"A PROSPECTIVE OBSERVATIONAL STUDY TO DETERMINE THE USEFULNESS OF ULTRASOUND GUIDED AIRWAY ASSESSMENT PREOPERATIVELY IN PREDICTING DIFFICULT AIRWAY"

Submitted to the

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APRIL 2015

DECLARATION BY THE STUDENT

I, **Dr.G.MIRUNALINI**, solemnly declare that the dissertation, titled "**A PROSPECTIVE OBSERVATIONAL STUDY TO DETERMINE THE USEFULNESS OF ULTRASOUND GUIDED AIRWAY ASSESSMENT PREOPERATIVELY IN PREDICTING DIFFICULT AIRWAYS"** is a bonafide work done by me during the period of JUNE 2014 to AUGUST 2014 at Government Stanley Medical College and Hospital, Chennai under the expert guidance of **Dr. DHANASEKARAN M.D, D.A**, Professor of Anaesthesiology, Department Of Anesthesiology, Government Stanley Medical College, Chennai.

This thesis is submitted to The Tamil Nadu Dr. M.G.R. Medical University in partial fulfillment of the rules and regulations for the M.D. degree examinations in Anesthesiology to be held in April 2015.

I have not submitted this dissertation previously to any university for the award of any degree or diploma

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CERTIFICATE OF THE GUIDE

This is to certify that the dissertation "**A PROSPECTIVE OBSERVATIONAL STUDY TO DETERMINE THE USEFULNESS OF ULTRASOUND GUIDED AIRWAY ASSESSMENT PREOPERATIVELY IN PREDICTING DIFFICULT AIRWAYS"** presented herein by **Dr. G.MIRUNALINI** is an original work done in the Department of Anesthesiology, Government Stanley Medical College and Hospital, Chennai in partial fulfillment of regulations of the Tamilnadu Dr. M.G.R. Medical University for the award of degree of M.D. (Anesthesiology) Branch X, to be held on April 2015. It was done under the expert guidance of **DR.DHANASEKARAN M.D, D.A**, Professor, Department of Anaesthesiology at Stanley Medical College, Chennai, during the academic period 2012-2015.

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LIST OF ABBREVIATIONS

A-M interface	Air Mucosa Interface
TMD	Tempero Mandibular Distance
USG	Ultra Sono Gram
MRI	Magnetic Resonance Imaging
CL	Cormack Lehane
ECG	Electro Cardio Graphy
NIBP	Non Invasive Blood Pressure
ROC curve	Receiver Operating Characteristic Curve
SD	Standard Deviation
CT	Computed Tomography
LMA	Laryngeal Mask Airway
BMI	Body Mass Index
IDS	Intubation Difficulty Scale

ABSTRACT

Title :

A prospective observational study to determine the usefulness of ultrasound guided airway assessment preoperatively in predicting difficult airway

Keywords :

Ultrasound, Difficult airway prediction, Airway assessment, Cormack-Lehane classification, Soft tissue thickness in neck.

Aim :

The primary aim of this study was to assess the usefulness of ultrasonogram as a preoperative assessment tool in identifying difficult airway. To compare and correlate the ultrasound view of the airway and clinical airway assessment with Cormack Lehane classification of the direct laryngoscopy

Methods :

150 patients who were to undergo elective surgery and required endotracheal intubation were included in the study. Patients with no teeth and head and neck anatomical abnormality were excluded from study. On the previous day evening of surgery, Patients were shifted to the ultrasound room in the department of anaesthesiology and clinical airway assessment which included Mallampatti's

classification, inter incisor gap and thyromental distance were measured. The ultrasound airway assessment was done to measure the thickness of soft tissues in the anterior neck at 3 levels namely (a) hyoid bone, (b) thyrohyoid membrane and (c) suprasternal notch. The patient's demographic details like age, sex, height and weight were also recorded. On the day of surgery, the attending anesthesiologist provided anesthesia to the patient according to the standardization measures explained to them by the anesthetists who performed the airway assessment. The Cormack-Lehane was recorded. Statistical analysis was done using the collected data.

Results :

The statistic analysis tools that were used in this study for comparison between demographic variables, ultrasound measurements and Cormack-Lehane classification was independent t test an Chi square test. To evaluate for correlation between clinical assessment and ultrasound assessment, Spearman's Rank correlation coefficient was used. There was no statistical significance between the demographic variables like age (P=0.613), sex (P=0.670) and height (P=0.614) of the patients and the occurrence of difficult airway. Among the demographic variables, significant correlation was found between the weight (P=0.000) and difficult airway. The ultrasound measurements made at the 3 levels (a) hyoid bone, (b) thyrohyoid membrane and (c) suprasternal notch level showed significant results. The P values for each of the levels are P=0.000, P=0.000 and P=0.000 respectively. Among the 3 levels, the measurement made at thyrohyoid membrane level (skin to epiglottis thickness) was found to be highly sensitive(100%) and specific(99.3%). A cutoff point of 2.33cms was calculated using the Receiver Operating Characteristic curve(ROC curve). This cutoff point delineates difficult airway and difficult airway. No significant correlation was found between clinical assessment and ultrasound assessment.

Conclusion :

Based on this study we concluded that ultrasound can be used as a reliable tool to identify difficult airway by measuring the thickness of soft tissues in the anterior part of neck. The measurement made at thyrohyoid membrane level is more accurate than the other 2 levels.

"A PROSPECTIVE OBSERVATIONAL STUDY TO DETERMINE THE USEFULNESS OF ULTRASOUND GUIDED AIRWAY ASSESSMENT PREOPERATIVELY IN PREDICTING DIFFICULT AIRWAY"

INTRODUCTION

The management of the airway with induction of anesthesia is the primary responsibility of the anesthesiologist. From the time of introduction of endotracheal intubation, several problems have occurred due to failed intubation. An unusual and unanticipated situation is one of "Cannot ventilate and cannot intubate". Closed claims analysis[1] has found that vast majority (85%) of airway related events involve brain damage and one third of mortality was attributable solely to anesthesia. This was related to inability to maintain a patent airway in these cases.

Many methods have been introduced since then to overcome these problems and identify the patient who will be difficult to intubate. Important among those is the preoperative assessment of the airway in the patients posted for surgery.

Initially the airway assessment was carried out by single factors like Mallampatti's oropharyngeal classification,[2,3] Thyromental distance,[4] Head and neck movement and Inter incisor gap. But when it was realized that the visualization of larynx during intubation is affected by many factors, the concept of multivariate factor analysis [5,6,7,8,9] came into existence. Even with the use of multivariate factors there have been instances when a patient predicted to have easy intubation had an difficult intubation and vice versa.

In the last few years, Ultrasonogram has been gaining popularity and practical applicability in the hands of anesthesiologist [10,11,12] . There have been many studies using Ultra Sonogram to assess the airway of patients and to predict difficult intubation.[13,14,15]

In this study conducted in the Department of Anaesthesiology and Critical care, Government Stanley medical college and Hospital, we have assessed the utility of ultrasonogram in predicting difficult intubation, by measuring the thickness of soft tissue in the anterior part of neck at three different levels, namely skin to Hyoid bone, skin to epiglottis at thyrohyoid membrane level and skin to tracheal ring at suprasternal notch level.

AIM OF THE STUDY

1) To assess the usefulness of ultrasound as a non invasive tool to assess airway and to assess its use in identifying difficult airways.

2) To assess for any correlation between the ultrasound assessment of airway and clinical assessment of airway.

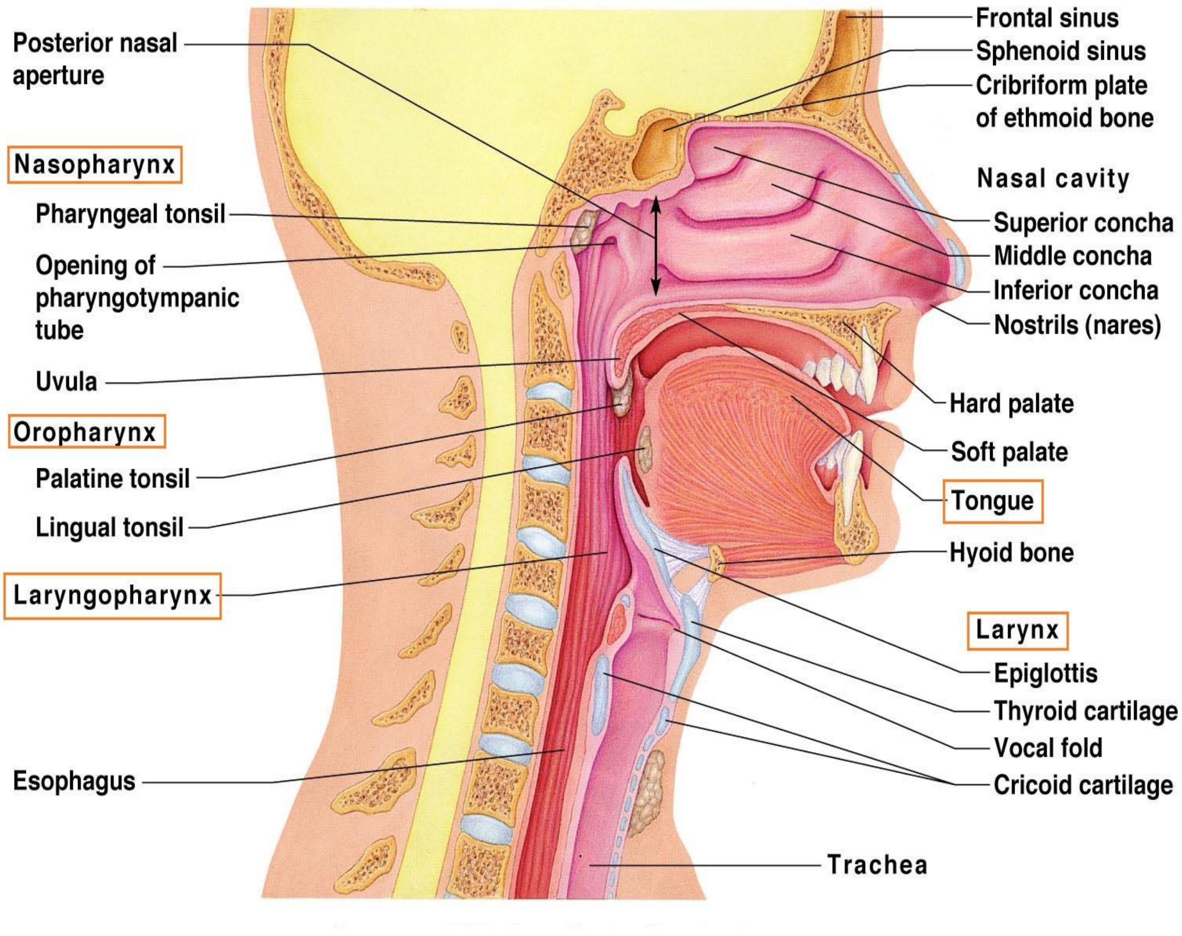
3) To assess for any statistical significance between demographic variables and occurrence of difficult airway.

ANATOMY OF UPPER AIRWAY [16,17,18]

The term airway refers to the upper airway which is the non respiratory airway passage. It consists of the following structures namely nasal cavity, oral cavity, pharynx, larynx, trachea and large bronchi. The normal airway in the awake state and in health performs a variety of functions including filtration of ambient air, air conditioning, humidification and conduction of air to and from the lungs for gaseous exchange between pulmonary alveoli and capillaries.

The airway is converted into a passive state during induction and maintenance of general anesthesia due to the suppression of nervous system which regulates the vital respiratory functions. The anesthesiologist should be able to ventilate the patient during this state by either bag mask or via endotracheal tube. He should be well versed with the anatomy of the airway, its application and various methods of assessment of the airway like mouth opening, nasal patency, head and neck movement, thyromental distance and sternomental distance which will help him to evaluate and anticipate the difficulty of airway maintenance and formulate a plan for safety of the patient.

Fig 1. ANATOMY OF UPPER AIRWAY



Mouth

Mouth is made up of two parts. They are the vestibule and the oral cavity. Both of these structures communicate with each other through the angle of mouth. The vestibule is formed by the lips, cheeks, gums and teeth. The oral cavity is bounded in front by the alveolar arch and teeth. It is bounded superiorly by the palates, inferiorly by the anterior part of tongue and posteriorly by the oropharynx.

The palate

Hard palate : is made up of the following two bones.

A) Palatine processes of maxilla

B) Horizontal plates of the palatine bones.

Soft palate : Continues from the posterior border of the hard palate. In its central free part it has Uvula. It continues on each side with the pharyngeal wall. There are five muscles.

- ✓ The tensor palati,
- ✓ The levator palati,
- ✓ The palatoglossus,
- ✓ The palatopharyngeus
- ✓ The muscular uvulae.

These help to close the nasopharynx from the mouth during swallowing and speaking.

Nose

Ellis et al (2004) in his work, "Anatomy for anaesthetist" has described that the nose is divided into the external nose and the nasal cavity, He described that the external nose is made of nasal bones, the nasal part of frontal bone and the frontal processes of maxillae, cartilages in the lower part.

The nose consists of the following parts. Choanae - posterior nasal opening Nasal cavity consists of roof, floor, medial wall and lateral wall.

Blood supply Arterial supply is by the anterior ethmoidal artery, posterior ethmoidal artery, maxillary artery, superior labial artery. The venous drainage occurs through the sphenopalatine, facial and ophthalmic veins.

Nerve supply : The olfactory nerve and trigeminal nerve.

The nasal cavity is subdivided by the nasal septum into two separate compartments that open to the exterior by the nares and into the nasopharynx by choana.

PHARYNX

The pharynx forms a common pathway of respiratory and alimentary tracts. It has three parts namely nasopharynx, oropharynx and laryngopharynx.

Nasopharynx : The nasopharynx lies behind the nasal cavity and the soft palate. It communicates with the oropharynx through the pharyngeal isthmus. Eustachian tube, adenoids, Fossa of Rossenmuller are the important structures present in nasopharynx.

Oropharynx : Extends from oral cavity to tip of epiglottis as described by Ellis in " Anatomy for Anaesthetist" Palatine tonsils are the noteworthy structure present here.

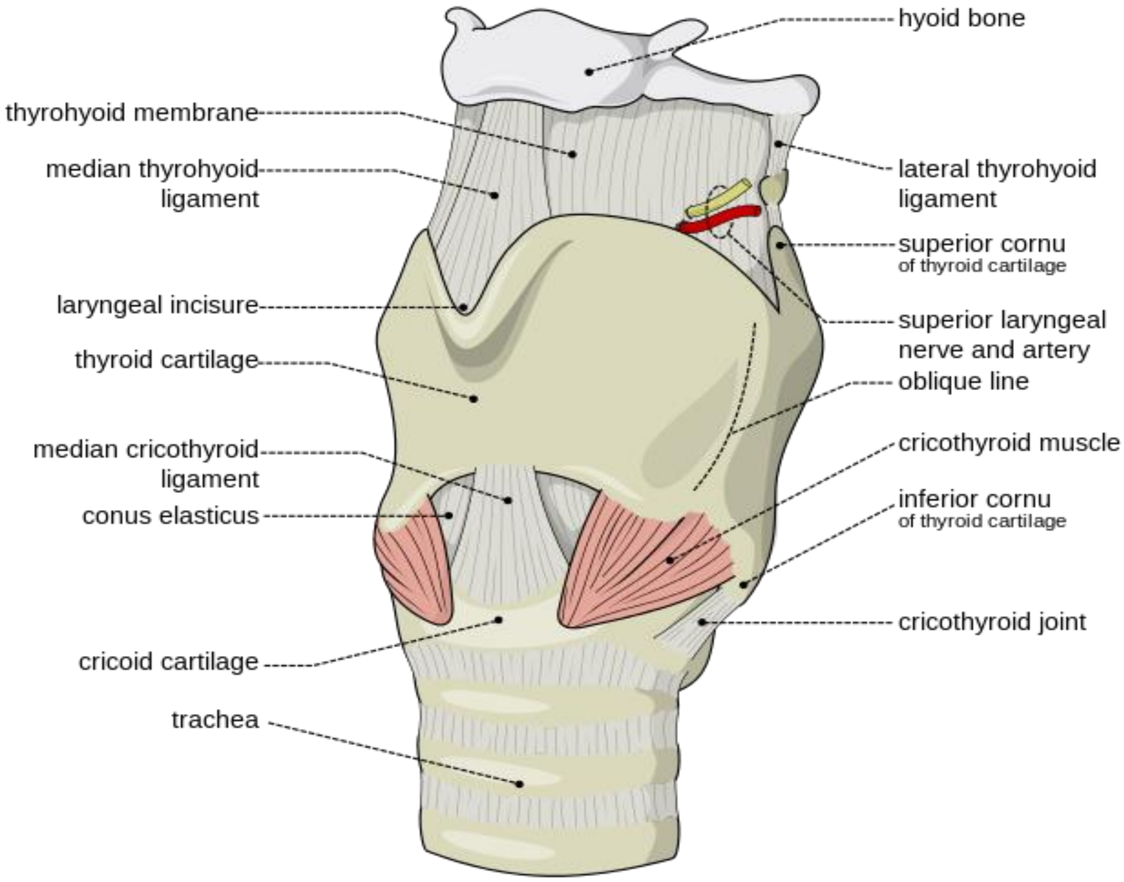
Laryngopharynx : Extends from tip of epiglottis to C6 level. Contains Pyriform fossa.

The muscles of the pharynx : The muscles of the pharynx are superior, middle and inferior constrictors, the stylopharyngeus, salpingopharyngeus and palatopharyngeus.

LARYNX

Larynx is situated anterior to the bodies of C4, C5, C6 vertebra and commands the entrance to the pulmonary system. It is a strong muscular organ that is primarily a valve of the respiratory tract. The development of larynx as organ of speech is much later and is popularly known as voice box. Structurally the larynx is in the form of a box composed of nine cartilages, connected by ligaments and moved by nine muscles.[17]

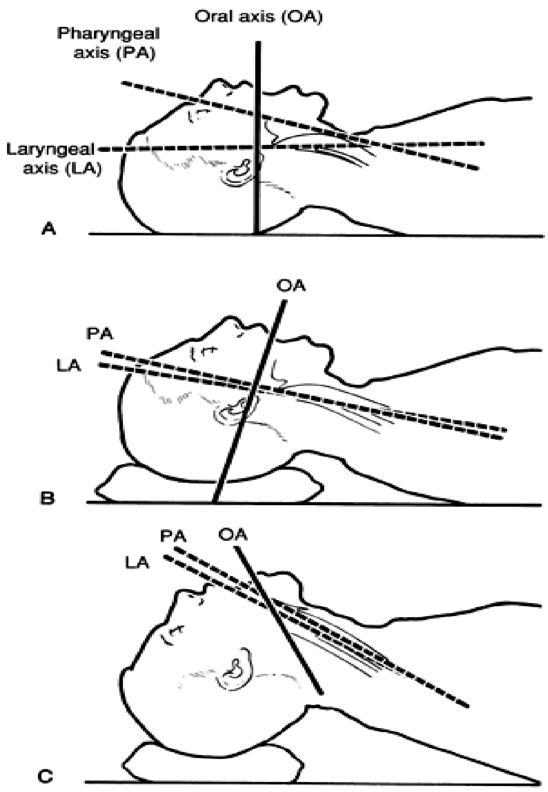
Fig 2. THE LARYNX



Laryngoscopic anatomy of larynx

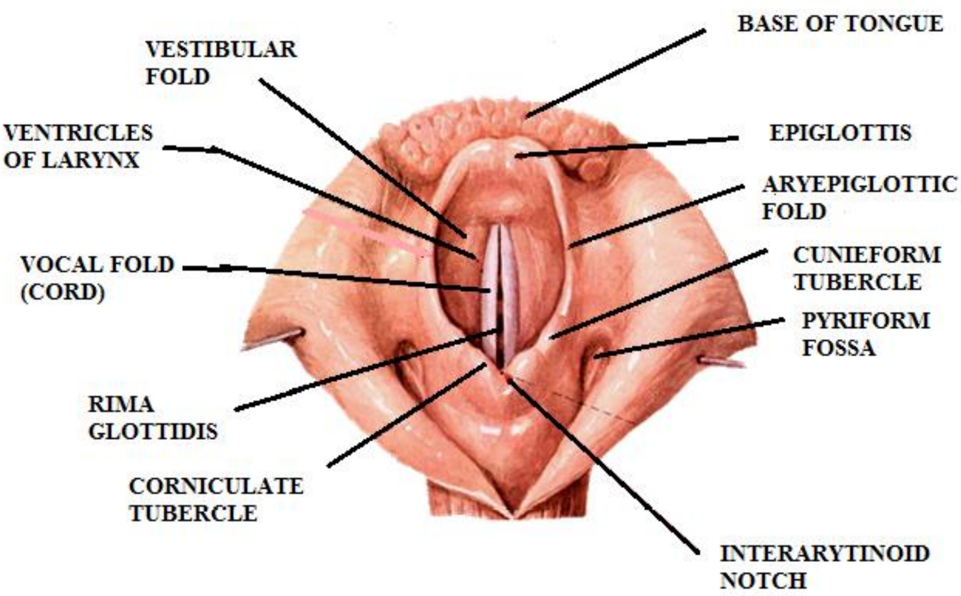
In order to view the glottic opening during direct laryngoscopy, the oral axis, pharyngeal axis and the laryngeal axis that normally lie in perpendicular plane to each other must be aligned such that they come to lie in the same plane. Elevation of the head about 10 cms with pillow under the occiput with shoulders remaining on the table aligns the laryngeal and pharyngeal axis. Flexion of the neck and extension at the atlanto-occipital joint creates almost a straight line from the incisor teeth to glottic opening. This position is termed the sniffing position [19,20,21,22,23]

