"COMPARISON OF LINEAR VERSUS MICRO CONVEX TRANSDUCER FOR ULTRASOUND-GUIDED SUBCLAVIAN VEIN CANNULATION"

By

Dr. DHANALAKSHMI. M

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In partial fulfillment of the requirements for the degree of

DOCTOR OF MEDICINE

IN

ANAESTHESIOLOGY

Under the Guidance of

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ABSTRACT

INTRODUCTION

Insertion of central venous catherization (CVC) is one of the most prevalent procedures in the critical care unit (CCU) & operation theatres for gaining venous access, fluid resuscitation, and administering medications, particularly vasopressors. Traditionally subclavian vein cannulation was performed under ultrasound-guided using high-frequency (6 to 13 MHz) linear transducers. Recent literature suggests that a micro-convex ultrasound probe can also be used to cannulate the subclavian vein. As there is not much literature comparing micro convex (5 to 8 MHz) and linear transducers (6 to 13 MHz) for CVC, we have taken up the study to compare the strengths and weaknesses using the above mentioned probes for subclavian vein cannulation through the infraclavicular approach.

OBJECTIVES OF THE STUDY

The primary objective of the study was to compare the following parameters while performing ultrasound-guided subclavian vein cannulation using linear or micro convex transducers.

1. Time taken for cannulation.
2. Number of attempts taken for cannulation.

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Date: **Dr. DHANALAKSHMI. M**

Place: Kolar

ABBREVATIONS

CVC	Central venous catherization
USG	Ultrasound guided
CCU	Critical care unit
ICU	Intensive care unit
IJV	Internal jugular vein
CLABSI	Central line associated blood stream infection
IV	Intravenous
CRBS	Catheter-related blood stream
US	Ultrasound
Hz	Hertz
USG	Ultrasound-guided
Sec's	Seconds
m/sec	Meter/second
Cm's	Centimeters
TGC	Time gain compensation
THI	Tissue Harmonic Imaging
B-mode	Brightness mode
M-Mode	Motion mode

ABBREVATIONS

IBW	Ideal Body weight
BMR	Body mass rate
ECG	Electrocardiogram
Group – L	Linear
Group – M	Micro-convex
OT	Operation theatre
INR	International Normalized ratio
NICE	National Institute for health & clinical Excellence

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ABSTRACT

COMPARISON OF LINEAR VERSUS MICRO CONVEX TRANSDUCER FOR ULTRASOUND-GUIDED SUBCLAVIAN VEIN CANNULATION

INTRODUCTION

Insertion of central venous catherization (CVC) is one of the most prevalent procedures in the critical care unit (CCU) & operation theatres for gaining venous access, fluid resuscitation, and administering medications, particularly vasopressors. Traditionally subclavian vein cannulation was performed under ultrasound-guided using high-frequency (6 to 13 MHz) linear transducers. Recent literature suggests that a micro-convex ultrasound probe can also be used to cannulate the subclavian vein. As there is not much literature comparing micro convex (5 to 8 MHz) and linear transducers (6 to 13 MHz) for CVC, we have taken up the study to compare the strengths and weaknesses using the above mentioned probes for subclavian vein cannulation through the infraclavicular approach.

OBJECTIVES OF THE STUDY

The primary objective of the study was to compare the following parameters while performing ultrasound-guided subclavian vein cannulation using linear or micro convex transducers.

1. Time taken for cannulation.
2. Number of attempts taken for cannulation.
3. Rate of infection at the site of insertion.
4. Rate of complication’s like – pneumothorax, hematoma, and
5. arterial puncture.

MATERIALS AND METHODS:

SOURCE OF DATA

A randomized control trial was conducted on 40 patients requiring subclavian vein cannulation & admitted to either ICU or undergoing an elective surgical procedure in operation theatre at R.L Jalappa hospital & Research centre (RLJH), Tamaka, kolar from January 2021 to May 2022

METHODOLOGY

Total of 40 patients, 20 in each group was calculated. Patients in group- L will be subjected to USG guided infraclavicular approach to subclavian vein cannulation using a linear transducer (6 to 13 MHz) and patients in group- M will be subjected to USG guided infraclavicular approach to subclavian vein cannulation using a micro convex transducer (5 to 8 MHz).

RESULT:

Mean time taken for cannulation in group L is 127.85 + 7.47 seconds and group M is 127 + 7.87 seconds with p value of 0.860, respectively.

CONCLUSION:

We conclude that the micro convex probe helps in a better appreciatio of sono-anatomy and visualisation of deeper structures & hence would decrease the incidence of complication when the procedure is performed by clinicians proficient in using ultrasound with a micro-convex probe.

KEY WORDS:

linear transducer, micro convex transducer, ultrasonography of subclavian vein.

INTRODUCTION

INTRODUCTION

Many studies have concluded that ultrasound-guided (USG) infraclavicular subclavian vein cannulation results in reduced rate of complications and a higher success rate when compared to the landmark technique.[1,2]

Internal jugular vein (IJV) and subclavian vein cannulations are associated with decreased risk of central line associated bloodstream infection (CLABSI) when compared to femoral venous cannulation. Subclavian vein is the preferred site for CVC because it is not only associated with decreased catheter-related blood stream infection (CRBS) but also associated with better patient compliance compared to IJV and femoral CVC. Traditionally, linear array transducer with (5 to 15 MHz) is used to cannulate central veins. Even subclavian vein is cannulated through infraclavicular approach using linear array transducer. Recent literature suggest that subclavian vein can also be cannulated using micro convex transducer (5 to 8 MHz).[7]

In the past, clinician had difficulty in visualization of subclavian vein using ultrasound & hence higher complication rate when subclavian vein was cannulated under ultrasound guidance. Over a period of time, the clinicians have developed proficiency in cannulating subclavian vein under USG.[3,4,5]

AIMS & OBJECTIVES

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- ✓ To compare the safety and efficacy of micro convex probe over linear transducer probe for real-time ultrasound-guided infraclavicular subclavian vein cannulations.

1. The primary objective of the study was to compare the following parameters while performing ultrasound-guided subclavian vein cannulation using linear or micro convex transducers.

- Time taken for cannulation.
- Number of attempts taken for cannulation.
- Rate of infection at the site of insertion.
- Rate of complications like – pneumothorax, hematoma, and arterial puncture.

HISTORY

Forssmann carried out the first central venous catheterization in 1929.[8] In order to quickly and efficiently deliver emergency medications on the table during periods of sudden cardiac failure, he came up with the notion of inserting a catheter into the right heart.

The idea of performing venepuncture through the infraclavicular subclavian vein was initially proposed by Aubanaic in 1952.[9] This method was initially solely employed for blood sample and the infusion of life-saving medications. Aubanaic used this method to do angiography later in 1954.[10]

Through this method, Wilson et al. were the first to introduce a flexible central catheter into the superior vena cava after 8 years. In an effort to prevent the pneumothorax complication, Yoffa first reported the supraclavicular technique for subclavian vein surgery in 1965.[11]

ANATOMY

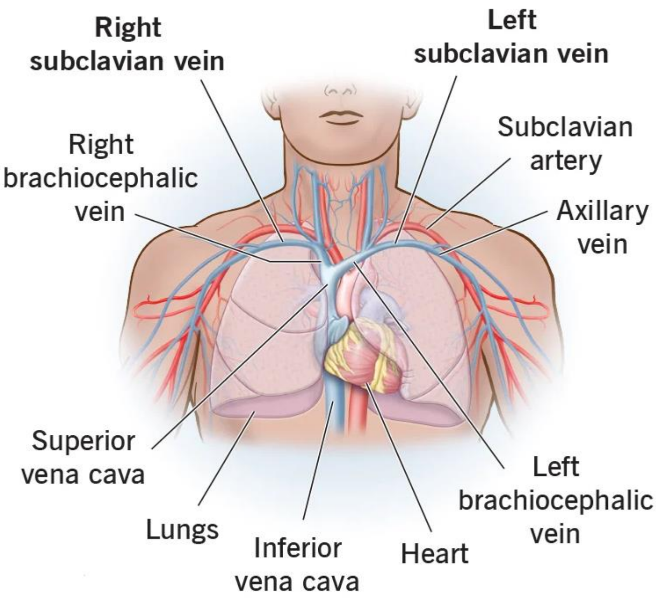
Axillary vein is formed by union of brachial vein and basilic vein at inferior border if thr teres major. Axillary vein becomes "subclavian vein" at the lateral border of 1st rib.[12]

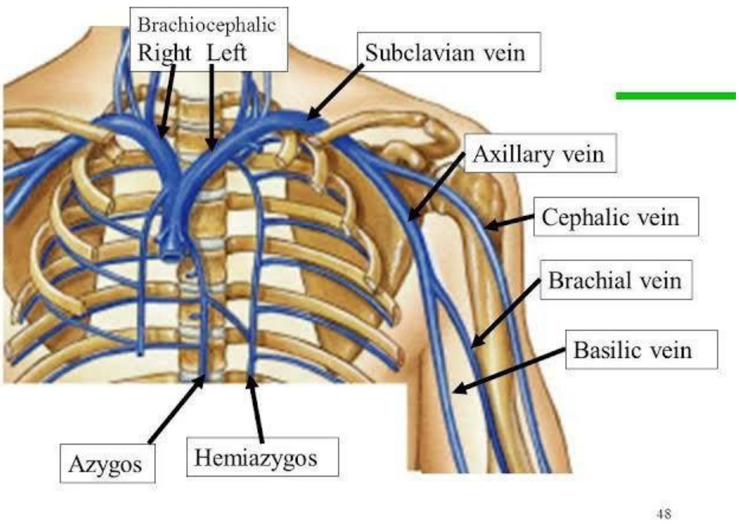
Subclavian and internal jugular vein are preferred site for CVC for both landmark and USG-guided CVC. Understanding the anatomy of the upper extremity venous system is crucial for both landmark & USG guided CVC.[13]

Superficial and deep veins make up the upper extremity veins. Arteries are always present alongside deep veins. The brachial, axillary and subclavian veins are the deep veins of upper limb.

