"A COMPARISON OF CENTRAL VERSUS POSTERIOR APPROACH TO INTERNAL JUGULAR VEIN CANNULATION- A ONE YEAR HOSPITAL BASED RANDOMISED CONTROLLED TRIAL"

By

REG NO.BA0117002

Dissertation

Submitted to the
KLE Academy of Higher Education & Research
(Deemed University) Belagavi, Karnataka
In Partial Fulfillment
of the requirements for the degree of

M. D.
in
ANAESTHESIOLOGY

DEPARTMENT OF ANAESTHESIOLOGY,
JAWAHARLALNEHRUMEDICALCOLLEGE,
BELAGAVI, KARNATAKA

APRIL– 2020

KLE Academy of Higher Education & Research
(Deemed University) Belagavi, Karnataka

ENDORSEMENT

This is to certify that the dissertation entitled **"A COMPARISON OF CENTRAL VERSUS POSTERIOR APPROACH TO INTERNAL JUGULAR VEIN CANNULATION- A ONE YEAR HOSPITAL BASED RANDOMISED CONTROLLED TRIAL"** is a bonafide research work done by **REG. NO. BA0117002**

DR. RAJESH MANE M.D.DNB
Professor and Head of the Department,
Department of Anaesthesiology,
J. N. Medical College,
Nehru Nagar, Belagavi – 10

Date:
Place: Belagavi

Dr. (Mrs) N.S Mahantshetti MD(paed)
Principal,
J. N. Medical College,
Nehru Nagar, Belagavi – 10

Date:
Place: Belagavi

JAWAHARLAL NEHRU MEDICAL COLLEGE

(A constituent unit of KLE Academy of Higher Education & Research Deemed-to-be University)
Accredited 'A' Grade by NAAC (2nd Cycle) Placed in Category "A" by MHRD (GoI)
Nehru Nagar, Belagavi-590 010, Karnataka-India

Website : http/www.jnmc.edu
E-Mail : Principal@jnmc.edu

☎ Office :+91-(0)831 2471350
FAX :+91 (0)831-2470759

Ref. No. : MDC/PG/2288 Date : 20/03/19

To,

REG NO.BA0117002
Postgraduate Student,
Department of Anesthesiology,
2017-18 Batch,
J. N. Medical College,
Belagavi.

Sub: Acceptance Letter

Sir/Madam,

The softcopy of thesis entitled "A COMPARISON OF INTERNAL JUGULAR VEIN CATHETERIZATION, CENTRAL VERSUS POSTERIOR APPROACH – A ONE YEAR HOSPITAL BASED RANDOMIZED CONTROLLED TRIAL" has been submitted for Anti-Plagiarism check through Turnitin software. The scan has been carried out and the scanned output reveals a match percentage of 6% (Six percentage) which is within the acceptable limits of 10% as per the guidelines given by UGC.

Thanking you,

Yours sincerely,

Coordinator
Department of Anesthesiology,
J. N. M. C. Belagavi.

Guide.

Chairman,
Antiplagiarism Committee

Dr. Chaitanya A. Kamat
Consultant Anaesthesiology
KMC Reg.No.-85590

Dr. Kedareshvara K.S.
Consultant Anaesthesiology
KMC Reg.No..52409

KAHER BELAGAVI J.N. MEDICAL COLLEGE

ACKNOWLEDGEMENT

Today, I take this opportunity to express my deep gratitude to my guide and teacher **DR.KEDARESHVARA.K.S** M.D.PDCC*Professor, Department of Anesthesiology, J. N. Medical College, Belagavi for his continuous supervision, able guidance, valuable suggestions and unparalleled encouragement provided to me throughout the course of this study. Without his immense professional insight and guidance, it would not have been possible for me to complete this dissertation.*

My sincere thanks to ***DR. RAJESH MANE*** ***M.D. DNB****Professor & Head, Department of Anesthesiology, J. N. Medical College, Belagavi for his constant motivation and invaluable guidance.*

*I take this opportunity to thank Professors****Dr. C. S. Sanikop****M.D,DA****, Dr. S. N. Suresh*** ***M.D,DA,*** ***Dr.VandanaGogate****M.D,DNB,****Dr. M.G Dhorigol*** ***M.D,****Dr.Manjunath C. Patil*** ***M.D,*** *Associate Professors****Dr.ChaitanyaKamat.*** ***M.D,DA,*** ***Dr MahanteshMudakangoudar*** ***M.D,*** *Assistant Professors****Dr.ShreedeviYenni****M.D,****Dr.VinayakJannu****M.D,*** ***Dr.GuruprasadShetty****M.D,* ***Dr.PavanDhuleked****M.D,*** ***Dr. Ravi Kerur****M.D,*** ***Dr.PurvashreeDeshmukh*** ***DA,DNB,*** ***Dr.MeghanaHanagandi****DNB,*** ***Dr NikithaKalyanshetti****M.D,*** ***Dr ManjunathShivpujimath****M.D,*** ***Dr PriyankaGadvi*** ***DA,DNB,****Dr.RaghavendraKalal****M.D* *and****Dr SnehaChikkodi*** ***DA,DNB*** *for their kind support.*

I express my sincere gratitude to ***Dr.(Mrs) Niranjana S Mahantshetti****MD,* *Principal, J. N. Medical College, Belagavi,* ***Dr. M. V. Jali****MD,* *Medical Director and Chief Executive, KLES Dr. Prabhakar Kore Hospital and Medical Research Centre, Belagavi for allowing me to utilize the facilities in above institution for the dissertation.*

I sincerely thank ***Dr.AnandVagarali**$_{MD}$*, ***Dr.SharanPatil** $_{MD}$, and all other teachers of J. N. Medical College, Belagavi for their kind support and timely help during the study.*

I wish to offer my thanks to ***Mr.Dr.K.P.Suresh, Scientist (Biostatistics),*** *for the statistical analysis.*

I sincerely thank ***Mrs.Akkamadevi*** *and* ***Mr.ShivanandHattarki****, Department of Anesthesiology, J. N. Medical College, Belagavi for their support and assistance throughout the period of study.*

I take this opportunity to thank my greatest assets, my mother ***Mrs.Anita Chopda,*** *my brother****Mr. Karan Chopda*** *and my uncle* ***Mr. Mahesh Chopda*** *who are the pillars of my strength and achievements.*

I sincerely thank all my post graduate ***Colleagues*** *and* ***Friends*** *for their valuable support and suggestions in completing this study. Special thanks to****Dr Karthavya**$_{DA}$*, ***Dr TejaswiniGowda*** *and* ***Dr NehaPadia*** *for their assistance throughout my study.*

This would have not been possible without the co-operation and understanding of my patients involved in this study. I also thank the authors of numerous publications whose knowledge have been freely utilized in the preparation.

Finally, I thank ***Almighty*** *for all the blessings.*

Date:

Place: ***Dr.NEERAJ CHOPDA***

ABBREVIATIONS

aPTT	-	Activated partial thromboplastin time
ASA	-	American society of Anesthesiologists
BP	-	Blood Pressure
CCA	-	Common carotid artery
cm	-	centimeter
CPR	-	Cardio-pulmonary resuscitation
CVC	-	Central venous catheter
CVP	-	Central venous pressure
DVT	-	Deep vein thrombosis
ECG	-	Electrocardiography
EJV	-	External jugular vein
Fr	-	French scale
Hb%	-	Hemoglobin percent
HR	-	Heart Rate
ICA	-	Internal carotid artery
IJV	-	Internal jugular vein
INR	-	Internationalized normalized ratio
IV	-	Intravenous
kg	-	kilogram
LA	-	Local anesthetic
PCWP	-	Pulmonary capillary wedge pressure
pH	-	measure of the hydrogen ion concentration of a solution
PICC	-	Peripherally inserted central venous catheter
PT	-	Prothrombin Time

RR	-	Respiratory Rate
SCM	-	Sternocleidomastoid muscle
SpO2	-	Peripheral capillary oxygen saturation
SVC	-	Superior vena cava
Temp	-	Temperature
USG	-	Ultrasonography

ABSTRACT

TITLE:

"A COMPARISON OF CENTRAL VERSUS POSTERIOR APPROACH TO INTERNAL JUGULAR VEIN CANNULATION- A ONE YEAR HOSPITAL BASED RANDOMISED CONTROLLED TRIAL"

Background:

Among the different large veins that can be cannulated the right internal jugular vein (IJV) is most preferred. Cannulation of the right IJV is most commonly done using the landmark guided central approach. It is associated with a higher risk of carotid puncture. In this context the posterior approach has been found to be better and safer.

Objective:

To compare the placement of an internal jugular central venous catheter via central versus posterior approach in terms of attempts and time to locate the vein, duration of cannulation and complications.

Methods:

A total of 120 adult patients were divided into two groups of 60 each to be cannulated by either the central or the posterior approach. Central approach the needle entry was at the apex of the sedilott's triangle towards the ipsilateral nipple while in the posterior approach entry was along the lateral border of sternocleidomastoid muscle where it is crossed by the external jugular vein directed towards the sternal notch.

Success rate and time taken to locate IJV, time taken for cannulation, number of carotid punctures and other complications were assessed.

Results:

Our analysis showed that in the posterior approach group the vein was located faster (12.04±1.49s vs 14.27±2.30s, p<0.001) and with fewer attempts (51(85%) vs 42(70%), p=0.054), both statistically significant. The duration of cannulation was also shorter with the posterior approach (205.54±29.58s vs 278.51±41.14s, p<0.001). Arterial punctures were more with the central approach (13 vs 3, p<0.001), instances of hematoma and catheter malposition were not statistically significant and no instances of pneumothorax were observed.

Conclusion:

The posterior approach has a higher first attempt success rate, shorter duration of cannulation and lower incidence of complications. It is a viable and efficient alternative to the central approach but involves a small learning curve.

Key words: Central venous catheter, Internal jugular vein, Posterior approach, Central approach.

CONTENTS

LIST OF FIGURES

LIST OF TABLES

LIST OF GRAPHS

LIST OF PHOTOGRAPHS

INTRODUCTION

Establishing a central venous access has been experimented from the 19th century and refined over the years and in the last 60 years has become safer for both the patient and the anaesthesiologist.[1,2,3] Fast forward to the present and ultrasound guided placement of central venous cannula using the seldinger's technique has now become a standard of care, to improve the success rate and reduce the complications.[4,5]

In the day to day practice securing a good intravenous access has increasingly become one of the most important interventions for an anaesthesiologist, this is required for not only administering fluids and drugs but also as a monitoring aid.[6] A central venous cannula is also used for dialysis.

Among the different large veins that can be cannulated the most commonly selected is the right internal jugular vein, for its straight course to the right side of the heart, lack of valves, mostly predictable anatomy and ease of cannulation.[6–9]While ultrasound guided placement is ideal[10] not all institutions have the equipment, hence even today a majority of the central venous catheters are placed based on the traditional landmark guided approaches.[11,12]

To secure a cannula in the right internal jugular vein, one can use one of many approaches.While each approach has its merits and demerits, the onus falls upon us to find out the best approach to minimize the complications inherent to the landmark based approaches.

The cannulation is mostly performed using the central or landmark approach, i.e. at apex of triangle formed by the two heads of sternocleidomastoid. This approach is easier for beginners to learn and hence popular but carries a higher risk of carotid puncture, haematoma formation and pneumothorax.[13,14,15]

Comparatively the posterior approach i.e. behind the lateral border of sternocleidomastoid, is practiced less frequently but in a few studies has been found to be a better approach than the standard central approach with fewer incidences of complications and easier access to the vein.[13]

The study was undertaken to compare the above two approaches and find out if indeed the posterior approach is better than the central approach in securing the internal jugular vein on the right side.

AIMS & OBJECTIVES

To compare the placement of an internal jugular central venous catheter via central versus posterior approach in terms of

1. Success

- Time taken to locate the vein.
- Number of attempts/punctures to locate the vein.
- Duration of cannulation.

2. Complications

- Arterial puncture.
- Haematoma.
- Pneumothorax.
- Catheter displacement.

BASIC SCIENCES

Anatomy of the Internal Jugular Vein

Blood vessels carrying deoxygenated blood to the heart are called veins. They form a network all over the body to collect and transport the blood and through these access is established to administer medication and fluids intravenously.

Amongst them one of the largest is the Internal Jugular Vein(IJV). The IJV is a paired venous structure that collects blood from the brain, superficial regions of the face and neck, and carries it to the right atrium.

Embryologically the internal jugular veins are derivatives of the right and left anterior cardinal veins which then along with the common cardinal vein form the SVC.The IJV originates(fig. 1) as a direct continuation of the sigmoid sinus, which is also joined by the superior and inferior petrosal sinuses, it then exits the cranium via the jugular foramen.[16]

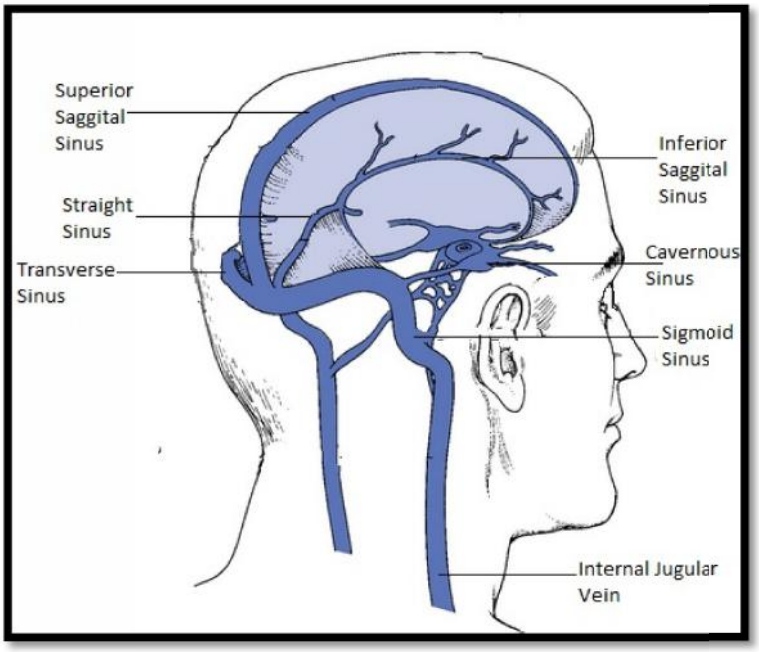


FIGURE 1

At the jugular foramen (fig. 2) it forms a dilatation called as the superior bulb containing a pair of valves. The superior bulb is located in the jugular fossa of the temporal bone and is present in relation to the floor of the middle ear. It is accompanied by the cranial nerves 9, 10 and 11.

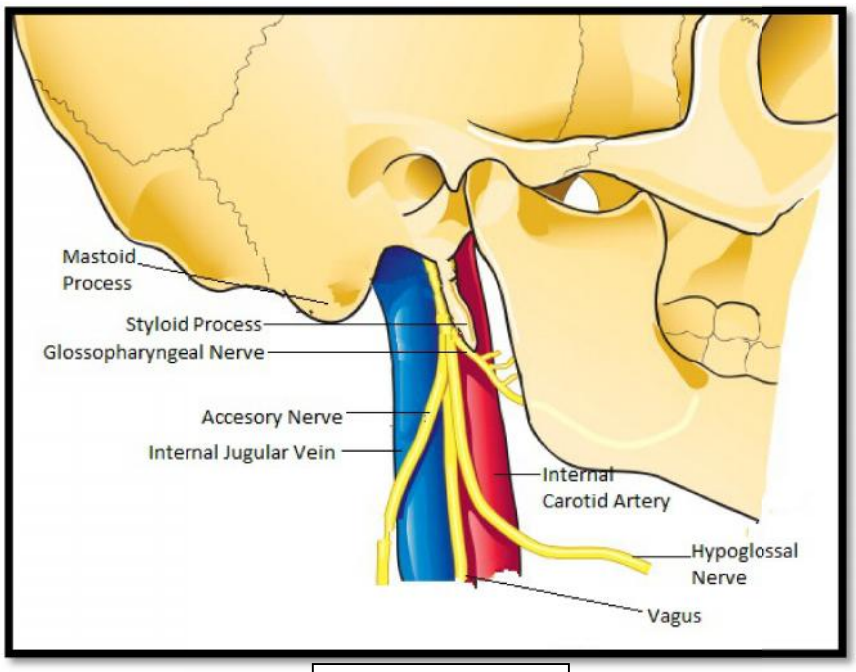


FIGURE 2

The right IJV descends vertically downwards to eventually join the right subclavian vein forming the right brachiocephalic vein at the level of the sterno-clavicular joint and then joining the SVC. Along its course its located lateral to the ICA and CCA, and the vagus(X) nerve. All the three are enclosed in a sheath called the carotid sheath.

At its lower end in the lesser clavicular fossa there is an inferior bulb containing valves.

The left IJV also descends vertically downwards (fig. 3), it then joins the left subclavian vein to form the left brachiocephalic vein at the level of the left sternoclavicular joint. The left brachiocephalic vein then crosses over to the right to

join the SVC at an angle.Thus the left IJV has two bends along its course, also the vein is more medially located along its course than the right side.

As on the right the left also has a superior and inferior bulb.