Fig 3. SNIFFING (MAGILL'S) POSITION FOR INTUBATION



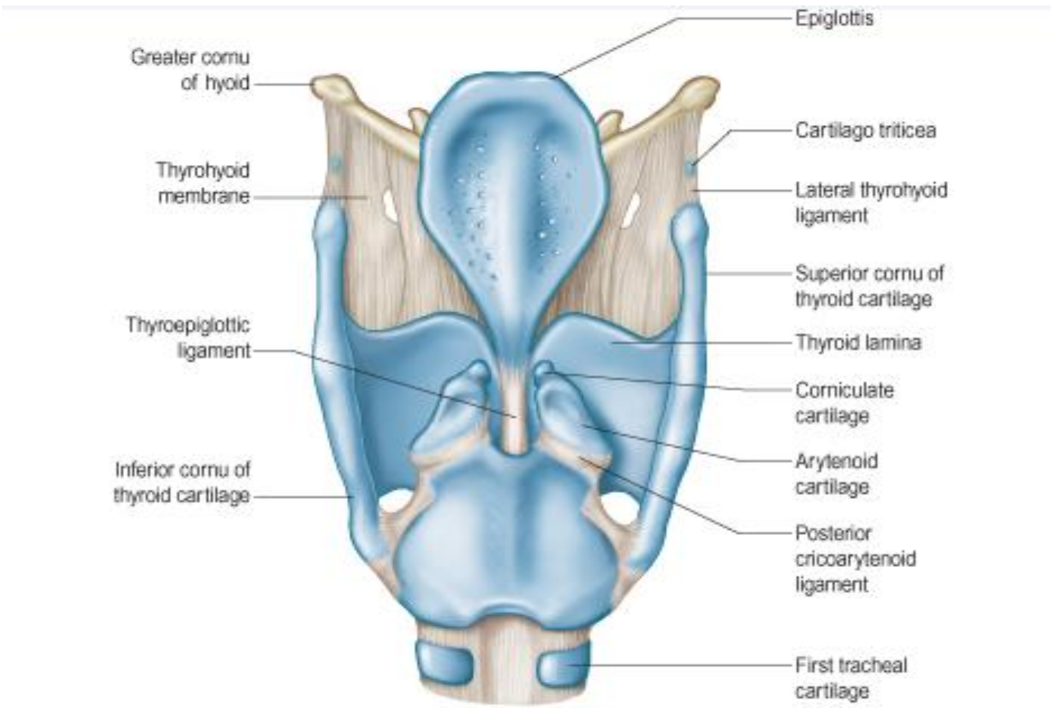
The structures that are visualized as the laryngoscopic blade is passed through the oral cavity, in the order of appearance are base of the tongue, the valleculae, the anterior surface of the epiglottis and then the laryngeal opening. Thin fold of tissue are seen running from the epiglottis posteriorly. They are the Aryepiglottic folds. They contain cuneiform and corniculate cartilages in their posterior end. The vocal cords are seen as pale paired structures that are abducted as the patient is paralysed with a muscle relaxant prior to laryngoscopy. The opening in between vocal cords are called rima glottidis. Through this opening the tracheal rings can be seen.[24]

Fig 4. DIRECT LARYNGOSCOPIC VIEW OF GLOTTIC OPENING



Laryngeal cartilages : The laryngeal cartilages comprise the single cricoid, thyroid and epiglottic cartilages and the paired arytenoid, cuneiform and corniculate cartilages.

Fig 5. CARTILAGES OF LARYNX



1. Arytenoid cartilages

These are pyramid shaped cartilages. They are present on the sides of cricoid cartilages. The posterior cricoarytenoid muscle and the lateral cricoarytenoid muscles are attached on the lateral aspect of the arytenoid cartilage. The vocal ligaments are attached to the anterior aspect. Corniculate cartilage are present medially.

2. Corniculate cartilages

These are paired cartilages. Conical in shape. Attached to the medial end of the arytenoid cartilage.

3. Cuneiform cartilages

They are paired cartilages present in relation to the corniculate cartilage.

4. Cricoid cartilage

Cricoid cartilage can be regarded as the skeletal foundation of the larynx, attached below to the trachea and articulated by synovial joints to the thyroid cartilage and the two arytenoids. It is the only cartilage of larynx that is present as a complete ring. It forms the entire wall of the lower part of larynx. Cricoid lamina : is quadrilateral in outline, 2-3cm in vertical dimension.

Cricoid arch : Narrow anteriorly, broader posteriorly.[18]

Cricotracheal ligament is attached on the lower side and cricothyroid ligament is attached on the upper side.

5. Thyroid cartilage

The thyroid cartilage is an unpaired cartilage. It is the largest of laryngeal cartilages. It consists of Adam's apple, thyroid notch, superior cornua and inferior cornua. Thyrohyoid membrane is attached to the superior cornua.

6. Epiglottic cartilage

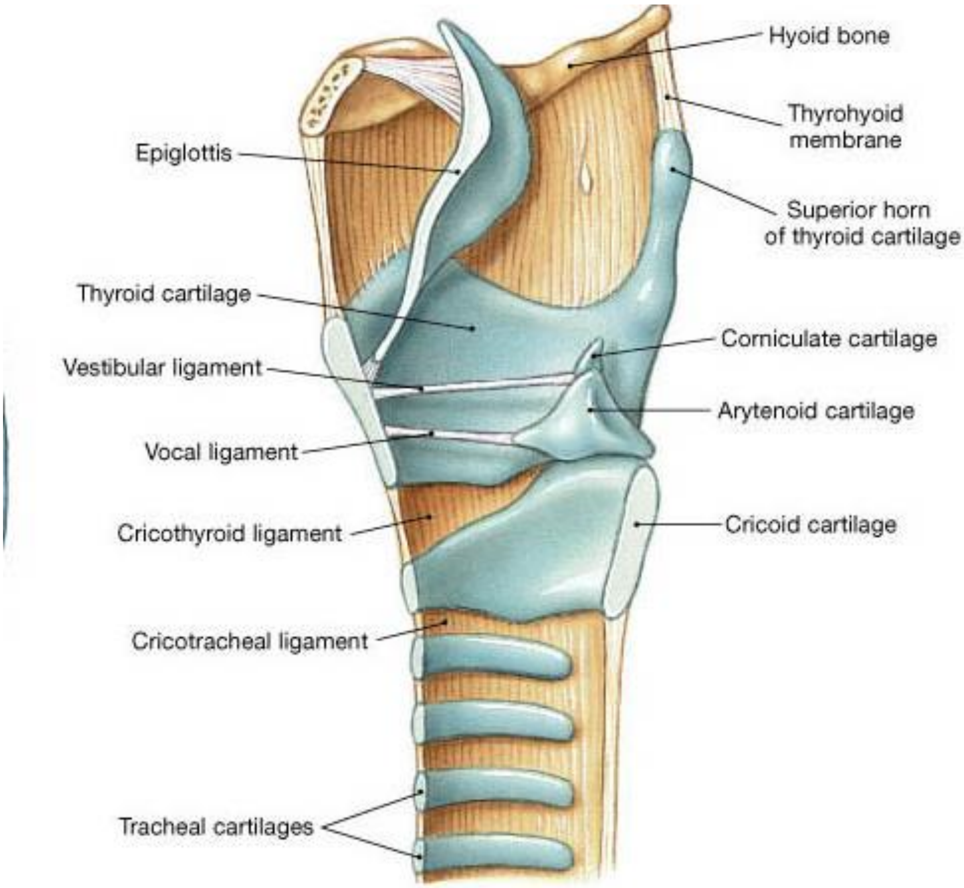
The epiglottic cartilage is a fibroelastic cartilage. It is leaf shaped. Its upper end is free and lower end is attached to thyroid notch.

Its sides are attached to the arytenoid cartilages by aryepiglottic folds. The median depression is called Vallecula. Epiglottic tubercle is seen in the posterior part.

Laryngeal ligaments

The ligaments of the larynx is divided into extrinsic ligaments and intrinsic ligaments.

Fig 6. LIGAMENTS OF LARYNX



Extrinsic

1. Thyrohyoid membrane

It is a broad fibroelastic membrane attached below to the superior border of the lamina of thyroid cartilage and its superior cornua and above to the superior margin of the body of hyoid bone and greater cornua. Its thicker part is the median thyrohyoid ligament and thinner lateral part is the lateral thyrohyoid ligament. The membrane is pierced by internal branch of superior laryngeal nerve and superior laryngeal vessels.

2. Cricotracheal ligament

It unites the lower cricoid border to the first tracheal cartilage.

3. Hyoepiglottic ligament

It connects the epiglottis to the back of body of thyroid.

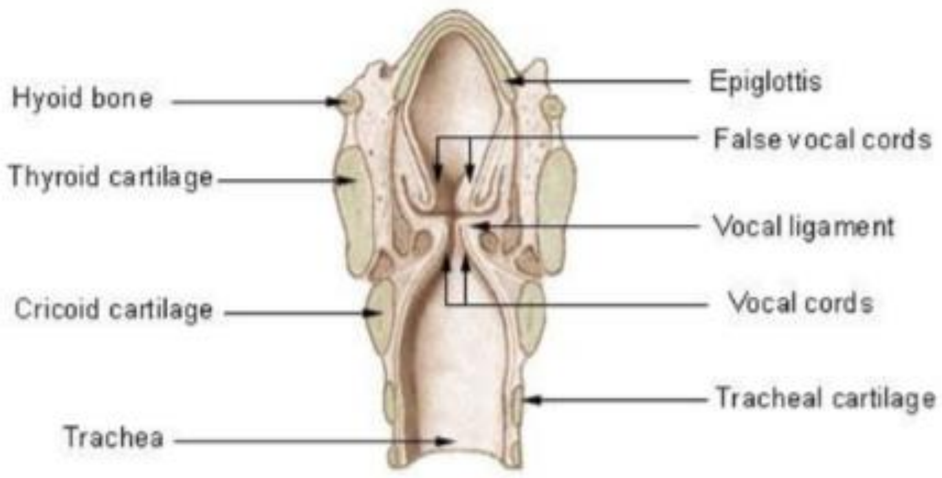
4. Cricothyroid ligament

It comprises the inferior larger part of laryngeal membrane and is comprised of anterior and lateral parts. The single thick anterior (median) cricothyroid ligament is broad below and narrow above. It connects adjacent margins of cricoid and thyroid cartilages. An anastomoses between the cricothyroid arteries crosses it and supply perforating branches to the larynx. The paired smaller lateral cricothyroid ligaments are thinner.

Laryngeal cavity

The laryngeal cavity space extends from the laryngeal inlet, from the pharynx, down to the lower border of cricoid cartilage where it continues into the trachea. It is partially divided into upper and lower parts by paired upper and lower mucosal folds, with a middle part between the two sets of folds

Fig 7 . CAVITY OF LARYNX



Upper folds are vestibular folds, median aperture that they guard is Rima vestibuli and the lower pair are vocal folds and the fissure between the latter are Rima glottidis or glottis.

The muscles of the larynx

There are two groups of muscles in larynx. The Extrinsic group and The Intrinsic group.

The extrinsic muscles

- ✓ Sternothyroid
- ✓ Thyrohyoid
- ✓ Stylopharyngeus
- ✓ Palatopharyngeus

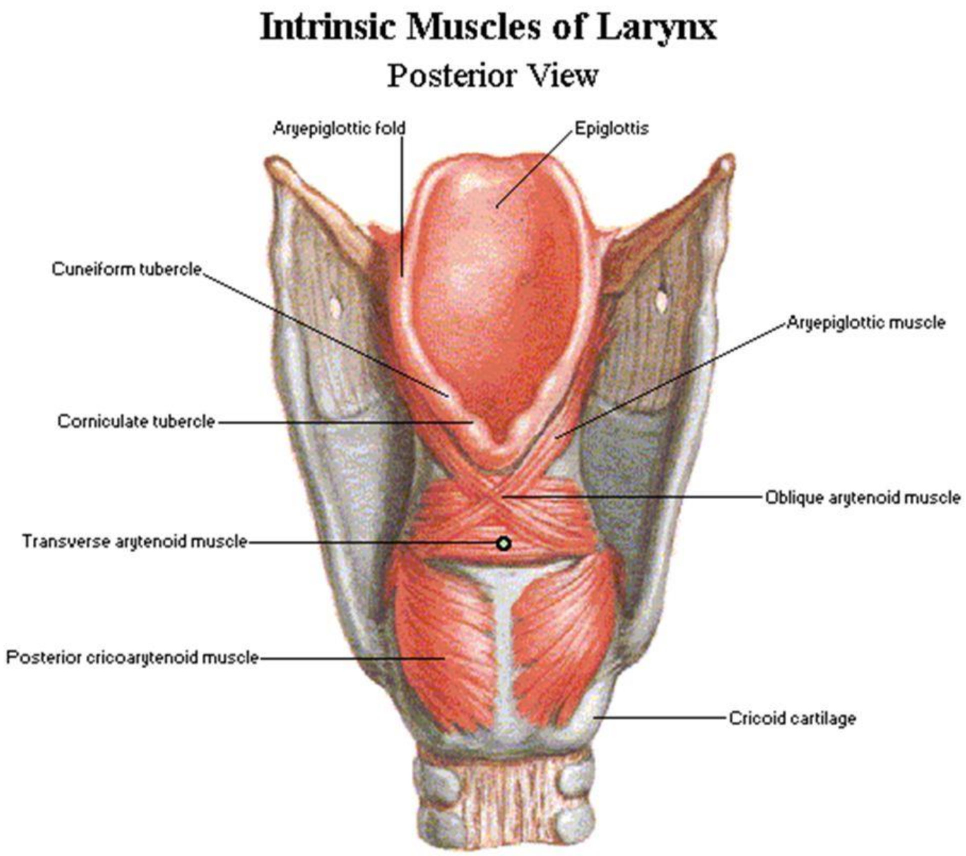
Fig 8. EXTRINSIC MUSCLES OF THE LARYNX

The *intrinsic muscles of the larynx* function in, Opening, closing and tensors of the cords.[19]

The Intrinsic muscles are

- ✓ Lateral Cricoarytenoids,
- ✓ Posterior Cricoarytenoids
- ✓ Interarytenoids,
- ✓ Aryepiglottic,
- ✓ Thyroarytenoid,
- ✓ Thyroepiglottic,
- ✓ Vocalis
- ✓ Cricothyroid muscles.

Fig 9. INTRINSIC MUSCLES OF THE LARYNX



Nerve supply

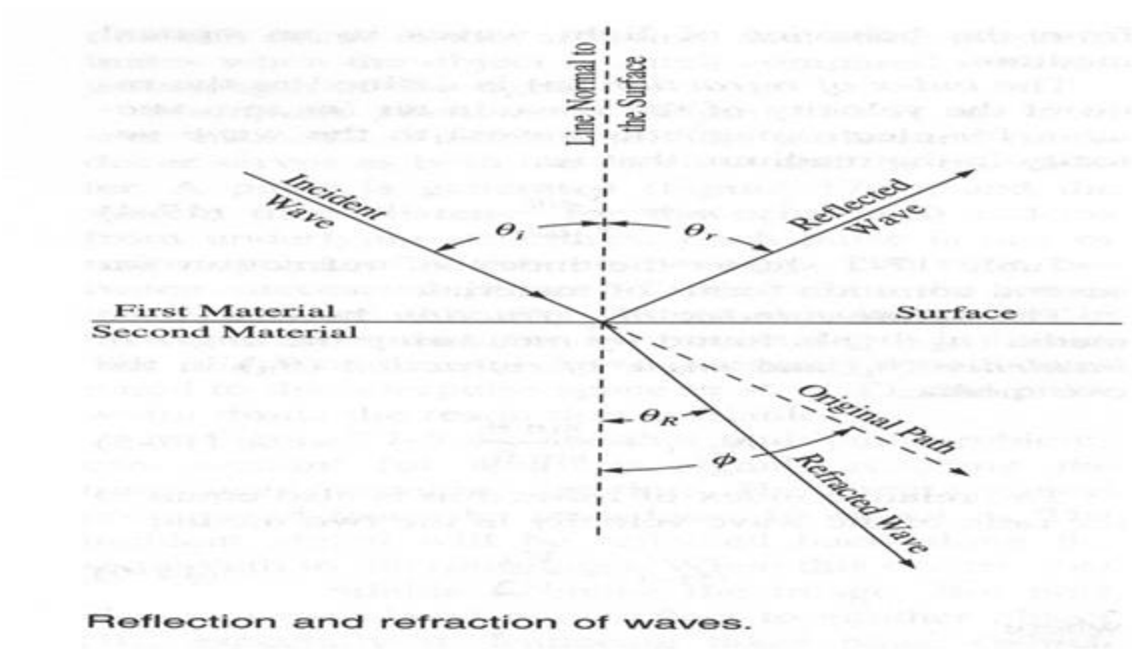
Superior laryngeal branch and Recurrent laryngeal branch of vagus nerve.

THE ULTRASOUND MACHINE

Principle of Ultrasound [25,26] :

Ultrasound uses sound waves to produce images of structure through which they pass. these sound waves pass through tissues as alternating pressure waveforms. The high pressure wave is called Compression and low pressure wave is called rarefaction.

Fig 10. REFLECTION AND REFRACTION OF WAVES

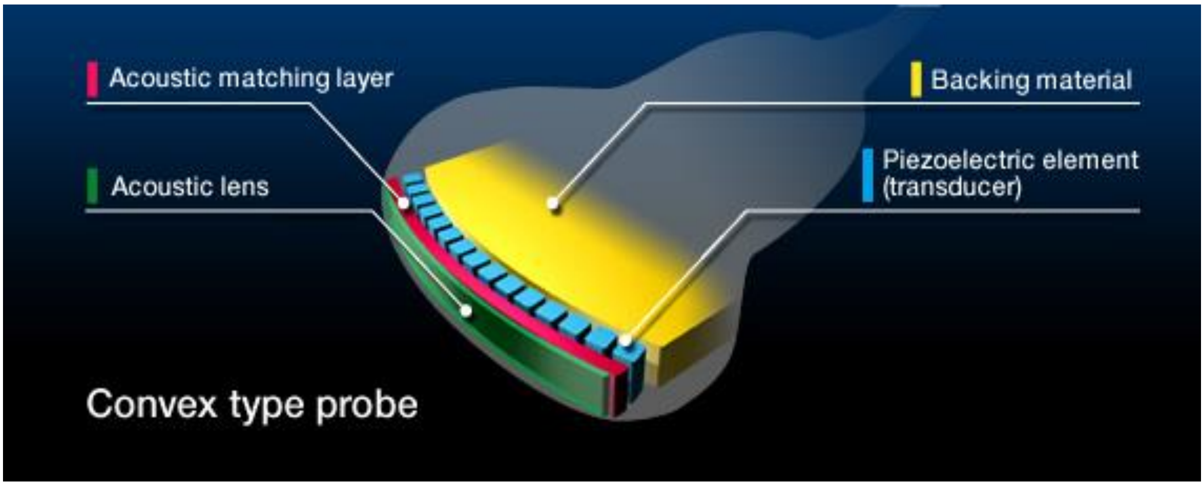


Reflection and refraction of waves.

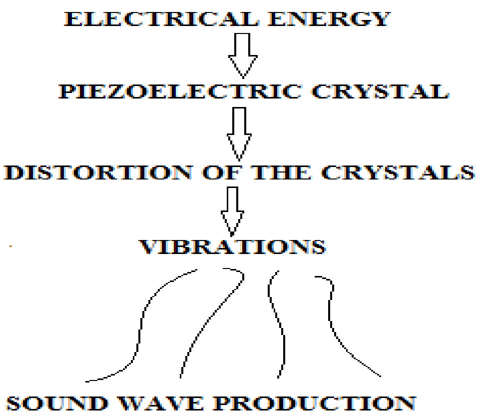
The frequency of sound waves transmitted by an ultrasound is greater than the audible range of human ears. that is the frequency is greater than 20,000 Hz. Human hearing range is 20-20,000 Hz.

Generation of an ultrasound wave

Fig 11. ULTRASOUND TRANSDUCER WITH PIEZOELECTRIC CRYSTAL



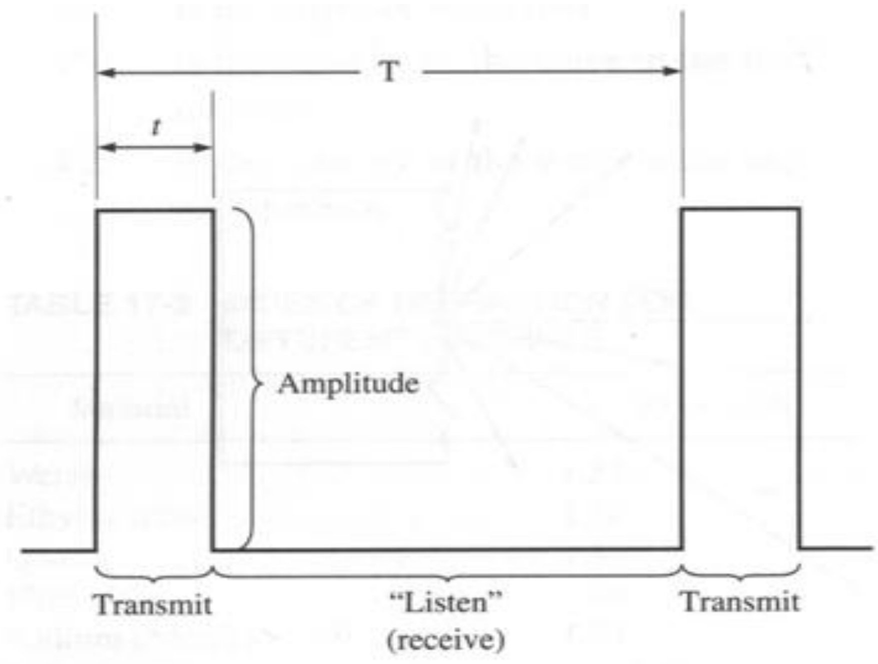
The main concept in the production of an ultrasound wave is the conversion of electrical energy to mechanical sound waves and reconversion of the sound waves energy to electrical energy. The core element that is needed to generate the ultrasound waves are the Piezoelectric crystals. These crystals are present on the transducer probe.