Subclavian vein originates at the outer border of the first rib and extends 3 to 4 cm under the clavicle. Subclavian vein continues as brachiocephalic vein at sternoclavicular junction my union of subclavian and IJV.[14]

Fig 1 : Anatomy of subclavian vein





Central venous catheter:

CVC is a thin, flexible tube that is inserted into central vein like IJV, subclavian, or femoral. It is used to give IV fluids, blood transfusions, vasopressors, inotropes, chemotherapy & other drugs. A distal and proximal end is on the catheter body of a central venous catheter.[15]

The distal end, which is located closer to the patient, has several lumens running the length of it. The proximal end is the operator's end and has side ports that continue with the corresponding lumens.

These side ports of a triple-lumen catheter are labeled as proximal, medial, and distal ports, and they are coloured according to where the distal lumens are located.

The distal port is the biggest and is mostly utilized for intravenous fluid administration and central venous pressure monitoring. Total parenteral nourishment and intravenous drugs are administered through the medial port, while blood and blood products are administered through the proximal port.

The guide wire or Seldinger technique

Seldinger technique is a commonly used procedure to obtain safe access to central vein. Sven Ivar Seldinger, a Swedish radiologist, first proposed it as an arterial cannulation technique for performing arteriography. Under strict asepsis, a central line is punctured by an appropriate size needle & a guide wire is then inserted via the needle to enlarge the tract for catheter insertion, one or more dilators are employed.[16]

The guide wire is withdrawn after the catheter has been inserted over it. Sterile transparent dressing is applied over the catheter insertion site &all the waste materials are discarded in appropriate biomedical waste bins.

Methods of cannulating subclavian vein through infraclavicular approach

1. The traditional or landmark method;
2. Ultrasound guidance

- ✓ The two primary techniques for subclavian catheterization—supraclavicular and infraclavicular—can be carried out using either of the methods described above. The most frequent method is the infraclavicular approach.
- ✓ In the present study we performed USG subclavian cannulation.

Ultrasound-guided method:

USG central venous cannulation is regarded as the gold standard technique because of faster insertion & fewer complications when compared to landmark technique.[17]

BASIC PRINCIPLES OF ULTRASOUND PHYSICS

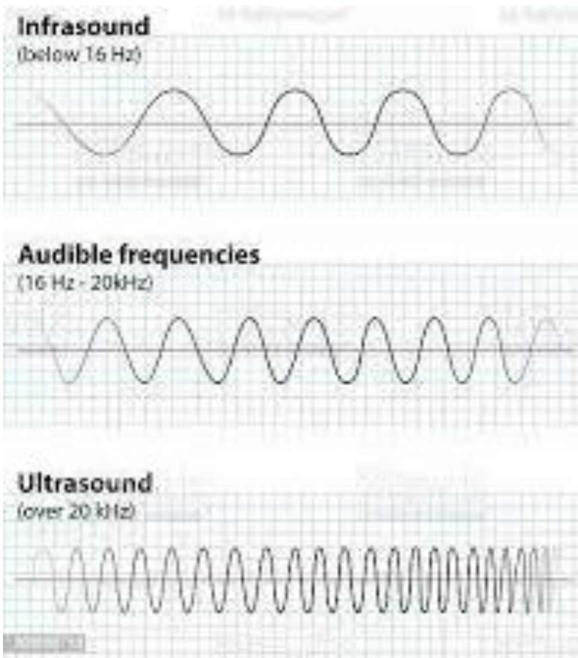
Sounds and their types:

Mechanical vibration is what is being transferred as sound through an elastic material. Within the tissue, this vibration causes a region of compression followed by rarefaction. One cycle or wavelength is equal to the product of one compression and one rarefaction. The frequency, which is measured in Hertz (Hz), is the number of wavelengths per unit of time. The velocity of sound, which is approximately 1540 meters per second in soft tissue, is the result of the inverse relationships between frequency and wavelength. There are three different types of sounds: infrasound, ultrasound, and audible sound.[18]

Depending on the frequencies, they can be differentiated:

- 20 Hz to 20,000 Hz for audible sound
- Infrasound is below 20 Hz.
- Ultrasound is above 20,000 Hz

Fig 2 : Sound waves

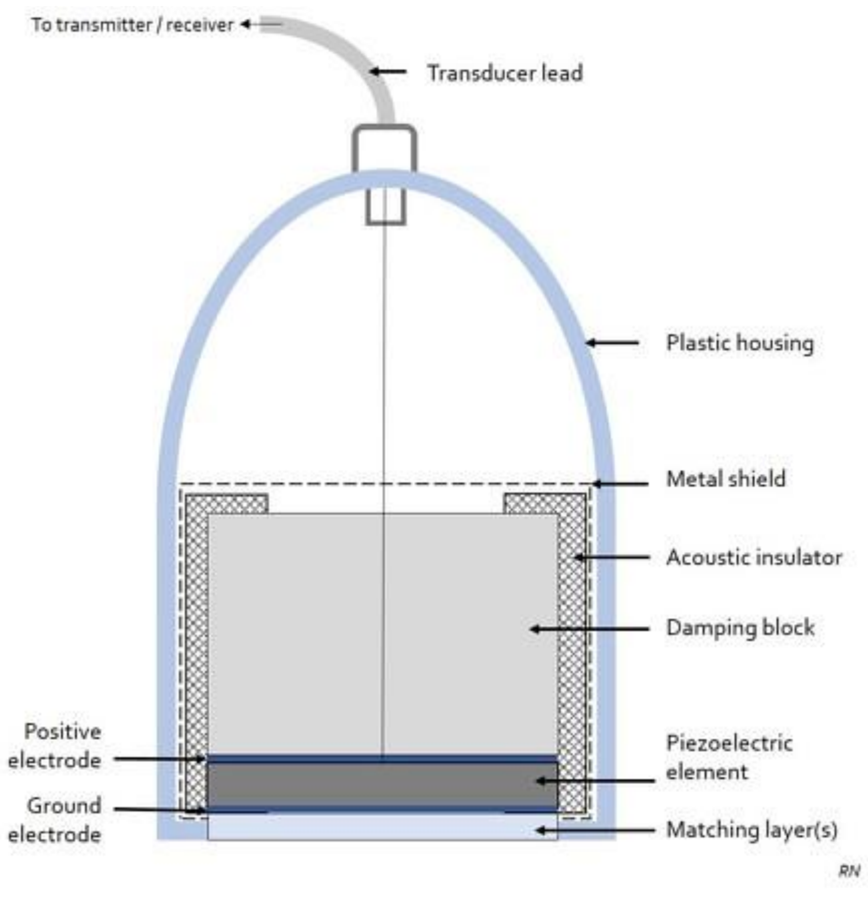


Ultrasound probe:

The piezo-electric crystals present in the transducer of the ultrasound machine produce ultrasound waves when subjected to alternating electric current.

These crystals vibrate as a result of the alternating electric current, and produce ultrasound waves that pass into the tissues & reflected back to piezo-electric crystals. [18]

Fig 3 : Ultrasound transducer



Frequency:

The frequency of an ultrasonic wave is determined by how many cycles or pressure changes take place in a second. Cycles per second or hertz are the units.[19]

Propagation speed:

Propagation speed, which is generally regarded as 1540 m/sec for soft tissue, is the rate at which sound may move through the body tissues.[19]

Pulsed ultrasound:

This term refers to a technique for producing ultrasound waves from a source. Pulsed beams are utilised to provide the depth of resolution needed for therapeutic purposes.[19]

Transducer Structure:

The backing material, piezo-electric crystals, and matching layer make up the bulk of the transducer's construction, which is built to create and transmit ultrasonic waves as efficiently as possible.[20]

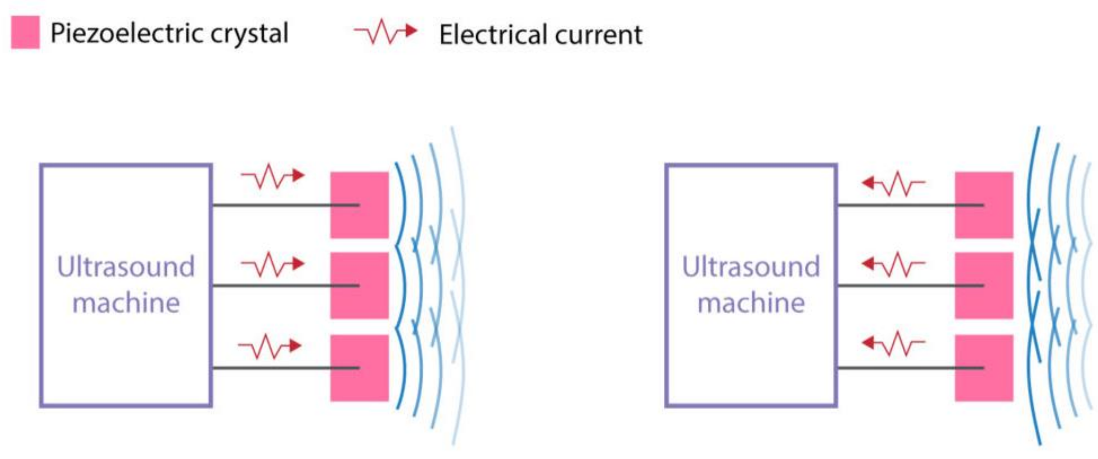
The matching layer and the backing layer are sandwiched between the piezoelectric crystals. Piezoelectric crystals are systematically placed and electronically coupled. The thickness of each crystal determines the frequency of the transducer. The backing material absorbs the backward and laterally transmitted ultrasonic energy and shortens the piezoelectric crystals' ringing response to the brief excitation pulse. The matching layer, which is positioned immediately below the transducer's footprint (where it touches the skin), reduces the ultrasonic beam's reflection and refraction as it passes through the transducer.