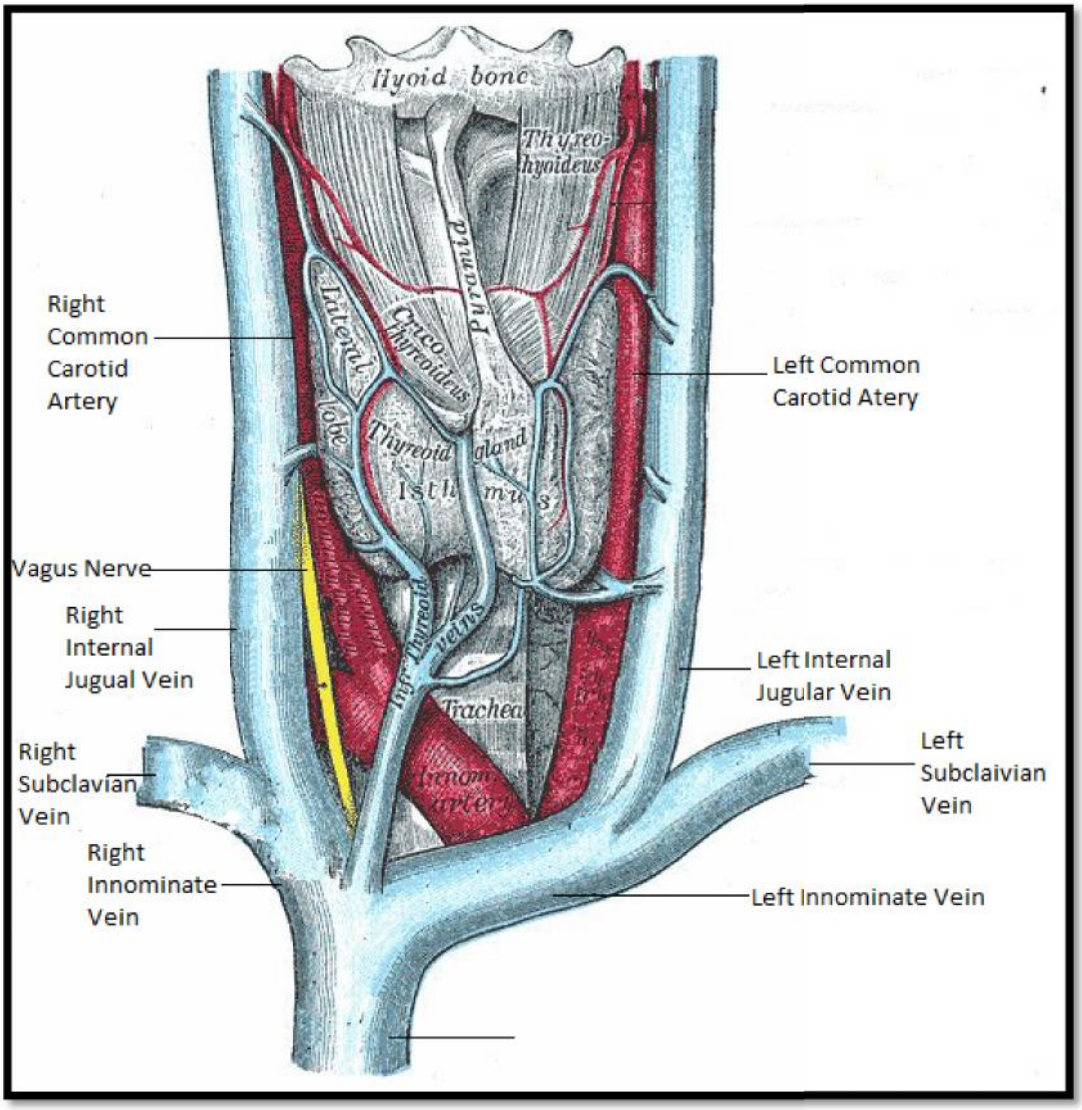


FIGURE 3

Carotid Sheath

It is formed by the condensation of fibro areolar tissue and surrounds the important blood vessels of the neck. Formed anteriorly by pretracheal fascia and posteriorly by the prevertebral fascia (fig. 4)

Contents: IJV, ICA and Vagus nerve.

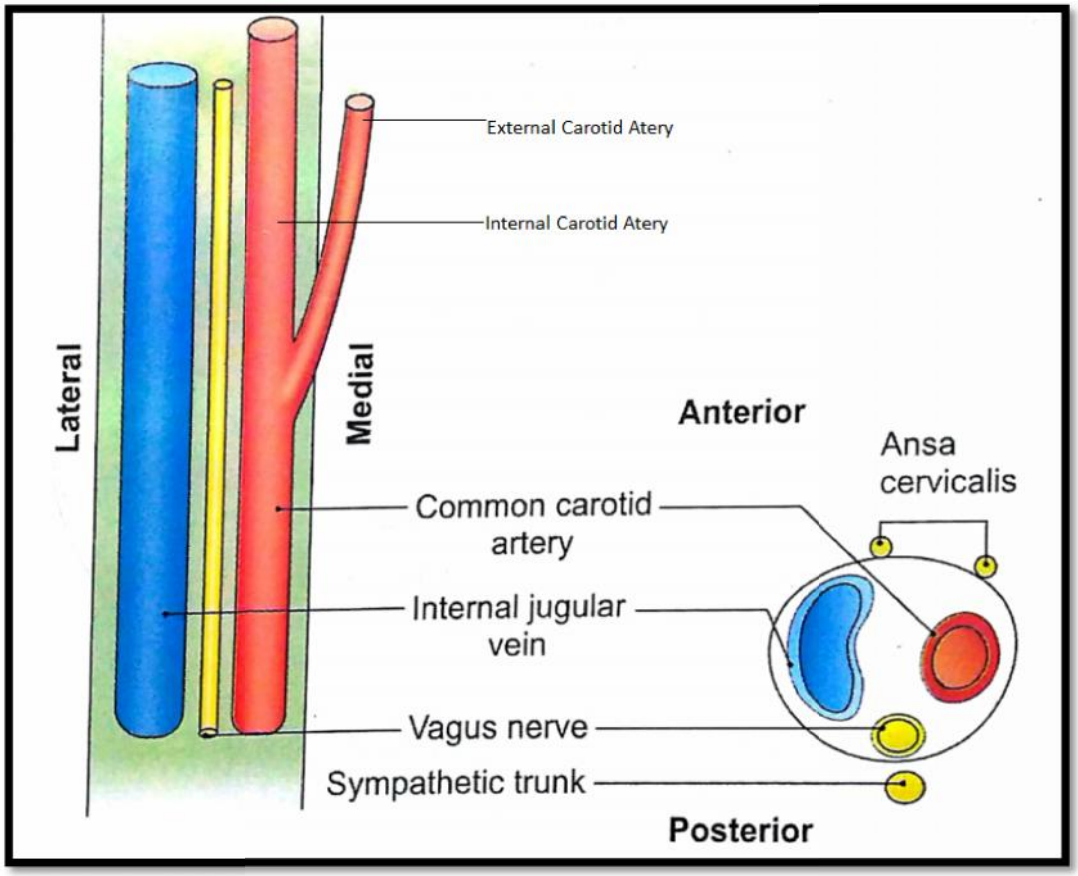


FIGURE 4

Relations of the IJV

It is important to know the structures in relation to the IJV so as to anticipate and avoid complications during the procedure of placing a catheter through it.

It's strikingly steady in position and can be demonstrated superficially by a vertical line drawn from midpoint between the tip of the mastoid process and the angle of the mandible, to the sternoclavicular joint.

The right IJV, at the base of the skull has the CCA located anterior to it, as the veins descends the artery becomes medial to the vein. It is similar on the left side but the left IJV also shifts medially thus is located much closer and sometimes overlapping the common carotid artery.

Superficial

From above downwards (fig. 5):

1. Two muscles :
    - Posterior belly of Digastric (upper part)
    - Superior belly of omohyoid (lower part)
    - Sternocleidomastoid
2. Two arteries
    - Occipital Artery
    - Posterior auricular artery
3. Anterior jugular vein
4. Two Nerves
    - Spinal accessory nerve
    - Ansa cervicalis
5. Styloid process

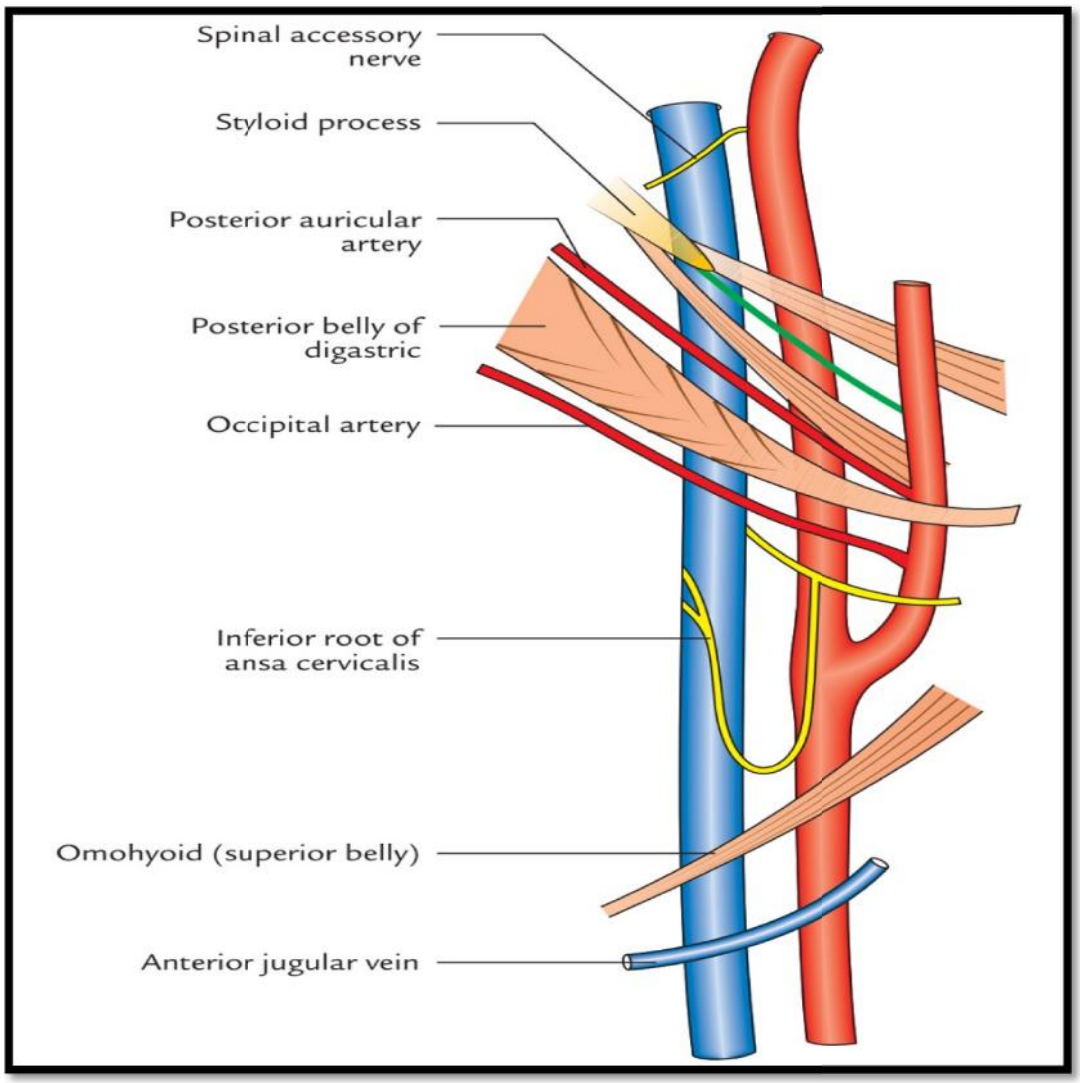


FIGURE 5

Deep relations (fig. 6):

1. Rectus capitis lateralis.
2. Transverse process of atlas.
3. Levator scapulae.
4. Scalenus medius and cervical plexus.
5. Scalenus anterior and phrenic nerve.
6. Thyrocervical trunk and first part of vertebral artery.
7. First part of the subclavian artery.
8. Thoracic duct on the left side.

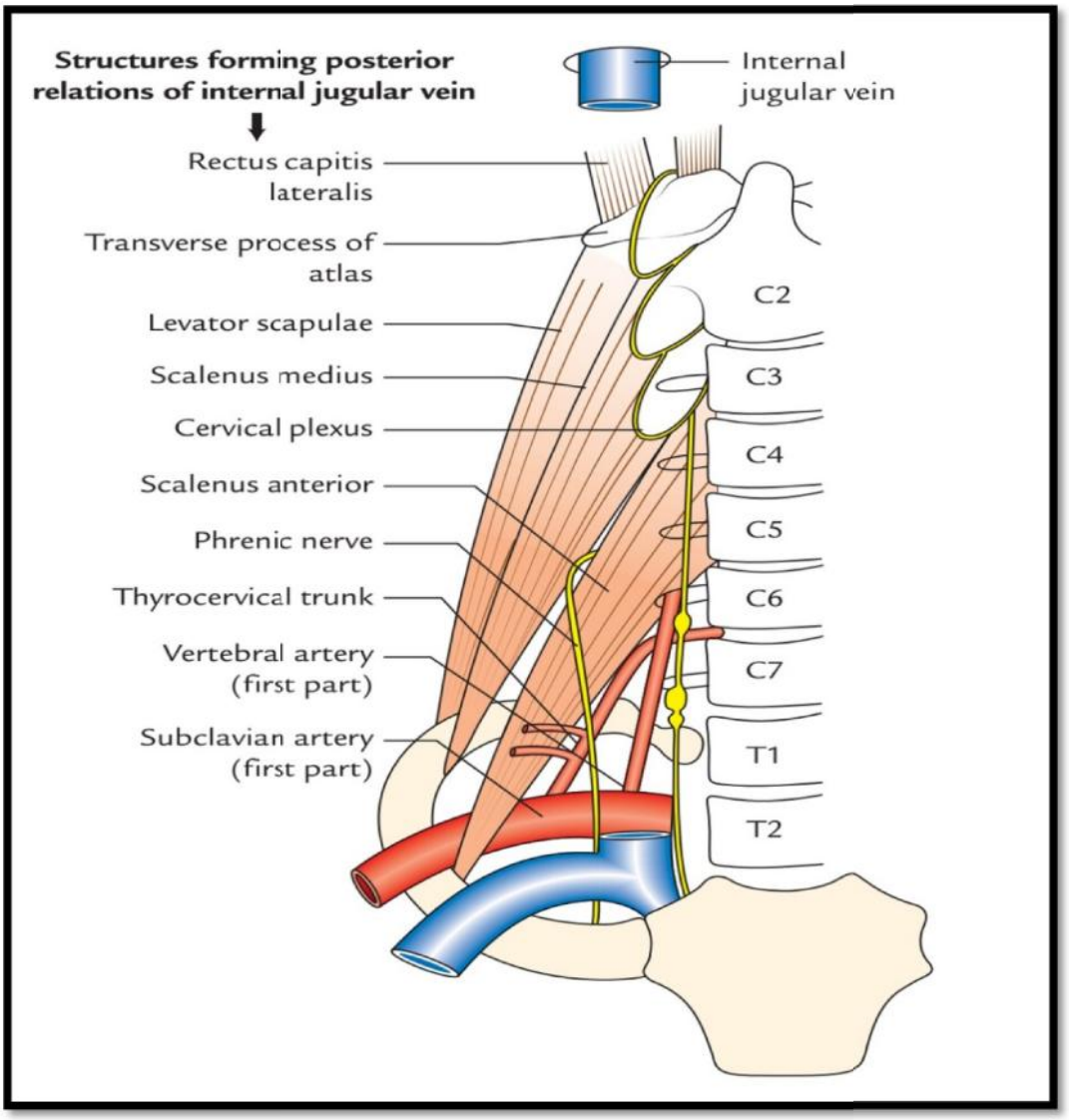


FIGURE 6

Medial

Upper Course:

1. ICA
2. IX, X , XI ,XII cranial nerves

Lower Course:

1. CCA
2. X cranial nerve.

Relevant anatomy

1. **Sternocleidomastoid**

Origin: Two heads

- Manubrium of the sternum
- Clavicle

Insertion: Mastoid process

The two origins of the muscle result in the formation of a triangle between them, with the clavicle as the base (fig. 7). This triangle is called as the sedillot's triangle.The IJV in its course on both sides passes below the apex of the triangle formed by the two heads and hence this is used a landmark for placement of the catheter.

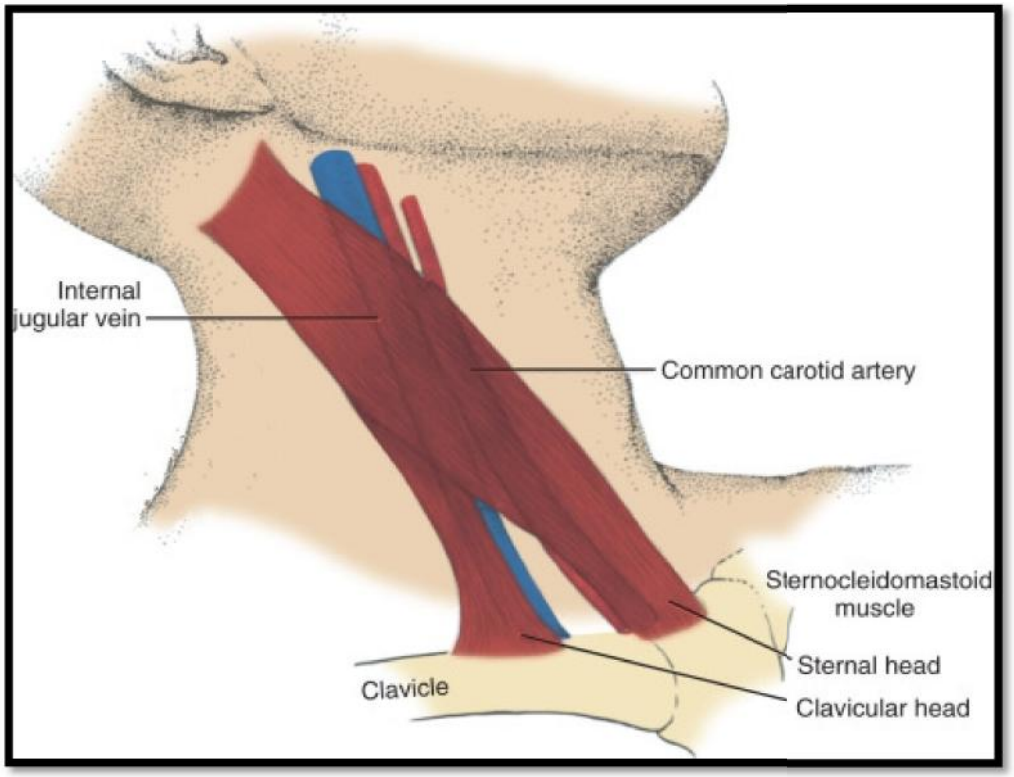


FIGURE 7

2. External Jugular Vein

It originates by the union of the posterior division of the retromandibular vein and the post auricular vein.The vein drains blood from regions outer to the cranium and also from the face.

It begins in the parotid gland, at the level of the angle of mandible and runs at a right angle down the neck on top of the SCM muscle.

It eventually penetrates the deep fascia and terminates in the subclavian vein and has two pairs of valves along its course (fig. 8).

The EJV where it crosses the clavicular head of sternocleidomastoid muscle, a point above that,approximately at the level of the upper border of the thyroid cartilage is also used as a landmark for placement of an IJV catheter in the posterior approach.