The conversion of electric energy to sound wave is called converse piezo electric effect.

Generation of an ultrasound image

Fig 12. GENERATION OF ULTRASOUND IMAGE



Ultrasound system transmits and then listens for pulse.

The ultrasound transducer transmits the sound waves and the waits to receive back the returning sound waves before transmitting the next wave. The sound waves that were transmitted from the transducer, travel through the body tissues and then get reflected. these reflected waves return back to the transducer probe and are received by it. this is then converted back to the electrical energy. This effect is called as

Piezoelectric effect. This electrical energy is converted by the machine computer to Images that are displayed.

As the sound waves pass through the body tissues they undergo the following,

- ✓ Reflection
- ✓ Rarefaction
- ✓ Diffraction that bending of waves on hitting a different density medium
- ✓ Scattering
- ✓ Acoustic impedence that is opposition to the sound waves.

There are 3 modes in ultrasound

1)Amplitude(A)Mode

2)Brightness(B)Mode

3) Motion (M) Mode

There are 5 basic components of an ultrasound scanner that are required for generation, display and storage of an ultrasound image.

1. Pulser - applies high amplitude voltage to energize the crystals.

2. Transducer - converts electrical energy to mechanical (ultrasound) energy

and vice versa.

3. Receiver - detects and amplifies weak signals.

4. Display - displays ultrasound signals in a variety of modes.

5. Memory - stores video display and images.

Selecting a transducer probe [27,28]

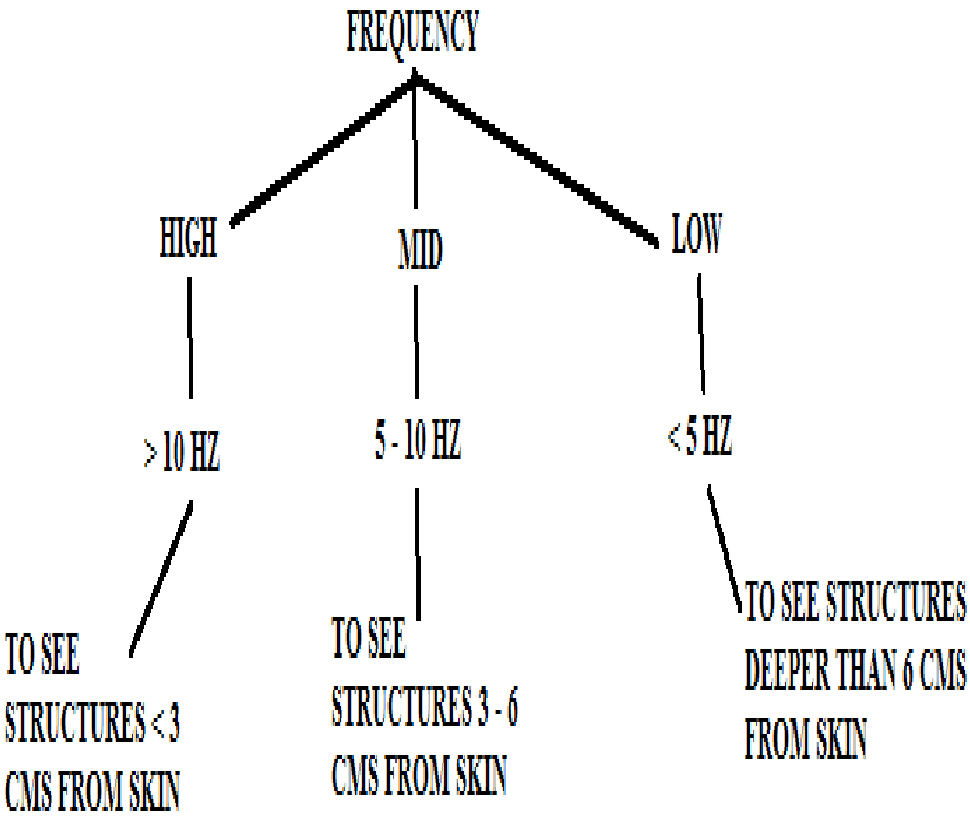
Fig 13. TYPES OF ULTRASOUND TRANSDUCER

There are three main properties based on which the transducer is selected.

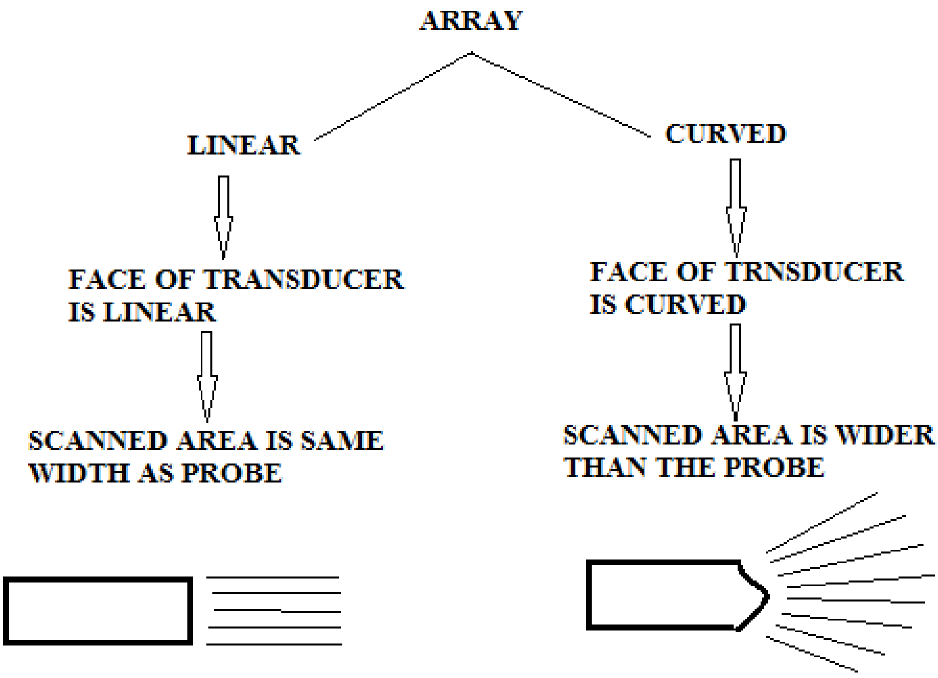
They are

- ✓ Frequency
- ✓ Array configuration
- ✓ Foot print - It is the diameter of the probe.

Based on frequency the transducers are classified as follows.



Based on array configuration the transducers are classified as follow.



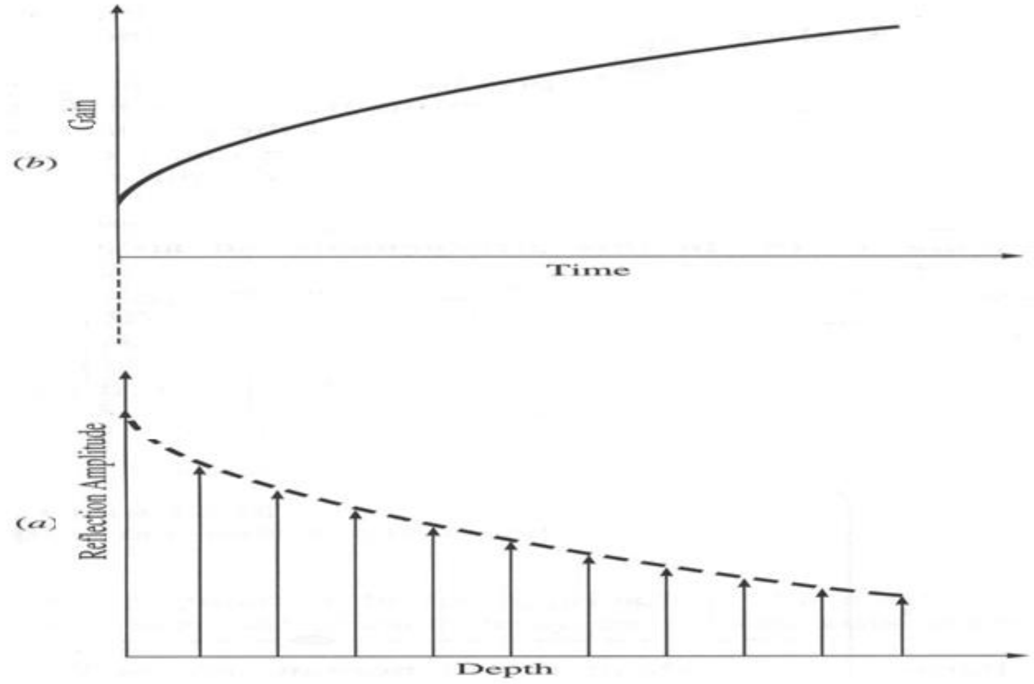
Enhancement and Attenuation

Structures that are originally deeper appear brighter than expected for that depth. This is because more sound waves has passed to the structure than expected as the other tissues surrounding the structure absorbed more sound waves. This phenomenon is called Enhancement.

The opposite effect where superficial structures appear dark because of reduced passage of sound waves to it due to increased impedence is called Attenuation.

CONTROLS IN THE MACHINE

Fig 14. TIME GAIN COMPENSATION CURVE



(a) Deeper targets return weaker signals. (b) Time-gain compensation curve.

- Gain – amplification of returning echoes (Overall brightness)
- Time gain compensation (curve) :Adjust brightness at different depths
- Freeze
- Depth :Zoom in superficial, or zoom out for wide view. Depth limited by frequency
- Focal zone :Optimal resolution wherever focal zone is.

ULTRASOUND ANATOMY OF AIRWAY

Kristensen et al (2013)[29] has stated that 'the linear high-frequency transducer is most suitable for imaging superficial airway structures (within 2–3 cm from the skin)[29] and that the curved low-frequency transducer, is most suitable for obtaining sagittal and parasagittal views of structures in the submandibular and supraglottic regions, mainly because of its wider field of view'[29].

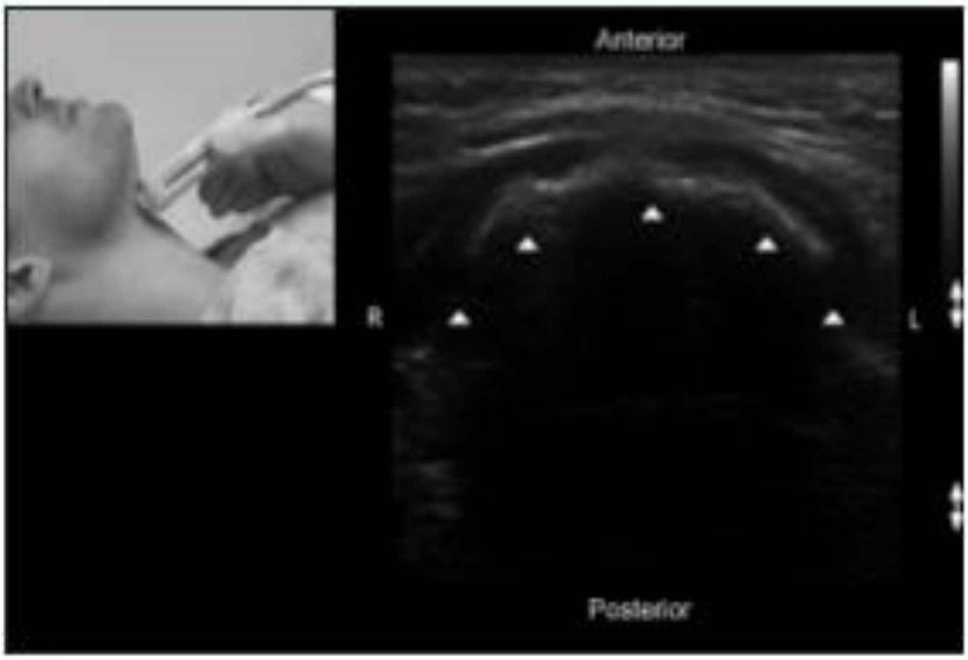
Ultrasonogram appearances of upper airway structures are as follows. [30,31,32,33,34]

Bones	Mentum	Linear hyperechoic with acoustic shadow
	Mandible	Linear hyperechoic with acoustic shadow
	Hyoid	Linear hyperechoic with acoustic shadow
	Sternum	Linear hyperechoic with acoustic shadow
Cartilages	Thyroid	Homogenously hypoechoic
	Cricoid	Homogenously hypoechoic
Muscles		Hypoechoic Heterogenous striated
Tissue membranes		Hypoechoic Heterogenous striated
Glands	Sub - mandibular	Homogenous hyperechoic
	Thyroid	Homogenous hyperechoic

Any interface between the mucosa lining the upper airway tract and the air within it (an air-mucosa [A-M] interface) has a bright hyperechoic linear appearance. In an air- filled space deep to an A-M interface, air artifacts such as comet tail and reverberation artifacts[35,36] could be visualized.

HYOID BONE

FIG 15. TRANSVERSE VIEW OF HYOID



The hyoid separates the upper airway into 2 areas:

- ✓ The Suprahyoid region
- ✓ The Infrahyoid region.

Transverse view : Seen as a hyperechoic structure. It is seen as inverted U shaped. Posterior acoustic shadow is seen.

Sagittal View and Parasagittal View : Seen as cross section. It is hyperechoic and curved. Has an acoustic shadow [30,31,32,33,34]

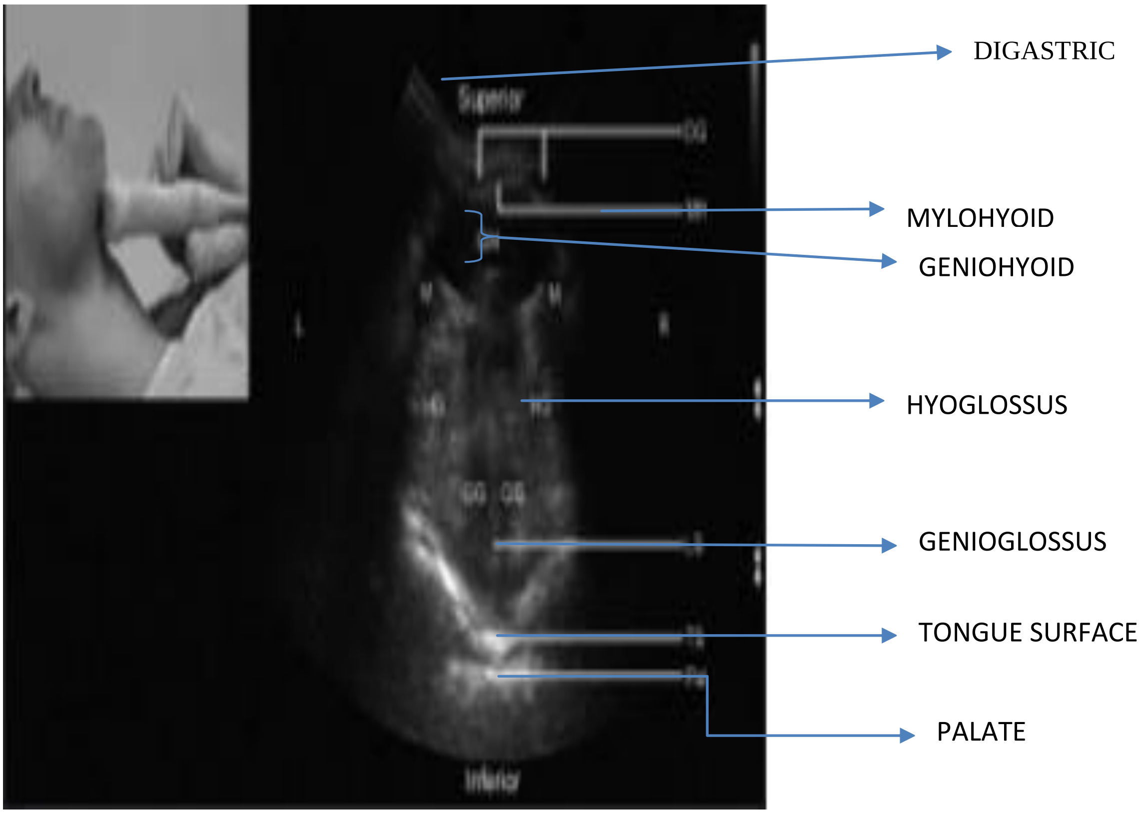
- **Suprahyoid Region**

The curved low frequency transducer is preferred for imaging structures in the suprahyoid region[29]. The increased depth of penetration allows better visualization of deeper structures in the floor of the mouth, and the wider field of view facilitates identification of anatomic structures and their relationship to each other.

FLOOR OF THE MOUTH

Several hypoechoic muscle layers were visible on the transverse view at the submandibular position. The most superficial layer is the platysma muscle, followed by the mylohyoid muscle, a thin curved band of tissue connecting the mandibular ramus on each side. The anterior belly of the digastric muscle is seen in cross section as a circular hypoechoic structure superficial to the mylohyoid muscle; however, the intermediate tendon and the posterior belly of the digastric muscle are obscured by the mandibular ramus[37,38].The geniohyoid muscle is visible as a thicker and more hypoechoic band of tissue deep to the mylohyoid muscle. The genioglossus muscles are hypoechoic and striated and lay deep to the geniohyoid muscle and on either side of the lingual septum.[37,38,39]

Fig 16. FLOOR OF THE MOUTH TRANSVERSE VIEW



On the sagittal view, the mylohyoid and geniohyoid muscles are visible as linear hypoechoic bands. The genioglossus and hyoglossus muscles lay deep to the geniohyoid muscle and are seen running in a fanlike fashion toward the dorsal surface of the tongue[37,38,39]

- **Infrahyoid Region**

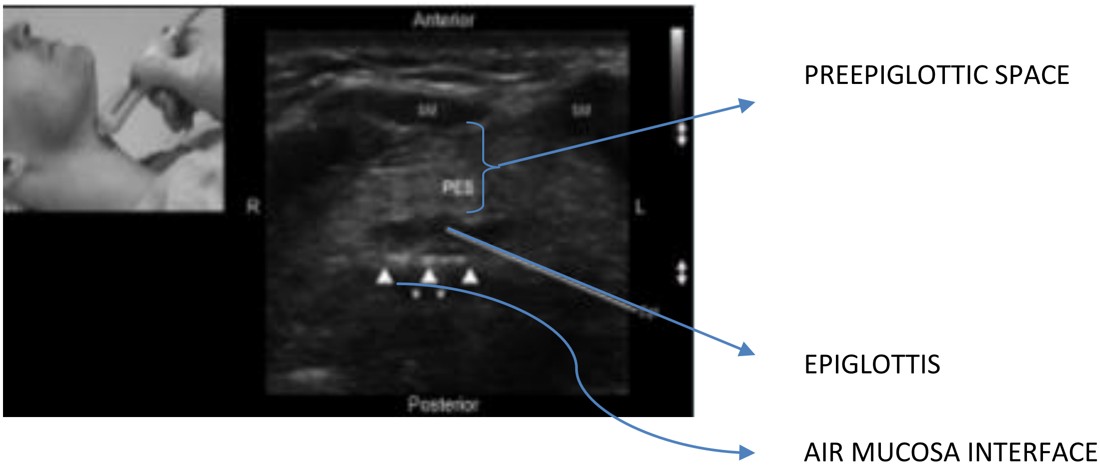
With the curved low-frequency transducer oriented in a sagittal plane and placed in the submandibular region, the infrahyoid as well as suprahyoid midline structures can be visualized in a single view[30]. The linear high frequency transducer is most useful for detailed examination of the anatomic structures in the infrahyoid region[30]

- **Thyrohyoid Membrane** [30,31,32,33,34]

The thyrohyoid membrane as the name suggests, is a membrane running between the hyoid bone above and the thyroid cartilage below. Through this membrane the Epiglottis can be seen in ultrasonogram.

- **Epiglottis**

<u>Fig 17. THYROHYOID MEMBRANE LEVEL TRANSVERSE VIEW</u>



The epiglottis is visible through the thyrohyoid membrane as a hypoechoic curvilinear structure on the parasagittal and transverse views. Pre epiglottic space is seen anterior to the epiglottis. Its posterior border has a bright linear A-M interface [40,41,42,43,44,45].