Piezoelectric effect:

The idea behind the piezo-electric effect was put forth by the Curie brothers in 1880. Modern transducers frequently use artificially formed crystals that have been subjected to high temperatures and powerful electric fields in order to give them the piezoelectric qualities required to produce sound waves. Based on the theory of piezoelectricity, which claims that some materials generate a voltage whenever a pressure is applied and a pressure when a voltage applied to them, ultrasonic beams are created. As a result, depending on the polarity of the applied voltage, a crystal will either expand or contract when a voltage is applied to its faces.[21]

As a result of the crystals resonance, ultrasound is produced from electricity. The crystal's thickness affects the frequency of the sound generated. On the other hand, when the crystal hears an echo, the sound deforms it and creates a voltage on its faces, which the system then analyses.

Fig 4 : Piezoelectric effect



Types of transducers :

The transducers are comprised of piezoelectric crystals, which convert electrical energy into mechanical energy to produce ultrasonic waves. These crystals also act as a medium for converting ultrasound echoes back into electrical energy. The thickness of these crystals controls the transducer's frequency, and the transducer's form affects the ultrasonic beam's shape.[22]

Frequencies used by medical ultrasounds range from 1 to 20 MHz. Curvilinear probes (5-10 MHz) have lesser resolution but greater penetration. In contrast, high-frequency probes (10-15 MHz) have lesser penetration but offer superior resolution. Therefore, intermediate-frequency probes are chosen to visualise somewhat deeper structures (5-6 cm) while probes with higher frequencies are used for visualizing structures that lie superficially (2-4 cm).

These transducers come in various shapes and sizes, including linear, curvilinear, phased array, & micro convex. Low-frequency curvilinear probes are employed to image deep abdominal structures, while high-frequency linear probes are favored for superficial imaging vascular structures. For instance, a transducer with a curved (round) footprint will emit a cylindrical beam (the footprint is the region of the transducer that touches the skin). A large rectangular beam will be produced by the transducer with a rectangular (linear) footprint.[23]

Fig 5 : Ultrasound probe

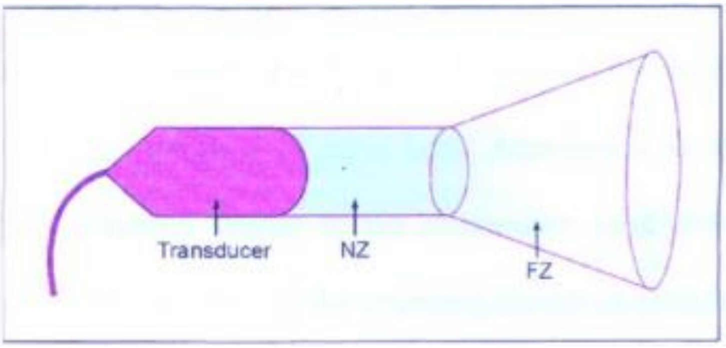


Fig 6 : Transducer with curved footprint producing a cylindrical beam

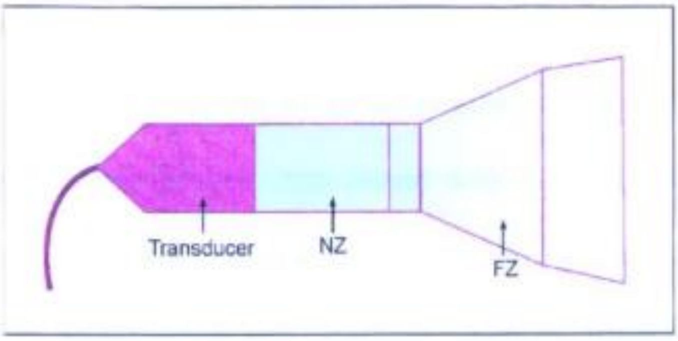


Fig 7 : Transducer with rectangular footprint producing a rectangular beam

Amplitude:

The ultrasound's amplitude is defined as the difference between both the peak and average pressures created by the sound wave inside the tissue. It is a measurement of the sound wave's power and is expressed in decibels. A rise of six decibels, on average, doubles the loudness.

Attenuation:

When ultrasound travels through the body, its amplitude diminishes, or it is attenuated. The main causes of attenuation are absorption, reflection, and scatter. Approximately 80% of acoustic energy absorbs and transformed to heat. Frequency also influences attenuation. The attenuation increases with frequency. The process of reducing attenuation by boosting the returning signals in specific portions of the image is known as time gain compensation (TGC).[24]

Acoustic Impedence:

The resistance to ultrasonic wave propagation is known as acoustic impedance. The density of the material through which ultrasonic wave travels affects impedence. The interface is the boundary zone between two tissues with varying resistance to ultrasound (e.g., bony surface and surrounding tissue). More ultrasound is reflected back towards the transducer as resistance increases. Rayles units are used to quantify acoustic impedence, which is a function of the medium's physical density and sound wave velocity.

Image Resolution:

The ultrasound machine's built-in image resolution is incredibly useful to the operator. Resolution is the ultrasonic device's capacity to separate two features (reflectors or scatters) that are near to one another into independent images. Image resolution is described as following.[25]

1. **Axial resolution:** It is the ability to visualize two structures that are side by side as distinct image when they are parallel to the US beam.
2. **Temporal resolution:** Describes how quickly successive images are perceived. It is dependent on the pulse rate or frame rate. It helps to visualize rapidly moving structures.
3. **Lateral resolution:** The ability to differentiate tissues on ultrasound monitor can be done by altering the picture gain.
4. **Contrast resolution:** Any imaging modality's capacity to differentiate between changes in image intensity.[20]

Frequency, Penetration, and Resolution Relationship:

The operator will be better able to select the appropriate transducer for a specific process if they are aware of the link between frequency, penetration, and resolution (of the probe). Since speed is the result of wavelength and frequency, sound moves through tissues at a roughly constant rate.

$$\text{Wavelength x frequency = Speed}$$

The frequency will rise at the expense of the wavelength if the speed must remain practically constant. In other words, the resolution is improved, but the penetration is decreased. High-frequency transducers are most appropriate for ultrasound-guided blocks because the majority of the nerves are superficial structures.

Tissue Harmonics Imaging:

The original frequency of the ultrasound may vary as it spreads into soft tissue due to nonlinear interactions with the tissues. New frequencies that were not present in the original ultrasound are produced as a result, and they are referred to as harmonics. Two things set harmonic frequencies apart from fundamental frequencies. As the wave enters the body, the harmonics become more potent (contrary to the behavior of fundamental frequency).

The fundamental frequency's strength attenuates by about 80% at a depth of 6 to 8 cm, where the relative strength of the harmonic frequency is maximum. As a result, an image created using only reflected harmonics is sharper and practically artifact-free (after deleting the reflected fundamental). Tissue Harmonic Imagining (THI) mode, for instance, will provide a better image for adult lumbar plexus blocks.

Doppler:

Christian Doppler, an Austrian physicist, initially identified the Doppler Effect in 1841.

Doppler ultrasonography detects sound waves emitted by moving objects like red blood cells. This is referred to as the Doppler effect. Doppler shift refers to the frequency difference between the incident ultrasound beam and the returned echoes.[26]

Colour Doppler:

This sort of Doppler utilizes a computer to convert sound waves into distinct colours. These colours represent the speed and direction of blood flow. Because proximal nerves are often hypo-anechoic and can be misidentified for blood vessels, this function may be beneficial. When necessary, it can also be utilized to determine the blood flow's direction. There might be no color on the screen if the flow is low and the angle of incidence is near 90°, which could lead to a misleading negative reading that there is "no flow."

To improve vascular detection sensitivity, the probe should be tilted out and away from the perpendicular angle of incidence. In such cases, Power Doppler should be used since, in contrast to regular Color Doppler, it is more able to detect low flow in small blood arteries despite an unfavorable angle of incidence.[27]

Echogenicity:

The ability of a tissue to reflect or transmit ultrasonic waves in relation to other tissues is referred to as echogenicity. A noticeable change, in contrast, will be displayed on the screen whenever there is an interface of structures with varied echogenicities. A structure can be classified as hyperechoic (white on the screen), hypoechoic (grey on the screen), or anechoic based on its echogenicity (black on the screen). Blood in the vessels is anechoic. Bone appears hyperechoic. [28]

If US is performed while the patient is breathing, it is frequently possible to see a "shimmering," hyperechoic pleura sliding in rhythm with each breath comet tail artefacts.

Loss of sliding and shimmering pleura and comet tail artefact may be caused by pneumothorax.[29]

Angle of incidence:

The angle of incidence, which determines how the structure appears on the screen, is the angle at which the US waves interact with its surface. The image will be better if the angle is perpendicular or nearly perpendicular because more US waves will be reflected back to the transducer, and fewer will be "scattered" away. The image will have less definition if the US waves are more parallel to the object's surface (at an incidence angle greater than 45°). By tilting or rotating the probe, the operator can change the angle of incidence and enhance the image of the target.[23]

Gain, Focus, and Scan Mode in Knobology:

Gain is the process of increasing the signal's amplitude upon return. As the gain is adjusted, the quantity of white, black, and grey on the screen changes. The general signal strength and brightness increase as the gain is increased. As background structures (noise) are also increased, this might not be ideal43.

The ability to differentiate tissues on ultrasound monitor can be done by altering the picture gain; the quantity of gain to use is a personal preference.[18]

- Greater gain results in a brighter visual presentation.
- Less gain results in a darker visual projection.[20]

An auto-gain knob, found on the majority of US machine, is frequently used.

The sound waves "focus" in a location known as the focal zone before diverging. Although it is seldom required for surface structures if the depth is appropriately specified, it may aid in increasing visibility of the intended structure.