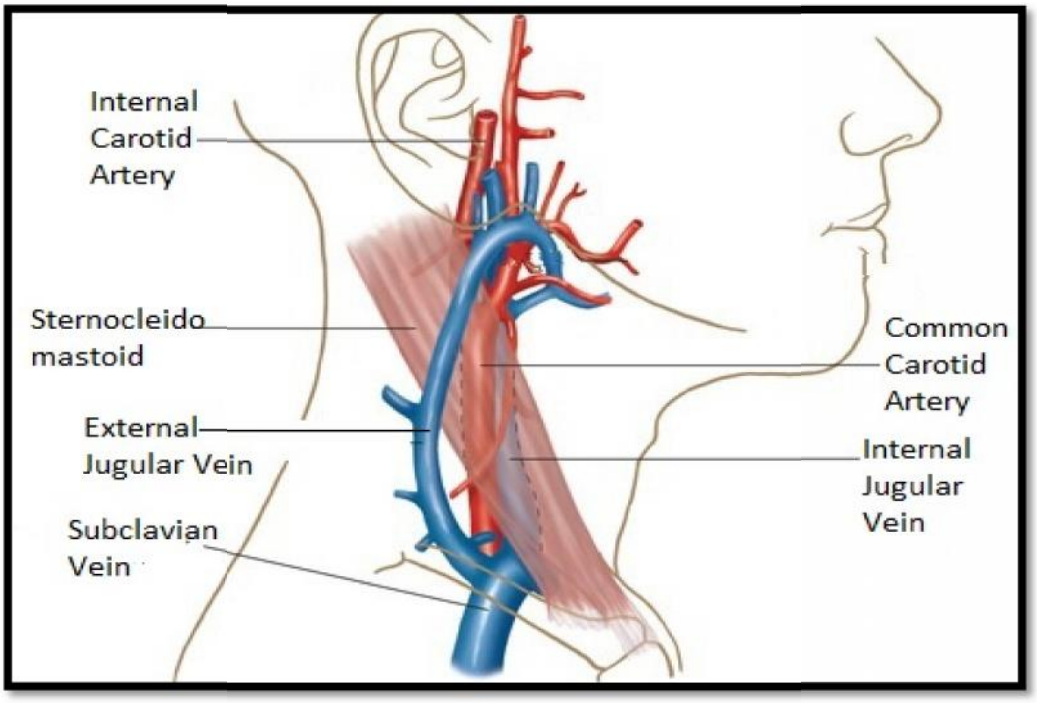


FIGURE 8

Central Venous Cannulation

Central venous cannulation is the placement of a catheter into a large vein of the body such that the tip lies in the proximal superior vena cava/right atrium/proximal inferior vena cava. The tip should lie at the atrio-caval junction as this decreases the incidence of thrombosis since it's an area of high blood flow.

Also called as a central line/central venous catheter.

If maintained correctly and kept free of infection they may be used for long periods of time ranging from weeks to months.

Uses[6,10]

1. Administer drugs
    - Long term medications such as antibiotics /Total parenteral nutrition
    - Chemotherapeutic medications
    - Drugs with high osmolality/low pH they irritate the small peripheral veins eg. Potassium chloride, calcium chloride etc.
    - Vasopressors and inotropes
    - Massive Blood transfusions
2. Therapeutic
    - Haemodialysis
    - Plasmapheresis
    - Extracorporeal membrane oxygenation
    - Cardiac cath procedures
3. Intravenous access
    - Long term or frequent IV access requirement
    - Repeated blood draws for investigations
    - Inability to find peripheral access
4. Monitoring

- CVP
- PCWP

Relative Contraindications to central venous cannulation[10]

- Thrombosed/stenosed vein (e.g. clot)
- Severe coagulopathy/thrombocytopenia
- Infection at site of insertion
- Trauma to site(e.g. clavicle fracture and subclavian line)
- Burn at site of insertion
- Uncooperative awake patient/Patient refusal

No absolute contraindications

Types of central venous cannulas[6]

1. Non tunnelled
2. Tunnelled
    - Semi-implantable
    - Totally implantable
3. PICC[17]

Non Tunnelled Catheters

In this type the catheter exits the skin at the puncture site and is fixed here with non-absorbable sutures (fig.9).

These short duration catheters are made of polyurethane and are usually 20-30cm in length and with calibres up to 8.5Fr. They are placed by the direct puncture of the vein such that tip lies at the atrio-caval junction.

They are meant for continuous use in hospital inpatients only as the catheter is secured with sutures to the skin.

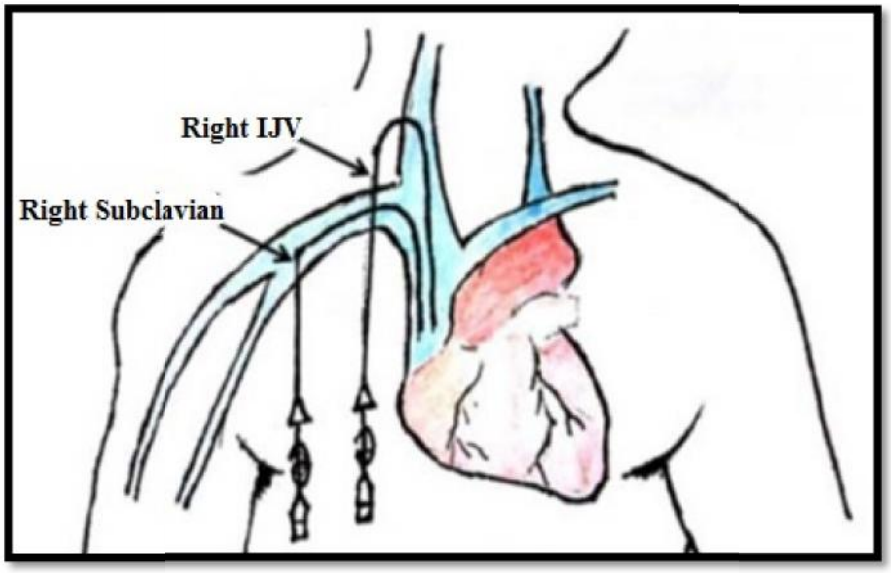


FIGURE 9

Peripherally inserted central venous catheters (PICC)[17]

These are commonly placed through a large peripheral vein in the arm (fig.10), the cephalic and basilic veins such that the catheter enters and its tip lies at the atrio-caval junction.

They are made of polyurethane, are comparatively longer at 50-60cm and up to 5Fr in calibre. Since the calibre is small not meant to be used for large volume resuscitation. Maybe used intermittently to administer drugs/antibiotics and can be kept in situ for weeks to months.

Since it has a long course and exits at the arm, where it is fixed, hence can be kept for use at home also.

PICC lines are easy to place and associated complications are few, in this regard they have become popular means to establish IV access and are often used in children.

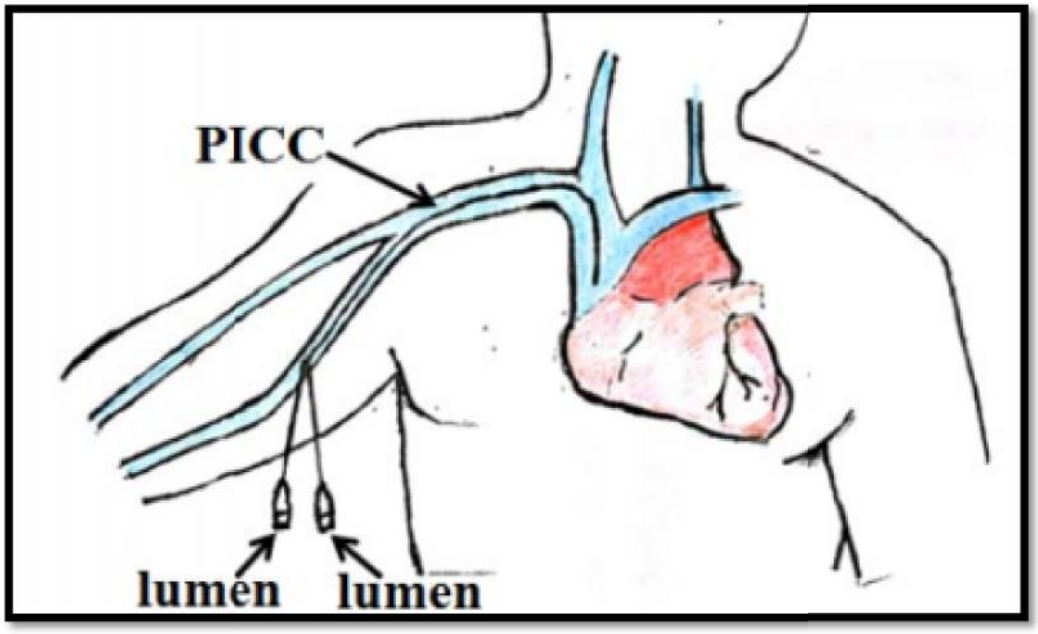


FIGURE 10

Tunnelled Catheter

These flexible catheters are tunnelled underneath the skin for some distance to finally puncture the vein and lie at the atrio-caval junction.

They more durable and maybe kept for much longer as the subcutaneous course provides protection against infections.

Meant for intermittent long term use lasting from months to years. Usually used for chemotherapy.

Routes for central venous access:

Route	Advantage	Disadvantage
Internal Jugular Vein[10]	• Direct straight path to the SVC, less contact with the intima • Consistent anatomical location across the patient population • Easily to apply compression in case of bleeding • Low incidence of pneumothorax • Less incidence of stenosis • Easy to visualize on USG	• Technical expertise required for placement • Uncomfortable for patients as sutures are on the neck • Chances of carotid artery puncture are present • Difficult to insert in hypovolemic patient, difficult even in obese oedematous patient with short neck • Dressing and catheter care is difficult for non-tunnelled catheters. • Difficult to secure in patients with tracheostomies
Subclavian Vein[10]	• More comfortable for patients, who may easily ambulate • Lesser incidence of catheter site infection hence maybe used for longer periods • The vein located attached to the under surface of the clavicle doesn't collapse completely and hence easier to secure in those in shock • Difficult to visualize on USG	• Not a simple procedure, technical expertise is required • Chances of pleural puncture are high • Compression cannot be applied in case of bleeding • Stenosis of the subclavian vein, brachiocephalic vein or SVC tends to occur in up to 50% of the cases • Catheter doesn't have a straight path and hence comes in contact with and damages the intima eventually causing stenosis • Chances of malposition also are high

Femoral Vein[10]	• Fast and simple • In many institutions it is a nursing procedure • Good for acute situations • No risk of pneumothorax • Can be inserted during CPR	• Arterial puncture is the most common complication as a result of the variable position of the femoral vein in relation to the femoral artery • Migration of micro-organisms from the groin, which invariably reach the blood stream within days • Cannot be kept in ambulating patients as there a risk of vein wall puncture • High risk of DVT
Cephalic and Basilic Vein[6]	• Patient comfort • Ease of insertion • Minimal incidence of complications • Can be kept in-situ for prolonged periods • Lesser incidence of catheter related infection	• Cannot be placed in all patients , require good peripheral veins • Small calibre hence slower flow rates

Right IJV[10]	Left IJV[10]
• Straight course to the SVC • More reliable anatomical location compared to the left side • Right IJV is larger in diameter and more superficial compared to the left side	• Has two bends along its course ,first where it joins the left subclavian and second where the left brachiocephalic vein joins the SVC • It shifts medially along its course lying close to the left CCA • Smaller in diameter and has a higher frequency of being overlapped by the CCA • There is a chance of injury to the thoracic duct.

Complications associated with central venous cannulation:[6,10,18,19,20]

Immediate

- Failure to cannulate
- Arterial puncture
- Local haematoma
- Pneumothorax
- Haemothorax
- Guidewire-induced arrhythmia
- Thoracic duct injury(left)
- Air embolism

Delayed

- Catheter site infection
- Vascular erosion
- Vessel stenosis
- Thrombosis of the vein

Seldinger's Technique[5,10]

The Seldinger technique, is a procedure to achieve safe access to blood vessels & other hollow organs. The technique is named after a Swedish radiologist, Dr. Sven Ivar Seldinger who introduced the technique in 1953.

This technique introduced thenovel idea to gain vascular access using a hollow needle, exchange wire, and catheter.

Uses

- placement of central venous catheters
- insertion of chest drains
- insertion of pacemaker leads or implantable cardioverter-defibrillators
- insertion of percutaneous enterogastrostomy tubes
- digital subtraction angiography

Practically the most of interventional radiological procedures utilize the seldinger's technique for initial vascular access.

The steps (fig.11) are puncture of vein using needle, passage of guidewire, removal of the needle, dilating the subcutaneous tract, insertion of the catheter on the guidewire and finally guidewire removal.

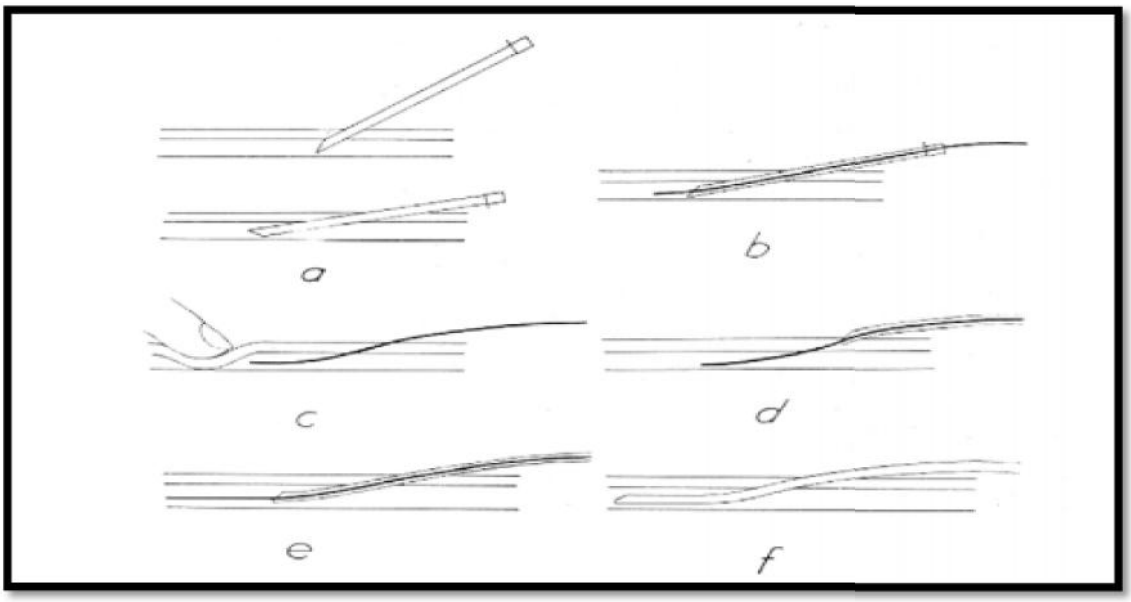


FIGURE 11

Approaches to IJV cannulation(fig.12)[21]

1. Anterior
2. Central
3. Posterior
4. Others

Landmarks (Photograph 1):

- Two heads of Sternocleidomastoid
- External jugular vein
- Clavicle
- Sternal notch

Position: Patient in supine position with head turned 45 degrees to the left in Trendelenburg position to make the IJV more prominent.

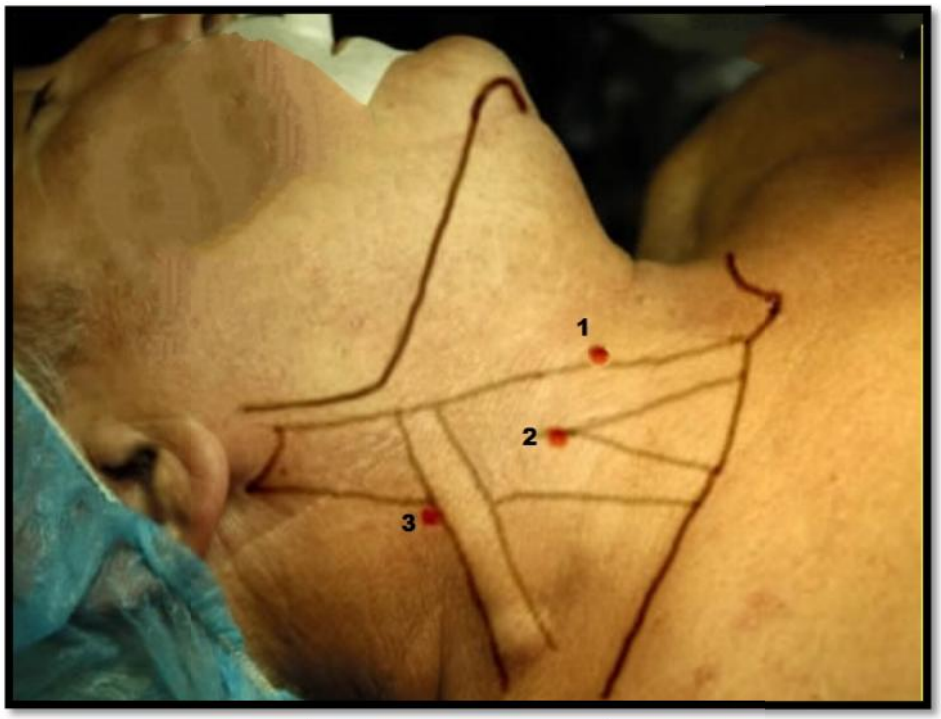


FIGURE 12

1. Anterior

In this approach the carotid artery is palpated along the anterior border of sternal head of sternocleidomastoid.The carotid artery is then pushed medially with one hand while with the other a needle is advanced next to it towards the ipsilateral nipple.Vein is usually located at 2-3cm depth.Chances of carotid puncture are high in this approach.[6]

2. Central

In this approach the point of entry is at the apex of the triangle formed by the two heads of SCM muscle. Under continuous aspiration the needle is introduced at an angle of 30-40°directed towards the ipsilateral nipple, the vein is usually found at around 1-3cm depth.[12,15]

3. Posterior

Point of needle entry in this approach is where the EJV crosses the lateral border of SCM muscle or a horizontal line drawn from the upper border of thyroid cartilage cutting the lateral border of SCM muscle can be considered as a landmark when the EJV is not prominent. Under continuous aspiration the needle is advanced in a direction towards the jugular notch after lifting the bulk of the SCM muscle. Usually the IJV is located at a depth of 2-5cm.[13,22]

4. Others

- Medial transverse approach[23,24]

The needle is introduced into the skin directly above the point where the CCA pulse is felt next to the thyroid cartilage, along the anterior border of the SCM muscle. Use of a small finder needle first is advised. The angle of entry at this point is 70

degrees to the horizontal. Once the vein is identified the needle is turned 20-30 degrees towards the sagittal plane to pass the guidewire.

Once there is aspiration of dark coloured blood then the syringe is disconnected and the guidewire is passed through the needle. The needle is then removed, the subcutaneous dilator followed by the catheter is passed into the IJV.

Device

The central venous catheter from its first inception in 1929 has undergone amazing amount of development.In 1929 a German surgical resident Werner Forrsmann passed a 4Fr ureteric catheter (35cm) via his antecubital vein centrally and confirmed with x-ray the position of the tip in the right atrium. Though in his own country his ideas were rejected and he was fired, in the USA it generated a great deal of interest leading to major development of the catheter.[1]

A new means to study cardiac physiology and its blood supply was opened with the ability to cardiac catheterize, thus giving a major boost to it in the 1950's and 1960's.At the same time the commercial manufacturing and sale of the catheter had begun, it underwent further modifications in terms of its material to reduce inflammation and the design of its tip, from single lumen to multi-lumen for simultaneous administration of incompatible medications and even the larger haemodialysis catheter was developed.