- **Thyroid Cartilage**

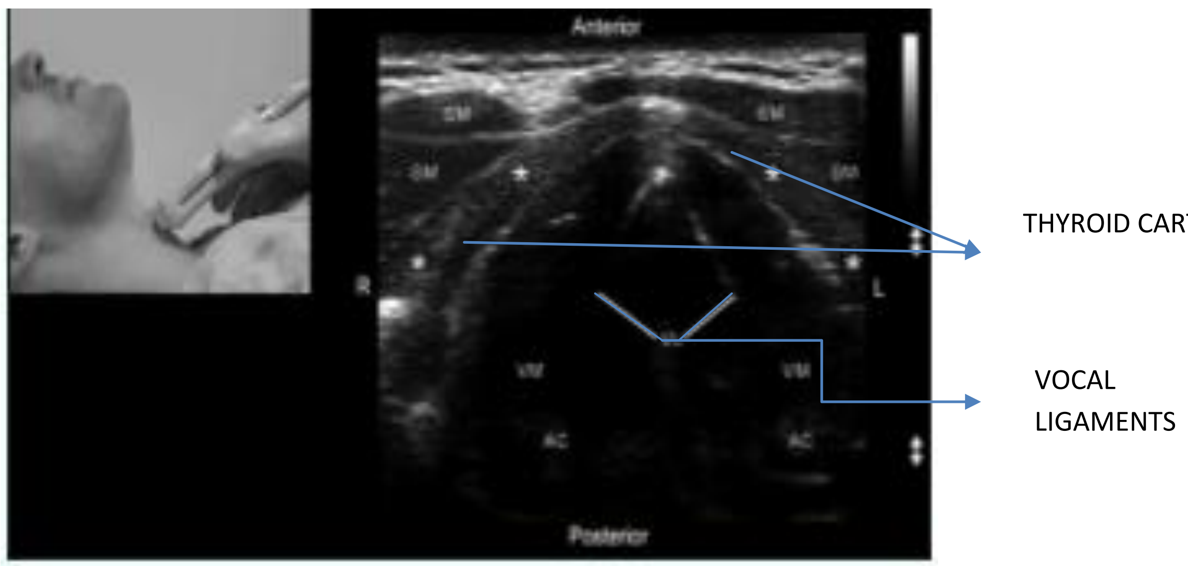
Sagittal plane - Linear hypoechoic. Posteriorly A-M interface is seen.

Parasagittal plane - Linear hypoechoic. Posteriorly A-M interface is seen.

Transverse plane - Inverted V. The vocal cords are seen in this plane.[30,31,32,33,34]

- **Vocal Cords**

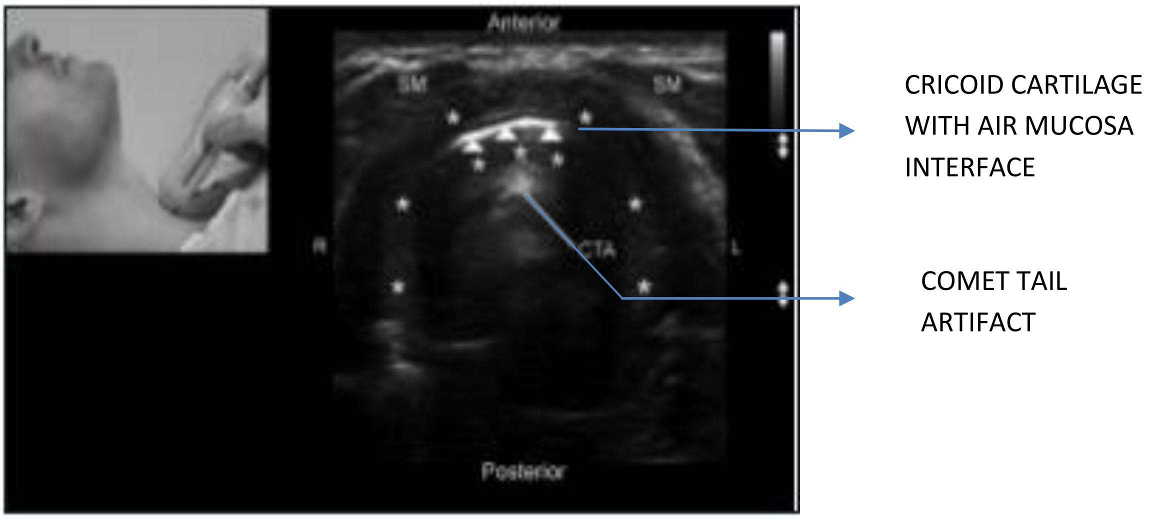
Fig 18. VOCAL CORDS IN TRANSVERSE VIEW



The vocal cords are seen in a transverse plane and placed at 3 separate locations: (1) the thyrohyoid membrane; (2) the thyroid cartilage; and (3) the cricothyroid membrane. The true cords are hypoechoic, outlined by the hyperechoic vocal ligaments. They are triangular in shape. The false vocal cords lay parallel and cephalad to the true cords and are more hyperechoic in appearance. The true and false cords can be further distinguished during phonation (“aa-aa” and “ee-ee” words): the true cords will be observed to oscillate and move toward the midline compared with the false cords, which will remain relatively immobile [30,31,32,33,34]

- **Cricoid Cartilage and Cricothyroid Membrane** [30,31,32,33,34]

<u>Fig 19. CRICOID CARTILAGE AND CRICOTHYROID MEMBRANE</u>



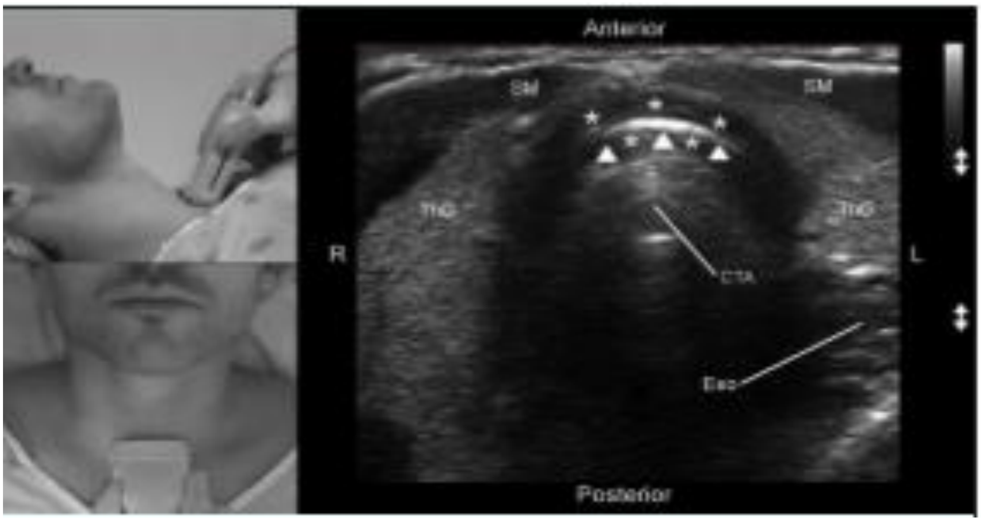
Parasaggital plane : Round hypoechoic

Transverse plane : Arch shaped.

The posterior surface of its anterior wall is delineated by a bright A-M interface as well as reverberation artifacts [35,36] from intraluminal air.

- **Trachea and Neighboring Structures** [30,31,32,33,34]

<u>Fig 20. SUPRASTERNAL NOTCH LEVEL WITH TRACHEA , AIR MUCOSA INTERFACE AND COMET TAIL APPEARANCE</u>



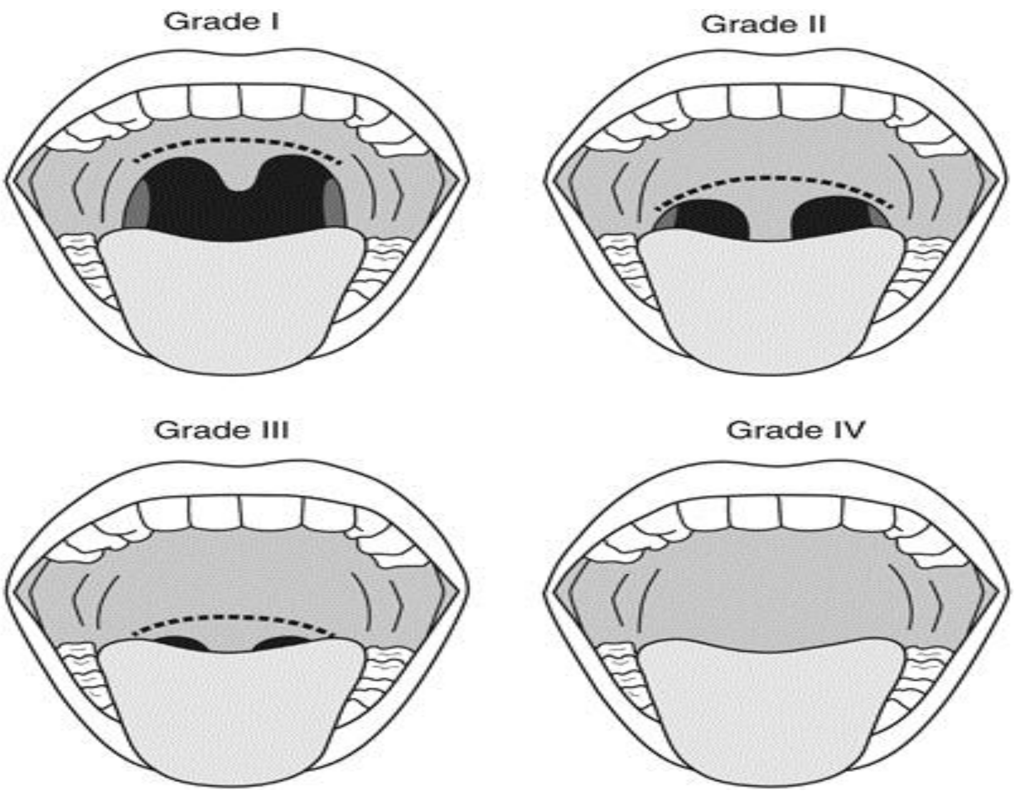
As in other cartilaginous structures, the tracheal rings are hypoechoic. On the parasagittal and sagittal views, they resemble a “string of beads,” and on the transverse view, they resemble an inverted U highlighted by a linear hyperechoic A-M interface and reverberation artifact posteriorly. The 2 lobes and isthmus of the thyroid gland are visualized anterolateral to the trachea on the transverse view at Suprasternal notch level. The thyroid gland is homogeneously hyperechoic with a finely speckled appearance.

ANATOMICAL PREDICTORS OF DIFFICULT AIRWAY

1. Mallampatti's test : [2,46,47]

The Mallampatti's classification gives us the relationship between the size of the tongue and the size of the pharynx. The patient is seated, head held in neutral position, mouth open as wide as possible and tongue protruded out maximum. Patient should be instructed not to speak. Classification is done based on the structures that are visible.

Fig 21. MALLAMPATI CLASSIFICATION



Mallampatti's I : Soft palate, faucets; uvula, anterior and the posterior pillars are visible.

Mallampatti's II : Soft palate, faucets and uvula are seen.

Mallampatti's III : Soft palate and base of uvula alone are seen.

In Samson and Young’s modification (1987) [3] of the Mallampatti's classification, a IV class was added.

Mallampatti's IV : Only hard palate seen.

2. Atlanto occipital joint (AO) extension : [48,49,50]

Ability to maintain Sniffing or Magill position for intubation is assessed by this test.. The patient is asked to hold head erect, facing directly to the front, then he is asked to extend the head maximally and the examiner estimates the angle traversed by the occlusal surface of upper teeth. Measurement can be by simple visual estimate or more accurately with a goniometer. Any reduction in extension is expressed in grades:

Grade I : >35°

Grade II : 22°-34°

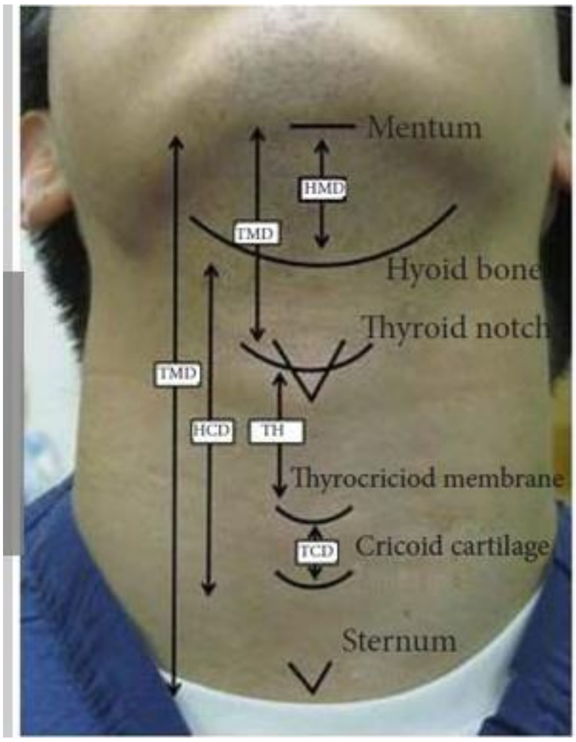
Grade III : 12°-21°

Grade IV : < 12°

Normal angle of extension is 35° or more.

3. Mandibular space

Fig 22. MANDIBULAR SPACE



HMD - HYOMENTAL DISTANCE

TMD - TEMPERO MANDIBULAR DISTANCE

TH - THYROHYOID

TCD - THYRO CRICOID DISTANCE

HCD - HYOCRICOID DISTANCE

SMD - STERNOMENTAL DISTANCE

- ❖ **Thyromental (T-M) distance (Patil's test):** [51]

Thyromental distance as the name suggests is the distance between the thyroid notch and tip of mentum. It is measured after asking the patient to keep the neck fully extended. Thyromental distance gives a rough idea of the relation between larynx and pharynx. It gives us information regarding the alignment of each other when the neck is placed in the intubating position.

- ✓ Difficult intubation - distance is < 6 cm in adults;
- ✓ Less difficult intubation- 6 - 6.5 cms
- ✓ Easy intubation - > 6.5 cm

❖ **Sterno-mental distance :** [52]

Sterno mental distance is the distance between suprasternal notch and tip of mentum. It is measured after asking the patient to keep the neck fully extended.

Sterno mental distance < 12cms - intubation difficult.

❖ **Mandibulo-hyoid distance :** [53]

Distance from tip of mandible to hyoid bone is called mandibulo hyoid distance. If the distance is increased then intubation is difficult. Normal is <4 cms.

4**) Inter-incisor distance :**

The vertical distance from upper incisor to lower incisors.

Normal is > 4 cm.

<4 cm - difficult airway.

5) **<u>Wilson's scoring system</u>** [54]

PARAMETER	0	1	2
Weight (Kg)	<90	90-110	>110
Head and Neck movement	>90 degree	=90	<90
Inter incisor gap	>5 cm	= 5cm	<5 cms
Sliding mandible beyond maxillary incisors	>0	>0	<0
Receding mandible	None	Moderate	Severe
Buck tooth	None	Moderate	Severe

Score 5 or < : Easy laryngoscopy

Score 6 - 7 : Moderate difficulty

Score 8 - 10 : Severe Difficult laryngoscopy

6) LEMON criteria [55,56]

L	Look	Facial trauma Large incisors Large tongue Beard or moustache
E	Evaluate	Incisor distance - 3 finger Hyoid-mental distance - 3 finger Thyroid-to-mouth distance - 2 finger breadths
M	Mallampatti's	Score > 3
O	Obstruction	Epiglotitis Peri-tonsillar abscess, Trauma
N	Neck mobility	Limited

Difficult intubation - high LEMON score.

REVIEW OF LITERATURE

1) MANDEEP SINGH et al ; 2009 they did study to evaluate the usefulness of ultrasonogram for identifying the structures in the upper airway .Their sample size was 24.They placed the patient in sniffing position and

conducted the study .

Results : They were able to identify all the structures in all the patients . They used both linear probe and curved probe .They studied the anatomy in three planes , namely

- Sagittal
- Para sagittal
- Transverse

Bones were seen as bright hyper echoic followed by hypo echoic shadow .Cartilages were hypo echoic .The other structures that was seen was vocal cords .They were not able to visualize the posterior parts of pharynx and trachea because of air column .

Conclusion : They concluded that sonography of airway is useful in identifying the structures .

2.JACEK A. WOJTCZAK et al ; 2011

Objectives : This study was conducted in obese patients, whose neck circumference was large . They used ultrasonogram to measure the size of tongue and hyomental distance ratio.

Methods : The sample size was 12 . Of the 12 , 5 were obese and 7 were moderately obese .Patients were positioned first in supine position with head neutral. Hyomental distance was taken first in this position .Then the patients were asked to extend the neck to the maximum .The second measurement of hyomental distance was taken in this position. The ratio between the two distance was calculated .This ratio was taken as the hyomental distance ratio .The size of the tongue was calculated . It was the product of area and width of the tongue . The tongue was visualized in transverse plane .

Conclusion : They found out that , ultrasonogram can be used to measure the hyomental distance ratio .It was also useful in measuring the size of the tongue. The hyomental distance ratio is a predictor of difficult laryngoscopy .

3.SRIKAR ADIKARI et al

Objectives : To assess the usefulness of ultrasonogram in measuring the tongue thickness and anterior neck soft tissue at two levels namely , Hyoid and Thyrohyoid membrane . To use this measurement in differentiating difficult laryngoscopy from easy laryngoscopy .

Methods : This was a pilot study .Sample size was 50 . Study design was prospective observational .They included patients posted for elective surgery who needed intubation .All the ultrasound measurements were collected pre operatively .The Cormack - Lehane grading was done on the day of surgery .

Conclusion : They concluded that ultrasound measurements of anterior neck thickness was useful in identifying difficult airway.

4.KARIM LAKHAL et al ; 2007

Aim of the study : To use the ultra sonogram , to measure the airway diameter , that might help in choosing the correct size endo tracheal tube .

Methods : Sample size chosen was 19 .They used the ultrasonogram to measure the cricoids lumen diameter in the transverse plane .They compared this value with MRI measurement of the cricoids lumen .

Results : The statistical analysis used was Bland –Altman .They found positive correlation between USG measurements and MRI measurements .

Conclusion : They concluded that ultra sonogram is useful in measuring sub- glottis diameter .

5. DEEPAK GUPTA et al 2012

Study Objectives: The purpose of the study was to compare and correlate the ultrasound view of the airway and the Cormack Lehane classification of the direct laryngoscopy.

Methods/Study Procedures: The present study was conducted on patients scheduled for elective surgery and requiring general anesthesia with direct laryngoscopy and endotracheal intubation. In the pre-operative holding area, the following measurements were obtained with the oblique-transverse ultrasound view of the airway: (a) the distance from the epiglottis to the midpoint of the distance between the vocal folds, (b) the depth of the pre-epiglottic space, and (c) the total time taken by the operator to achieve the final ultrasonic image. The data was then compared with the Cormack Lehane classification during direct laryngoscopy in the operating room. Subsequently based on the correlation data, the ultrasonographic modification of Cormack- Lehane Classification was developed.

Results: It was observed that there was a correlation of the distance between the epiglottis and the vocal cords (E-VC) with the Cormack Lehane Grading; correlation was strong negative with regression coefficient of -0.966 (95% CI -1.431 to -0.501; p = 0.0001). Subsequently, the correlation of the pre-epiglottis space (Pre-E) with the Cormack Lehane Grading was strong in positive direction with regression coefficient of 0.595 (95% CI 0.261 to 0.929; p = 0.0008). Finally the ratio of Pre-E and E-VC distances with the Cormack Lehane Grading had the strongest positive correlation with regression coefficient of 0.495 (95% CI 0.319 to 0.671; p <0.0001). Based on these statistical calculations and after rearranging the data, we found that prediction of Cormack Lehane (CL) grades can be adequately (67%-68% sensitivity) made by the ratio of Pre-E and E-VC distances (Pre-E/E-VC) {0<[Pre-E/E-VC]<1 ≈ CL grade 1; 1<[Pre-E/E-VC]<2 ≈ CL grade 2; and 2<[Pre-E/E-VC]<3 ≈ CL grade 3}. The average time taken to complete the ultrasound examination of airway in the preoperative area was 31.7 ± 12.4 seconds.

Conclusion: The non-invasive ultrasonographic modification of invasive Cormack Lehane classification for pre-anesthetic airway assessment can supplement the presently available non- invasive modalities of pre-anesthetic airway assessment including the Mallampatti's Classification.

6. SHIGA et al ;

Objective : They conducted a study to assess the accuracy of clinical airway assessment for identifying difficult intubation .

Methods : They selected previously done studies from data bases .The total studies chosen were 35 and the total patients included were 50,760 .The inclusion criteria was , patients with nil airway abnormality . The clinical airway assessment tests used in this study were Mallampatti's test , Thyro-mental distance , Sterno – mental distance , Mouth opening and Wilson’s score . The sensitivity and specificity of each test was calculated individually .

Results :The individual sensitivity for each test was 20 % to 62 % , which means that the sensitivity is poor . The individual specificity for each test was 82 % to 97 % ,which means that specificity is moderate .On Calculating the positive likelihood ratio for combination of test , it was found that Mallampatti's and Thyro –mental distance was useful .

Conclusion : Individual clinical assessment tests are poor tools in identifying difficult intubation .Combination tests improves the diagnostic ability .

7.EZRI et al

AIM OF THE STUDY: To assess whether increased soft tissue thickness at vocal cord level as measured by ultrasonogram is useful in identifying difficult intubation.

METHOD : Sample size was 50. Patients chosen were morbidly obese. Using ultrasonogram thickness of neck tissue at the level of vocal cords was measured.