Modes of ultrasound:

1) A-mode:

This is ultrasound's most basic mode. A-mode scan results in a waveform with spikes at the interface of two different tissues. A-mode ultrasound is also utilised for therapeutic ultrasound because it permits destroying wave energy to be accurately directed on a specific tumor or calculus.[30]

2) B-mode:

B-mode scan produce a two-dimensional image of underlying tissues. This mode helps in identification of lesions, cysts or tumors. This is the imaging technique most frequently used for performing CVC. It makes it possible to see vascular structures and their properties in great detail. Additionally, it offers details on the vessel's dimensions, the presence of luminal blockage, and morphological changes

3) M-mode:

It is a form of ultrasound imaging in which a single scan line is emitted, received & displaced graphically often utilized for its excellent axial & temporal resolution of structures.[31]

Depth settings:

It is advisable to start ultrasound scan with slightly higher depth setting in order to obtain a bigger image. Once the desired structure has been identified, the depth should be gradually decreased. The desired depth should be 1 cm deeper than the desired target. Depth should be further increased if another significant structure like a vessel or lung, is located in the immediate vicinity of the target tissue.[23]

Probe orientation:

Probe orientation is crucial to prevent confusion with regard to probe manipulation, insertion & advancement of the needle. Therefore, in order to determine the proper orientation of the image, it is important to orient the marker on the probe with marker on the screen.

Probe (transducer) movements:

The three probe movements that are most frequently utilized for picture optimization are sliding, angulations, and rotation.[23]

Needle and probe relationship:

'In-Plane' approach

In this method, the entire needle is visualized on the screen as the needle is placed into the plane of ultrasound beam.

'Out-of-plane' approach

In this approach, the needle insertion path will cross the plane of ultrasound beam. Unlike the in-plane approach, only the tip of the needle is visualized on the screen as a dot when the needle crosses the ultrasound beam

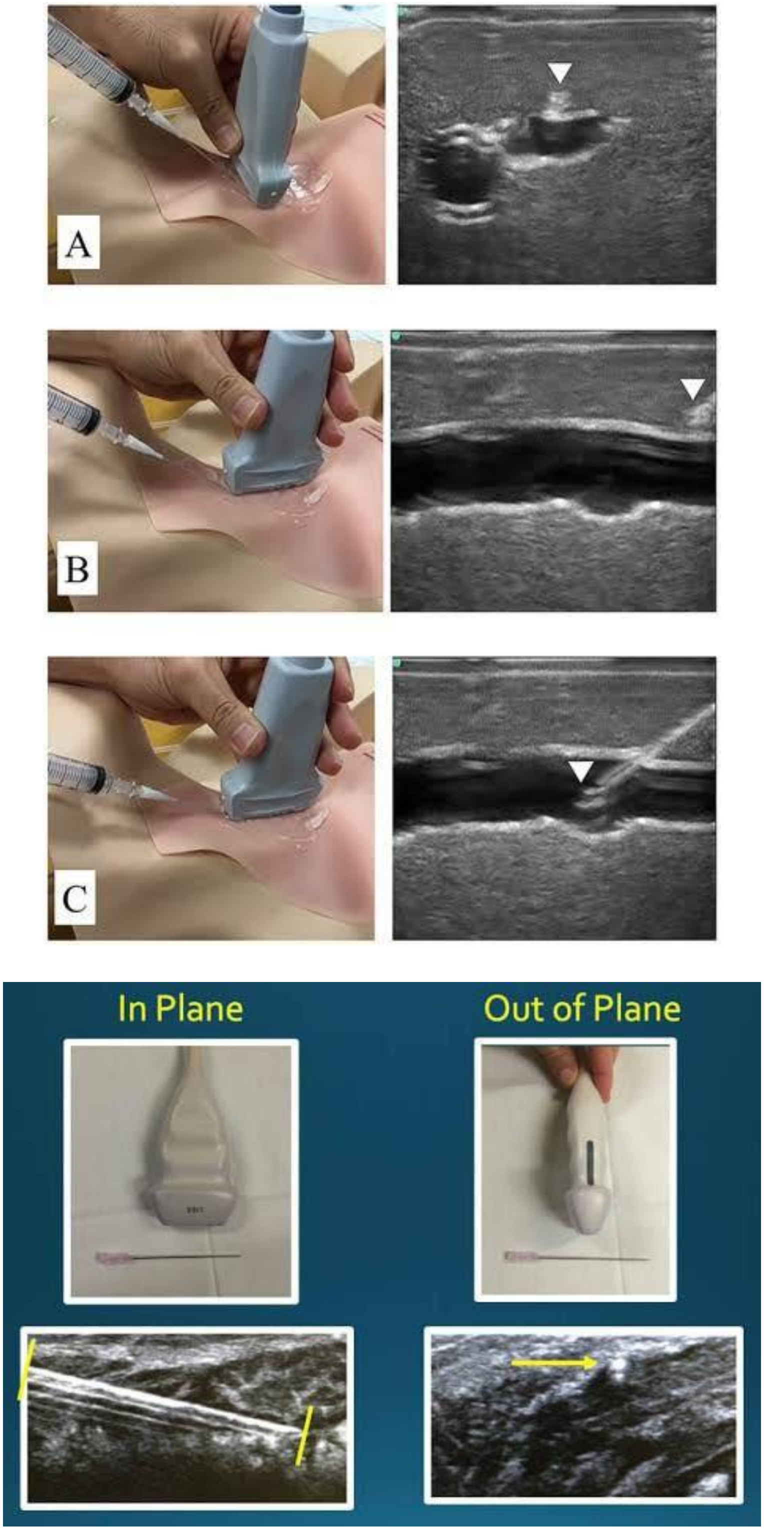


Figure 8 : In-plane and Out-of-plane approach

Sterility of the Probe:

Strict asepsis must have adhered to while inserting a CVC to prevent catheter-related bloodstream infection. A sterile plastic probe cover of about 1-meter length was used to maintain the sterility of the field during CVC.[32]

Ergonomics of ultrasound-guided procedure:

For better ergonomics, the operator should stand on the patient's ipsilateral side, which needs to be blocked or investigated, & the US machine should be placed on the patient's contralateral side. The operator often holds the transducer in their non-dominant hand and the needle in their dominant hand. Transducer should be held very low on the probe close to the scanning surface rather than firmly gripping top of the handle. It is recommended to place the probe exactly perpendicular to the skin when using the in-plane approach. Ultrasound gel should be applied over the skin such that the air between the skin & transducer is absent.[23]

Coupling agent:

Coupling agent, which helps in better penetration of ultrasound waves. In the direct contact approach, gel, mineral oil, and white petrolatum are the most often used coupling agents; the immersion technique uses water.[33]

Selection of Needle :

There is no fixed standard for the type of needles used in CVC. Any needle can be seen clearly under ultrasonography. The capacity to visualize the needle and a more pronounced needle tip echo have been proven to positively connect with needle gauge, despite the fact that a large bore needle can be seen quite well. Contrary to smooth conventional needles, coated, dimpled, and notched commercially available needles have been proven to have higher needle echogenicity.[34]

Procedure:

A central vein can be accessed using US by following views.

1) **Long axis view**
2) **Short axis view**

- **LONG AXIS VIEW:**

This view aids in appreciating the vessel's transverse plane. It is accomplished by placing the probe along the longitudinal view of the vein. This view does not display the anatomical relationships of surrounding structures and aids in visualizing only one structure at a time. In this picture, a needle is perforated in-plane such that the total length of the needle visualised. Insertion angle of the needle is less than 30 degree to the skin’s surface.[35]

- **SHORT AXIS VIEW:**

By aligning the probe with short axis of central vein. It aids in better appreciation of surrounding tissues. In this approach only the tip of the needle is visualized. Insertion angle of the needle is about 45 degree to the surface of skin.

The subclavian vein need to be visualised under US before the procedure for cannulation through the infraclavicular route. During CVC cot/operating table is titled 15 degree Trendelenburg position with ipsilateral arm abducted at 45 degree. For better ergonomics, the ultrasound machine is placed on the opposite side.[35]

USG cannulation done under strict aseptic conditions. A sterile plastic transparent sheath is used to cover the probe & the cable for a length of 1 meter. Initially, the subclavian vein is visualized in short-axis plane immediately under middle of the clavicle. The transducer (linear/micro convex) is further moved laterally to locate the subclavian vein under lateral third of the clavicle. To visualize the vein longitudinally the probe is rotated 90 degree. After local anesthetic infiltration, the subclavian vein is located using in-plane approach. After aspiration of blood, the vein, CVC is performed using seldinger technique.

REVIEW OF LITERATURE

REVIEW OF LITERATURE

- **Lanspa M J et al** in **2014** done a study cannulating subclavian vein using paediatric micro convex probe. The catheter was inserted successfully without any adverse events in 23 out of 24 patients. (hematoma, pneumothorax, infection). One patient had hematoma. The author concluded that, cannulating subclavian vein using micro convex pediatric probe seem to be a sage and efficient technique.[7]

- **Kim S C et al** in **2016** did a study in 20 patients who underwent elective surgery by cannulating subclavian vein using micro-convex probe on supraclavicular fossa. They did not witnessed any adverse events during cannulation. Cannulation was unsuccessful in 2 patients. The study concluded that right subclavian vein cannulation was not only feasible with micro-convex probe but, it had added advantage of CVC tip confirmation.[36]

- **Fragou M et al** in **2011** conducted a prospective randomized trial comparing with landmark technique in 463 critically ill patients on ventilator support the infraclavicular approach of subclavian catheterization using linear transducer. They appreciated 100% in patients underwent USG block as opposed to 87.5% in landmark approach. They came to the conclusion that USG cannulation is superior to the anatomical technique.[37]

- **Sidoti A et al**. conducted an observational research on 148 patients in **2019** comparing USG to landmark technique guided subclavian vein cannulation. The primary objective was catheterization success rate, and the secondary outcomes are cannulation attempts, failure rate, and adverse effects. They concluded that when compared to the anatomical approach, USG cathertization had a lesser complication and attempts to cannulate.[1]

- In **2009, Gopal B Palepu et** colleagues looked at the effect of USG on CVC in 45 patients who are admitted to the critical care unit. They compared internal jugular vein cannulation utilising (linear probe) USG and landmark method. They came to the conclusion that USG improves the accuracy, safety, and efficiency of CVC insertion. Additionally, USG decreased failure rates, many attempts, and complications in IJV cannulation. They proposed that USG cannulation become the norm in the ICU.[5]

- **Lahham S. et al in 2016** studied on 155 patients in emergency room and evaluated sonographic images of subclavian vein using namely long foot print linear probe (38mm, 5-10 MHz) short foot print linear probe (25mm, 6-13MHz) & micro convex tightly curved foot print endocavitary probe (5-8 MHz). The major goal of the study was for sonologists to prefer the probe for visualising the central vein. To view the subclavian vein utilising the supraclavicular technique, the physician sonologists preferred a linear probe.[6]

MATERAIL & METHODS

MATERIALS AND METHODS

This was a prospective, randomised observer blinded study.