Today millions of patients undergo this procedure to secure an intravenous access. Initially what took off as a landmark based procedure, now after the inception of the USG and the proof of lower failure rates with it, it has been made the standard of care in most institutions.

There are many companies which manufacture the catheter, in our institution the kit available and commonly used is the one manufactured by ARROW.

Catheter:

1. Length and Calibre

They vary from 2inches to 12inches in length

Calibre from 4Fr to 12Fr are available(24G to 16G), for use in paediatrics and adults.

2. Material

Made of polyurethane, the newer models are also coated with antibacterial solutions such as chlorhexidine and silver sulphadiazine.The material is such that the catheter is flexible and doesn't kink and can be easily fixed to the skin in multiple ways.

3. Lumen/Ports

Initially all catheters were only single ports now there are upto 4 port catheters (fig.13) available for administration of 4 different medications simultaneously.

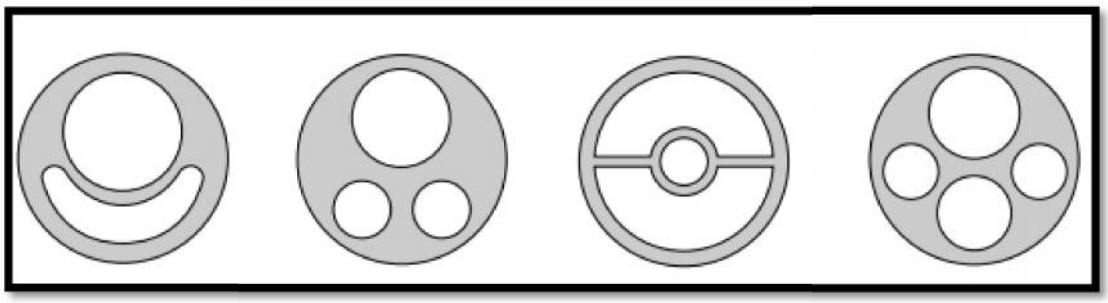


FIGURE 13

4. Kit

The kit consists of all material required for the cannulation (fig.14)

- Puncture needle
- J tip spring guidewire
- Dilators
- Blade
- Catheter
- Newer sets even have suture materials and drapes included.

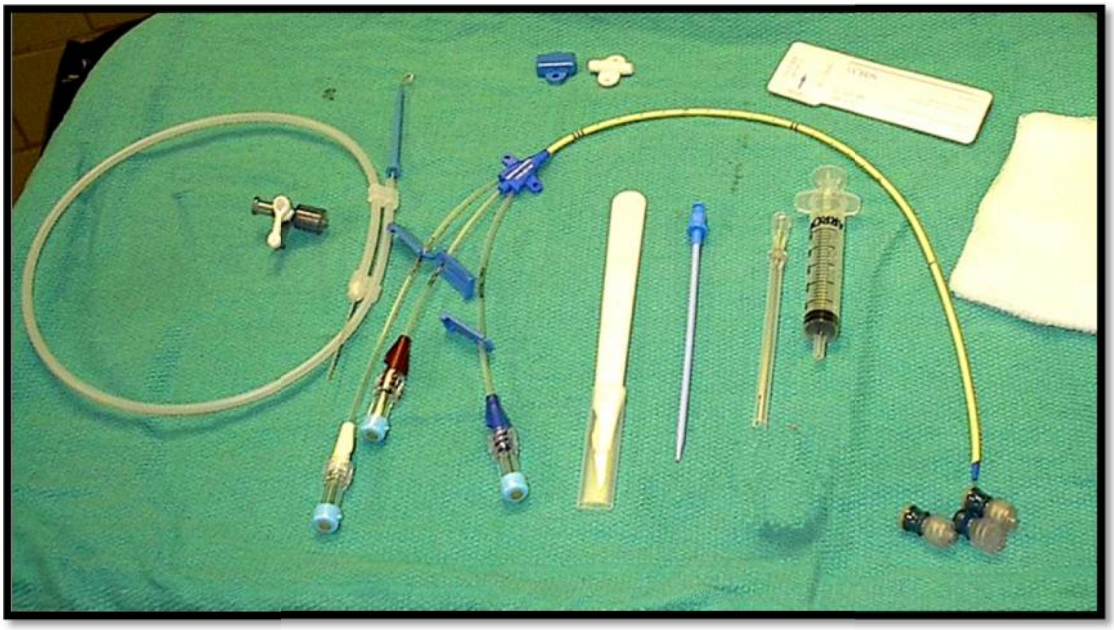


FIGURE 14

5. Parts of a CVC[25]

This multiport catheter consists of 3 lumen. The brown opens in the midline and is the largest calibre, the other two open on the side and smaller calibre.

The catheter has a hub which sits outside on the skin at the site of puncture and has holes through which sutures are passed to secure it (fig.15).

The 3 individual lumens arise from this point and are colour coded. Small plastic clamps are also present to occlude the lumen when not in use.

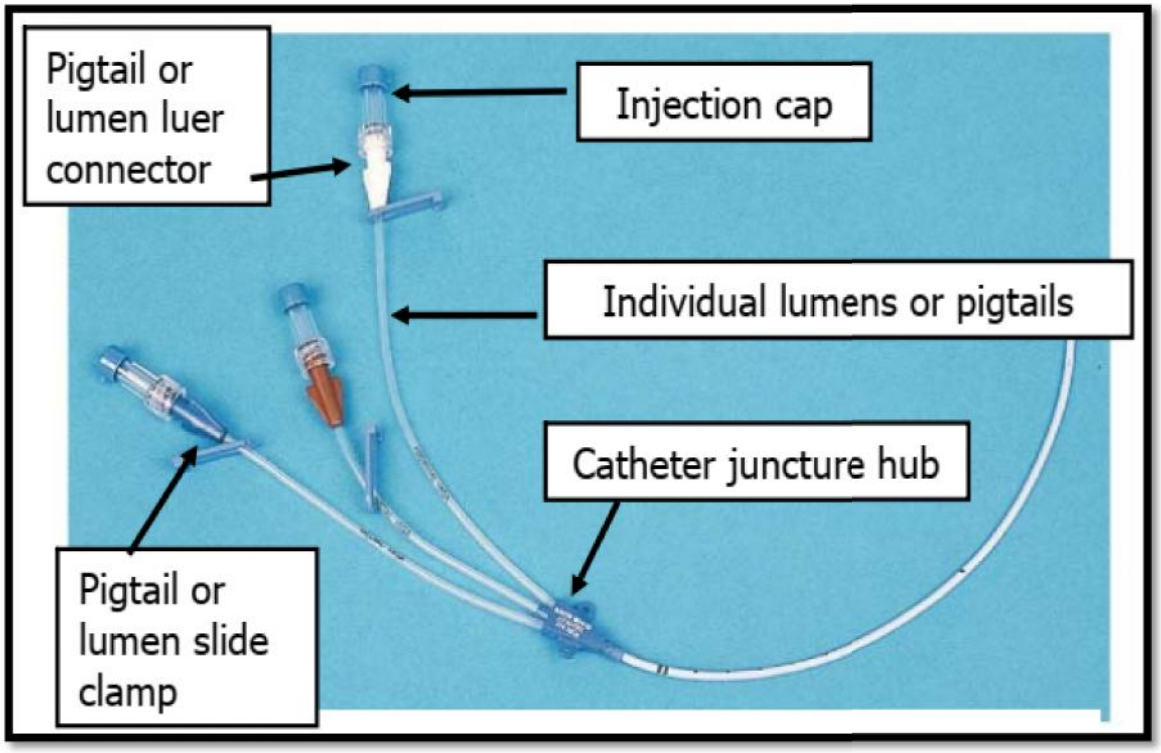


FIGURE 15

Care of the central venous catheter[25]

Amongst the most frequent problems encountered with the central lines are infections and hence they have to be taken care of according to strict protocols and guidelines to increase the longevity of the catheter.

REVIEW OF LITERATURE

B Vishnu Mahesh Babu et al[13] in 2014 conducted a study on Comparison of Posterior and Anterior Approaches for Internal Jugular Venous Cannulation.

The study included 50 subjects in whom they compared the anterior vs posterior approach to cannulate the IJV with regards to the attempts and the time to locate the IJV, total duration to cannulate, ease of catheter threading and complications. Their analysis showed that while in the anterior approach group only 52% underwent IJV cannulation in the first attempt, it was 80% in those in the posterior approach group. Thus they concluded that the posterior approach required fewer attempts.

The mean time required to identify the vein was 0.18min in posterior while it was 1.06min in anterior approach indicating the anterior took much longer and this was also statistically significant (p=<0.0001). The duration of cannulation was shorter in the posterior group 2.43min compared to 3.64min in the anterior group, which was statistically significant (p=<0.0001). Though they have commented on the ease of threading being better in the posterior group this was not statistically significant.

Posterior approach had significantly lower complications. In the posterior approach group there was only one instance of carotid puncture while there were 3 in the anterior group. There were no cases of pneumothorax and hemothorax in the posterior group compared to 2 cases of pneumothorax in the anterior approach group.

They concluded that the posterior approach is better than the anterior approach as it improves the success rate and reduces complications.

A study was conducted by **LS Chudhari et al**[22] in 1998 comparing two different approaches of internal jugular vein cannulation in surgical patients.

They studied 200 patients undergoing open heart surgery and compared the anterior to the posterior approaches in terms of attempts required, ease of cannulation and complications. Their findings showed that the ease of threading was better with the posterior approach. In relation to weight of the patients, analysis showed that the rate of successful cannulation was 97% with the posterior approach compared to 75% with the anterior approach.

In obese patients carotid punctures were more (16.6%) and cannulation more difficult by the anterior approach when compared to posterior approach (3.1%). The frequency of inadvertent arterial puncture was 5% in anterior and 2% in posterior approach.They found six instances of haematoma via the anterior approach compared to three in the posterior approach.

They concluded that repetition and experience improved the success rate for both approaches, but in obese patients and those with short necks posterior approach was found to be easier and with fewer complications than the anterior approach.

Mohan Chandralekha V et al[26] conducted a study on "Internal jugular vein cannulation - comparison of central approach (palpation method) and posterior approach (non-palpation method)."

They included 600 patients scheduled for renal transplant in the study. In them the IJV was cannulated by either one of the two approaches. Parameters recorded were the approach used, number of attempts, time to cannulate and complications.

Analysis of the recorded data showed that the posterior approach required fewer attempts and had a greater percentage of successful cannulations in comparison to the anterior approach (93.8% vs 87.5% respectively). They also found that the incidence of carotid puncture was lower in posterior approach group. The authors concluded that, IJV cannulation by posterior approach is better than the central approach.

M. Mathur et al[27] conducted a study in 2015 to "compare central versus posterior approach for internaljugular haemodialysis catheter insertion. The aim was to assess for complication rates, insertion failure rates, interruption during haemodialysis and infection rates amongst the two approaches."

Their study had 104 participants, divided into two groups, 54 in the central and 50 in the posterior groups. The analysis of the data showed increased incidence of arterial puncture with central approach (14.81% versus 6%).The posterior approach group had a much higher haemodialysis interruption rate mainly due to blood flow obstruction at 46% compared to only 9.25% in central approach.

They concluded from their study that because of the greater frequency of HD interruption, central approach should still be the favoured approach for haemodialysis catheter placement. Posterior approach while being safer, may be considered as an alternative method in cases where there is local exit site infection or after failed attempts with the central approach.

Deepak K. Tempe, SanjulaVirmani et al[12] conducted a study in 2012 to assess the success rate and safety of internal jugular vein cannulation using anatomical landmark technique in patients undergoing cardiothoracic surgery.

Overall 976 patients scheduled using for cardiac surgery were included over a period of one year with the aim of finding out the success rate, complications and the time taken for IJV cannulation when the anatomical landmark technique. Left IJV was cannulated only in 23(2.4%) while the right IJV cannulation was performed in 953(97.6%) patients. In 809 (82.9%) patients, successful cannulation was performed in the first attempt and greater than four attempts were required in only 2.7% of the patients. The mean duration for catheter placement was 3.2mins. No complications were seen in 96.6% cases. The most common complication encountered was carotid artery puncture (2.3%).

They concluded that in patients undergoing cardiothoracic surgery right IJV cannulation via the landmark technique is highly successful. The authors also felt that while their results were comparable to studies in which ultrasound was used to place the cannula with regards to the number of punctures and time taken but the complication rate was lower with ultrasound guidance.

T. Lamkinsi et al[14] conducted a study in 2010 internal jugular venous cannulation: What is the best approach? To compare the anterior versus the posterior approach to IJV cannulation, with the primary objective to asses for the rate of success and secondarily to assess for complications and difficulties.

101 patients requiring cannulation were randomly divided into two groups. Posterior group had a success rate of 96% with a fewer attempts 1.3 ± 0.7 compared to 68% and 2.1 ± 1.3 in the anterior group. When reviewing the instances of complications, they found no episodes of pneumothorax in the posterior approach but the percentage of arterial puncture was higher than the anterior approach (34% vs 25.5%).

They concluded that the posterior approach for IJV cannulation is better than the anterior approach.

Bikash R Ray et al[27] conducted a study in 2013 internal jugular vein cannulation: A comparison of three techniques. The study compared the anatomical landmark based technique (i.e. central approach) to the USG guided technique for right internal jugular vein cannulation.

A total of 120 patients were included and divided into 3 groups. Group AL normal landmark guided method was used, group US-PL in which the IJV was initially located and marked using USG and then cannulated and third the group US-RT in which under real-time guidance the cannulation was done. The rate of success was 85% in group AL, 92.5% in group US-PL and 95% in group US-RT. The mean venous access time was shortest in the US-PL group 9.5s compared to 14.5 in the AL group and 11s in the US-RT group. The median time to place the catheter was much longer in the AL group 225s. They also found that the success rate was the highest in the group US-RT. There were 3 instances of arterial puncture all of which occurred in the AL group.

The authors concluded that use of USG techniques improves the success rate of internal jugular vein cannulation, reduces complications and duration of cannulation.Therefore USG guidance must be used when available to improve the safety of the procedure.

Izumi Miki et al[28] conducted a study in 2013 to assess Anatomical relationship between the common carotid artery and the internal jugular vein during head rotation.

The purpose of the study was to assess the effects of head rotation on the anatomic relationship between the common carotid artery and internal jugular vein and on changes in IJV contour using USG. The study population included thirty fit volunteers (16 men and 14 women) with no previous history of internal jugular vein cannulation. They wanted to measure how much of the common carotid artery and internal jugular vein overlap each other and the cross-section of the internal jugular vein, this was checked at 2cm and 4cm above the clavicle. As the head was rotated to the left, the percentage overlap progressively increased, at both 2cm and 4cm above the clavicle. The head in neutral position, the amount of overlap was found to be 23.6% at 2cm and 30.2% at 4cm. The overlap was much greater when the head was rotated 45^0 and 30^0 from neutral. Overlapping increases the chances of carotid puncture as it's often seen that the needle passes through the posterior wall of the vein and into the carotid artery underneath. IJV compression gradually reduced as the head was turned to the left, providing a greater cross-sectional area for access.

Thus the authors concluded that, when turning the head left it should be restricted to $<45^0$ for interventions occurring 2cm above the clavicle and to $<30^0$ for interventions occurring 4cm above the clavicle. Also increase in the cross-section of the vein as the head is turned to either side improves the chances of successful cannulation.

Thomas Suarez et al[29] conducted a study on Central Venous Access: The Effects of approach, Position and Head Rotation on Internal Jugular Vein Cross-Sectional Area. They examined the effects of position (supine vsTrendelenburg), head rotation (0°, 20° and maximum) and approach (lateral vs anterior), during central venous catheterization on the area of the right internal jugular vein.

Their study included 24 patients and was designed such that initially each patient would be placed supine, followed by a 25^0Trendelenburg position, in each of these positions the patients head would be kept at 0^0(neutral) followed by turning by 20^0 and max rotation. In these positions the cross-section of the IJV in the anterior and lateral approach was recorded. They analysed the data and found that when the patient was in Trendelenburg position the lateral approach managed to achieve the largest cross-sectional area, irrespective of head rotation.

Hence they concluded that if the patient's condition allows then the combination of Trendelenburg position + lateral approach (irrespective of head rotation), would give the maximum cross-sectional area to successfully cannulate the IJV. If and where Trendelenburg position is not permissible then the authors have recommended the use of other approaches.

ShantaChandrasekaran, V.P.Chandrasekaran et al[30] conducted a study to assess anatomical variations of the internal jugular vein in relation to common carotid artery in lesser supra clavicular fossa.

The study had 81 healthy participants. In them Doppler was used to assess the relation of the internal jugular vein to the CCA bilaterally. The safe relation was when the vein was located lateral/antero-lateral to the artery and dangerous when it was located anterior to the artery. Amongst the volunteers, Doppler on the left showed that 80% safe relation while it was 74% on the right side. There was no variation on the basis of age and gender. They also recorded the diameter of the IJV on the right and left (8.7mm and 8.6mm respectively).

The authors based on their findings were able to conclude that in those undergoing cannulation of the IJV a significant number of volunteers had the unsafe relation, increasing the chances of arterial puncture.

MATERIALS AND METHODS

KLE'S Dr.Prabhakar Kore Hospital and Medical Research Centre, Nehrunagar, Belagavi,in patients requiring internal jugular vein cannulation in the operation theatre and critical care unit between January 2018 to December 2018.

Study design: A one year hospital based randomized controlled trial.

Selection Criteria:

Inclusion Criteria:

- ASA physical status I/II/III.
- Age between 18 to 80 years.
- Undergoing elective/emergency surgery.
- Patients in the critical care unit requiring central venous access.

Exclusion Criteria:

- Lack of patient consent.
- Coagulopathy (INR > 1.5).
- Infection at the site of cannulation.
- Prior neck surgery.
- SVC syndrome.

Sample size:

Total sample size=120

Group C(IJV cannulation using central approach) =60

Group P(IJV cannulation using posterior approach) =60

Sample size calculation:

The minimum sample size formula based on two proportions is

$$n = \frac{(z_\alpha + z_\beta)^2 \bar{p}(1-\bar{p})}{d^2}$$

$$p = \frac{p_1 + p_2}{2} \text{ and } d = p_1 - p_2$$

where p_1 and p_2 are the proportions (percentages) of the two groups.

Zα is linked with the level of significance and Zβ is linked with the power of the test.

For 5% level of the significance zα = 1.96 and zβ = 0.84 for 80% power of the test.

By taking proportion of success in the first attempt p_1 = 52% and p_2=80% the sample size obtained is 45.

To improve the validity of the study a sample size of 60 in each group has been taken.

Methodology:

Following departmental research committee and institutional ethical board approval, written informed consent was obtained from 120 adult patients aged above 18 years, ASA I, II and III meeting the inclusion criteria. Standard anaesthesia monitors include non-invasive blood pressure, pulse oximeter and electrocardiogram were applied. Baseline blood pressure, heart rate and peripheral O2 saturation were recorded.