RESULTS : Totally 9 patients had difficult laryngoscopy. These patients had increased thickness of soft tissue which was statistically significant.

CONCLUSION : They conclude that increased thickness at vocal cord level is useful in identifying difficult intubation.

8. PRASAD et al

AIM : To compare between ultrasound airway measurement and computed sonography airway measurements.

METHOD : Sample size was 15. All patients included in the study were subjected to both ultrasound measurement of airway and computed sonographic measurement of airway at the suprahyoid level and infra hyoid level. The results were compared and analyzed for any statistical significance.

CONCLUSION : They concluded that there was no statistically significant difference between the two modalities of measurements at the supra hyoid region. So ultra sound can be used to assess airway.

9.WHITE AND KANDER IN 1975 studied radiographs of the mandible, upper jaw and cervical spine in thirteen patients in whom direct laryngoscopy was difficult. They found that posterior depth of mandible was the most important factor for determining the ease of direct laryngoscopy and an increase in this distance hinders the displacement of soft tissues by larygoscope blade.

10.NICHOLE AND ZUCK IN 1983 suggested that the atlanto-occipital distance is a major anatomical factor that determines the ability to extend the head on the neck and exposure of larynx.

11.VANDER LINDE, ROELOFSE AND STEENKAMP IN 1983 suggested that no single anatomical factor determined the ease of direct laryngoscopy, but rather a combination of them.

12.PATIL, STEHLING AND ZANDER (1983) suggested that if during the initial clinical examination existing signs of a potentially difficult intubation supplement a distance less than 6.0cms between the lower border of chin and the thyroid notch, then intubation is going to be difficult and fiberoptic laryngoscopy is indicated

13.IN 1983, MALLAMPATTI SR hypothesized that concealment of faucial pillars and uvula by the base of the tongue rendered the exposure of larynx by direct laryngoscopy difficult. He evaluated his hypothesis on 210 adult patients.. Visibility of oropharyngeal structures were noted and graded.

He evaluated his hypothesis on 210 adult patients and showed significant correlation between ability to visualize pharyngeal structures and ease of laryngoscopy.

In 155 patients with class I exposure, all had easy visualization at laryngoscopy (100%). In 40 patients with class 2 exposure, laryngoscopy was easy in 26 patients and difficult in 14 patients. In 15 patients with class 3 exposure, only one patient had easy laryngoscopy and in all other patients laryngoscopy was difficult.

14.JOHN MCINTYRE IN 1987 has elaborated the need for anticipation of difficulties in intubation, attempts to overcome them and the various possible outcomes of attempts at intubation. Based on previous studies he formed a comprehensive plan for examination of airway which included (a) viewing the patient from lateral and anterolateral position to rule out maxillary overgrowth or micrognathia (b) anterior viewing and palpation of the neck to check the position of trachea, to rule out submental, submandibular and other neck swellings, scarring of neck tissues and the mentohyoid distance which should be >6.0 cms (c) any restriction of flexion and extension of the neck (d) examining the oral cavity for adequate mouth opening, visualization of fauces, presence of large tongue, narrow mouth, small oral cavity, cleft lip or palate and long teeth. The presence of positive findings means that the vocal cords will be unusually difficult to visualize using standard intubating conditions. He also suggested the important factors to be taken into consideration during laryngoscopy include (1) the distance to the vocal cords (2) the compressibility of tongue and soft tissues into the mandibular space (3) prominent upper incisor teeth (4) blade maneuverability in small mouth.

15.WILSON, SPIEGELHALTER, ROBERTSON ET AL IN 1988 analyzed five factors simultaneously to predict difficult intubation which included weight [<90Kg, 90-110kg., >110Kg], head and neck movement [>90^o, about 90^o, <90^o], Jaw movement, receding mandible and buck teeth [Normal, moderate and severe] and assigned 0,1,2 points depending on severity. Using the sum risk criterion of ≥2, 75% of difficult laryngoscopies can be predicted but at the cost of high false positivity of 12.1%. Increasing the criterion to ≥4 reduced the false positive rate but at the cost of lowering the number of difficult laryngoscopies predicted and concluded that despite exploring many features it was not possible to identify difficult patients without high false positivity.

16.MATHEW M, HANNA LS, ALDRETTE JA IN 1989 studied the correlation between thyromental distance and the horizontal length of mandible with modified Mallampatti's test in 44 patients who were divided in to two equal groups. Group A consisting of 22 patients who presented as unanticipated difficulty in intubation. Group B is easy intubation consisting of 22 patients

The study showed that patients with Thyromental distance of < 6cms and mandible length < 9cms showed positive correlation with MMT grade III and IV and had a higher chance of difficult intubation. On the other hand, those with thyromental distance of < 6cms and horizontal length of mandible > 9 cms correlated well with MMT grade I and II with a lesser possibility of difficult intubation.

MATERIALS AND METHODOLOGY

This study was conducted at Government Stanley Medical College hospital, Chennai on 150 patients who underwent elective surgery requiring general anaesthesia and tracheal intubation. This study was conducted after obtaining approval from the institutional ethical committee. Patients were explained about the procedure in detail and consent was obtained for the same.

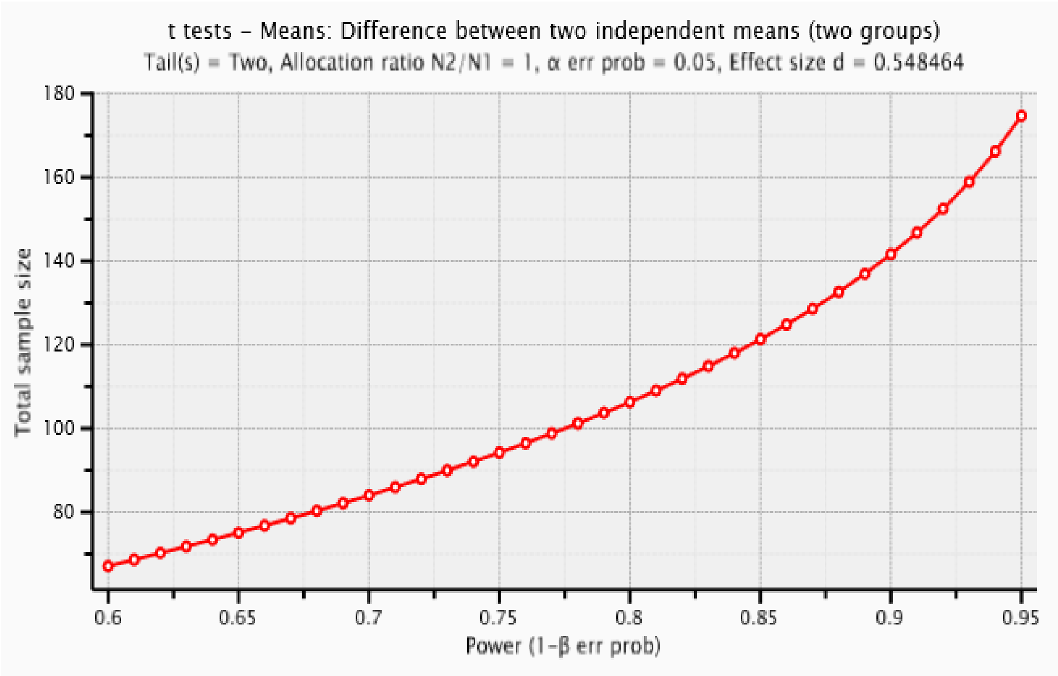
Study Design:

It is a prospective observational single blinded study. 150 patients, who satisfied the inclusion criteria were included in the study. At the end of the study the patients were classified as GROUP E and GROUP D based on the Cormack-Lehane classification of laryngoscopic view.

GROUP E : Easy intubation group.

GROUP D : Difficult intubation group.

Fig 23. SAMPLE SIZE REQUIRED



Based on the parent article, and the G*Power version 3.1.3 was used and power of the study was kept as 90% and the sample size calculated was 140. In this study we have taken a sample size of 150.

AIM OF THE STUDY

1) To assess the usefulness of ultrasound as a non invasive tool in assessing the airway and to assess its use in indentifying difficult airways.

2) To assess for any correlation between the ultrasound assessment of the airway and clinical assessment of the airway.

SELECTION OF CASES

INCLUSION CRITERIA :

- ASA grade I,II and III
- Age 18 to 80 years
- Both Sex
- Patients undergoing elective surgery requiring general anaesthesia with direct laryngoscopy and endotracheal intubation .

EXCLUSION CRITERIA :

- The patients with mouth opening less than 3 centimeters,
- Edentulous patients,
- The patients with head and neck anatomical pathologies that might have
  unpredictable effect on the ultrasound assessment of the airway.
- The patients who were not able to extend their neck >30 degree.

MATERIALS REQUIRED

- Ultrasound machine (GE LOGIQ – C2) with high frequency (6-12 MHz) linear probe transducer.
- Ultrasound gel.
- Weighing machine

- Measuring scale for height
- Inch tape
- 15 cm plastic scale.

STUDY METHOD

On the previous day of the surgery the patients were explained about the procedure and after obtaining informed written consent, they were shifted to the ultrasound room in the department of anaesthesiology and the following measurements were made and recorded.

1) Height : Patient was instructed to stand straight and upright against the measuring scale and the height was measured in centimeters.

2) Weight : Weight of the patient was measured in kilograms using a weighing machine.

3) Modified Mallampatti's classification of airway : Modified Mallampatti's Test similar to that used by Samsoon and Young[3] was performed in a seated patient who opened his mouth as wide as he could and protruded the tongue as far as possible, while the observes looked from the patient eye level and inspected the pharyngeal structures with a pen torch. It is important when performing this test that the patient does not phonate since this can alter what is seen. The view was then graded as:

Grade I : Soft palate, fauces, uvula and pillars seen.

Grade II : Soft palate, fauces and uvula seen

Grade III : Soft palate and base of uvula seen.

Grade IV : soft palate not visible.

4) Inter incisor gap : Maximum distance between the upper and lower incisors when the patient's mouth is wide open. It was measured in centimeters using an inch tape. The measurements made were recorded.

5) Thyromental distance [51] : Distance is measured from the thyroid notch to the tip of the mentum. It was measured with the head extended fully, using an inch tape. The measurements made were recorded.

6) Ultrasound measurement of thickness of soft tissue in anterior neck

The thickness of anterior neck soft tissues from the skin, was measured at 3different levels.

Level 1 : skin to hyoid bone thickness

Level 2 : skin to epiglottis level thickness at the thyrohyoid membrane level

Level 3 : skin to tracheal ring thickness at the suprasternal notch level.

Patient position : The patient was made to lie down supine with head in

neutral position without a pillow under head. Patient was instructed to keep the mouth closed and to take slow breaths during measurements to minimize errors in recordings due to movements during respiration.

Ultrasound machine control settings : The following controls were set in the ultrasound machine for obtaining the airway assessment measurements and images.

- Transducer - Linear High frequency transducer [27,28]
- Axis/Plane - Short axis/Transverse plane
- Frequency - 11 MHz
- Depth - 3.0 cms - 4.0 cms
- Gain - 20 - 30.

Obtaining measurements : The measurements of anterior neck soft tissues were made at the above mentioned three levels in short axis view.

a) The hyoid bone was identified as a inverted U shaped hyperechoic structure in the submandibular region [30,31,32,33,34]. The image was frozen on screen and measurement from skin to midpoint of hyoid bone was taken using the "measure" option in the ultrasound machine.

b) The Epiglottis was identified in the Thyrohyoid membrane level as a linear hypoechoic structure followed by a hyperechoic shadow[40,41,42,43,44,45]. Measurement was taken from skin to epiglottis as mentioned previously.

c) Tracheal ring was identified in the suprasternal notch level, as a hyperechoic structure followed by acoustic shadowing of air mucosal inter phase. [30,31,32,33,34] Measurements from skin to tracheal ring was obtained as mentioned previously.

Recording data : The collected data were recorded for further analysis.

The patients were then taken back to their wards. The next day morning on the day of surgery the patients were shifted to their respective operating rooms and the standard general anesthesia procedure was performed as per the discretion of the attending anesthesiologist . The following were kept ready.

→ Anesthesia machine and circuits checked,

→ Endotracheal tubes → cuffed portex tubes of appropriate size

and one size lower than required.

→ Macintosh laryngoscope → with medium and large sized blade.

→ Airway : oral and Nasopharyngeal airway

→ Laryngeal mask airway of appropriate size

→ Functioning suction apparatus

→ Malleable stylet / Magill's forceps.

→ Monitors → ECG Monitor and Pulse oximeter, sphygmomanometer

→ Emergency drugs → Atropine, Adrenaline, Dopamine, Lignocaine 2% and 4%.

In case of anticipated difficulty in intubation, fiberoptic equipment was kept ready.

The following standardization measures were taken before obtaining Cormack Lehane grading.

a) The attending anesthesiologist had an experience in the field of anaesthesiology for at least a minimum of 5 years.

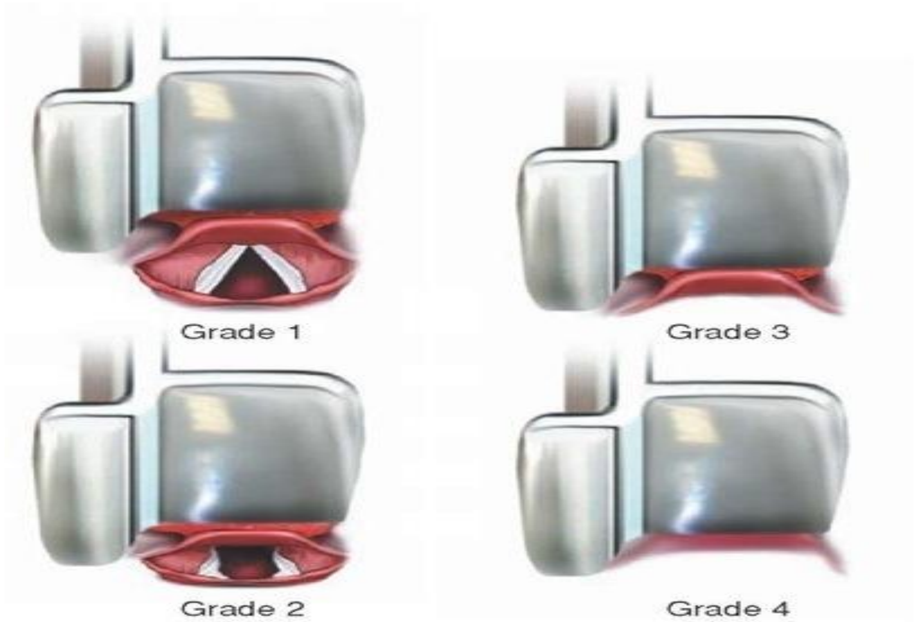
b) All patients were connected to monitors - ECG, NIBP and PULSE OXIMETER and any additional monitors required as per the type of surgical procedure were kept ready.

c) All patients were premedicated, preoxygenated, induced and paralysed using drugs according to the choice of the attending anesthesiologist before intubation.

c) A macintosh blade size 3 was used for laryngoscopy. [57]

d) The anaesthesiologists were asked to grade the vocal cord view as per Cormack Lehane grading. [58] The best view obtained at the first attempt by the laryngoscopy without any external maneuver were applied[58] was taken as the Cormack Lehane classification.

Fig 24. CORMACK LEHANE CLASSIFICATION



Cormack Lehane class 1 - visualization of the entire laryngeal aperture

Cormack Lehane class 2 - visualization of parts of the laryngeal aperture or the arytenoids

Cormack Lehane class 3 - visualization of only the epiglottis

Cormack Lehane class 4 - visualization of only the soft palate.

The surgery was carried out and after surgery was over the patients were reversed and extubated. They were observed for half an hour post operatively for full recovery and then the patients were shifted to the post operative wards for further management.

GROUPS

Based on the Cormack Lehane (CL) class noted, patients were grouped into two groups.

Group 1 : Easy laryngoscopy group (CL 1 and CL 2)

Group 2 : Difficult laryngoscopy group (CL 3 and CL4)

ANALYSIS PLAN

a) To allow for comparisons between the difficult airway and easy airway groups, *a two-sided Student's t-test* was employed as appropriate.

b) For sub group analysis, the measurements obtained by ultrasonogram at each level were divided into three subgroups and analyzed according to the percentage of cases falling into the Easy intubation group and Difficult intubation group.

c) *ROC curve analysis* was made for all three levels for obtaining cutoff points that delineates the Group E from Group D, and to assess for the sensitivity and specificity for each measured level.

d) *Spearman's rank correlation co-efficient* was used to analyze for any correlation between clinical screening tests and sonographic measurements.

e) Association between demographic variables and occurrence of difficult intubation was assessed using *Pearson's chi square test.*

f) $p < 0.05$ was considered significant and $p > 0.05$ was not significant

OUTCOMES MEASURED

Primary outcome : 1) Correlation between Cormack-Lehane classification and sonographic measurements of thickness of soft tissues in the anterior neck at three levels namely

a) Hyoid bone

b) Thyro hyoid membrane (Epiglottis)

c) Suprasternal notch.

Secondary outcome : Correlation between sonographic measurements at the three levels and clinical airway screening.

OBSERVATION AND RESULTS

A prospective observational study was conducted to assess the usefulness of ultrasonogram in identifying difficult airway and to assess for any correlation between clinical airway assessment and ultrasound airway assessment. Sample size selected was 150 patients. 150 patients under this study were classified into 2 groups prospectively based on their Cormack Lehane grading.

GROUP E (EASY AIRWAY)

GROUP D (DIFFICULT AIRWAY)

Of the 150 patients, 139 patients were classified into Group E and the rest 11 patients were classified in Group D.

Group E : N = 139

Group D : N = 11

The observations and results were as follows.

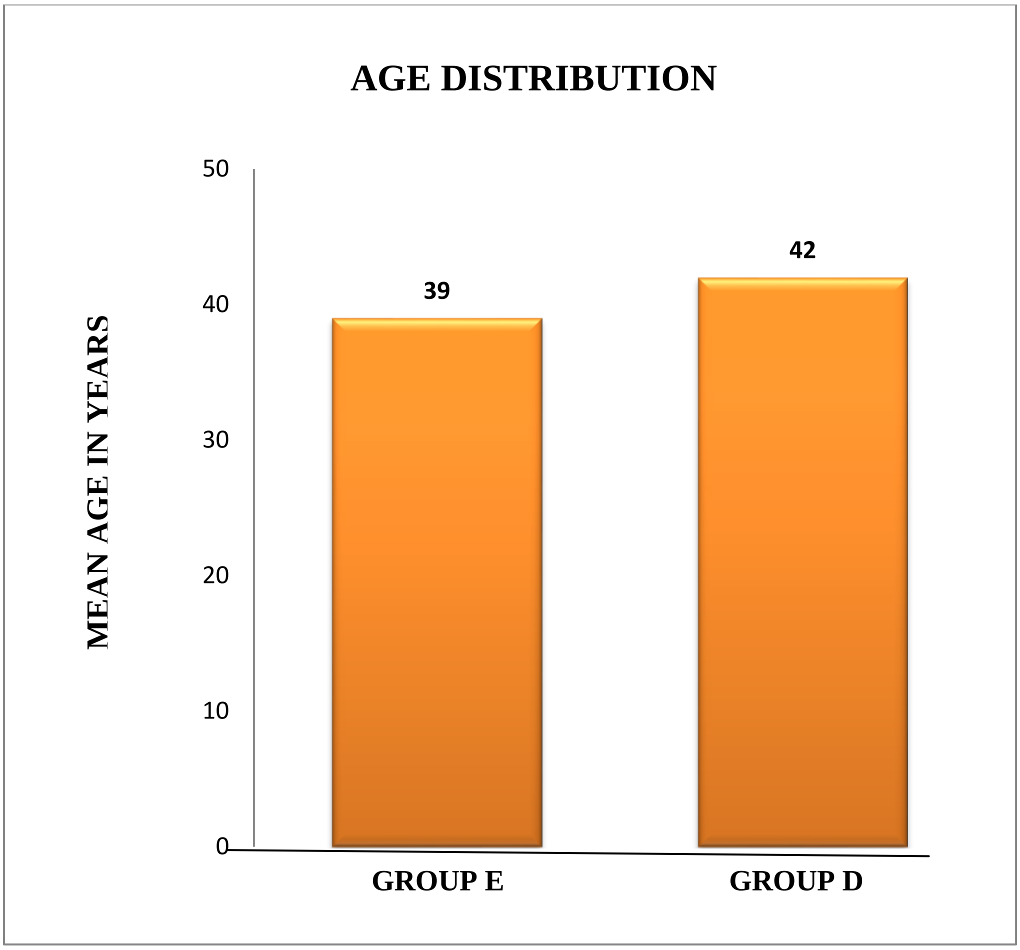
TABLE 1. AGE DISTRIBUTION

	N	MEAN	STANDARD DEVIATION
GROUP E	139	38.99	14.286
GROUP D	11	42.18	14.204

Independent t test , P = 0.613

Out of the total 150 cases, the mean age in group E (N = 139) was 38.99 years and the standard deviation was 14.286. Mean age in Group D was 42.18 and the standard deviation was 14.204

. **<u>CHART 1. AGE DISTRIBUTION</u>**



These data were computed using students t-test and the P value was found to be 0.613 which is not statistically significant.