SOURCE OF DATA:

A randomized control trial was conducted on 40 patients requiring subclavian vein cannulation & admitted to either ICU or undergoing an elective surgical procedure in operation theatre at RLJHl & Research centre, Tamaka, kolar from January 2021 to May 2022

- Study Design: Randomised control trail
- Sample Size: 40
- Duration of study: From January 2021 to May 2022.

METHOD OF COLLECTION OF DATA:

- Number of patients was 40
- Informed consent was taken from the patient's attenders
- Result values was recorded using a Performa

INCLUSION CRITERIA

Patient age more than 18 years, requiring subclavian central venous cannulation and admitted to either intensive care unit or under going elective surgical procedures.

EXCLUSION CRITERIA

Patient refusal, infection at the site of cannulation, Coagulopathy (INR > 1.5), Morbid obesity (BMR >35), and pregnancy.

RESEARCH QUESTION:

- Whether use of Micro convex transducer for ultrasound-guided infraclavicular subclavian vein cannulation will result in better appreciation of sono-anatomy and ease of inserting CVC when compared to linear transducer?
- Whether the use of Micro convex transducer for ultrasound-guided infraclavicular subclavian vein cannulation will decrease the incidence of complications in comparison to linear transducers?

HYPOTHESIS:

- Using a Micro convex transducer for ultrasound-guided subclavian vein cannulation improves the ease of insertion and decreases the rate of complication when compared to linear transducers.

NULL-HYPOTHESIS

- Using a Micro convex transducer for ultrasound-guided subclavian vein cannulation will not improve the ease of insertion and will not decrease the rate of complication when compared to linear transducer.

SAMPLING TECHNIQUE:

A universal sampling technique was used for the selection of study participants till the sample size is achieved.

SAMPLE SIZE

Total 40 patients were studied, 20 in each group, sample size was calculated using open epi software – considering 95% of CI, 80% Power with the Mean difference values of 1.14 +0.4

and 2 +1.29. Mean difference in ultrasound-guided and landmark groups, respectively.[1]

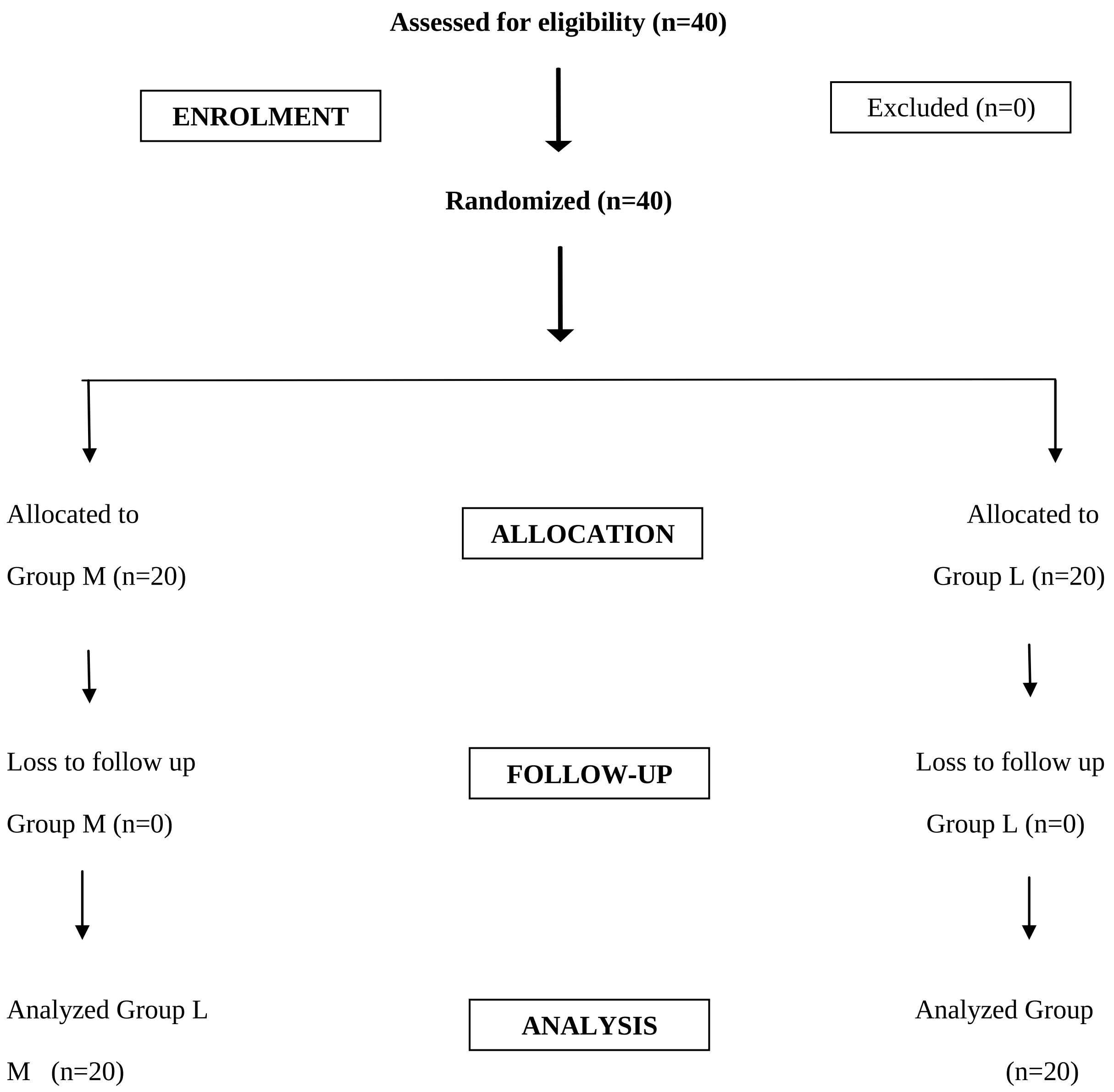
SAMPLING PROCEDURE :

Patients were enrolled in the study after taking written informed consent. The study was conducted on adult patients requiring subclavian vein cannulation either admitted to icu or undergoing elective surgical procedures in OT's from January 2021 to May 2022. Necessary investigations like prothrombin time and INR are done prior to subjecting the patients for CVC.

In the present study, we have divided the patients requiring subclavian vein cannulation into two groups (GROUP- L and GROUP- M). The groups will be randomized using computer-generated random table.

Patients in GROUP- L will be subjected to USG infraclavicular approach to subclavian vein cannulation using linear transducer [6 to 13 MHz] and patients in GROUP- M will be subjected to USG infraclavicular approach to subclavian vein cannulation using micro convex transducer [5 to 8 MHz]. Anesthetist performing the procedure would have cannulated at least 10 patients using USG independently.

Fig 9 : Consort Flow diagram



RANDOMIZATION DETAILS:

Randomization software has been used to generate a random allocation sequence to allocate participants to group L or group M. Block randomization with unequal block size will be used to generate the randomization sequence.

The allocation sequence will be concealed using sequentially numbered sealed opaque envelops. The envelops will be given to the investigator who will open the envelopes after finishing the baseline data collection and allocate the participants into two groups.

Blinding: Analyzer will be blinded, whereas participants and the investigator are not blinded.

PARAMETERS OBSERVED:

- Continuous ECG, HR and SPO2 were monitored during the procedure.
- Non-invasive BP is monitored every 5 minutes.
- Time taken for cannulation – from injection of local anesthetic to guide-wire insertion.
- Number of attempts taken for cannulation.
- Rate of complications like – pneumothorax, hematoma, arterial puncture, and inadvertent catheter placement into internal jugular vein (IJV).
- Rate of infection at the site of insertion.

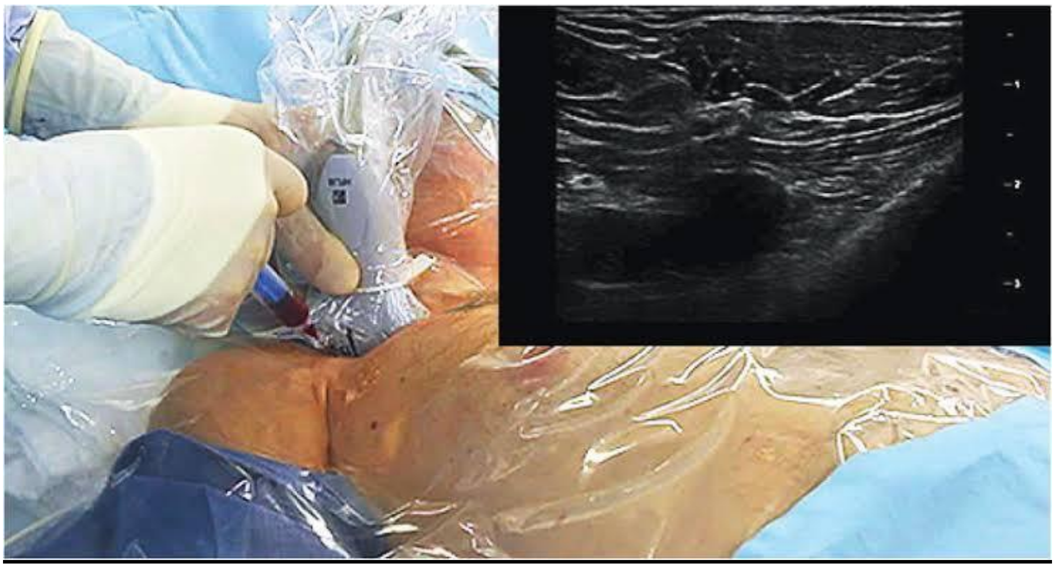
STATISTICAL ANALYSIS:

Collected data will be entered in MS Excel. The analysis will be done in SPSS version 22. The summarized data will be presented as mean and standard deviation for continuous variables, frequencies and proportion for categorical variables, to compare between groups t-test and chi-square will be done for continuous and categorical variables, respectively.