Patients were randomly divided into two groups by using a computer generated random number table.

- Group C – IJV cannulation using central approach.
- Group P–IJV cannulation using posterior approach.

The patient was positioned supine with 20° Trendelenburg. A small pillow/folded bedsheet was placed underneath the shoulders and the head turned to the opposite side of cannulation, then the sedilott's triangle , EJV, carotid pulsations and suprasternal notch identified.

A triple lumen, 7 Fr IJV catheter, along with an 18G × 7 cm introducer needle and 0.035" × 70 cm 'J' tip guide wire used for catheterization. Simple sutures used to fix to the skin.

Initially in both groups under aseptic precautions povidone iodine (10%) solution followed by spirit solution was used to paint the right side of the neck up-till the pinna and down the chest wall till the nipple and draped (Photograph 1).

In group C: IJV cannulation was done by the central approach. The sedilott's triangle was identified and at the apex of this triangle 2% lignocaine was used to infiltrate the skin, then using an 18G needle under constant aspiration needle was

introduced at the same point(Photograph 2) and advanced at an angle of 30° (directing it towards the ipsilateral nipple) until there was free aspirate of dark coloured blood.

In group P: patient's the head was turned to the left side so that the right sternocleidomastoid is clearly visible as a straight muscle. The neck was prepared and draped as described earlier. The EJV remains well distended and is seen to cross the sternocleidomastoid. The point where the external jugular vein crosses the lateral border of sternocleidomastoid was infiltrated with 2% lignocaine. Skin puncture done with an 18G needle made at angle of 30°, lifting up the bulk of the muscle (Photograph 3), the needle was then advanced under the SCM directed towards the suprasternal notch until there was free aspirate of dark coloured blood.

In both cases the IJV was cannulated by the modified Seldinger's technique. The hub of the cannula was secured to the skin with simple sutures.

Success rate of puncture of internal jugular vein on first attempt, time taken to identify the vein, time taken for cannulation, number of carotid punctures and other complications were assessed.

RESULTS

Study design: A comparative two group's clinical study

TABLE 1: Age distribution of patients studied

Age in years	Group P	Group C	Total
20-30	23(38.3%)	24(40%)	47(39.2%)
31-40	10(16.7%)	14(23.3%)	24(20%)
41-50	12(20%)	14(23.3%)	26(21.7%)
51-60	9(15%)	6(10%)	15(12.5%)
61-70	4(6.7%)	2(3.3%)	6(5%)
>70	2(3.3%)	0(0%)	2(1.7%)
Total	60(100%)	60(100%)	120(100%)
Mean ± SD	40.08±14.44	37.30±12.17	38.69±13.37

P=0.256, Samples are age matched, Statistical test: Student t test

GRAPH 1:

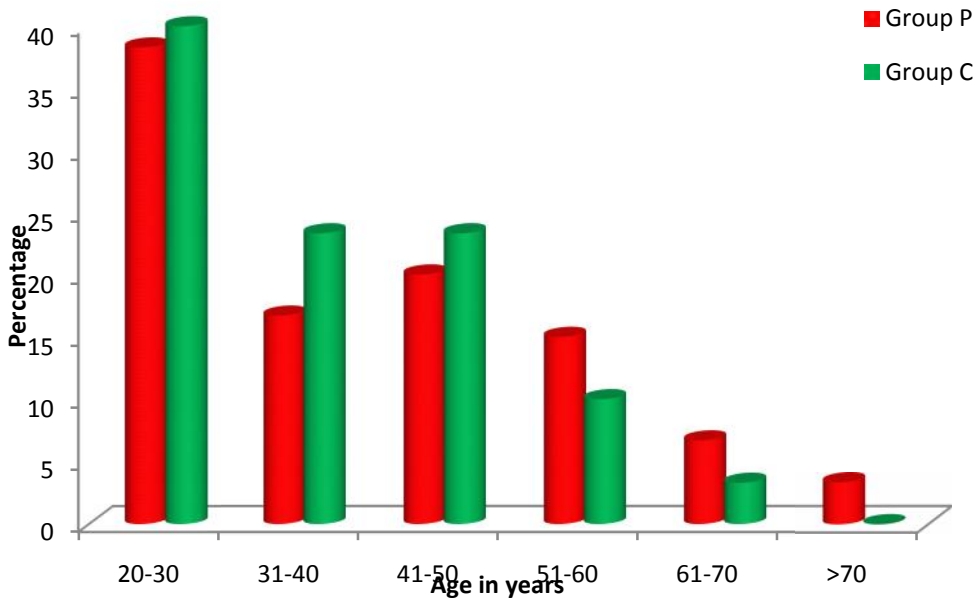
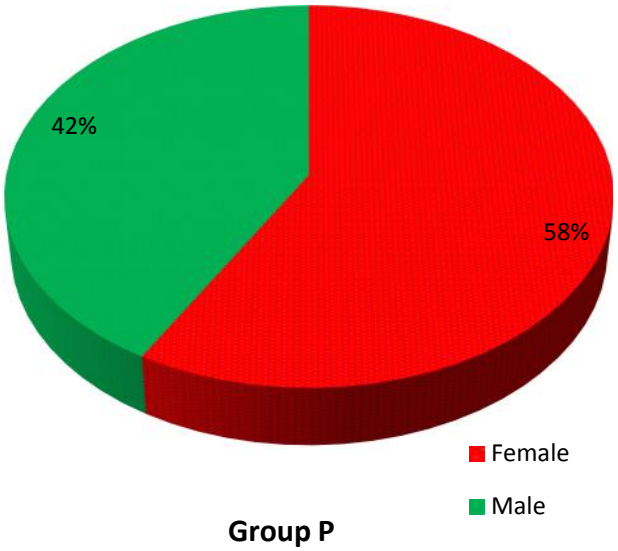


TABLE 2: Gender distribution of patients studied

Gender	Group P	Group C	Total
Female	35(58.3%)	33(55%)	68(56.7%)
Male	25(41.7%)	27(45%)	52(43.3%)
Total	60(100%)	60(100%)	120(100%)

p=0.713, Samples are gender matched,Statistical Test: Chi-square test.

GRAPH 2A:



GRAPH 2B:

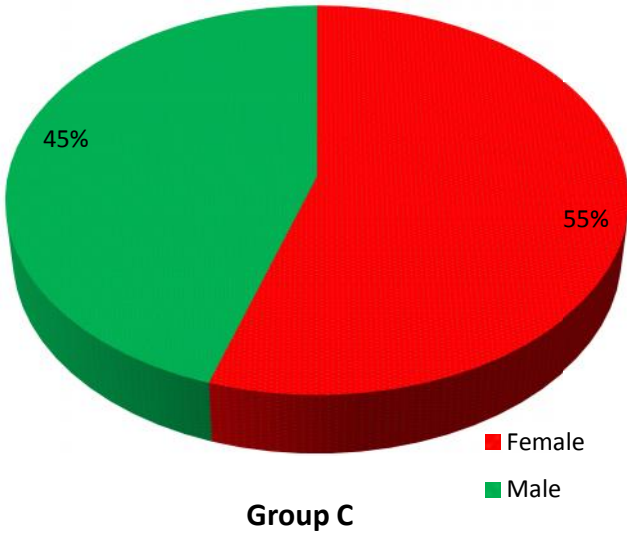


TABLE 3: Weight (kg) distribution in two groups of patients studied

Weight (kg)	Group P	Group C	Total
41-50	20(33.3%)	24(40%)	44(36.7%)
51-60	26(43.3%)	26(43.3%)	52(43.3%)
61-70	12(20%)	9(15%)	21(17.5%)
>70	2(3.3%)	1(1.7%)	3(2.5%)
Total	60(100%)	60(100%)	120(100%)

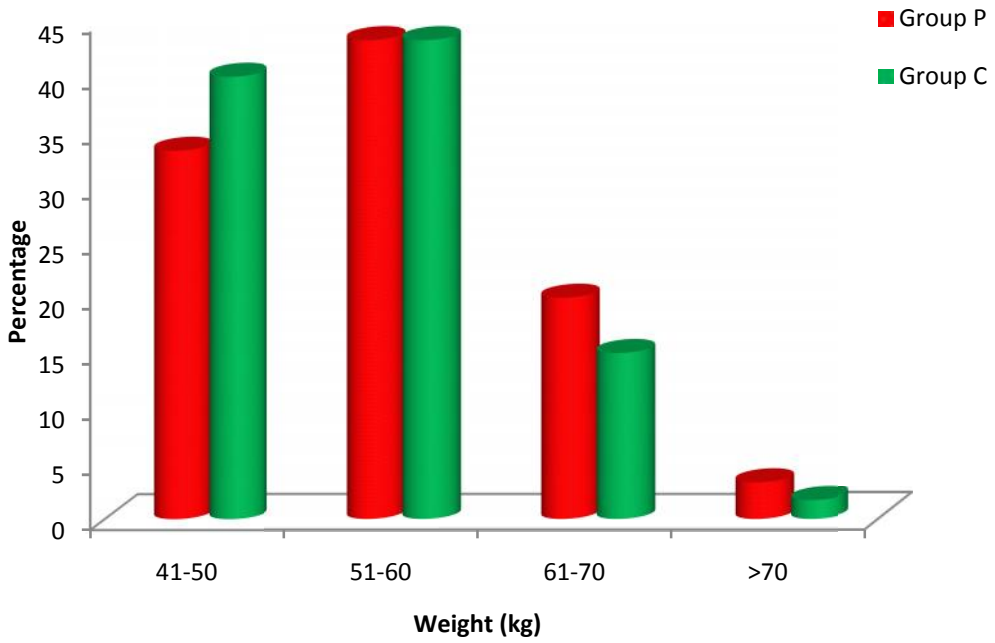
p=0.751, Not Significant, Statistical Test: Fisher Exact test

TABLE 4: Height (cm) distribution in two groups of patients studied

Height (cm)	Group P	Group C	Total
141-150	12(20%)	12(20%)	24(20%)
151-160	37(61.7%)	35(58.3%)	72(60%)
161-170	11(18.3%)	13(21.7%)	24(20%)
Total	60(100%)	60(100%)	120(100%)

p=0.895, Not Significant, Statistical Test: Chi-Square test

GRAPH 3:



GRAPH 4:

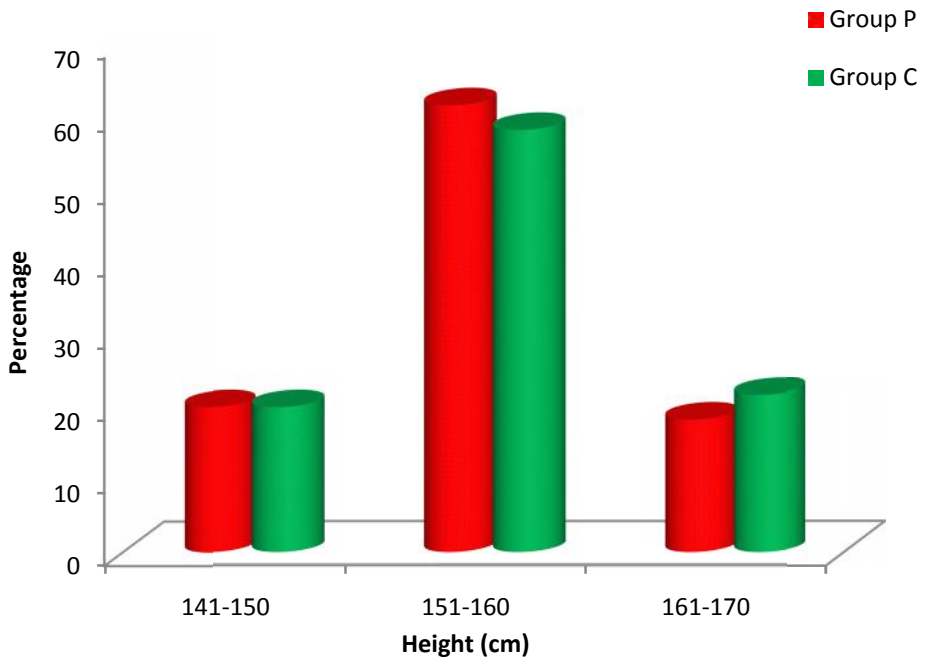
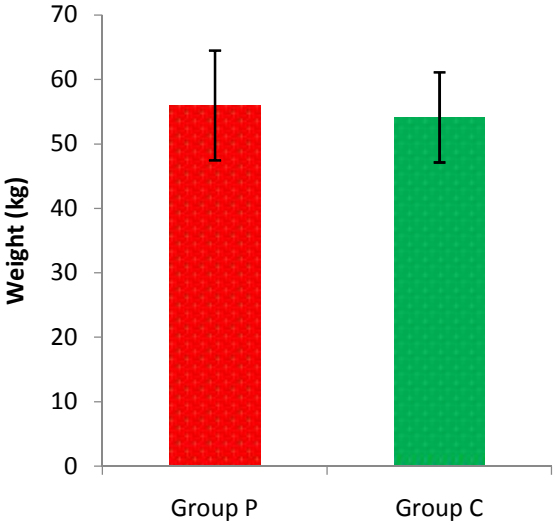


TABLE 5: Comparison weight/height in two groups of patients studied

variables	Group P	Group C	Total	P value
Weight (kg)	55.98±8.52	54.12±6.98	55.05±7.81	0.192
Height (cm)	155.70±5.44	156.53±6.10	156.12±5.77	0.431

GRAPH 5:



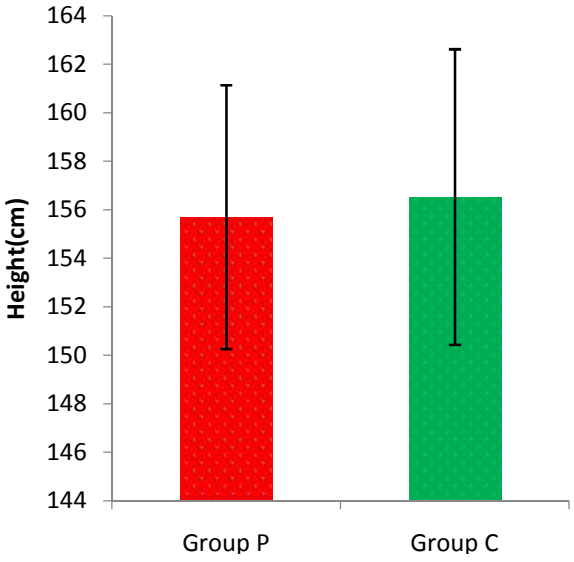


TABLE 6: ASA Grade distribution in two groups of patients studied

ASA Grade	Group P	Group C	Total
I	9(15%)	5(8.3%)	14(11.7%)
II	36(60%)	32(53.3%)	68(56.7%)
III	15(25%)	23(38.3%)	38(31.7%)
Total	60(100%)	60(100%)	120(100%)

p=0.216, Not Significant, Statistical Test: Chi-square test. Majority of the patients were in the ASA physical status II grade.

GRAPH 6:

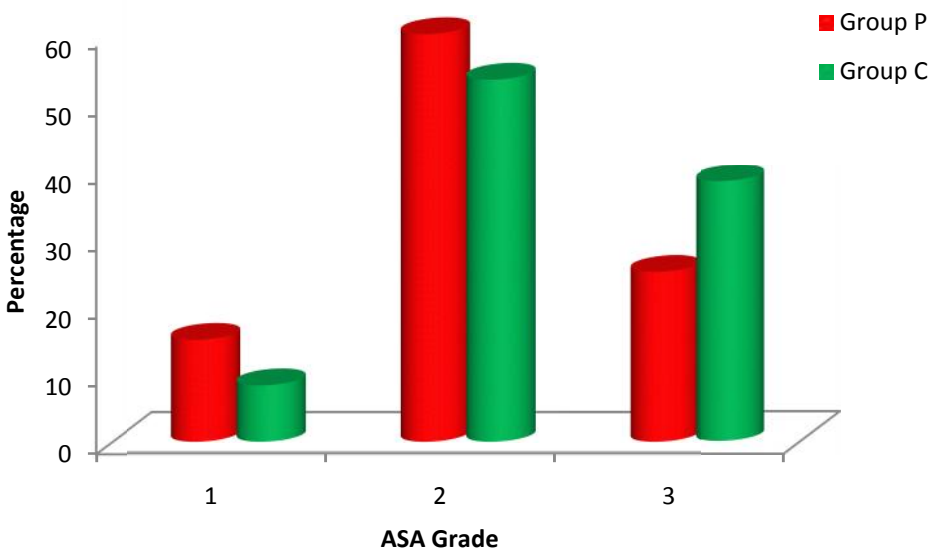


TABLE 7: Time to locate vein distribution in two groups of patients studied

Time to Locate vein(seconds)	Group P	Group C	Total
<12	29(48.3%)	5(8.3%)	34(28.3%)
12-18	31(51.7%)	49(81.7%)	80(66.7%)
>18	0(0%)	6(10%)	6(5%)
Total	60(100%)	60(100%)	120(100%)
Mean ± SD	12.04±1.49	14.27±2.30	13.16±2.23

p<0.001, shows significant statistical difference between the two groups. Thus the posterior approach requires lesser time to locate the vein.Statistical test: Student t test.

