 volunteers participated in the study. There was a significant increase in the mean diameter of RIJV in 15^o Trendelenburg position along with head on a small pillow, when compared to supine position. The mean diameter of RIJV had significantly reduced on palpation of carotid artery.*
CONCLUSION :*From this study we concluded that the optimal position for IJV cannulation may be achieved by positioning the subject in supine, head on the pillow and rotated to opposite side with 15^o Trendelenburg tilt of the table and avoiding carotid artery palpation.*
KEYWORD: *RIJV- right internal jugular vein , 2D- 2 dimensional , various body position, USG- ultrasound guided.*

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I. INTRODUCTION :

The jugular and subclavian venous routes have become increasingly popular for establishing central venous access. The right internal jugular vein is commonly preferred for securing central venous access, and success of cannulation shows a positive correlation with veins diameter.

Cannulation of IJV was first described in 1969. The traditional methods of using anatomic landmarks to guide the cannulation of the right internal jugular vein (RIJV) have yielded various rates of success access and complications.

A variety of manoeuvres and different body positions have been used in the past to maximize the RIJV diameter for increasing the success rate of cannulation and to decrease complications. Of these Realtime Ultrasonography has gained a good success rate.

Ultrasound has been applied to describe the anatomy, size of IJV and its anatomical relations for percutaneous cannulation. These features make this instrument a useful tool to study various body positions which maximize IJV diameter, thereby increasing the first pass success rate of RIJV cannulation.

II. AIM & OBJECTIVE :

The objective of our study is to establish the optimal position that maximizes the RIJV diameter, thereby increasing the first pass success rate of IJV cannulation.

III. METHODS :

An observational study was conducted in 100 volunteers in the Department of Anaesthesiology, CMCH Coimbatore after obtaining approval from the Institutional Ethical Committee.

Patients with ASA group I & II, of either sex and in the age group of 20-50 years were included in the study. Volunteers with any of the following conditions like previous neck surgeries, cervical spine deformities, post burn contracture of the neck, neck swellings and obese patient with short neck were excluded in the study. Base line values of heart rate and blood pressure were noted.

A 2D Ultrasonography machine 7.5 MHz, was used to visualize the transverse axis with the linear probe, 4 cm lateral to the cricoid cartilage. The surface marking of the apex of the triangle formed by the two heads of the sternocleidomastoid muscle was marked and the lateral diameter of the right internal jugular vein was measured at this point in the following four positions.

P_1 – Table flat, subject supine, with head on the table and rotated contralaterally.
P_2 – Table flat, subject supine, with head on a small pillow and rotated contralaterally.
P_3 – 15^0 Trendelenburg tilt, subject supine, head on a small pillow and rotated contralaterally.
P_4 – 15^0 Trendelenburg tilt, subject supine, head on a small pillow, rotated contralaterally along with palpation of carotid artery.

Head in neutral(midline) position was defined as having the subject's sagittal plane perpendicular to the floor. The operator can reasonably approximate 45^0 rotation angle without needing any tools. Table flat means patient positioned with no tilt.

Carotid artery was palpated gently by another operator with the left hand from the head end so as to stimulate the real cannulation technique. A 8 cm height pillow was used. The lateral diameter of the IJV in millimetres was measured because we assume that the increase in lateral diameter decreases the chance of hitting the carotid artery.

The ultrasound probe was held in a horizontal position directed 30^0 caudal. The probe was held on the skin with minimal pressure to limit neck vessel compression. The mean of the higher 2 of the 3 measurements was taken with accuracy up to 0.1 mm.

Considering a difference in IJV diameter of 2.5 mm between two positions as clinically significant and for an alpha value of 0.05. we included 100 volunteers and the results were analysed using unpaired Student's T test, a $p<0.05$ was considered statistically significant. Karl Pearson's correlation test was applied for correlation.

IV. RESULTS :

All the 100 volunteers participated in the study.