DESCRIPTION OF VENIPUNCTURE:

US imaging was done on (Sonosite SII) using both linear and micro convex transducer under stringent aseptic conditions, with the area wrapped with chlorhexidine and the patient well protected. Transducer was wrapped in sterile plastic and place below the clavicle. After appreciating the subclavian vein in short axis, the probe was rotated 90 degree to visualize the vein in long axis. In the middle of the probe, we angled the needle at 45 degrees, aligned with the ultrasonic plane, and visualized the entire length of the needle during the procedure. Confirmation of needle placement was done after visualizing the needle and guide-wire in the central vein.[7]

Fig 10 : DESCRIPTION OF VENIPUNCTURE



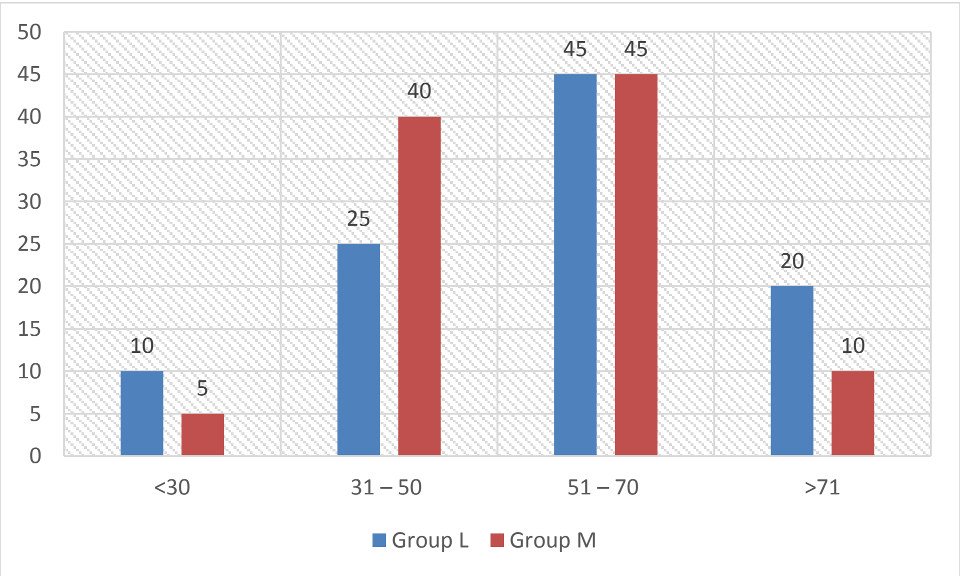
RESULTS

OBSERVATION AND RESULTS

Table 1: Age distribution among the study participants

S No	Age (years)	Group L		Group M		P value
		Frequency	Percentage	Frequency	Percentage	
1	<30	2	10	1	5	
2	31 – 50	5	25	8	40	
3	51 – 70	9	45	9	45	
4	>71	4	20	2	10	0.639

Figure 7 : Age distribution among the study participants

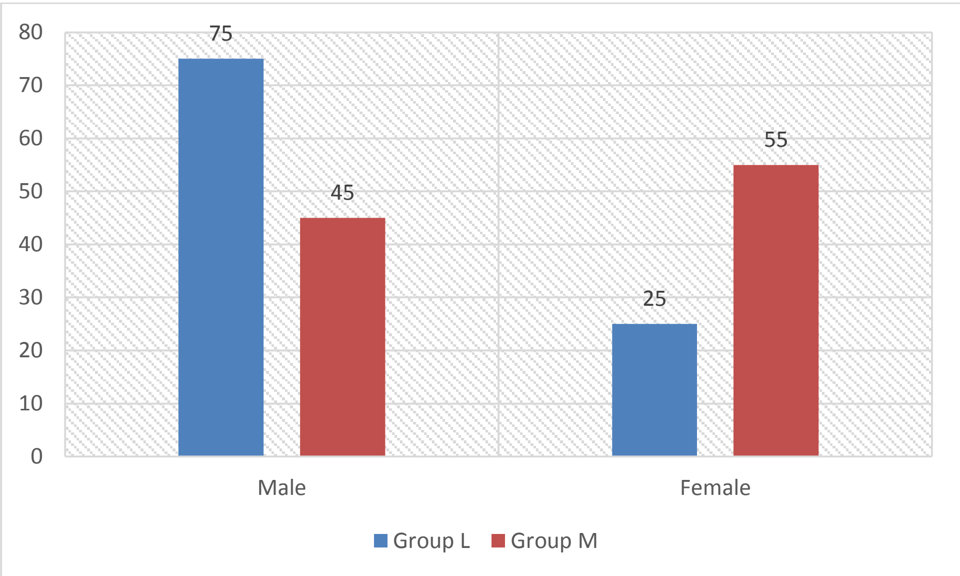


The observation of our study showed about 75 % of subjects were in the age group of 30 to 70 years. Mean age of the study participants in group L & group M was 56.06 $\pm$ 14.45 and 51.85 $\pm$ 13.94, respectively with p value of 0.639

Table 2: Gender distribution among the study participants

S No	Gender	Group L		Group M		P value
		Frequency	Percentage	Frequency	Percentage	
1	Male	15	75	9	45	0.053
2	Female	5	25	11	55	

Fig 8: Gender distribution among the study participants

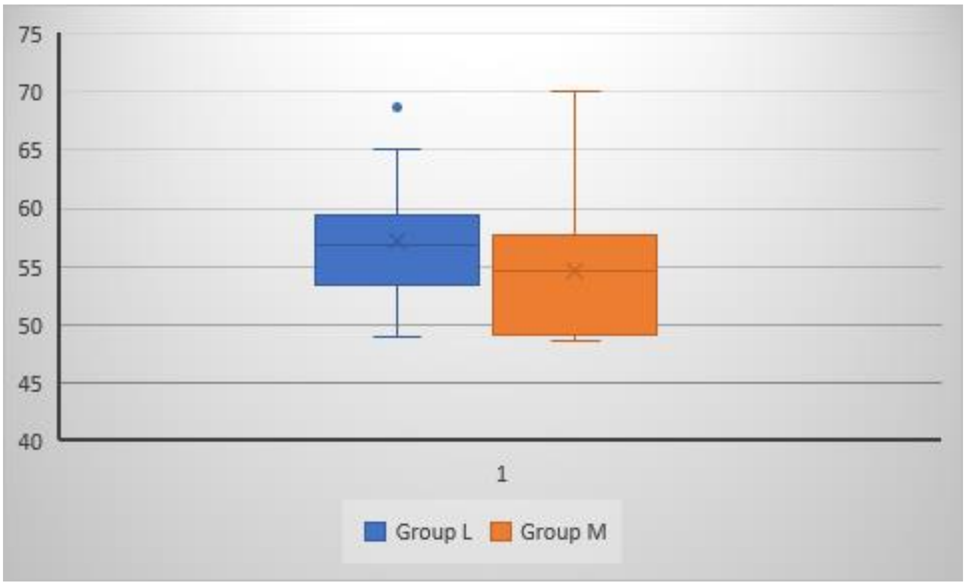


The observation in our study showed that male participants in group L were 15 (75%) and group M were 9 (45%), whereas female participants in group L - 5 (25%) and 11 (55%) in group M.

Table 3: IBW distribution among the study participants

S No	Variable	Group L		Group M		P value
		Mean	SD	Mean	SD	
1	IBW	57.16	4.77	54.68	5.35	0.079

Fig 9 : IBW distribution among the study participants

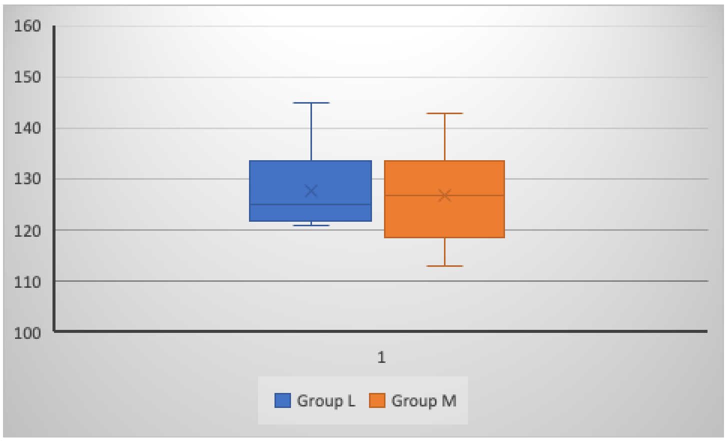


Mean body weight of the study participants in group L is 57.16 + 4.77, and group M is 54.68 + 5.35, respectively with p value of 0.079.