TABLE 2. SEX DISTRIBUTION

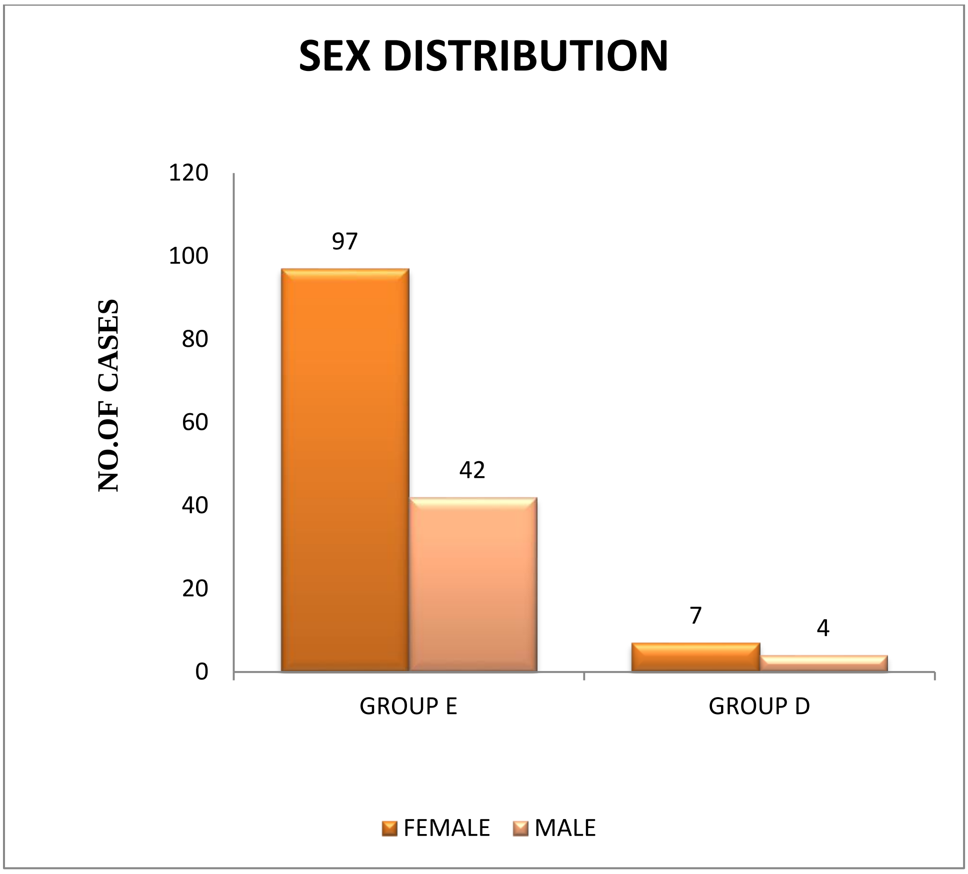
	GROUP E	GROUP D
FEMALE	**97**	**7**
MALE	**42**	**4**

Pearson's chi square test , P = 0.670

Out of the total 150 case, 104 cases were females and 46 cases were males.

Of the 104 female cases, 97 belonged to Group E and 7 belonged to Group D.

CHART 2. SEX DISTRIBUTION



Of the 46 male cases, 42 cases belonged to Group E and 4 cases belonged to Group D. These data were computed using Pearson's chi square test and the P value was found to be 0.670 which is not statistically significant.

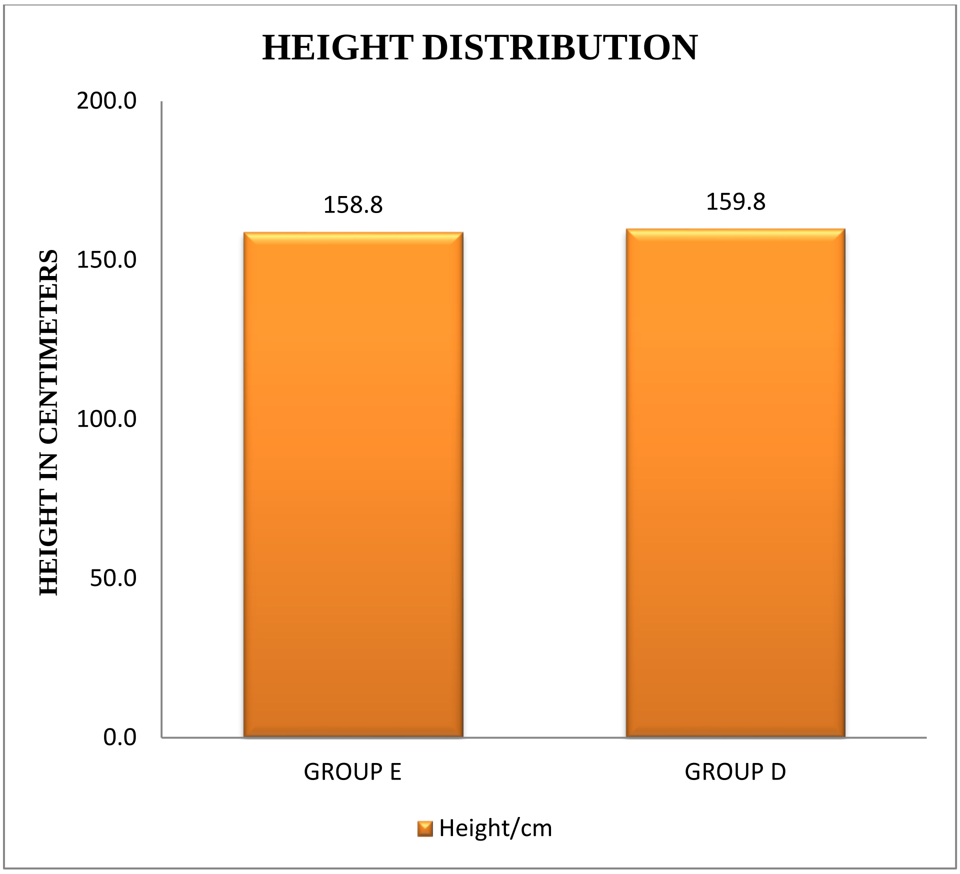
TABLE 3. HEIGHT DISTRIBUTION

	N	MEAN	STANDARD DEVIATION
Group E	**139**	**158.84**	**6.128**
Group D	**11**	**159.82**	**6.661**

Independent t test , P =0.614

Out of the total 150 cases in our study, 139 cases belonged to the Easy airway group (GROUP E) and 11 cases belonged to the Difficult airway group (GROUP D)

CHART 3. HEIGHT DISTRIBUTION



The mean of heights in the group E is158.8 cms ± 6.128 standard deviation and that in the group D is 159.8 cms ± 6.661 standard deviation. By using the independent T test p value was calculated as 0.641, which is statistically not significant.

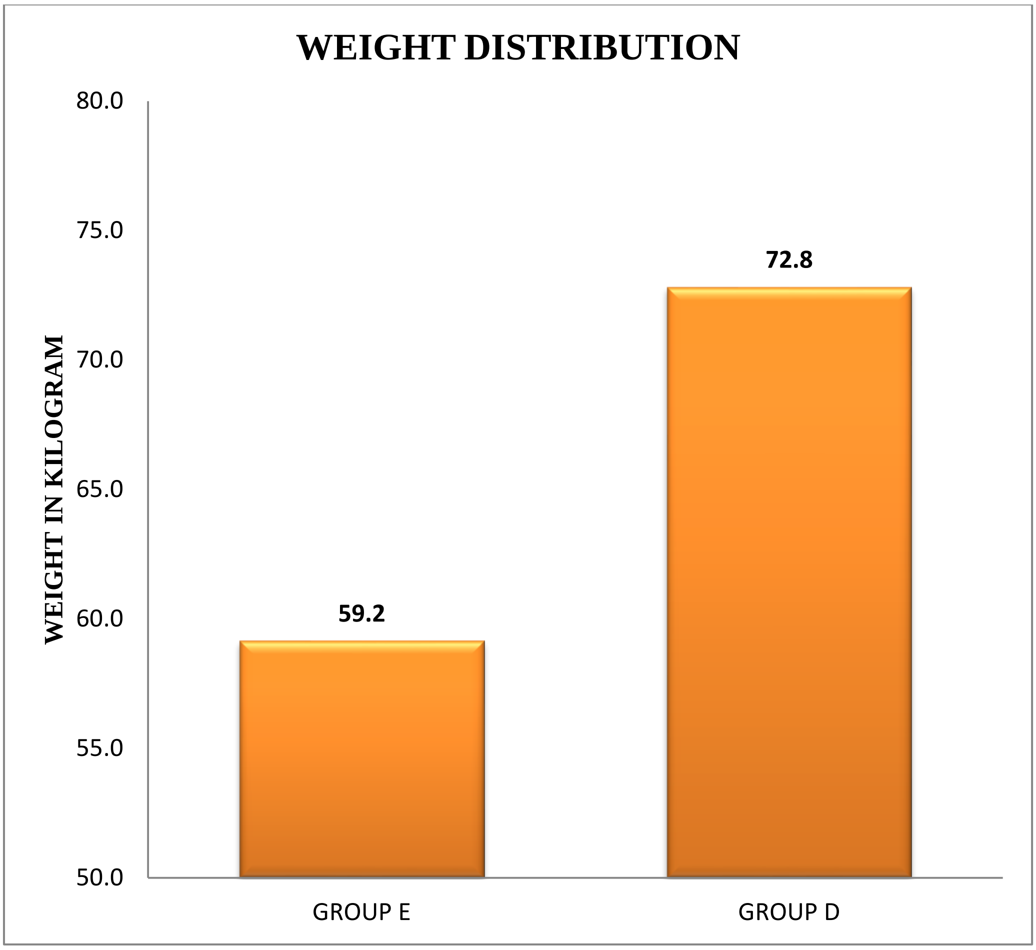
TABLE 4. WEIGHT DISTRIBUTION

	N	MEAN	STANDARD DEVIATION
Group E	**139**	**59.15**	**7.019**
Group D	**11**	**72.82**	**6.306**

Independent t test, P =0.000

The mean of weight in the group E is 59.15 kgs ± 7.019 standard deviation and that in the group D is 72.82 kgs ± 6.306 standard deviation.

CHART 4. WEIGHT DISTRIBUTION



By using the independent T test p value was calculated as 0.000, which is of high statistical significance.

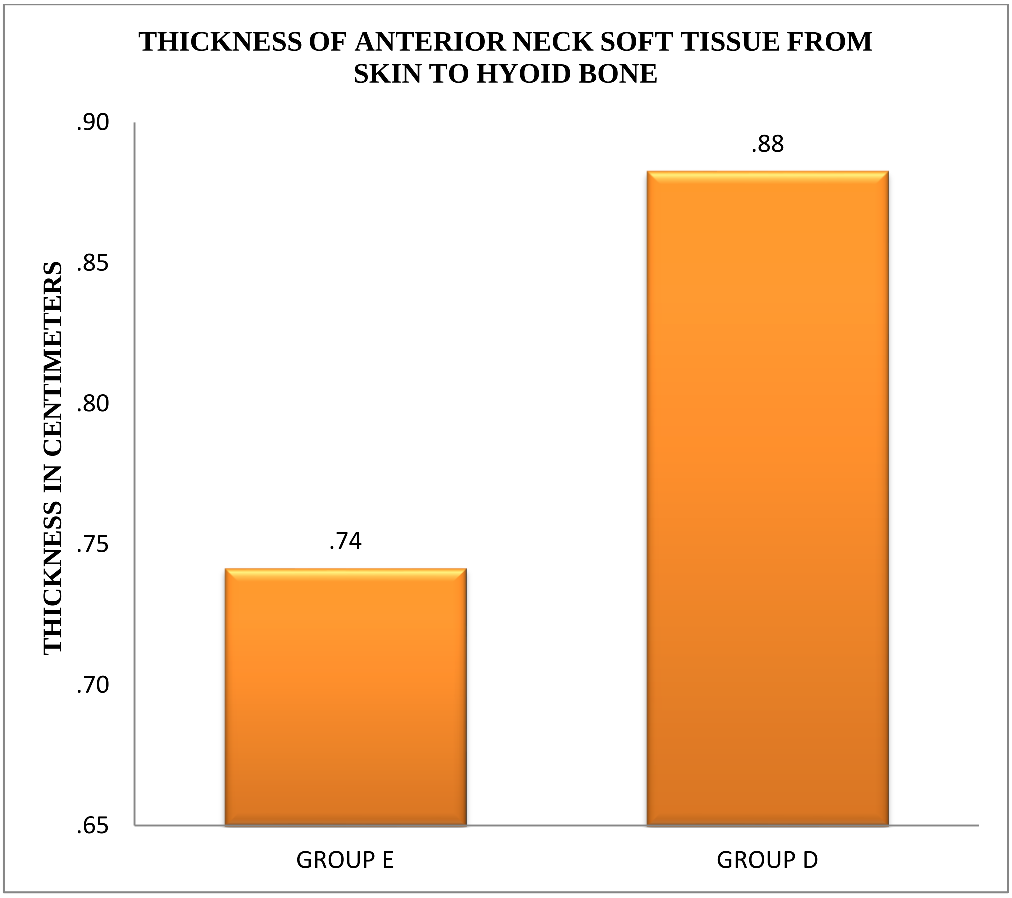
TABLE 5. THICKNESS OF ANTERIOR NECK SOFT TISSUE FROM SKIN TO HYOID BONE

	N	MEAN	SD
GROUP E	139	0.74	0.1233
GROUP D	11	0.88	0.1465

Independent t test P = 0.000

Out of the 139 cases in Group E, the mean value of thickness of the anterior neck soft tissue from skin to hyoid bone is 0.74cm ± 0.1233 standard deviation.

CHART 5. THICKNESS OF ANTERIOR NECK SOFT TISSUE FROM SKIN TO HYOID BONE



. Out of the 11 cases in Group D, the mean value of thickness from skin to hyoid bone is 0.88cm ± 0.1465 standard deviation. By using independent T test for statistical analysis, the P value was calculated to be 0.000, which is statistically highly significant.

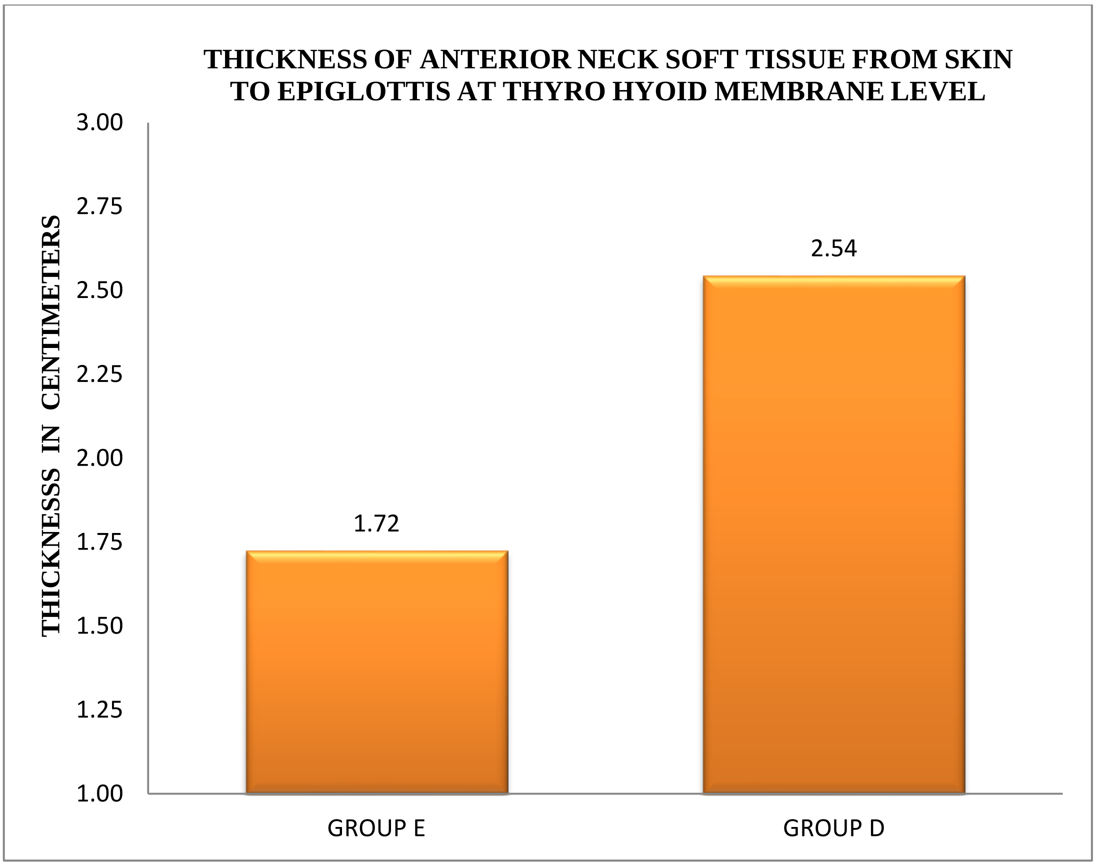
TABLE 6. THICKNESS OF ANTERIOR NECK SOFT TISSUE FROM SKIN TO EPIGLOTTIS AT THYROHYOID MEMBRANE LEVEL

	N	MEAN	SD
GROUP E	139	1.72	0.260
GROUP D	11	2.54	0.098

Independent t test, P = 0.000

Out of the 139 cases in Group E, the mean value of thickness of the anterior neck soft tissue from skin to epiglottis at thyrohyoid membrane level is 1.72cm ± 0.260 standard deviation.

CHART 6. THICKNESS OF ANTERIOR NECK SOFT TISSUE FROM SKIN TO EPIGLOTTIS AT THYROHYOID MEMBRANE LEVEL



Out of the 11 cases in Group D, the mean value of thickness from skin to epiglottis at thyrohyoid membrane level is 2.54cm ± 0.098 standard deviation.

By using independent T test for statistical analysis, the P value was calculated to be 0.000, which is statistically highly significant.

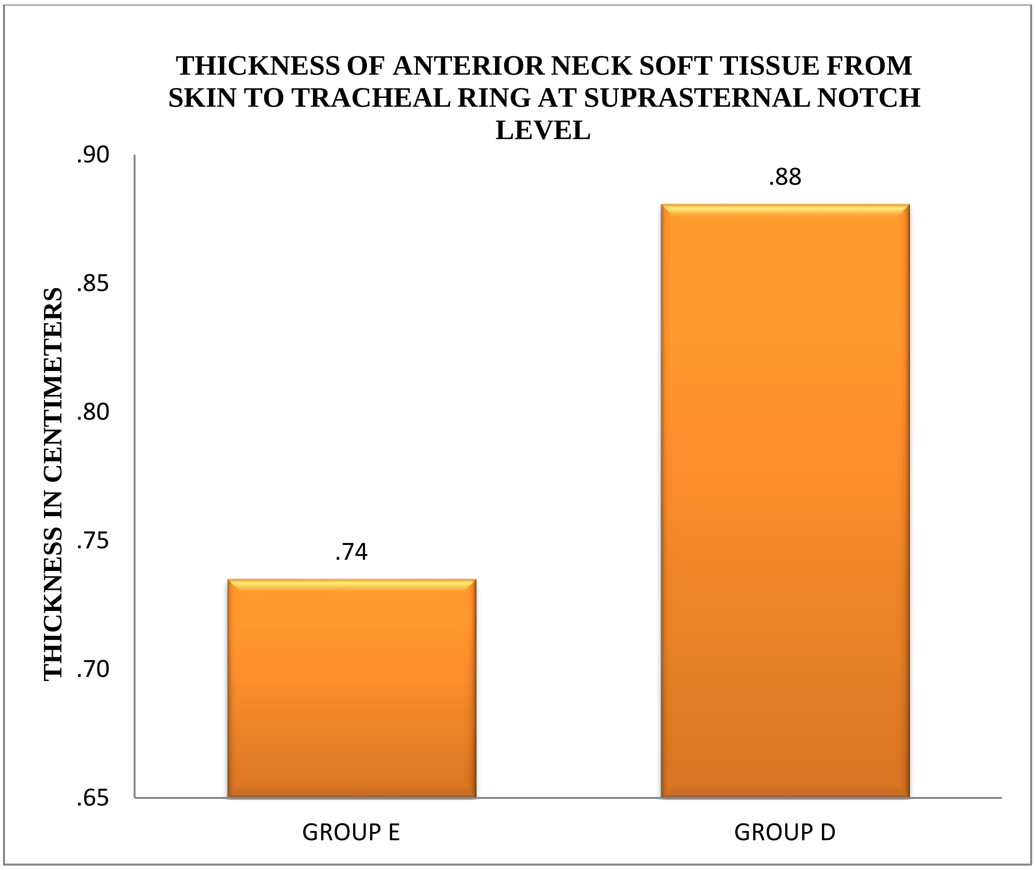
TABLE 7. THICKNESS OF ANTERIOR NECK SOFT TISSUE FROM SKIN TO TRACHEAL RING AT SUPRASTERNAL NOTCH LEVEL

	N	MEAN	SD
GROUP E	139	0.74	0.113
GROUP D	11	0.88	0.117

Independent t test, P = 0.000

Out of the 139 cases in Group E, the mean value of thickness of the anterior neck soft tissue from skin to tracheal ring at suprasternal notch level is 0.74cm ± 0.113 standard deviation.

CHART 7. THICKNESS OF ANTERIOR NECK SOFT TISSUE FROM SKIN TO TRACHEAL RING AT SUPRASTERNAL NOTCH LEVEL



Out of the 11 cases in Group D, the mean value of thickness from skin tracheal ring at suprasternal notch level is 0.88cm ± 0.117 standard deviation.