GRAPH 7:

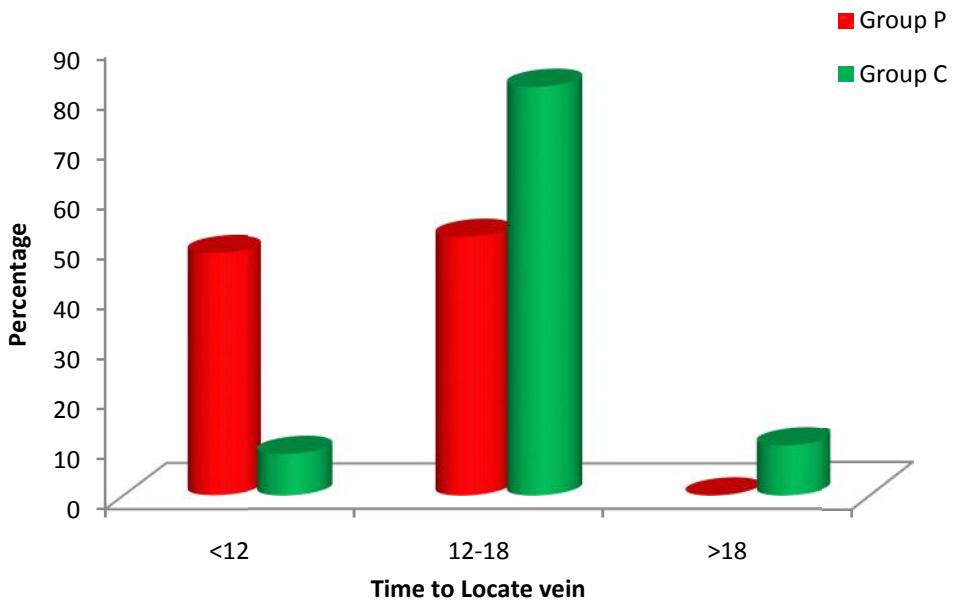


TABLE 8: No of attempts distribution in two groups of patients studied

	Group P (n=60)	Group C (n=60)	Total (n=120)
No. of Attempts			
• **1**	51(85%)	42(70%)	93(77.5%)
• **2**	9(15%)	14(23.3%)	23(19.2%)
• **3**	0(0%)	4(6.7%)	4(3.3%)

p=0.054, shows significant statistical difference. This shows greater success rate at first attempt with the posterior approach at 85% and that none of the patients required more than two attempts in the posterior approach group. Statistical test: Fisher Exact Test

GRAPH 8:

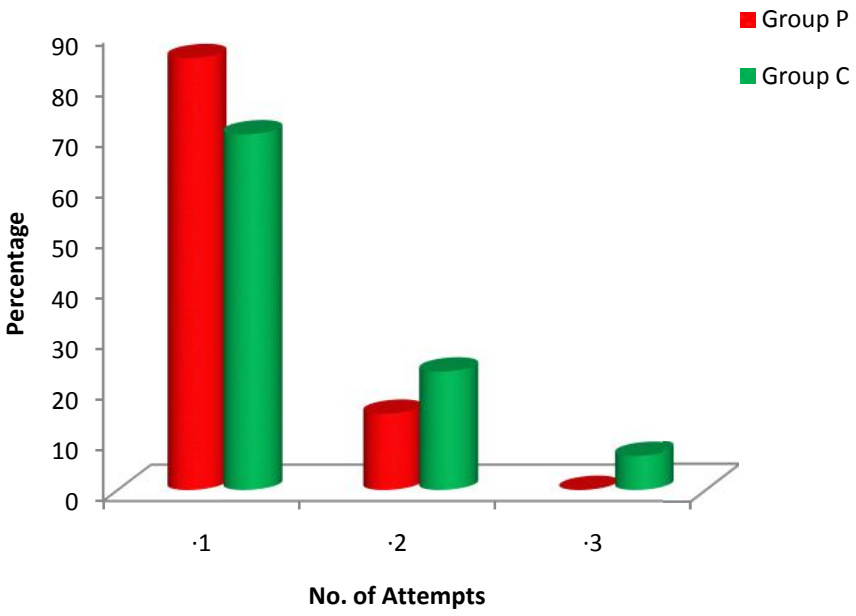


TABLE 9: Duration of Cannulation in seconds

Duration of Cannulation(secs)	Group P	Group C	Total
180-240 secs	35(58.3%)	1(1.7%)	36(30.0%)
241-300 secs	25(41.7%)	26(43.3%)	51(42.5%)
301-360 secs	0	33(55.0%)	33(27.5%)
Total	60(100.0%)	60(100.0%)	120(100.0%)
Mean ±SD	205.54±29.58	278.51±41.14	242.04±51.14

$p<0.001$, shows significant statistical difference. The duration of cannulation was much lesser with the posterior approach. Statistical Test: Student t test

GRAPH 9:

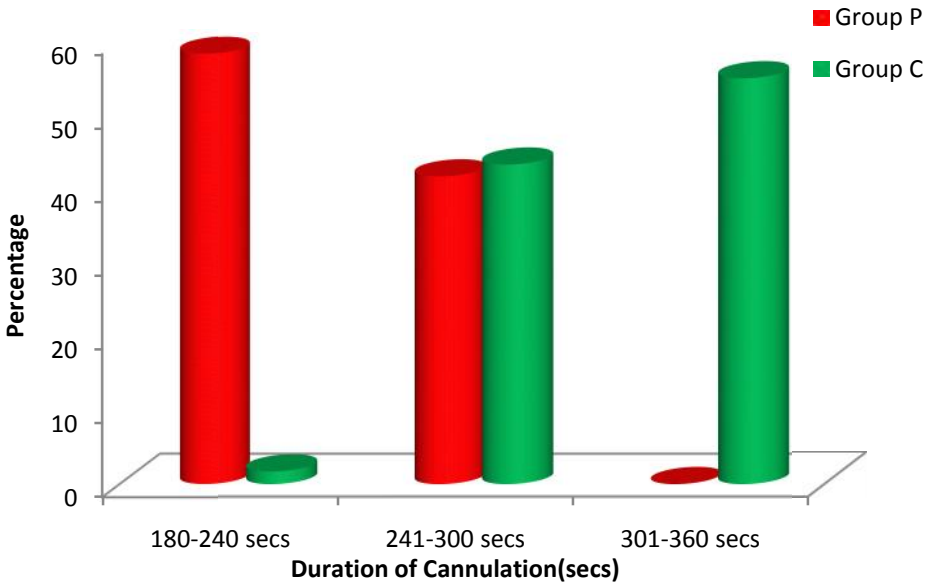
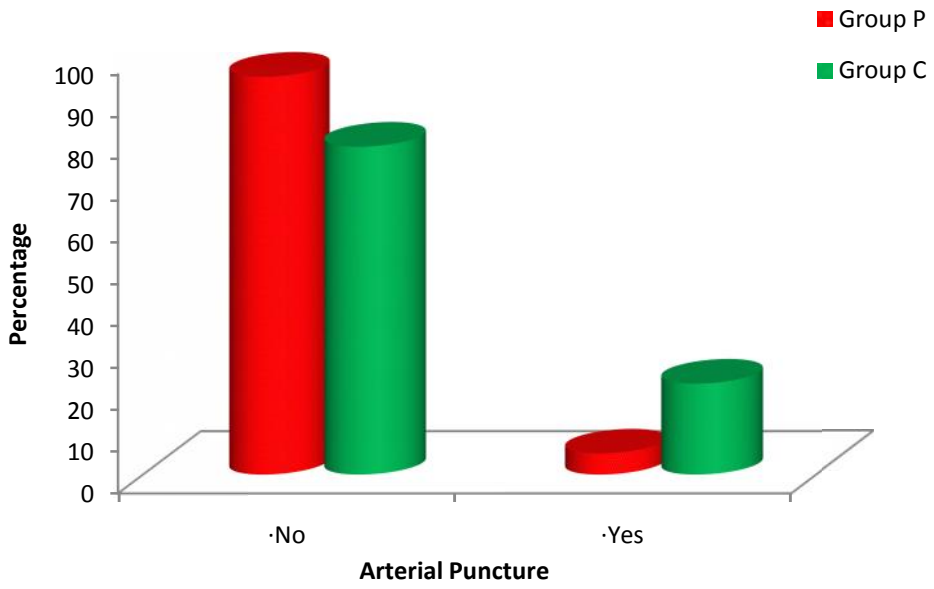


TABLE 10: Complication in two groups of patients studied

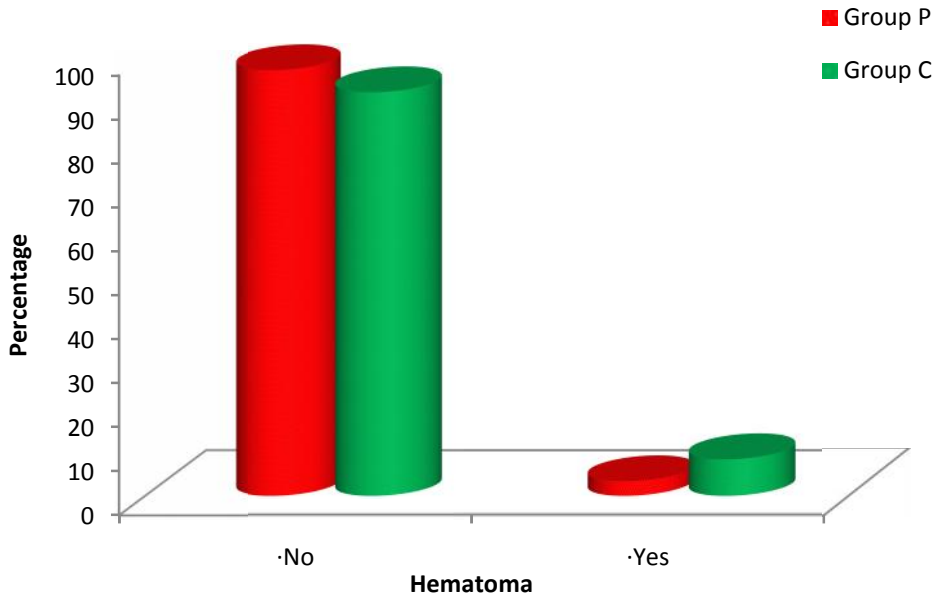
Complications	Group P (n=60)	Group C (n=60)	Total (n=120)	P value
Arterial Puncture				
• **No**	57(95%)	47(78.3%)	104(86.6%)	<0.001
• **Yes**	3(5%)	13(21.7%)	16(13.3%)	
Hematoma				
• **No**	58(96.7%)	55(91.7%)	113(94.2%)	0.439
• **Yes**	2(3.3%)	5(8.3%)	7(5.8%)	
Pneumothorax				
• **No**	60(100%)	60(100%)	120(100%)	1.000
• **Yes**	0(0%)	0(0%)	0(0%)	
Catheter Displacement				
• **No**	57(95%)	60(100%)	117(97.5%)	0.244
• **Yes**	3(5%)	0(0%)	3(2.5%)	

Incidence of arterial puncture was significantly higher in the central approach group, $p<0.001$. Other complications were comparable between the two groups and did not show statistical significance. Statistical Test: Chi-Square/Fisher Exact test

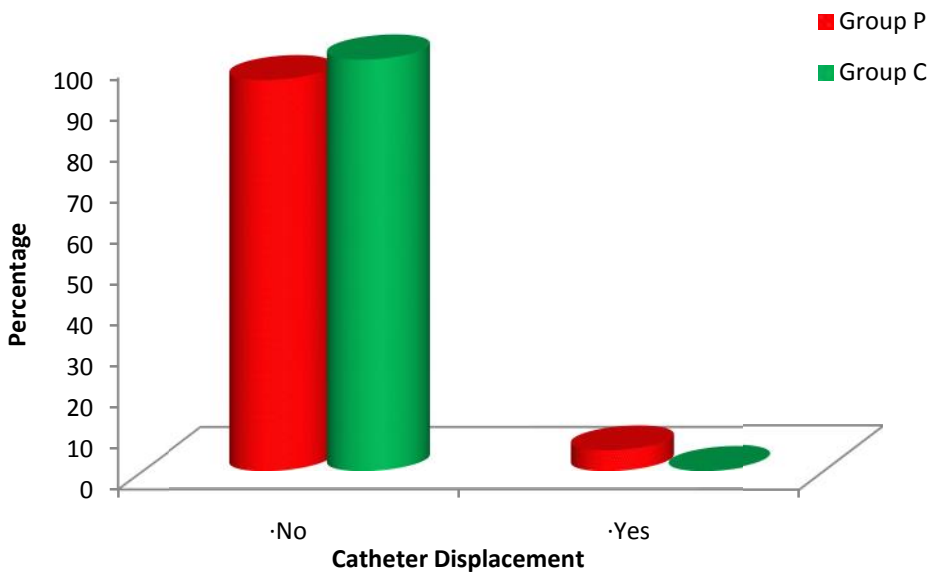
Graph 10:



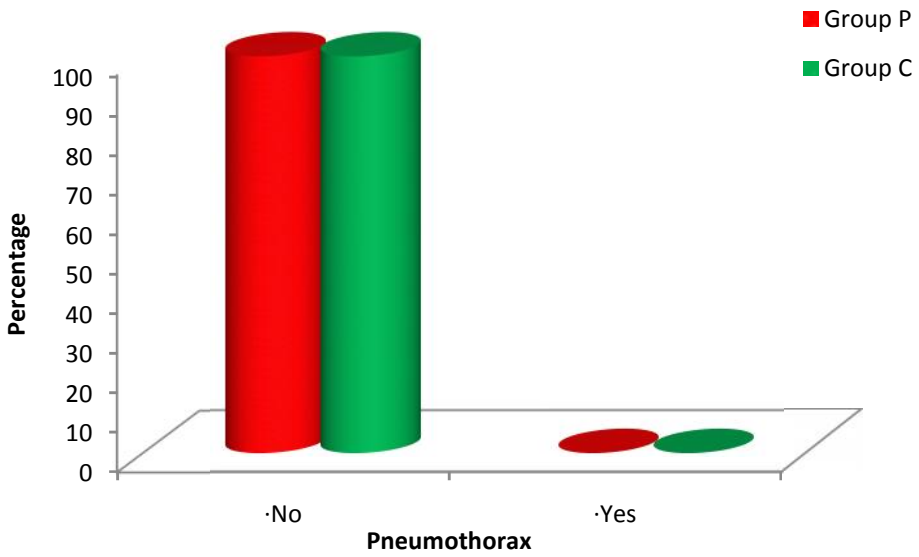
Graph 11:



Graph 12:



Graph 13:



Statistical Methods: Descriptive and inferential statistical analysis has been carried out in the present study. Results on continuous measurements are presented on Mean ± SD (Min-Max) and results on categorical measurements are presented in Number (%). Significance is assessed at 5 % level of significance. The following assumptions on data is made, **Assumptions: 1.**Dependent variables should be normally distributed, 2.Samples drawn from the population should be random, Cases of the samples should be independent

Chi-square/ Fisher Exact test has been used to find the significance of study parameters on categorical scale between two or more groups, Non-parametric setting for Qualitative data analysis. Fisher Exact test used when cell samples are very small.

Statistical software: The Statistical software namely SPSS 22.0 and R environment ver.3.2.2 were used for the analysis of the data and Microsoft word and Excel have been used to generate graphs, tables etc**.**

DISCUSSION

Central venous catheterization has been one of the most crucial advances in medicine. While these CVC are commonplace now they have evolved over several generations and today have many varied uses. In today's practice of medicine the focus is always on improving the success rate and reducing the complications of any procedure. In our institute the central approach is the method that most residents learn and perform on a day to day basis. While it has success rate of 85-95 %[6,33] it is often associated with complications such as arterial puncture. The posterior approach on the other hand is less often learnt and used but has been found to be as efficient and with a lower incidence of complications[13,14,22].

In a study conducted by ShantaChandrasekaran et al[30] they analysed the relation of IJV to CCA and found that amongst the patients studied 74% and 80% on the right and left sides respectively had the safe (i.e. lateral/antero-lateral) relation while the remaining had the unsafe (i.e. anterior) relation. In another study conducted by Izumi Miki et al[28] on the relation of internal jugular vein to common carotid artery with head rotation also found that the IJV overlapping the CCA significantly increased beyond 45° head rotation 2cm above and beyond 30° head rotation 4cm above the clavicle.In a study conducted by Thomas Suarez et al[29] found that if the patient's condition allows then the combination of Trendelenburg position + lateral approach (irrespective of head rotation), would give the maximum cross-sectional area to successfully cannulate the IJV. In this regard we considered comparing the traditional and commonly used central approach to the posterior approach in terms of success of cannulation and complications.

All patients were matched for age, weight and height. There was no significant statistical difference between the two groups.

In our study the mean time to locate the vein was 12.04±1.49 seconds in posterior approach group and 14.27±2.30 seconds in the central approach group. This was found to be strongly significant ($p<0.001$), indicating that it took a shorter duration of time to identify the vein using the posterior approach. This result was similar to a study conducted by B Vishnu Mahesh Babu et al[13], though in their study the difference between the two groups was far more obviously significant, time to identify the vein was 1.06±0.56 minutes in anterior group and 0.18±0.12 minutes in the posterior group. This could probably be explained in the sense that in our study all cannulations were performed by a single person with experience in securing central venous catheters.

In our study, in 51(85%) patients the IJV could be identified and cannulatedon the first attempt via the posterior approach,while only 42(70%) patients in the central approach group. The remaining 9(15%) patients in the posterior group the vein was identified on the second attempt, while in the central group 14(23.3%) in the second attempt and 4(6.7%) in the third attempt vein was identified. This correlation was found to be statistically significant ($p=0.054$). Our results concurred with a study conducted by MohanChandralekha V et al[26] in which they found that the posterior approach required fewer attempts and had a greater percentage of successful cannulations in comparison to the anterior approach (93.8% vs 87.5% respectively).Another study conducted by T. Lamkinsi et al[14] similarly found that the success rate and the number of attempts in the posterior approach group (96%,1.3±0.7) was significantly better when compared to the anterior approach group(68%,2.1±1.3).Another similar study conducted by Chudhari LS et al[22] found

that by the posterior approach 80% of patients were cannulated by first attempt and 20% required more than one attempt, whereas only 58% of patients were cannulated in the first attempt by anterior approach and 42% required more than one attempt.Thus we found that the posterior approach required fewer attempts to locate the IJV and hence this in turn would reduce the risk of complications.[12]

The duration of cannulation in our study was defined as the time taken from puncture of vein to catheter insertion into the internal jugular vein. In the study conducted by MohanChandralekha V et al[26] they found that the duration of cannulation was shorter via the posterior approach (319.62 ± 69.58 seconds) than in the central approach(413.87 ± 88.02 seconds). Similarly in our studythe Mean ±SD duration was 205.54±29.58seconds in the posterior group compared to 278.51±41.14seconds in the central group, this was found to be strongly significant with a $p<0.001$.The posterior approach had a shorter duration of cannulation when compared to the central approach. The shorter duration for cannulation via the posterior approach (in Trendelenburg position) is probably because of the greater cross-sectional area of the IJV achieved.[29,34,35] This would allow faster identification of the IJV and easier threading of the catheter.

M. Mathur et al[36] have noted that the incidence of arterial puncture was lower in the posterior approach (3/50) when compared to the central approach (7/54), which was statistically significant, while placing internal jugular haemodialysis catheters. In the study by Chudhari LS et al[22] also the overall incidence of carotid puncture was high(5%) in anterior approach than the posterior approach(2%). In our study the rate of carotid puncture with the central approach was 21.7% (13/60) & it was much higher than the posterior approach where it was only 5% (3/60), this was found to be statistically significant ($p<0.001$). Our results are similar to the above mentioned

studies.On encountering carotid puncture, the needle was withdrawn and removed immediately and firm pressure was applied for a few minutes. Central approach involves identifying the two heads of SCM & the apex of the triangle formed between them, this is not always possible particularly in obese/short neck patients. Also very often the IJV is located overlapping the CCA and hence the risk of going through the vein and into the artery also increases, these maybe the reasons for the higher incidence of carotid puncture via the central approach.[28–30,33,37]

Most of the studies report a lower incidence of haematoma with the posterior approach[13,14,22]. In our study there were 3 instances of haematoma by the posterior approach and 5 in the central approach. This was statistically not significant (p=0.439). The haematoma's in all cases resolved within 24-48hours. The lower incidence of haematoma formation via the posterior approach could be as a result of fewer episodes of arterial puncture by this route.