Table 4 : Total time interval (sec's) taken for cannulation among the study participants

S No	Variable	Group L		Group M		P value
		Mean	SD	Mean	SD	
1	Total time interval	127.85	7.47	127	7.87	0.860

Fig 10 : Total time interval (sec's) taken for cannulation among the study participants

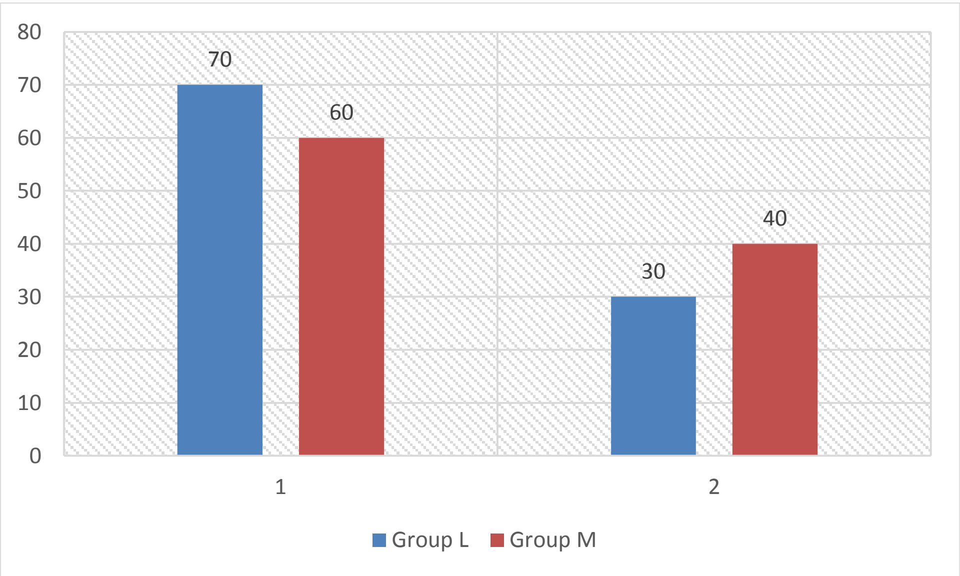


Mean time taken for cannulation in group L is 127.85 ± 7.47 seconds, and group M is 127 ± 7.87 seconds with p value of 0.860, respectively.

Table 5: Number of attempts taken for cannulation among the study participants

S No	Attempts	Group L		Group M		P value
		Frequency	Percentage	Frequency	Percentage	
1	1	14	70	12	60	0.507
2	2	6	30	8	40	

Fig 11 : Number of attempts taken for cannulation among the study participants

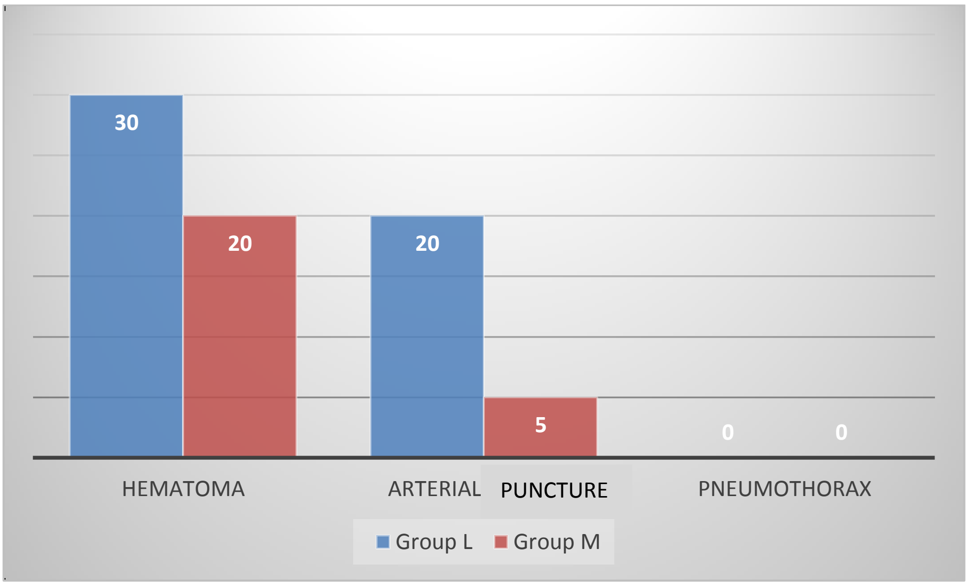


In the present study, most of the cannulations in either group were done successfully in the first attempt 14 (70%) in group L & 12 (60%) in group M had first attempt success. Whereas 6 patients (30%) in group L & 8 patients (40 %) in group M had successful cannulation in the second attempt.

Table 6 : Complications among the study participants

S No	Complications	Group L		Group M		P value
		Frequency	**Percentage**	**Frequency**	**Percentage**	
1	Pneumothorax	0	0	0	0	
2	Hematoma	6	30	4	20	
3	Arterial puncture	4	20	1	5	0.202

Fig 12 : Complications among the study participants



In the present study, we did not come across pneumothorax in either group. Haematoma was observed in 6 cases (30%) in Group L & 4 cases (20%) in Group M., Whereas accidental arterial puncture occurred in 4 patients (20%) in group L & 1 patient (5%) in group M.

DISCUSSION

DISCUSSION

Insertion of central venous cannulation has become a standard management protocol not only in managing patients in icu but also in patients undergoing major surgical procedures.

CVC's are routinely sited for administration of vasoactive hyperosmolartic medication , hemodynamic monitoring & haemodialysis , parental nutrition, pacing for simultaneously infusing multiple fluids, medications blood products and patients with failed peripheral venous cannulation.

Commonly used sites for CVC are femoral, internal jugular & subclavian veins. The preferred site for CVC would be subclavian because of lower incidence of thrombosis, CVC related sepsis, better patient compliance & nursing care.[38,39,40]

Subclavian venous cannulation will be changeling in patient with hypovolemia & obesity when the cannulation done using landmark technique.

In the recent years, UGS guided cannulation has become a standard. National Institute of Health & Clinical Excellence (NICE) in 2002 recommended USG IJV cannulation as the standard of care. USG less commonly used for cannulating subclavian vein when compared to femoral or IJV cannulation d ue to acoustic shadowing of the upper clavicle, the subclavian vein is difficult to see.. A Cochrane systematic review published in the year 2015 concluded that, in comparison with landmark technique US-guided femoral or subclavian vein cannulation had advantage both in terms of safety & quality of cannulation.[41]

In the recent years, many studies conducted that, US-guided cannulations have shown improvement in first pass success rate and also decreased complication. [37,42,43,44,]

All these years US guided infraclavicular subclavian vein cannulation is done using in-plane approach with linear transducer. The view not only identified subclavian vessels but also the pleura, lung sliding & there by decreasing the breach of pleura during the procedure. According to the study done by **Siodti Ann et al**[1] success rate for in-plane infraclavicular subclavian vein cannulation using linear probe was slightly better with 96% success in USG group when compared to the landmark technique's 92% success rate. However, the first try success rate in the USG group was significantly higher (86.5%) than in the landmark technique (40%). Furthermore, complications associated with USG group were less when compared to landmark technique.

The main disadvantage of using linear probe in-plane approach is the length of the footprint of linear transducer & thus the cannulation of smaller axillary vein rather than more proximal subclavian vein while attempting in-plane infraclavicular subclavian vein cannulation. Because the medial cutaneous nerve is so close to the axillary vein, cannulation of the more distal axillary vein may increase the risk of injury. Furthermore, axillary veins deeper than subclavian vein & hence the operator can expert technical difficulties and at times, may require longer needles.

At present, there are not many studies found in the literature using micro convex probe for cannulating subclavian vein. Hence, we conducted a prospective, randomized control trial on 40 patients (20 in each group) to compare the ease of cannulation & associated complication rate following subclavian vein catheterization using linear & micro convex probes.

In our study, the total time interval taken for cannulating subclavian vein was similar in either group (127.85 ± 7.47 seconds in Group L versus 127 ± 7.87 seconds in group M with p value of 0.86). We observed that more number of attempts were required to cannulate subclavian vein using micro convex probe when compared to linear probe, though statistically insignificant. (1st attempt success rate was 70% & 60 % in group L and group M, respectively).

As micro convex transducer is a new inclusion in our armamentarium, the familiarity of using micro convex probe by the anaesthesiologists working in our institute might have resulted in more number of attempts during CVC.

Though statistically insignificant, further observed that we encountered less number of complications like arterial puncture (30 versus 20 in group L and group M respectively) & local hematoma while using
micro convex probe.

In comparison to linear probe, we appreciated that, micro convex probe will not only help in better visualization of deeper structures but, will also cast minimal acoustic shadowing of the clavicle. Hence, using micro convex probe would have resulted in lesser of complications like arterial puncture & local hematoma in our study. We did not encounter any pneumothorax or local site infection or catheter-related bloodstream infection in any of the patients who participated in our study.

STRENGTHS

This is a randomized controlled study which was conducted in a tertiary care hospital. There are not many studies done comparing micro convex probe with linear probe for CVC. Though the micro-convex probe was a new inclusion in our USG armamentarium, we took enough precautions & the procedure was performed by anaesthesiologists who had reasonably good proficiency in using USG for CVC. Research question, inclusion & exclusion criteria are well-defined. The sampling procedure & statistical analysis are well executed.

LIMITATION

LIMITATIONS

We excluded obese, pregnant patients & paediatric patients from the study. A micro convex probe would have been more ideal in these patients. Our study was done on only 40 patients and required larger studies for a better conclusion.

RECOMMENDATIONS

Micro convex probes are definitely superior to linear probes for cannulating the subclavian vein in obese and short-stature patients.

Despite the fact that we have a smaller sample size, a larger RCT is necessary to verify the competency of the micro convex transducer.

Mean time taken for cannulation in group L is 127.85 + 7.47 seconds and group M is 127 + 7.87 seconds with p value of 0.860, respectively though statistically insignificant. But clinically, according to our observation micro convex probe helps in better appreciation of sono-anatomy and visualisation of deeper structures in our study participants

CONCLUSION

CONCLUSION

Micro convex transducer is a good alternative for linear probe while cannulating subclavian vein through an infraclavicular approach. A smaller foot print and deeper penetration of ultrasound waves by micro-convex probe would be an advantage while cannulating subclavian vein, particularly in obese, patients with small stature and paediatric patients. Further studies with larger sample size and including both obese, small stature patients & paediatric patients are required to establish the efficacy of micro convex probe for central venous cannulation.

We conclude that, micro convex probe helps in better appreciation of sono-anatomy and better visualization of deeper structures & hence, would decrease the incidence of complication when the procedure is performed by clinicians proficient in using ultrasound with micro convex probe.

SUMMARY

SUMMARY

This was a prospective randomized observer-blinded study was conducted on 40 patients more than 18 years of age requiring subclavian vein either in icu or undergoing elective surgical procedures in operation theatre at RLJH and Research centre, Tamaka, kolar from January 2021 to May 2022. Written informed consent was taken. Patients were divided into two groups according to computer-generated random table (Group L & Group M).