1. The RIJV diameter significantly improved in position P2 when compared with position P1($p<0.005$). Hence a small pillow under the head increases the RIJV diameter.
2. The RIJV diameter significantly improved in position P3 when compared with position P2, (p value<0.000) i.e. a 15^0 Trendelenburg tilt of the table, subject supine, with the head on a pillow and rotated contralaterally significantly improved when compared to without tilt.
3. The diameter again decreased in position P4(15^0 Trendelenburg tilt, subject supine, head on a small pillow, rotated contralaterally along with palpation of carotid artery), when compared to position P3(15^0 Trendelenburg tilt, subject supine, head on a small pillow and rotated contralaterally).
4. So carotid artery palpation could reduce the RIJV diameter.
5. The data showed that there was no significant difference between either sex with respect to diameter of RIJV in different positions ($p>0.05$). Age in both the sexes was comparable.

Figure :P 1

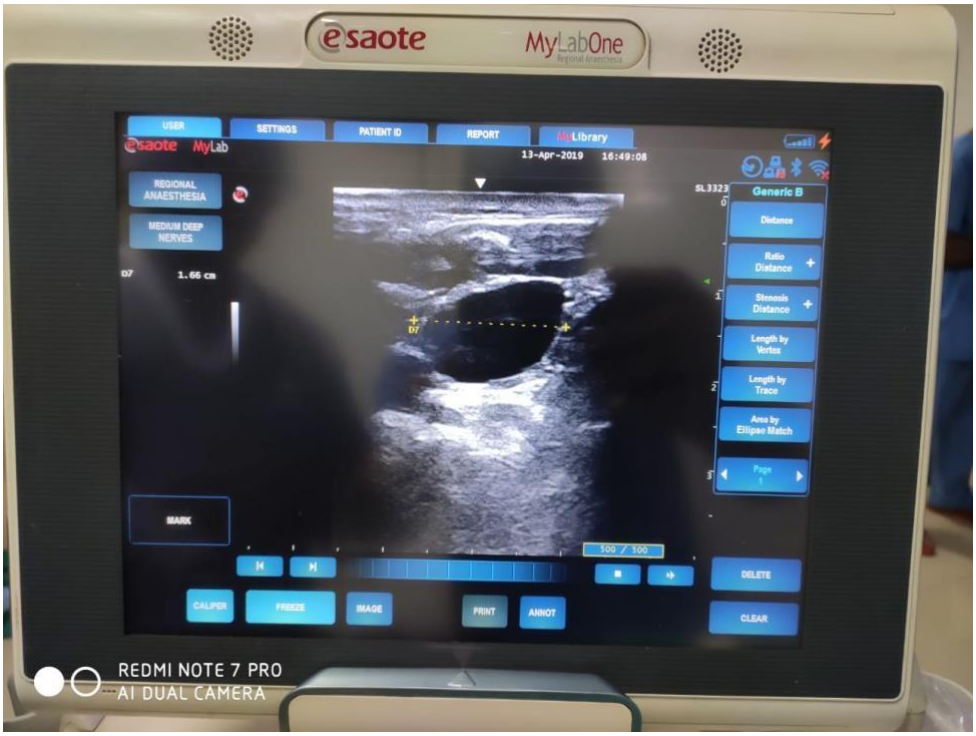

Figure : P2

Figure :P3

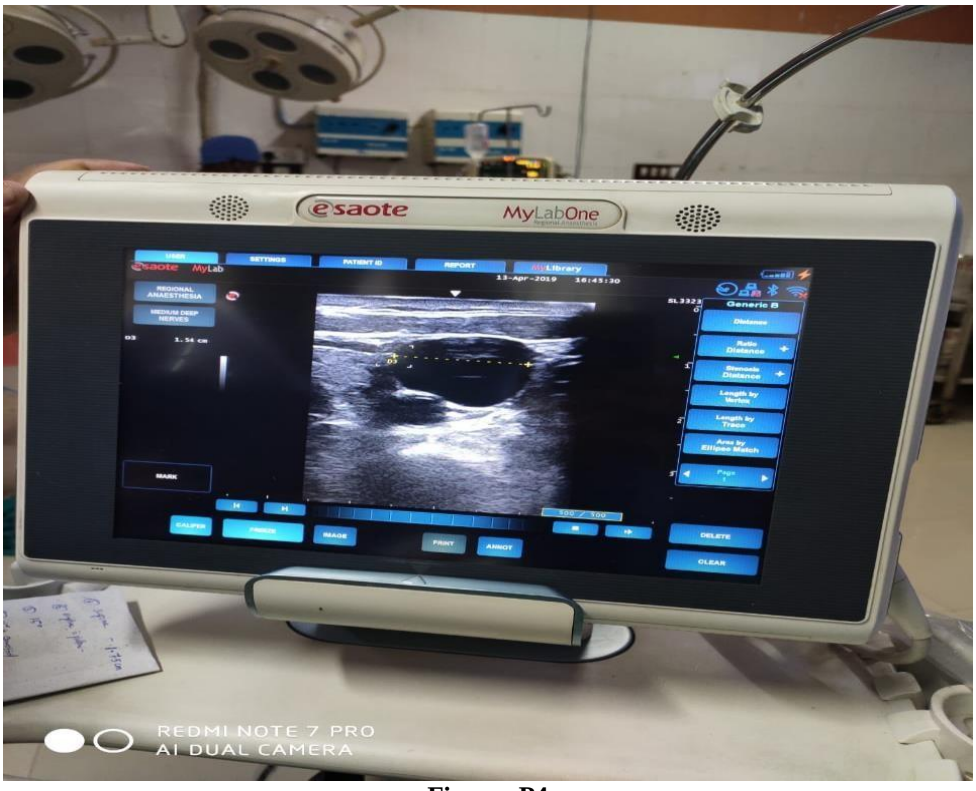

Figure :P4

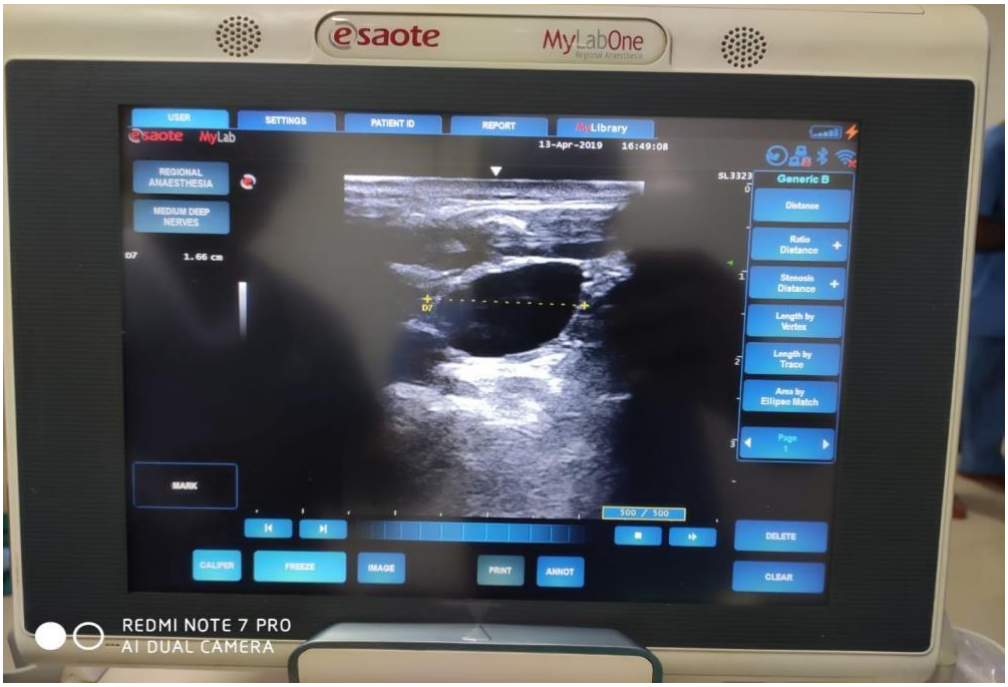

Table no.1: Demographic data of the participants.

Independent Variables	**Mean ± SD**
Age(yrs)	**30.38 ± 8.70**
Weight(kgs)	**58.20 ± 9.32**
Height(cms)	**158.72 ± 10.60**

Table no. 2: Mean RIJV diameter in various positions.