By using independent T test for statistical analysis, the P value was calculated to be 0.000, which is statistically highly significant.

SUB GROUP ANALYSIS

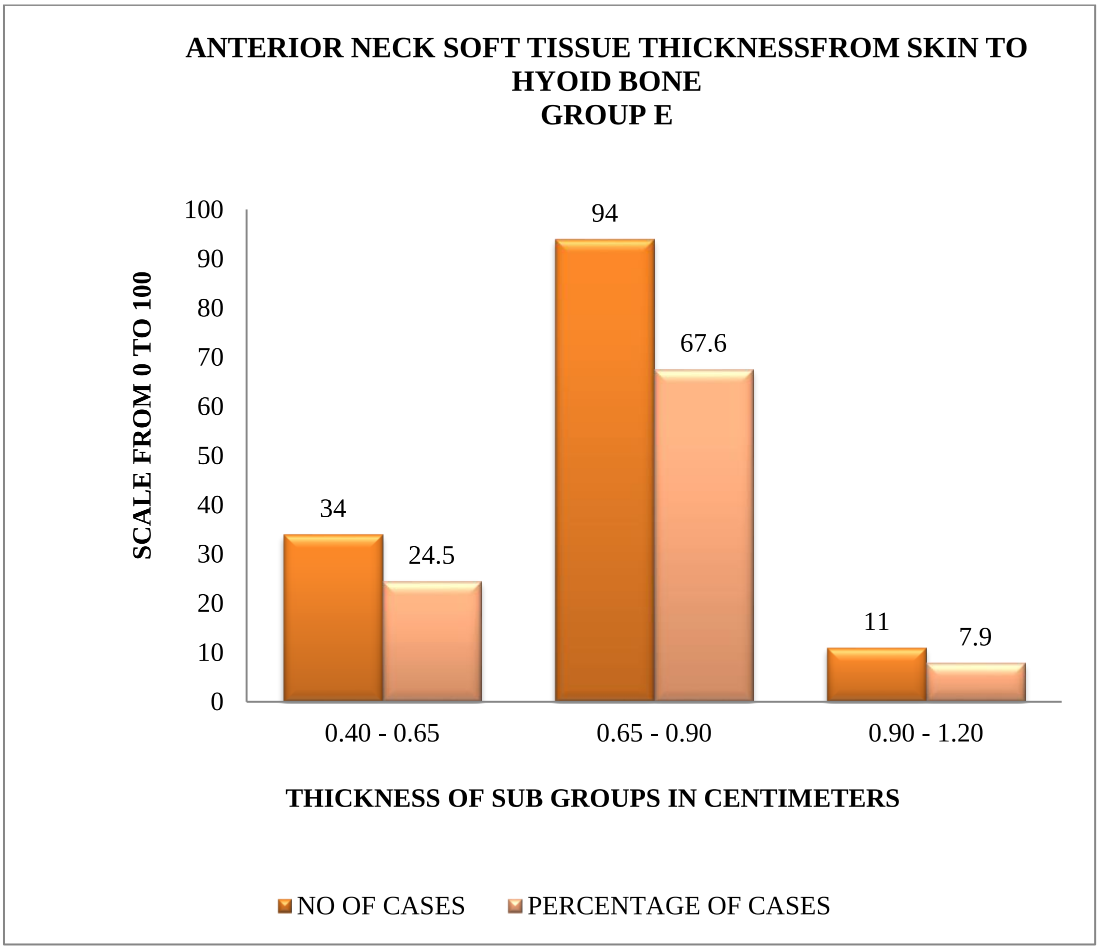
The measurements obtained by ultrasonogram at the three levels are further subdivided into three subgroups and the percentage of cases from Group E and Group D falling into each subgroup is observed.

TABLE 8 . ANTERIOR NECK SOFT TISSUE THICKNESS FROM SKIN TO HYOID BONE

	GROUP E		GROUP D	
	N	**%**	**N**	**%**
0.40-0.65 cms	34	24.5 %	0	0
0.66-0.90 cms	94	67.6%	6	54.5%
0.91-1.20 cms	11	7.9%	5	45.5%
TOTAL	139		11	

Out of the 139 cases in Group E, 24.5% of cases belonged to the thickness range of 0.40 cms to 0.65 cms. 67.6% of cases belonged to the thickness range of 0.66cms to 0.90 cms and 7.9% of cases belonged to 0.91cms to 1.20cms

CHART 8A. ANTERIOR NECK SOFT TISSUE THICKNESS FROM SKIN TO HYOID BONE - GROUP E



Out of the 11 cases in Group D, 54,5% of cases belonged to the thickness range of 0.66cms to 0.90cms and 45.5% of cases belonged to the thickness range of 0.91cms to 1.20cms where as 0% cases belonged to the thickness range 0.40cms to 0.65cms.

CHART 8B. ANTERIOR NECK SOFT TISSUE THICKNESS FROM SKIN TO HYOID BONE - GROUP D

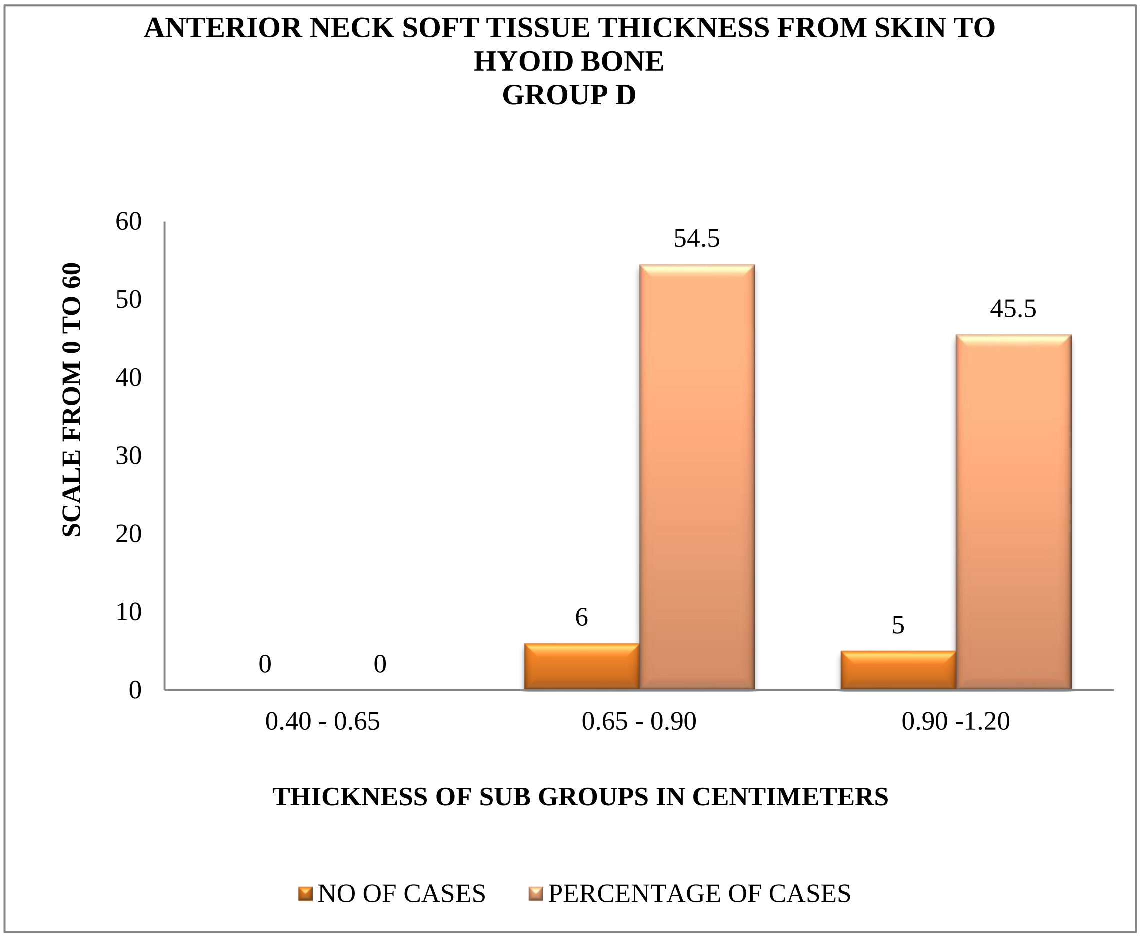
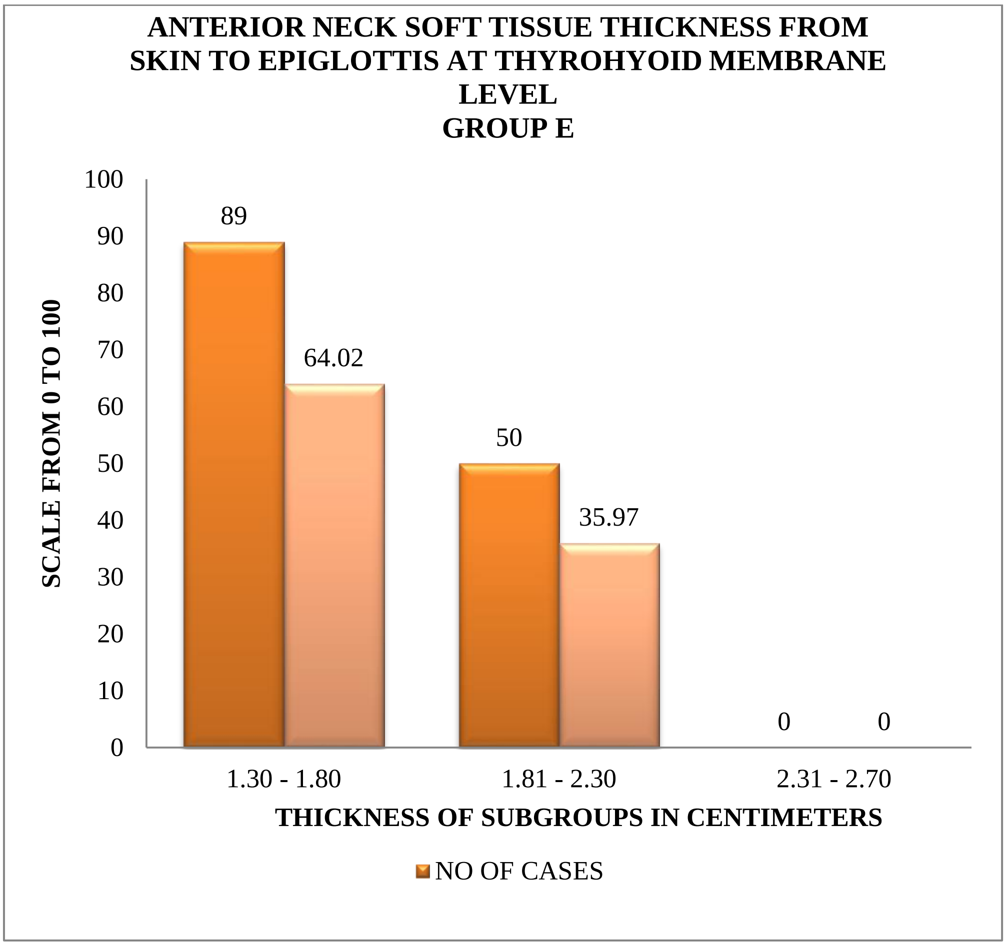


TABLE 9 : THICKNESS OF ANTERIOR NECK SOFT TISSUE FROM SKIN TO EPIGLOTTIS AT THYROHYOID MEMBRANE LEVEL

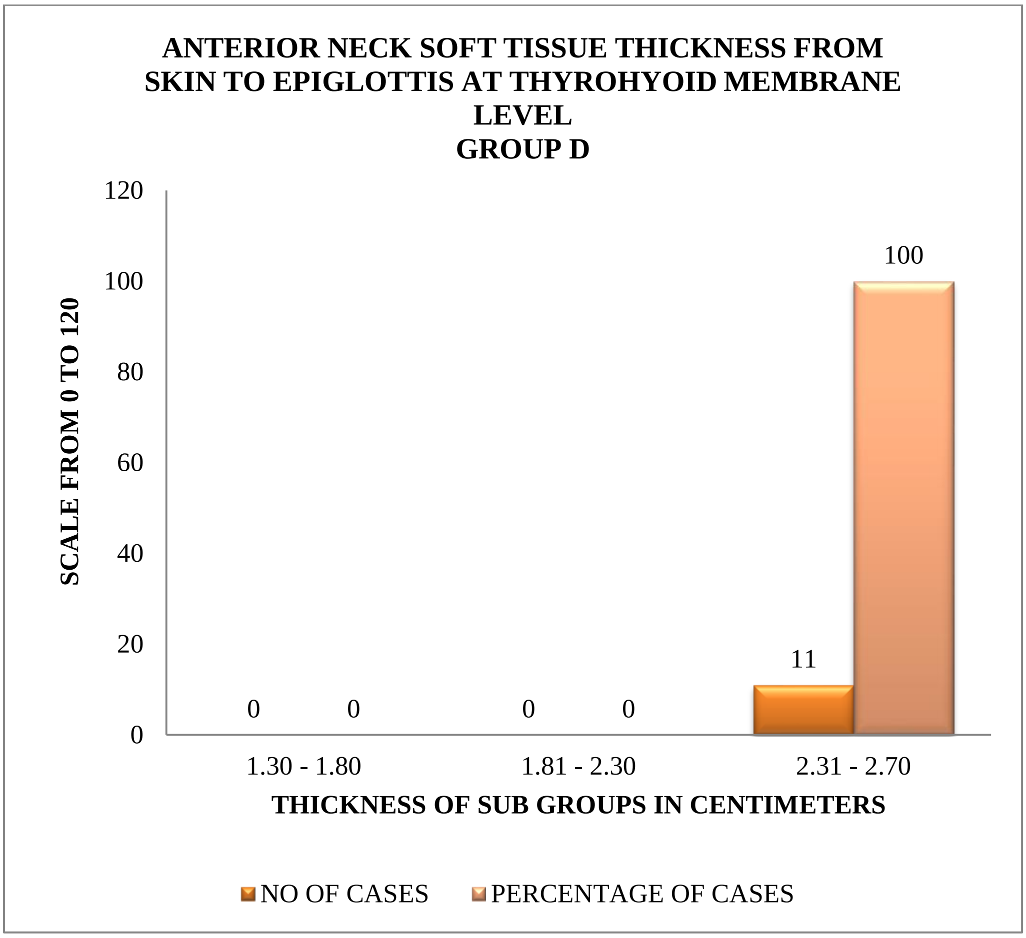
	GROUP E		**GROUP D**	
	N	**%**	**N**	**%**
1.30-1.80 cm	89	64.02	0	0
1.81-2.30 cm	50	35.97	0	0
2.31-2.70 cm	0	0	11	100
TOTAL	139		11	

CHART 9A. THICKNESS OF ANTERIOR NECK SOFT TISSUE FROM SKIN TO EPIGLOTTIS AT THYROHYOID MEMBRANE LEVEL - GROUP E



Out of the 139 cases in Group E, 64.02% of cases belonged to the thickness range of 1.30 cms to 1.80 cms. 35.97% of cases belonged to the thickness range of 1.81cms to 2.30 cms and 0% of cases belonged to 2.31cms to 2.70cms.

CHART 9B . THICKNESS OF ANTERIOR NECK SOFT TISSUE FROM SKIN TO EPIGLOTTIS AT THYROHYOID MEMBRANE LEVEL - GROUP D

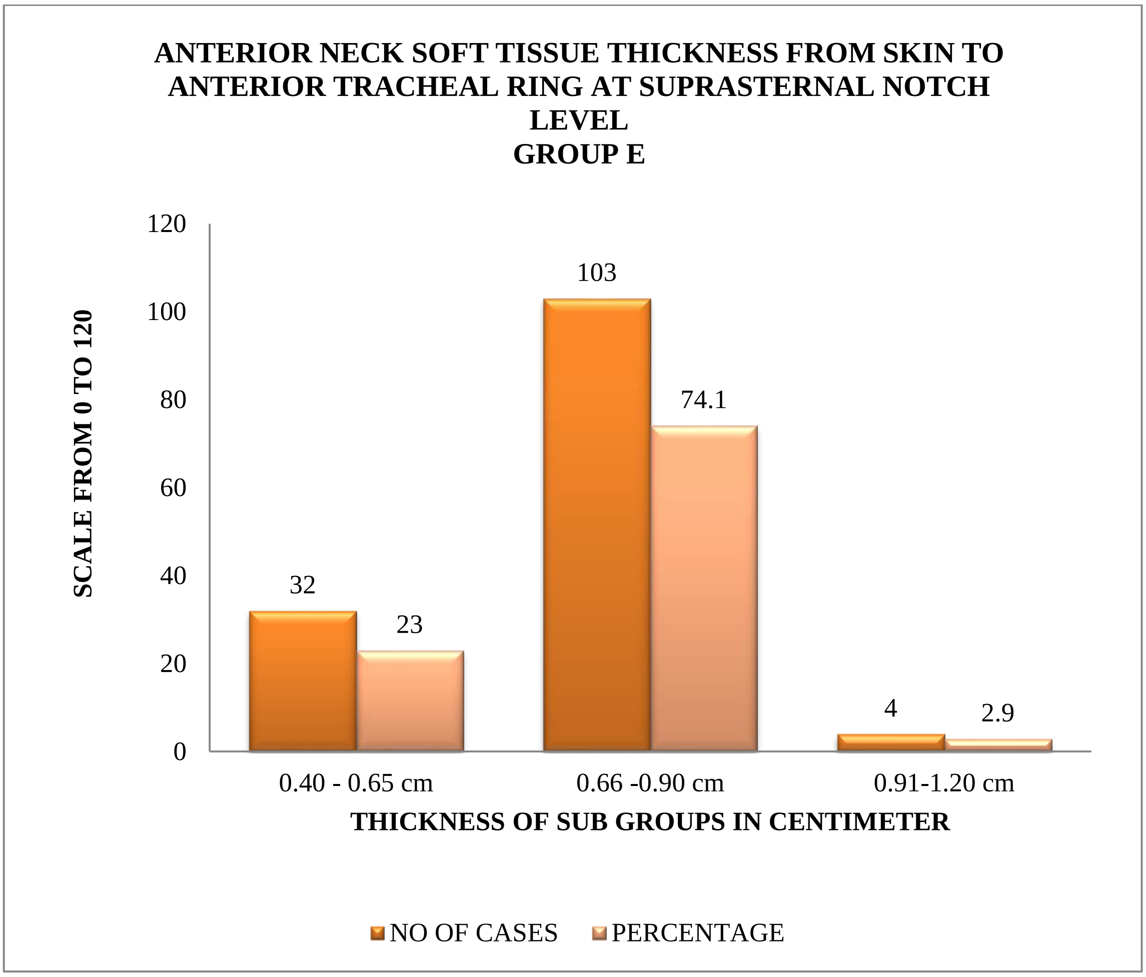


Out of the 11 cases in Group D, 0% of cases belonged to the thickness range of 1.30 cms to 1.80 cms. 0% of cases belonged to the thickness range of 1.81 cms to 2.30 cms and 100% of cases belonged to 2.31cms to 2.70cms

TABLE 10 : THICKNESS OF ANTERIOR NECK SOFT TISSUE FROM SKIN TO TRACHEAL RING AT SUPRASTERNAL NOTCH LEVEL

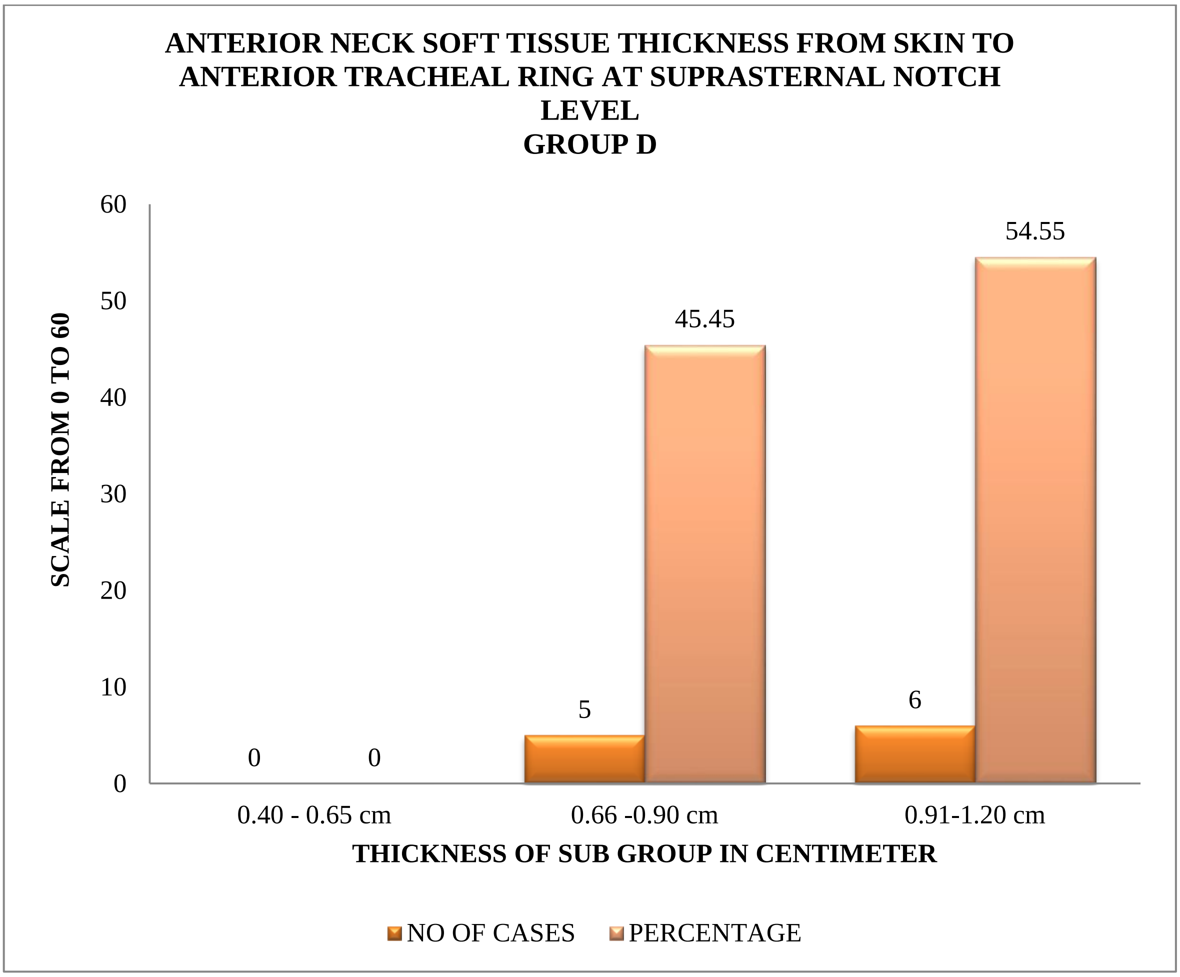
	GROUP E		**GROUP D**	
	N	**%**	**N**	**%**
0.40-0.65 cm	32	23%	0	0
0.66-0.90cm	103	74.1%	5	45.45%
0.91-1.20cm	4	2.9%	6	54.55%
TOTAL	139		11	