GROUP- L will be subjected to USG infraclavicular approach to subclavian vein cannulation using linear transducer (6 to 13MHz).

GROUP- M will be subjected to USG infraclavicular approach to subclavian vein cannulation using micro convex transducer (5 to 8 MHz).

Continuous ECG, HR and SPO_2 were monitored during the procedure. Non-invasive BP is monitored every 5 minutes. Time taken for cannulation, number of attempts taken for cannulation, rate of complications like – pneumothorax, hematoma, arterial puncture, inadvertent catheter placement into IJV, and rate of infection at the site of insertion were observed. Collected data will be entered in MS Excel. Analysis will be done in SPSS version 22, operating on windows 10, with a p value less than 0.05 was considered statistically significant.

To compare the safety and efficacy of micro-convex probe over linear transducer probe for real-time ultrasound-guided infraclavicular subclavian vein cannulations. Mean time taken for cannulation in group L is 127.85 $\pm$ 7.47 seconds and group M is 127 $\pm$ 7.87 seconds with p value of 0.860, respectively though statistically insignificant. But clinically, according to our observation micro convex probe helps in better appreciation of sono-anatomy and visualisation of deeper structures in our study participants

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BIBLIOGRAPHY

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ANNEXURES

ANNEXURES

ANNEXURE-I PROFORMA

PERSONAL DETAILS:

NAME: AGE: SEX:

ADDRESS: DATE OF STUDY:

OCCUPATION:

HEIGHT: IBW:

TELEPHONE NO: UHIDNO:

CLINICAL FINDINGS:

1)PLATELET COUNT:

2)PROTHROMBIN TIME:

3)PTT:

4)INR :

PARAMETERS OBSERVATION :

LINEAR OR MICROCONVEX

CONTINUOUS ECG, HR, & SPO_2 MONITORING.	
NON INVASIVE BP.	
TIME TAKEN FOR CANNULATION.	
NUMBER OF ATTEMPTS FOR CANNULATION.	
RATE OF COMPLICATION.	
RATE OF INFECTION AT THE SITE OF INSERTION.	

Time taken for cannulation:

Local anaesthetic given time	Guide wire insertion time	Total time interval between them

CO-MORBIDITIES:

CLINICAL DIAGNOSIS:

REASON FOR SUBCLAVIAN VEIN CANNULATION:

ACUTE PROBLEM:

ANNEXURE

PATIENT INFORMATION SHEET

I, Mr/Mrs, , of the patient have been explained that the patient will be included in the study, **COMPARISION OF LINEAR VERSUS MICRO-CONVEX PROBE FOR ULTRASOUND GUIDED SUBCLAVIAN VEIN CANNULATION.**

I have been explained about the procedure, monitoring, clinical findings, investigations performed and advantages of ultrasound guided central venous cannulation in a language best understood by me and the same will be documented for the study purpose. I have been explained that my participation in this study is entirely voluntary and I can withdraw from the study anytime and this will not affect the treatment for my / patient's ailment.

I have understood that all the patient's details recorded during the study are kept confidential while publishing or sharing the findings.

I, in my sound mind on behalf of the patient give consent to be part of this study.

Signature:

Name:

Signature of the witness1:

Name:

Signature of the witness2:

Name:

Date:

Place

Signature of the doctor:

ANNEXURE-III

INFORMED CONSENT FORM

TITLE: COMPARISION OF LINEAR VERSUS MICRO-CONVEX TRANSDUCER FOR ULTRASOUND GUIDED SUBCLAVIAN VEIN CANNULATION.

I, **DR. DHANALAKSHMI.M** Post graduate in the department of Anesthesiology, Sri Devaraj Urs Medical College, Kolar. We are carrying out above mentioned study at RLJH, Tamaka, Kolar. The study has been reviewed and approved by the institutional ethical review board. We will be using either linear or Micro-convex probe for cannulating subclavian vein. Ultrasound guided central venous cannulation will result in lesser complications when compared to landmark technique. There is no difference in the incidence of complications when the above mentioned transducers are used.

Participation in this study doesn't involve any added cost to the patient. There is no compulsion to participate in this study and you will not be affected with regard to patient care, if you wish not to be part of this study.

All the information collected from the patient will be kept confidential and will not be disclosed to any outsider, unless compelled by the law. The information collected will be used only for this study. I request your kind self to give consent for the above mentioned research project.

For any further clarification you are free to contact,

Dr. DHANALAKSHMI.M
Post Graduate in Anaesthesiology
Mobile no: 8754850050.
Dr. SURESH KUMAR.N.
Professor in Anaesthesiology
Mobile no:9008222550

KEY TO MASTER CHART

Sl.No	Serial Number
UHID No.	Unique Health Identification Number
M	Male
F	Female
IBW	Ideal Body weight
ECG	Electrocardiogram
SPO_2	Peripheral capillary Oxygen saturation
NIBP	Non-invasive blood pressure
PT	Prothrombin Time
PTT	Activated partial thromboplastin Time
INR	International Normalized Ratio
Group - L	Linear
Group - M	Micro-convex

Sl.No	UHID.NO	AGE	SEX	IBW	CLINICAL FINDING				GROUP	PARAMETER OBSERVATION				
					PLATELET COUNT	PT	PTT	INR		LOCAL ANAESTHETIC TO LOCATOR NEEDLE INSERTION (SEC'S)	NEEDLE LOCATOR TO GUIDE WIRE INSERTION (SEC'S)	TOTAL TIME INTERVAL BETWEEN THEM (SEC'S)	ATTEMPTS OF CANNULATION	COMPLICATIONS
1	41101	71	MALE	60	155	15.6	30.2	1.4	L	68	77	145	1	BLEEDING
2	38494	55	FEMALE	53	160	14.5	28.9	1.35	M	63	68	131	2	HEMATOMA
3	41390	70	MALE	70	170	15.6	30	1.38	M	60	75	135	1	BLEEDING
4	69932	75	MALE	65	305	17.6	29.6	1.58	L	66	72	138	2	HEMATOMA
5	62462	53	MALE	58	427	18.6	27.9	1.28	M	62	68	130	1	BLEEDING
6	69934	46	MALE	57	165	12.8	29.8	1.5	L	67	74	141	1	BLEEDING
7	71067	22	FEMALE	55	123	16.8	29.6	1.48	M	64	69	133	2	BLEEDING
8	69540	58	MALE	58	166	15.6	30.2	1.34	L	65	72	137	2	ARTERIAL PUNCTURE
9	55810	65	FEMALE	56	144	16.6	29.8	1.48	M	62	66	128	1	BLEEDING
10	54068	48	FEMALE	52	100	17.8	29.6	1.44	M	63	64	127	1	BLEEDING
11	39650	54	MALE	50.3	99	14.5	24.8	1.15	M	62	64	126	1	BLEEDING
12	942708	56	MALE	56	140	14.6	28.6	1.37	L	60	67	127	1	HEMATOMA
13	947302	64	MALE	56.7	230	15.6	25.6	1.34	L	65	68	133	2	ARTERIAL PUNCTURE
14	94850	65	MALE	57.8	96	16.8	28.7	1.44	M	60	67	127	2	HEMATOMA
15	94944	32	FEMALE	48.6	172	17.8	28.9	1.32	M	60	62	122	2	BLEEDING
16	38548	55	FEMALE	48.8	155	16.8	26.8	1.34	M	69	74	143	1	BLEEDING
17	43134	58	MALE	56.8	145	17.8	27.8	1.43	L	60	68	128	2	BLEEDING
18	46150	30	FEMALE	49.8	133	18.9	26.8	1.48	L	60	62	122	1	BLEEDING
19	72466	38	FEMALE	52	90	18.6	25.5	1.34	L	60	64	124	2	ARTERIAL PUNCTURE
20	74880	28	MALE	56	100	17.8	24	1.25	L	60	62	122	1	HEMATOMA
21	78768	42	MALE	57.5	100	16.8	26	1.45	M	66	68	134	1	ARTERIAL PUNCTURE
22	80060	38	FEMALE	48.6	112	15.6	24	1.32	M	58	60	118	2	BLEEDING
23	79801	48	FEMALE	52.5	100	15	30	1.2	L	66	68	134	1	BLEEDING
24	80836	50	MALE	56.5	100	17	32	1.32	L	60	61	121	1	BLEEDING
25	79798	48	FEMALE	48.8	123	14	28.9	1.22	M	62	64	126	1	BLEEDING
26	84920	42	FEMALE	54.7	223	14.7	32.8	1.16	M	60	77	137	2	HEMATOMA
27	77485	36	MALE	61.2	233	17	29.4	1.56	M	67	68	135	1	BLEEDING
28	84159	48	MALE	59.6	188	18	30	1.47	L	66	60	126	2	BLEEDING
29	83819	52	FEMALE	48.9	165	17	26.7	1.45	L	64	60	124	1	HEMATOMA
30	82371	58	MALE	62.3	231	18	29.5	1.23	L	60	61	121	1	BLEEDING
31	70345	55	FEMALE	53.6	166	16	26.8	1.22	M	58	60	118	1	BLEEDING
32	81401	48	FEMALE	48.6	132	17	30	1.46	M	60	61	121	1	BLEEDING
33	90659	85	MALE	57.6	248	17.6	36	1.48	L	66	60	126	1	BLEEDING
34	100197	72	MALE	68.6	176	16	28	1.25	L	60	64	124	1	BLEEDING
35	93541	65	MALE	58.7	184	18	28	1.32	L	60	62	122	1	ARTERIAL PUNCTURE
36	60995	63	MALE	54.6	158	17.8	33	1.37	M	58	60	118	2	BLEEDING
37	93761	55	FEMALE	52.6	132	17	26	1.15	L	60	61	121	1	HEMATOMA
38	85747	64	MALE	58.6	143	18	32	1.2	L	60	61	121	1	HEMATOMA
39	93421	73	MALE	58.8	147	19	30	1.17	M	55	58	113	2	HEMATOMA
40	94018	73	MALE	57.8	157	18.7	32	1.2	M	58	60	118	1	BLEEDING