Sl.no.	**Position of subject**	**Mean ± SD (diameter in mm)**
P_1	Table flat, subject supine, with head on the table and rotated contralaterally.	**15.7 ± 2.02**
P_2	Table flat, subject supine, with head on a small pillow and rotated contralaterally.	**16.2 ± 2.34**
P_3	15^0 Trendelenburg tilt, subject supine, head on a small pillow and rotated contralaterally.	**18.2 ± 2.71**
P_4	15^0 Trendelenburg tilt, subject supine, head on a small pillow, rotated contralaterally along with palpation of carotid artery.	**15.2 ± 2.63**

Table no.3: relationship between age, weight and height with RIJV diameter in different positions P1 to P4 (Karl Pearson's coefficient(r)).

	P_1	**P_2**	**P_3**	**P_4**
Age	**0.124**	**0.0627**	**0.0019**	**0.0257**
Weight	**0.0270**	**0.0619**	**0.0579**	**0.087**
Height	**0.1568**	**0.1205**	**0.1913**	**0.1579**

V. DISCUSSION :

Central venous access for both surgical procedures and non surgical reasons has become a valuable adjunct to patient care. Placement of central venous catheter via right internal jugular vein has become one of the most popular routes. The internal jugular vein cannulation is commonly performed procedure in the practice of anaesthesiology.

External anatomical landmarks have traditionally been used to approximate the location of the neck blood vessels to optimise IJV cannulation. Although there are many effective methods to achieve IJV cannulation, there are very few quantitative data that identify the optimal position for successful placement.

Though the visual surface landmarks to guide cannulation were found to be clinically reliable and safe, it is associated with complications like carotid artery puncture, hematoma, pneumothorax and haemothorax.

Carotid Artery puncture is most frequently encountered complication. The risk is increased in association with several characteristics like

Abnormal patient anatomy (obesity, local scarring)

Emergency clinical setting

Co morbidity

Operator inexperience

Improper positioning

The best cannulation approach is often a point of controversy and supporting arguments are not often based on data. The variables in the control of anaesthesiologist include the patient position, amount of head rotation to the contralateral side, the degree of Trendelenburg tilt of the table and point of entry of needle.

A variety of manoeuvres and body positions were used in the past to maximize the RIJV diameter. It has been shown that the larger the diameter of the RIJV , the more likely one is to achieve first pass cannulation. In our study the dependent variables are pillow, Trendelenburg position, carotid artery palpation. In the study height, weight, age and sex did not influence the diameter of RIJV. These findings are consistent with previous studies.

In position P1 i.e. Table flat, subject supine, with head on the table and rotated contralaterally, the mean RIJV diameter was 15.7 mm which increased to 16.2 mm on placing a small pillow under the head. The observations made in our study agree with the findings of a study conducted on 21 volunteers , where in the diameter of RIJV significantly rose from 14.2

mm to 15.2 mm on placing a pillow. Many authors recommend the use of pillow as it cause slight flexion of neck which may allow for relaxation of neck musculature and reduced anxiety.

On placing the subject on 15 degree Trendelenburg tilt with head on a pillow and rotated contralaterally there was a significant increase in diameter compared to that of table in flat position P2 and P3. The Trendelenburg position has been shown to distend the IJV due to increase in venous pressure. A similar increase in diameter of IJV was seen in previous studies.

Even 10 degree tilt is efficient and more than 25 degree is of little help.

Traditionally carotid artery is palpated during cannulation which guides the direction of the needle and avoid inadvertent puncture of carotid artery during IJV cannulation. In our study a significant reduction in diameter of RIJV was observed while palpating the carotid artery in position P4 on comparing with P3. Palpation of the carotid artery exerts pressure over IJV and compresses it. There is mounting evidence of literature that carotid artery palpation reduces the IJV diameter.

VI. CONCLUSION :

From this study we concluded that the optimal position for IJV cannulation was achieved by positioning the subject in supine, with 15^{o} Trendelenburg tilt of the table, head on the pillow and rotated to opposite side. Carotid artery palpation should be avoided during cannulation.

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