Pneumothorax is a grave complication associated with IJV cannulation.[20,38,39]RandeepKauret al[19] in their study found that pneumothorax occurred more often in those who had >2 attempts to cannulate the IJV. It is more often seen with the central approach than the posterior approach. In our study in both groups there was no complication of pneumothorax which occurred in any of the cases.As cannulation by the posterior approach is anatomically at a higher level than the central approach, the risk of injury to the pleura is lower. We also noted that none of our study participants developed hemothorax.

Catheter displacement leads to the tip of the catheter to end elsewhere instead of the right atrium, though still functional this may lead to false central venous pressure readings and non-functioning ports.[19,40] In our study 3 cases in the posterior group had a malpositioned or displaced catheter tip and none in the central approach,

this was not statistically significant (p=0.244). The reason for this maybe as a result of the lateral entry into the IJV in the posterior approach causing the guidewire to enter at an angle.

M. Mathur et al[36] in their study observed that there was an increased incidence of interruption flow when haemodialysis catheters were placed via the posterior approach, which was statistically significant. They concluded that posterior approach may be used as an alternative when central approach has failed or there is a catheter site infection. In our study we did not place any haemodialysis catheters which are of larger diameter via the posterior approach and cannot comment on the same, but the normal 3 lumen 7Fr catheters which were used in the study did not show any such obstruction to flow.

Craig RG, Jones RA,Sproul GJ et al[41] have observed a comparatively higher rate of limitation in neck movements in the anterior approach in their study. In our study we did not record data regarding limitation of neck movement but we postulate that since the point of entry and securing of the hub of the catheter is beyond the SCM muscle in the posterior approach when compared to the central approach where the suture is invariably on the SCM muscle, it will allow the patient to be more comfortable and allow more movement of the neck.

CONCLUSION

To conclude, in our study we have found that central venous cannulation by the posterior approach is better than the central approach in terms of:

- Success of cannulation-fewer attempts and lesser time to locate the vein.
- Reduced duration of cannulation.
- Fewer complications like carotid puncture, hematoma formation and pneumothorax.

The posterior approach while a viable and efficient alternative to the central approach involves a small learning curve and some experience. It is especially useful in patients who are obese or have a short neck in whom the landmarks are not obviously discernable and in those in whom the central approach has failed.

SUMMARY

In this present study titled "A COMPARISON OF CENTRAL VERSUS POSTERIOR APPROACH TO INTERNAL JUGULAR VEIN CANNULATION- A ONE YEAR HOSPITAL BASED RANDOMISED CONTROLLED TRIAL" we have compared the success rate of cannulation between the two approaches in terms of time taken to locate the vein, number of attempts/punctures to locate the vein, duration of cannulation and complications associated with each.

The study was conducted in 120 adult patients aged between 18 and 80 years, ASA grade I,II & III, undergoing elective and emergency surgeries and in the critically ill,meeting the inclusion criteria. Patients were randomly assigned to two groups containing 60 patients each.Patients undergoing IJV cannulation by thecentral approach were categorized as Group C and those by posterior approach as Group P.

The data for both groups was recorded and analysed separately.All patients were similar in regards toage, sex, height & weight. The number of attempts and the time to locate the IJV was lower in the posterior approach group than in the central approach group.The duration of cannulation was also shorter with the posterior approach. When comparing the rate of complications it was found that the incidence of carotid puncture and haematoma formation was lower with the posterior approach than the central approach. There were no occurrences of pneumothorax and hemothorax in our study. Catheter tip malposition was seen with the posterior approach and not with central approach.

Hence it was concluded that the posterior approach is as efficient as and better than the central approach for internal jugular vein cannulation.

REFERENCES

1. Beheshti M V. A Concise History of Central Venous Access. *Tech Vasc Interv Radiol*. 2011;14(4):184-185. doi:10.1053/j.tvir.2011.05.002
2. Peters JL. The History of Central Venous Access. *Cent Venous Catheter*. 2009;(1818):1-13. doi:10.1002/9780470750186.ch1
3. Gow KW, Tapper D, Hickman RO. Between the Lines: The 50th Anniversary of Long-Term Central Venous Catheters. *JAVA - J Assoc Vasc Access*. 2017;22(4):165-177. doi:10.1016/j.java.2017.10.004
4. Guide- P. Practice guidelines for central venous access: A report by the American Society of Anesthesiologists Task Force on Central Venous Access. *Anesthesiology*. 2012;116(3):539-573. doi:10.1097/ALN.0b013e31823c9569
5. Higgs ZCJ, Macafee DAL, Braithwaite BD. The Seldinger technique : 50 years on. 2005;366:1407-1409. doi:10.1016/S0140-6736(05)66878-X
6. Miller RD. *Central Venous Cannulation*. Vol 33.; 2012. doi:10.1073/pnas.0703993104
7. Bannon MP, Heller SF, Rivera M. Anatomic considerations for central venous cannulation. *Risk Manag Healthc Policy*. 2011;4:27-39. doi:10.2147/RMHP.S10383
8. Mumtaz S, Singh M. Surgical review of the anatomical variations of the internal jugular vein: an update for head and neck surgeons. *Ann R Coll Surg Engl*. 2018;101(1):2-6. doi:10.1308/rcsann.2018.0185
9. Ishizuka M, Nagata H, Takagi K, Kubota K. Right internal jugular vein is recommended for central venous catheterization. *J Investig Surg*. 2010;23(2):110-114. doi:10.3109/08941930903469342

10. Central venous access guidance. *Paediatr Nurs*. 2001;13(6):5. doi:10.7748/paed.13.6.5.s5

11. Soni NJ, Reyes LF, Keyt H, et al. Use of ultrasound guidance for central venous catheterization: a national survey of intensivists and hospitalists. *J Crit Care*. 2016;36:277-283. doi:10.1016/j.jcrc.2016.07.014

12. Tempe DK, Virmani S, Agarwal J, Hemrajani M, Satyarthy S, Minhas HS. The success rate and safety of internal jugular vein cannulation using anatomical landmark technique in patients undergoing cardiothoracic surgery. *Ann Card Anaesth*. 2013;16(1):16-20. doi:10.4103/0971-9784.105364

13. Babu BVM. Comparision of Posterior and Anterior Approaches for Internal Jugular Venous Cannulation – A Prospective & Randomised Controlled Study. 2014;2(2):1-4.

14. Lamkinsi T, Kettani A, Belkhadir Z, et al. Cathétérisme veineux jugulaire interne : Quelle est la meilleure voie d'abord ? *Ann Fr Anesth Reanim*. 2012;31(6):512-516. doi:10.1016/j.annfar.2012.01.024

15. Botha R, Van Schoor AN, Boon JM, Becker JHR, Meiring JH. Anatomical considerations of the anterior approach for central venous catheter placement. *Clin Anat*. 2006;19(2):101-105. doi:10.1002/ca.20240

16. Standring S, Anand N, Birch R, et al. *Gray's Anatomy - The Anatomical Basis of Clinical Practice*. Vol الحـا العـدد.; 2016.

17. Duwadi S, Zhao Q, Budal BS. Peripherally inserted central catheters in critically ill patients – complications and its prevention: A review. *Int J Nurs Sci*. 2019;6(1):99-105. doi:10.1016/j.ijnss.2018.12.007

18. Napalkov P, Felici DM, Chu LK, Jacobs JR, Begelman SM. Incidence of catheter-related complications in patients with central venous or hemodialysis

catheters: A health care claims database analysis. *BMC Cardiovasc Disord*. 2013;13:1-10. doi:10.1186/1471-2261-13-86

19. Tyagi A, Kumar S, Sethi AK, Dhaliwal U. Mechanical and infectious complications of central venous catheterizations in a tertiary-level intensive care unit in northern India. *Indian J Anaesth*. 2012;56(4):342-347. doi:10.4103/0019-5049.100823
20. Kornbau C, Lee KC, Hughes GD, Firstenberg MS. Central line complications. *Int J Crit Illn Inj Sci*. 2015;5(3):170-178. doi:10.4103/2229-5151.164940
21. Gómez-Arnau J, Escarpa A, Burgos R. Internal jugular vein catheterization. *Anaesthesia*. 1982;37(2):221-222. doi:10.1111/j.1365-2044.1982.tb01082.x
22. Chudhari L S, Karmarkar U S, Dixit R T SK. Comparison of two different approaches for internal jugular vein cannulation in surgical patients. *J Postgrad Med*. 1998;44(3):57-62. http://www.jpgmonline.com/text.asp?1998/44/3/57/375.
23. Ho AMH, Ricci CJ, Ng CSH, et al. The medial-transverse approach for internal jugular vein cannulation: An example of lateral thinking. *J Emerg Med*. 2012;42(2):174-177. doi:10.1016/j.jemermed.2011.05.033
24. Dilisio R, Mittnacht AJC. The "medial-oblique" approach to ultrasound-guided central venous cannulation - Maximize the view, minimize the risk. *J Cardiothorac Vasc Anesth*. 2012;26(6):982-984. doi:10.1053/j.jvca.2012.04.013
25. Rolls K, Judy Currey. Nursing Care of Central Venous Catheters in Adult Intensive Care NSWHealth Statewide Guidelines for Intensive Care. 2010;1.
26. MohanChandralekha V, Darlong V KL. Internal jugular vein cannulation - comparison of central approach (palpation method) and posterior approach

(nonpalpation method). *Eur J Anaesthesiol*. 2005;22:197-198.

27. Bikash R Ray, Virender K Mohan, Lokesh Kashyap, Dilip Shende, Vanlal M Darlong and RKP. Internal jugular vein cannulation: A comparison of three techniques. *J Anaesthesilogy Clin Pharmacol*. 2013;29(3):367-371. doi:10.4103/0970
28. Miki I, Murata S, Nakazawa K, et al. Anatomical relationship between the common carotid artery and the internal jugular vein during head rotation. *Ultrasound*. 2014;22(2):99-103. doi:10.1177/1742271X14524571
29. Suarez T, Baerwald JP, Kraus C. Central venous access: The effects of approach, position, and head rotation on internal jugular vein cross-sectional area. *Anesth Analg*. 2002;95(6):1519-1524. doi:10.1097/00000539-200212000-00010
30. Chandrasekaran S, Chandrasekaran VP. Anatomical Variations of the Internal Jugular Vein in Relation To Common Carotid Artery in Lesser Supra Clavicular Fossa – a Colour Doppler Study. *Int J Basic Med Sci*. 2011;1(5):235-241.
31. Robert H Riffenburg. *Statistics in Medicine*. Second. Academic Press.; 2005.
32. Bernard Rosner. *Fundamentals of Biostatistics*. 5th ed. Duxbury; 2000.
33. Srinivasan S, Govil D, Gupta S, Patel S, Jagadeesh KN, Tomar DS. Incidence of posterior wall penetration during internal jugular vein cannulation: A comparison of two techniques using real-time ultrasound. *Indian J Anaesth*. 2017;61(3):240-244. doi:10.4103/ija.IJA_632_16
34. Clenaghan S, McLaughlin RE, Martyn C, McGovern S, Bowra J. Relationship between Trendelenburg tilt and internal jugular vein diameter. *Emerg Med J*. 2005;22(12):867-868. doi:10.1136/emj.2004.019257

35. Parry G. Trendelenburg position, head elevation and a midline position optimize right internal jugular vein diameter. *Can J Anesth*. 2004;51(4):379. doi:10.1007/BF03018243

36. M. Mathur, A. V. L. D'Souza, D. Prasad, R. Garsa, N. Bansal, R. Jhorawat, S. Sharma, P. Beniwal, D. Agrawal and V., Malhotra. A comparative study of central versus posterior approach for internal jugular hemodialysis catheter insertion. *Indian J Nephrol*. 2015;25(5):265-268. doi:10.4103/0971

37. Dhulkhed V, Reddy A, Gupta A, Dhulkhed P. An Observational Study Of Change In Diameter Of Right Internal Jugular Vein With Various Body Positions In Volunteers With The Aid Of 2-Dimensional Ultrasonography. *Internet J Anesthesiol*. 2012;21(2):1-6. doi:10.5580/2132

38. Tsotsolis N, Tsirgogianni K, Kioumis I, et al. Pneumothorax as a complication of central venous catheter insertion. *Ann Transl Med*. 2015;3(3):1-10. doi:10.3978/j.issn.2305-5839.2015.02.11

39. Ayas NT, Norena M, Wong H, Chittock D, Dodek PM. Pneumothorax after insertion of central venous catheters in the intensive care unit: Association with month of year and week of month. *Qual Saf Heal Care*. 2007;16(4):252-255. doi:10.1136/qshc.2006.021162

40. Pikwer A, Bååth L, Davidson B, Perstoft I, Åkeson J. The incidence and risk of central venous catheter malpositioning: A prospective cohort study in 1619 patients. *Anaesth Intensive Care*. 2008;36(1):30-37.

41. Craig RG, Jones RA, Sproul GJ et al. The alternate methods of central venous system catheterization. *Am J Surg*. 1986;34:131-134.

CONSENT FOR PARTICIPATION IN RESEARCH STUDY

Mr/Mrs/Miss. _____ we are requesting you to enroll yourself in study titled **"A COMPARISON OF CENTRAL VERSUS POSTERIOR APPROACH TO INTERNAL JUGULAR VEIN CANNULATION"- A ONE YEAR HOSPITAL BASED RANDOMISED CONTROLLED TRIAL** conducted by **Dr.** _____ , post graduate in M.D. Anaesthesiology under the guidance of **Dr.** _____ M.D.PDCC. Professor Department of Anaesthesiology, J.N. Medical College, Belagavi under KLE Academy of Higher Education & Research, Belagavi.

Respected Sir/Madam We request you to enroll yourself to participate in our study as you are eligible for participating in the study. During the study you will be asked some questions regarding your present complaint and if you consent you will undergo the below explained procedure. You are supposed to answer to the best of your knowledge.

Your participation in this research is voluntary. Your decision whether or not to participate in the study will not affect your relationship with J.N.Medical College. If you decide not to participate you are free to withdraw at any time.

Purpose of the study:

The purpose of this research is to compare the success rate of internal jugular vein cannulation, number of punctures to do so, duration for cannulation and complications in central versus posterior approach in adult patients.

Procedure Involved:

If you agree to enrol yourself in my study, I will ask your present, past and family history. Then you will be clinically examined in detail and routine investigations like haemoglobin, platelet count, will be done accordingly. You will be allotted into one of the two groups randomly using a computer generated random number table. One group will undergo internal jugular vein cannulation via central approach another via posterior approach.

Risks:

The risks like inadvertent puncture of the carotid artery leading to haematoma formation and puncture of pleura leading to pneumothorax are inherent to the procedure. All precautions will be taken to avoid the same.

Benefits:

It is found that posterior approach has fewer chances of associated complications and discomfort.

Voluntary Participation/Withdrawal:

Taking part in the study is voluntary. You may choose not to enrol yourself in this study. Your decision will not change present or future health care services offered to you at K.L.E. hospital.

Alternatives:

Even if you decline the participation in the study, you will get the routine line of management.

Privacy and Confidentiality:

The only people to know that you are a research subject are members of the research team. No information about you or information provided by you during the research will be disclosed to others without your written permission except:

1. In emergency to protect your rights and welfare.
2. If required by law.

Authorization to Publish Results:

When the results of the research are published or discussed, in a conference, no information will be displayed that would disclose your identity. Any information that is obtained in connection with this study and that can be identified with your identity will remain confidential.

Financial Incentives for participation:

No financial incentives are being offered to enrolled patients. It is purely being done with the idea of research and all the cost of the study will be borne by the investigator.

Compensation:

In the event of injury related to the study, treatment will be made available through KLE'S Hospital & MRC, Belagavi. There is no compensation or payment for such medical treatment by law.

Queries:

In case you have any questions related to the study, in future or in case of study related injury or illness, you can contact Dr._____ , Department of Anaesthesiology, KLE'S Hospital and MRC, Belagavi, Or Dr. _____M.D.PDCC., Professor, Dept. Of Anaesthesiology, KLES Hospital and MRC, Belagavi

If you have any queries about your rights as a study subject, you may call Dr. ROOPA M BELLAD, Professor, Department of Paediatrics and Chairman J.N. Medical College Institutional Ethical Committee for Human Subjects Research, Phone number-9448113403 at J.N. Medical College, Belagavi.

Consent for participation in research trial

"A COMPARISON OF CENTRAL VERSUS POSTERIOR APPROACH TO INTERNAL JUGULAR VEIN CANNULATION- A ONE YEAR HOSPITAL BASED RANDOMISED CONTROLLED TRIAL"

I, Mr/Ms/Mrs _____ voluntarily agree for the participation as a subject of the study. By signing this consent form I am not giving up any of my legal rights, I may withdraw from the study anytime. I am signing the consent form after having read or been read for me in vernacular language, including the risks and the benefits and having all my questions answered.

Subject Name : _____

Signature or the Left Thumb Print of patient : _____

Signature or the Left Thumb Print of legally authorized relative: _____

Date:

Witness Name : _____ Signature: _____

Date:

Investigators Name: _____ Signature: _____

Date:

Place : _____

ETHICAL CLEARANCE CERTIFICATE

K.L.E.UNIVERSITY'S
JAWAHARLAL NEHRU MEDICAL COLLEGE,
NEHRU NAGAR, BELAGAVI-590010 (KARNATAKA-INDIA)
(Accredited 'A' Grade by NAAC)

Website: http//www.jnmc.edu
E-Mail : dome@jnmc.edu

Phone: (+ 91-(0)831 Office : 2471350
Principal: 2471701
Fax No. +91 (0)831 – 2470759

Ref: MDC/DOME/50 **Date: 22/11/2017**

To,

PG student in Anaesthesiology,
J.N.Medical College,
BELAGAVI.

Sub: Institutional Ethical Clearance for the study.

With reference to the above, we wish to inform you that your proposed research project titled **"A COMPARISON OF INTERNAL JUGULAR VEIN CATHETERIZATION, CENTRAL VERSUS POSTERIOR APPROACH – A ONE YEAR HOSPITAL BASED RANDOMISED CONTROLLED TRIAL",** is ethical and justifiable. The proposed research project has been cleared by the JNMC Institutional Ethics Committee on Human Subjects Research.

(Dr. Arathi Darshan)
Member Secretary
JNMC Institutional Ethics Committee
on Human Subjects Research,
J.N.Medical College, Belagavi.

(Dr. Roopa M Bellad)
Chairman,
JNMC Institutional Ethics Committee
on Human Subjects Research,
J.N.Medical College, Belagavi.

61

PROFORMA

"A COMPARISON OF CENTRAL VERSUS POSTERIOR APPROACH TO INTERNAL JUGULAR VEIN CANNULATION- A ONE YEAR HOSPITAL BASED RANDOMISED CONTROLLED TRIAL"

Name & Address of the patient:

_____

_____

Age: _____ Sex: _____

IP. No. _____

Anaesthesiologist: _____

Chief Complaints:

Past History:

Family History

On Examination:

Weight: Height: BMI:

PR: B.P: RR: SpO2: Temp:

SYSTEMIC EXAMINATION:

Cardiovascular System:

Respiratory System:

Central Nervous system:

INVESTIGATIONS:

Hb%: Platelet count:

PT-Control APTT-Control

Test Test

INR Ratio

Any Other:

ASA STATUS: Grade I/II/III

Diagnosis:

Proposed Surgery (if Applicable):

Surgeon (if Applicable):

Inclusion Criteria:

- ASA physical status I/II/III.
- Age between 18 to 80 years.
- Undergoing elective/emergency surgery
- Patients in the critical care unit.

Exclusion Criteria:

- Lack of patient consent.
- SVC syndrome.
- Infection at the site of cannulation.
- Coagulopathy (INR > 1.5).
- Prior neck surgery.

Observations:

Technique used: _____.

Group: _____.

Time	Heart rate	Spo2

Time taken to identify/locate the vein/Puncture the vein: _____seconds.

(The needle is considered to be in the internal jugular vein when there is free aspiration of dark coloured blood)

No. of attempts to identify the vein	
1	
2	
3	

Duration for cannulation: _____seconds.

(Time from puncture of vein to catheter insertion into the internal jugular vein)

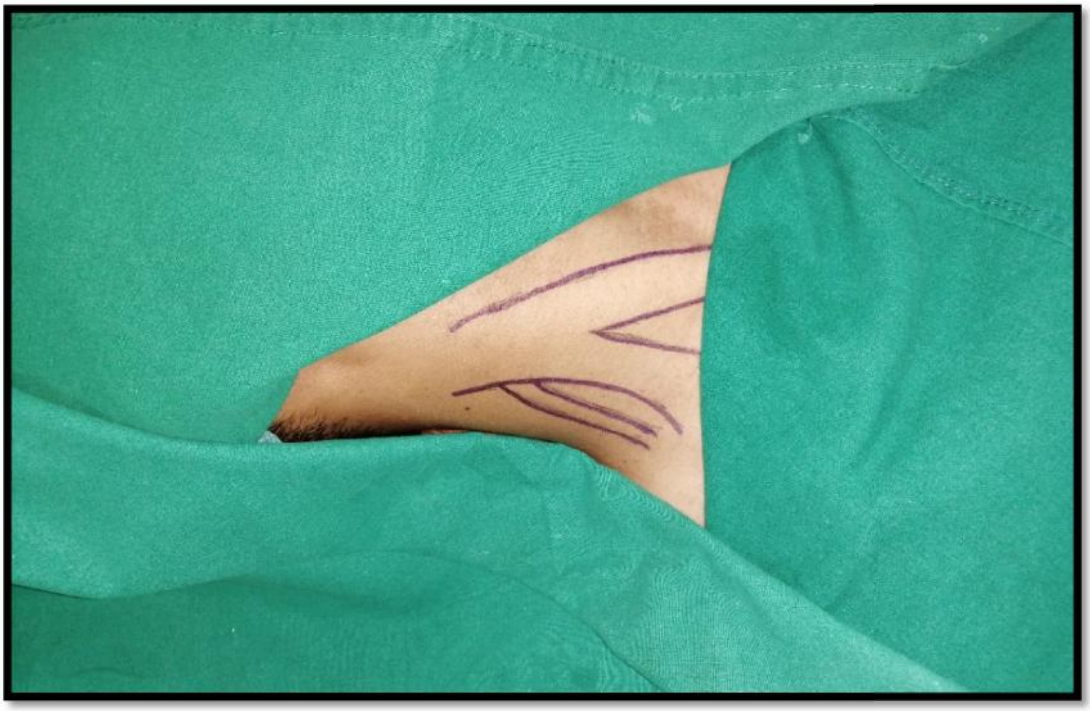
Arterial puncture	YES	NO

Complications	YES/NO
Haematoma	
Pneumothorax	
Catheter displacement	
Others	

Signature of staff in charge:

Signature of Guide:

ANNEXURE IV–PHOTOGRAPHS



PHOTOGRAPH 1

PHOTOGRAPH 2

PHOTOGRAPH 3

KEY TO MASTER CHART

ALD - Alcoholic liver disease

AKI - Acute kidney injury

ASA - American society anaesthesiology (Grades I –V)

CA - Carcinoma

CABG - Coronary artery bypass graft

cm - centimeter

DCM - Dilated cardiomyopathy

F - Female

HTN - Hypertension

HELLP - Hemolysis, low platelet, elevated liver enzymes

IUD - Intrauterine death

kg - kilogram

LSCS - Lower segment cesarean section

M - Male

MI - Myocardial infarction

MR - Mitral regurgitation

MS - Mitral stenosis

PPH - Postpartum haemorrhage

RTA - Road traffic accident

SDH - Subdural hematoma

Sl No.	Name	Age(years)	Gender	Weight(kg)	Height(cm)	ASA	Diagnosis	Time to locate the vein(seconds)	No. of attempts			Duration for cannulation(minutes)	Arterial puncture		Complications					
															Haematoma		Pneumothorax		Catheter Displacement	
									1	2	3		Yes	No	Yes	No	Yes	No	Yes	No
1	Usha Shivankar	28	F	50	152	II	PPH	13	1			4:15		No		No		No		No
2	Rajesh Themur	28	M	46	149	II	RTA with hypovolemic shock	13.4	1			4:20		No		No		No		No
3	Durgappa Desai	48	M	44	150	III	MI	13.9	1			3:45		No		No		No		No
4	Vidya Matre	25	F	47	147	III	DCM in failure	13.6	1			4:50		No		No		No		No
5	Rupali Pawar	22	F	51	156	II	Eclampsia	12.8	1			4:45		No		No		No		No
6	Sneha Patil	30	F	45	145	I	Burns	17.8		2		5:02		No		No		No		No
7	Archana Kanse	46	F	52	160	III	CABG	17.5		2		5:15	Yes			No		No		No
8	Shubangi Kumbar	42	F	55	162	III	DCM in failure	17.6		2		5:20	Yes			No		No		No
9	Savita Shirke	26	F	49	152	II	RTA with hypovolemic shock	14	1			4:05		No		No		No		No
10	Akkatai Javrat	60	F	55	159	III	CABG	17.1		2		5:12		No		No		No		No
11	Manish Yadav	36	M	50	165	II	Polytrauma	19			3	6:14	Yes		Yes			No		No
12	Poonam Thoke	43	F	46	151	II	Burns	16.8		2		5:32	Yes			No		No		No
13	Meenaj Bagwan	27	F	54	160	III	RHD with Severe MS	13.8	1			4:25		No		No		No		No
14	Rajani Mahamuni	41	F	58	165	III	MI	12.5	1			4:58		No		No		No		No
15	Suyesh Yadav	32	M	60	155	II	Hollow viscus perforation	12.3	1			5:10		No		No		No		No
16	Sheetal Khainade	25	F	45	150	II	DCM (LSCS)	12.4	1			5:14		No		No		No		No
17	Nirmal Dange	28	M	53	160	III	Blunt trauma Abdomen	12.7	1			5:15		No		No		No		No
18	Vishal Chougale	33	M	65	164	III	RTA with Polytrauma	18.6			3	6:35	Yes		Yes			No		No
19	Surekha Kambale	37	F	48	157	II	RTA with head injury	13	1			4:45		No		No		No		No
20	Santosh Maudvekar	40	M	59	158	II	ALD	11.8	1			4:55		No		No		No		No
21	Vishaka Kundap	34	F	62	156	II	Obesity, Whipples procedure	18.2			3	6:40	Yes		Yes			No		No
22	Suresh Tembre	31	M	66	165	I	Hollow viscus perforation	17.1		2		5:50	Yes			No		No		No
23	Pallavi Shinde	54	F	47	150	III	CABG	12.1	1			4:45		No		No		No		No
24	Ashwin Shinde	38	M	51	158	III	MI	13.1	1			5:25		No		No		No		No
25	Suvarna Shinde	52	F	57	154	II	CABG	12.5	1			4:20		No		No		No		No
26	Archana Pawar	68	F	56	155	II	CABG	16.7		2		5:20	Yes			No		No		No
27	Rohit Suryawamshi	40	M	49	148	II	Blunt trauma Abdomen	17		2		5:25		No		No		No		No
28	Pooja Tiwari	24	F	50	152	II	Puerperal Sepsis	12.3	1			4:48		No		No		No		No
29	Poonam Pawar	24	F	54	158	I	RTA	13.6	1			4:20		No		No		No		No
30	Reshma Diwan	30	F	51	149	II	IUD with Sepsis	12.3	1			4:35		No		No		No		No
31	Ramesh Pawar	26	M	58	159	II	Acute Pancreatitis	14.1	1			4:55		No		No		No		No
32	Pallavi Salunkhe	21	F	48	150	II	IUD with Sepsis	15.8		2		5:35		No		No		No		No
33	Prathamesh Potdar	60	M	55	154	III	Hollow viscus perforation	18.9			3	6:55	Yes		Yes			No		No
34	Archana Yelmar	28	F	50	152	I	Burns	13.4	1			5:40		No		No		No		No
35	Asmita Mohite	24	F	56	157	II	PPH	12.6	1			5:35		No		No		No		No
36	Vishal Jagtap	26	M	58	149	II	SDH	12.9	1			4:55		No		No		No		No
37	Sumal Bhusari	50	F	60	162	II	Crush injury	18.6		2		4:58	Yes			No		No		No
38	Savita Mandhare	21	F	46	149	III	severe MS	13.5	1			4:40		No		No		No		No
39	Vishwanath Chondale	44	M	65	168	II	ALD	13.1	1			4:45		No		No		No		No
40	Ravi Jadhav	54	M	68	164	III	MI	12.4	1			4:58		No		No		No		No
41	Gauri Jandale	29	F	50	154	II	MS with MR	18.2		2		5:30		No		No		No		No
42	Amit Shinde	68	M	50	160	III	CABG	14	1			5:15		No		No		No		No
43	Anandrao Salan	48	M	70	162	II	CABG	13.8	1			5:25		No		No		No		No
44	Vaishali Gaikwad	33	F	49	151	II	Intestinal obstruction	12	1			5:20		No		No		No		No
45	Renuka Jarapurkar	40	F	52	158	II	Crush Injury	13.1	1			5:30		No		No		No		No
46	Vaishali Jadhav	21	F	45	153	III	HELLP	12.6	1			5:18		No		No		No		No
47	Suvarna Nalawale	24	F	53	148	I	SDH	13.8	1			5:26		No		No		No		No
48	Jayesh salunkhe	42	M	50	155	III	ALD	17.1		2		6:00	Yes			No		No		No
49	Bharat Patil	48	M	69	168	II	Whipple's procedure	12.4	1			5:03		No		No		No		No
50	Sameer Surve	39	M	58	160	II	Hollow viscus perforation	13	1			5:08		No		No		No		No
51	Kalpesh Therath	50	M	50	154	II	RTA with Polytrauma	12.4	1			5:12		No		No		No		No
52	Priyank Jadhav	30	M	55	159	II	Acute Pancreatitis	11.5	1			4:55		No		No		No		No
53	Pravin salunkhe	40	M	72	169	III	HTN Bleed	11.8	1			4:40		No		No		No		No
54	Gautami Kambale	25	F	52	157	II	HELLP	11.9	1			4:30		No		No		No		No
55	Mathura Jadhav	45	F	50	152	III	DCM	16.9		2		5:16	Yes		Yes			No		No
56	Shivaji Kakade	25	M	52	160	II	Burns	14	1			4:42		No		No		No		No
57	Hanmant Giribuva	55	M	64	166	II	Crush Injury Leg	12.3	1			4:45		No		No		No		No
58	Shantal Pawar	24	F	66	170	III	Gunshot Aneurysm	11.9	1			4:58		No		No		No		No

Sl No.	Name	Age(years)	Gender	Weight(kg)	Height(cm)	ASA	Diagnosis	Time to locate the vein(seconds)	No. of attempts			Duration for cannulation(minutes)	Arterial puncture		Complications					
															Haematoma		Pneumothorax		Catheter Displacement	
									1	2	3		Yes	No	Yes	No	Yes	No	Yes	No
1	Dagudu Suryawamshi	53	M	68	167	II	Sepsis	10	1			3:50		No		No		No		No
2	Lalita Garud	35	F	52	154	II	RTA with hypovolemic shock	11	1			3:34		No		No		No		No
3	Laxmi Dhotare	27	F	48	147	III	Burns	9.5	1			3:45		No		No		No		No
4	Balu Kambale	60	M	69	165	III	MI	10.2	1			3:25		No		No		No		No
5	Reshma Patil	32	F	56	159	II	Eclampsia	9.6	1			4:02		No		No		No		No
6	Divya Pawar	27	F	51	152	II	PPH	10.6	1			3:56		No		No		No		No
7	Sarika Pawaskar	25	F	57	158	II	Eclampsia	9.4	1			3:38		No		No		No		No
8	Shankar Pachave	45	M	49	151	III	DCM in failure	10.3	1			3:52		No		No		No		No
9	Dattatreya Mohite	35	M	60	164	II	RTA with hypovolemic shock	11.4	1			3:32		No		No		No		No
10	Sujata Chavan	32	F	58	153	II	AKI with CHF	13		2		4:10		No		No		No	Yes	
11	Rijwana Shaikh	29	F	54	155	II	PPH	12.4	1			4:15		No		No		No		No
12	Prateek Ghadge	65	M	50	150	III	ALD with Failure	11.5	1			4:08		No		No		No		No
13	Rupali Naik	23	F	59	154	II	RHD with Severe MS	11.3	1			4:26		No		No		No		No
14	Uddhav Chavan	40	M	68	167	II	MI	14.8		2		3:50		No		No		No		No
15	Surekha Kanse	28	F	48	154	II	Puerperal Sepsis	9.8	1			3:40		No		No		No		No
16	Preeti Chaudri	30	F	53	157	II	DCM (LSCS)	9.4	1			3:56		No		No		No		No
17	Vidya Jadhav	43	F	80	159	II	Small bowel Perforation	10.8	1			4:10		No		No		No		No
18	Nishant Shinde	30	F	51	152	III	RTA with Polytrauma	13	1			4:25		No		No		No		No
19	Swati Satre	26	F	54	149	I	RTA with head injury	13.5	1			4:13		No		No		No		No
20	Asma Inamdar	64	F	47	150	III	CA Cervix	14.9		2		3:38		No	Yes			No		Yes
21	Nilesh salunkhe	42	M	85	168	II	Obesity, Whipples procedure	10.3	1			3:30		No		No		No		No
22	Ramappa	40	M	50	160	I	Hollow viscus perforation	13.6	1			3:48		No		No		No		No
23	Savita Pawar	45	F	55	151	II	Ca stomach	12	1			4:10		No		No		No		No
24	Rekha Kharade	48	F	58	159	II	MI	12.1	1			4:12		No		No		No		No
25	Kiran Chavan	41	M	62	155	III	CABG	15		2		3:28		No		No		No	Yes	
26	Shahin Aga	44	F	60	161	III	CABG	9.9	1			3:38		No		No		No		No
27	Sunita Jagdale	27	F	52	153	II	PPH	10.9	1			3:48		No		No		No		No
28	Mahadev Kumbar	62	M	56	159	II	Blunt trauma Abdomen	12.8	1			3:56		No		No		No		No
29	Seema Yedge	23	F	61	157	III	RTA	13.2	1			4:17		No		No		No		No
30	Sonali Khade	20	F	49	150	II	PPH	13.6	1			4:30		No		No		No		No
31	Uttam Desai	50	M	69	164	II	Acute Pancreatitis	11.7	1			4:45		No		No		No		No
32	Anita Jadhav	28	F	57	151	II	IUD with Sepsis	14.8		2		3:25		No		No		No		No
33	Shankar Bhaste	55	M	65	160	II	Hollow viscus perforation	10.8	1			3:35		No		No		No		No
34	Shobha Salunkhe	27	F	50	162	II	Sepsis	14.2	1			3:48		No		No		No		No
35	Seema Galve	24	F	45	149	II	RTA with splenic laceration	11.4	1			3:58		No		No		No		No
36	Anita Ainane	30	F	51	155	II	SDH	12	1			3:40		No		No		No		No
37	Rajashree Jadhav	30	F	50	153	II	Eclampsia	11.5	1			3:45		No		No		No		No
38	Satish Bansode	35	M	62	166	II	severe MS	13.5		2		3:55		No	Yes			No		No
39	Rupali Jadhav	48	F	45	147	II	Sepsis	12.6	1			3:58		No		No		No		No
40	Sunita Jadhav	55	F	48	156	III	MI	11.8	1			4:10		No		No		No		No
41	Sarika Phadtare	28	F	50	155	III	MS with MR	13	1			4:12		No		No		No		No
42	Jayawant Marathe	42	M	69	160	II	CABG	11	1			4:15		No		No		No		No
43	Yakeerappa	70	M	52	152	II	CA Oesophagus	12.4	1			3:54		No		No		No		No
44	Chandrakant	47	M	60	159	II	Intestinal obstruction	14.1		2		4:05		No		No		No		No
45	Barage Rani	35	F	49	150	I	Crush Injury	11.6	1			3:38		No		No		No		No
46	Manisha Chougale	25	F	60	151	I	PPH	12	1			3:59		No		No		No		No
47	Sharad Salunkhe	45	M	57	156	II	MI	12.3	1			3:45		No		No		No		No
48	Shivalingappa	72	M	50	149	II	CA Oesophagus	13	1			4:10		No		No		No		No
49	Allaya	60	M	51	150	III	Whipple's procedure	11.8	1			4:18		No		No		No		No
50	Rupali Desai	22	F	55	154	II	Blunt trauma Abdomen	13.6		2		4:20		No		No		No		No
51	Madhur Yadav	51	M	64	158	I	RTA with Polytrauma	12.4	1			3:37		No		No		No		No
52	Ramu	71	M	70	161	III	Polytrauma	11.8	1			3:46		No		No		No		No
53	Govind Patil	60	M	50	160	II	HTN Bleed	13.2	1			3:58		No		No		No		No
54	Anuradha Jadhav	24	F	57	154	I	Polytrauma	12.8	1			4:20		No		No		No		No
55	Bhosale Shubangi	60	F	45	150	III	HTN Bleed	13.8	1			4:17		No		No		No		No
56	Bhagyashree Zimre	25	F	45	149	I	Burns	13.8		2		3:48		No		No		No		No
57	Prasad M	24	M	50	151	I	Crush Injury Face	11.8	1			3:59		No		No		No		No
58	Bhimappa	52	M	47	152	III	Cerebral Aneurysm	12	1			4:04		No		No		No		No