CHART 10A. THICKNESS OF ANTERIOR NECK SOFT TISSUE FROM SKIN TO TRACHEAL RING AT SUPRASTERNAL NOTCH LEVEL - GROUP E



Out of the 139 cases in Group E, 23% of cases belonged to the thickness range of 0.40 cms to 0.65 cms. 74.1% of cases belonged to the thickness range of 0.66cms to 0.90 cms and 2.9% of cases belonged to 0.91cms to 1.20cms

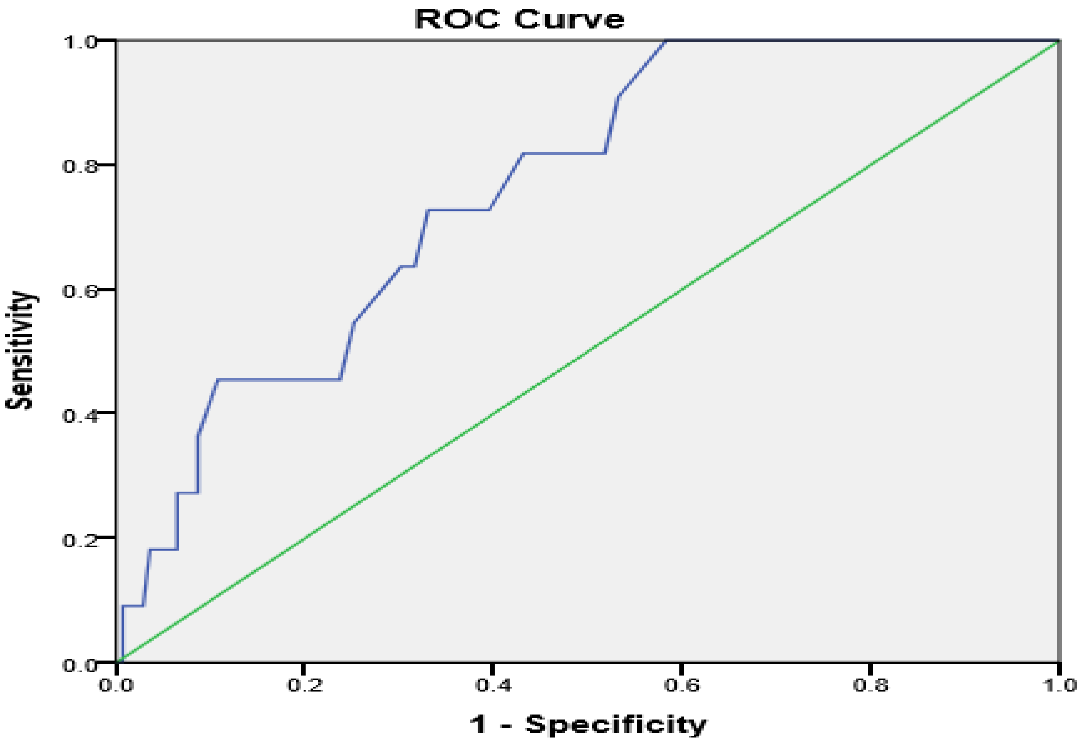
CHART 10B. THICKNESS OF ANTERIOR NECK SOFT TISSUE FROM SKIN TO TRACHEAL RING AT SUPRASTERNAL NOTCH LEVEL - GROUP D



Out of the 11 cases in Group D, 0% of cases belonged to the thickness range of 0.40 cms to 0.65 cms. 45.5% of cases belonged to the thickness range of 0.66cms to 0.90 cms and 54.5% of cases belonged to 0.91cms to 1.20cms.

ROC CURVE ANALYSIS FOR CUTOFF POINTS

CHART 11 . ANTERIOR NECK SOFT TISSUE THICKNESS FROM SKIN TO HYOID BONE LEVEL



Based on the ROC curve the the cutoff point that delineates the Group E and Group D for Hyoid level is 0.7850 cms. And Area under the curve is 0.761

Out of the total 150 cases in the study the number of cases above the cutoff point is 51 and the number of cases less than the cutoff point is 99. This states that based on the Cutoff point for hyoid bone, 51 cases are predicted to be difficult intubation but based on the Cormack Lehane grading, only 11 cases were categorized as Group D. Similarly 99 cases were predicted as Easy intubation group based on the cutoff point by hyoid bone. But based on the Cormack Lehane grading 139 cases belonged to Group E.

Based on these data the sensitivity and specificity were calculated for Anterior neck soft tissue thickness at hyoid level.

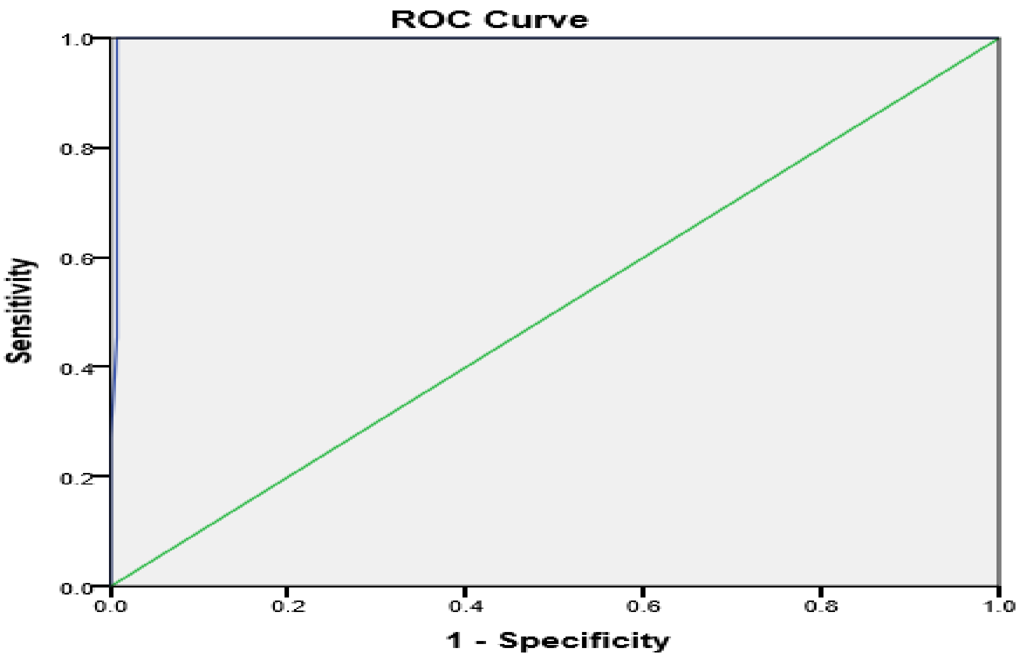
Cutoff point is 0.7850 cms.

Area under the curve is 0.761

Sensitivity was 0.636 i.e. 63.6% sensitive.

Specificity was 0.683 i.e. 68.3% specific.

CHART 12. THICKNESS OF ANTERIOR NECK SOFT TISSUE FROM SKIN TO EPIGLOTTIS AT THYROHYOID MEMBRANE LEVEL



Based on the ROC curve the the cutoff point that delineates the Group E and Group D for Thyrohyoid membrane level is 2.335 cms. Area under the curve 0.995

Out of the total 150 cases in the study the number of cases above the cutoff point is 11 and the number of cases less than the cutoff point is 139. This states that based on the Cutoff point for thyrohyoid membrane level, 11 cases are predicted to be difficult intubation and based on the Cormack

Lehane grading, 11 cases were categorized as Group D. Similarly 139 cases were predicted as Easy intubation group based on the cutoff point by thyrohyoid membrane level. And based on the Cormack Lehane grading 139 cases belonged to Group E.

Based on these data the sensitivity and specificity were calculated for Anterior neck soft tissue thickness at thyrohyoid membrane level (Epiglottis level)

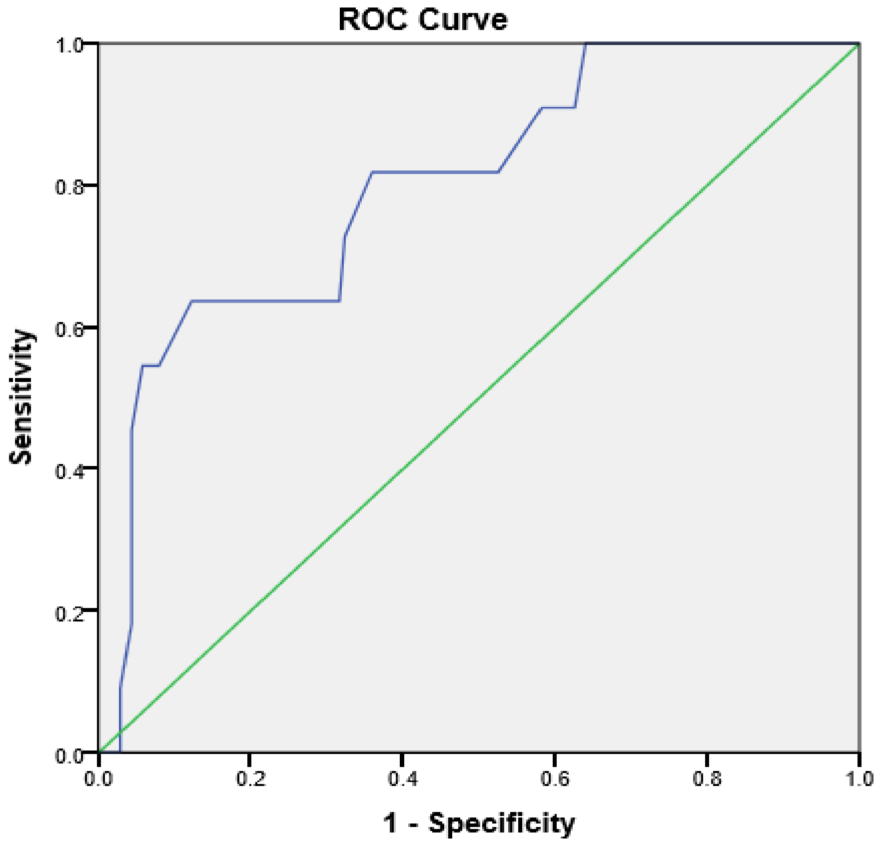
Cutoff point is 2.335 cms.

Area under the curve is 0.995

Sensitivity was 1 i.e. 100% sensitive.

Specificity was 0.993 i.e. 99.3% specific.

CHART 13. THICKNESS OF ANTERIOR NECK SOFT TISSUE FROM SKIN TO TRACHEAL RING AT SUPRASTERNAL NOTCH LEVEL



Based on the ROC curve the cutoff point that delineates the Group E and Group D for Suprasternal notch level is 0.785 cms. Area under the curve is 0.801.

Out of the total 150 cases in the study the number of cases above the cutoff point is 53 and the number of cases less than the cutoff point is 97. This states that based on the Cutoff point for suprasternal notch level, 53

cases are predicted to be difficult intubation but based on the Cormack Lehane grading, only 11 cases were categorized as Group D. Similarly 97 cases were predicted as Easy intubation group based on the cutoff point by suprasternal notch level. But based on the Cormack Lehane grading 139 cases belonged to Group E.

Based on these data the sensitivity and specificity were calculated for Anterior neck soft tissue thickness at suprasternal notch level.

Cutoff point is 0.785 cms.

Area under the curve is 0.801

Sensitivity was 0.727 i.e. 72.7% sensitive.

Specificity was 0.676 i.e. 67.6% specific.

OBSERVATION AND ANALYSIS FOR SECONDARY OUTCOME : CORRELATION BETWEEN ULTRASOUND AIRWAY ASSESSMENT AND CLINICAL AIRWAY ASSESSMENT

Mallampatti's classification is a grouped variable. Hence for comparison between Mallampatti's class and Ultrasonogram measurements at three level, Chi square test is used.

Grouping of the total number of cases into Easy intubation and Difficult intubation groups at each of the three levels namely

- ✓ Hyoid bone
- ✓ Epiglottis at Thyrohyoid membrane level
- ✓ Suprasternal notch level

is based on the cut off points obtained by the ROC curves at each level. Based on these 2 x 2 table is generated and Chi square test is performed to analyze for any significant correlation. $p < 0.05$ is taken as significant.

Inter incisor gap and Thyromental distance are individual variables. Hence for comparison between these dates and the Ultrasound measurements Spearman's correlation coefficient is used.

1) MALLAMPATTI'S CLASSIFICATION VS ULTRASOUND ASSESSMENT USING CHI SQUARE TEST :

TABLE 11. HYOID BONE LEVEL

		MALLAMPATTI'S NO OF CASES		
		Easy	Difficult	Total
HYOID LEVEL NO OF CASES	Easy	90	9	99
	Difficult	49	2	51
Total		139	11	150

Chi square test, P = 0.25

Out of the total 150 cases included in the study, Mallampatti's classification identified 139 cases as easy intubation and 11 cases as difficult intubation. Similarly, based on the cutoff point generated by ROC curve for measurements made at hyoid bone level 99 cases were identified as easy intubation and 51 cases were identified as difficult intubation.

Out of the 99 cases identified as easy intubation by hyoid bone level measurement, 90 cases were correctly identified by Mallampatti's test as easy intubation where as the rest of the 9 cases were identified as difficult intubation by the Mallampatti's test. Similarly, out of the 51 cases identified as difficult intubation by hyoid bone level measurement, 49 cases were correctly identified by Mallampatti's test as easy intubation, the other 2 cases were identified as difficult intubation by the Mallampatti's test.

Based on these data, Chi square test was performed and the P value was calculated as 0.25, which is insignificant.

TABLE 12. EPIGLOTTIS LEVEL

		MALLAMPATTI'S NO OF CASES		
		Easy	Difficult	Total
EPIGLOTTIS LEVEL NO OF CASES	Easy	129	10	139
	Difficult	10	1	11
Total		139	11	150

Chi square test, P = 0.87

Out of the total 150 cases included in the study, Mallampatti's classification identified 139 cases as easy intubation and 11 cases as difficult intubation. Similarly, based on the cutoff point generated by ROC curve for measurements made at epiglottis level 139 cases were identified as easy intubation and 11 cases were identified as difficult intubation.

Out of the 139 cases identified as easy intubation by epiglottis level measurement, 129 cases were correctly identified by Mallampatti's test as easy intubation where as the rest of the 10 cases were identified as difficult intubation by the Mallampatti's test. Similarly, out of the 11 cases identified as difficult intubation by epiglottis level measurement, 10 cases were correctly identified by Mallampatti's test as easy intubation, the other 1 case was identified as difficult intubation by the Mallampatti's test.

Based on these data, Chi square test was performed and the P value was calculated as 0.87, which is insignificant

TABLE 13. SUPRASTERNAL NOTCH LEVEL

		MALLAMPATTI'S NO OF CASES		
		Easy	Difficult	Total
SUPRASTERNAL NOTCH LEVEL NO OF CASES	Easy	88	9	97
	Difficult	51	2	53
Total		139	11	150

Chi square test , P = 0.21

Out of the total 150 cases included in the study, Mallampatti's classification identified 139 cases as easy intubation and 11 cases as difficult intubation. Similarly, based on the cutoff point generated by ROC curve for measurements made at suprasternal notch level 97 cases were identified as easy intubation and 53 cases were identified as difficult intubation.

Out of the 97 cases identified as easy intubation by suprasternal notch level measurement, 88 cases were correctly identified by Mallampatti's test as easy intubation where as the rest of the 9 cases were identified as difficult intubation by the Mallampatti's test. Similarly, out of the 53 cases identified as difficult intubation by epiglottis level measurement, 51 cases were correctly identified by Mallampatti's test as easy intubation, the other 2 cases were identified as difficult intubation by the Mallampatti's test.

Based on these data, Chi square test was performed and the P value was calculated as 0.21, which is insignificant

2) <u>INTERINCISOR GAP and THYROMENTAL DISTANCE VS ULTRASOUND ASSESSMENT USING SPEARMAN'S RANK CORRELATION COEFFICIENT:</u>

<u>TABLE 14. SPEARMAN'S RANK CORRELATION COEFFICIENT</u>

		HYOID LEVEL	**THYRO HYOID MEMBRANE LEVEL**	**SUPRASTERNAL NOTCH LEVEL**
Inter Incisor Gap	CORRELATION COEFFICIENT	-0.202	-0.504	-0.254
	SIGNIFICANCE	0.13	0.06	0.24
Thyro mental distance	CORRELATION COEFFICIENT	-0.213	-0.263	-0.226
	SIGNIFICANCE	0.09	0.07	0.06

Correlation is considered to be present if significance value is < 0.05

The correlation coefficient between Inter incisor gap and thickness from skin to hyoid is -0.202. It means that the correlation is negative The p value is 0.13 which is not significant.

The correlation coefficient between Inter incisor gap and thickness from skin to Epiglottis at thyrohyoid membrane level is -0.504. It means that the correlation is negative and the p value is 0.06 which is not significant.

The correlation coefficient between Inter incisor gap and thickness from skin to Anterior tracheal ring at suprasternal notch level is -0.254. It means that the correlation is negative and the p value is 0.24 which is not significant.

The correlation coefficient between Thyro mental distance and thickness from skin to hyoid is -0.213. It means that the correlation is negative The p value is 0.09 which is not significant.

The correlation coefficient between Thyro mental distance and thickness from skin to Epiglottis at thyrohyoid membrane level is -0.263. It means that the correlation is negative and the p value is 0.07 which is not significant.

The correlation coefficient between Thyro mental distance and thickness from skin to Anterior tracheal ring at suprasternal notch level is -0.226. It means that the correlation is negative and the p value is 0.06 which is not significant.

STATISTICAL TOOLS USED

1) The mean was calculated by the formula

$$\text{Mean} = \frac{\text{Sum of observations}}{\text{Total no. of observations}}$$

2) **The S.D (σ)** was on the basis of the formula

$$S.D. = \sigma = \sqrt{\Sigma\left(\frac{x-\bar{x}}{n}\right)^2}$$

3)**T test** (Example:sex) was used to find the significant difference between the mean values by the

formula.

$$t = \frac{|\bar{x}-\bar{y}|}{SE(\bar{x}-\bar{y})} = \frac{|\bar{x}-\bar{y}|}{\sqrt{\left(\frac{s_1^2}{n_1}+\frac{s_2^2}{n_2}\right)}}$$

where x = mean age of males

y = mean age of females

S 1 = SD of males and

S 2 = SD of female

n1 = no. of males and

n 2 = no. of females

4) $P < 0.05$ was considered as significant (S)

$P > 0.05$ was considered as not significant (NS)

4) **Chi-square test**

The Chi-square test procedure tabulates a variable into categories and computes a chi-square statistic. This goodness-of-fit test compares the observed and expected frequencies in each categories to test either that all categories contain the same proportion of values or that each category contains a user-specified proportion of values.

5) **Spearman's Rank correlation coefficient** is used to identify and test the strength of a relationship between two sets of data. It is often used as a statistical method to aid with either proving or disproving a hypothesis.

The formula used to calculate Spearman's rank correlation coefficient is

$$r = 1 - \frac{6\sum d^2}{n^3 - n}$$

6) Receiver Operating Characteristic curve (or ROC curve.) It is a curve plotted by using the true positives against false positives.

7) Sensitivity : The ability of test to identify the true positive results.

8) Specificity : The ability of test to identify the true negative results.

DISCUSSION

Airway management remains one of the most important responsibilities of an anesthetist. An anesthesiologist is expected to maintain a person's airway patency in the setting of an emergency situation and also while providing anesthesia in elective surgical situation. A patent airway means maintaining the ability of the person's lungs to provide oxygen to the tissues thereby preventing hypoxia and hypoxia related adverse effects. Failure to maintain a patent airway has been recognized as a serious patient safety concern. There are 3 main ways by which patency of the airway can be maintained.

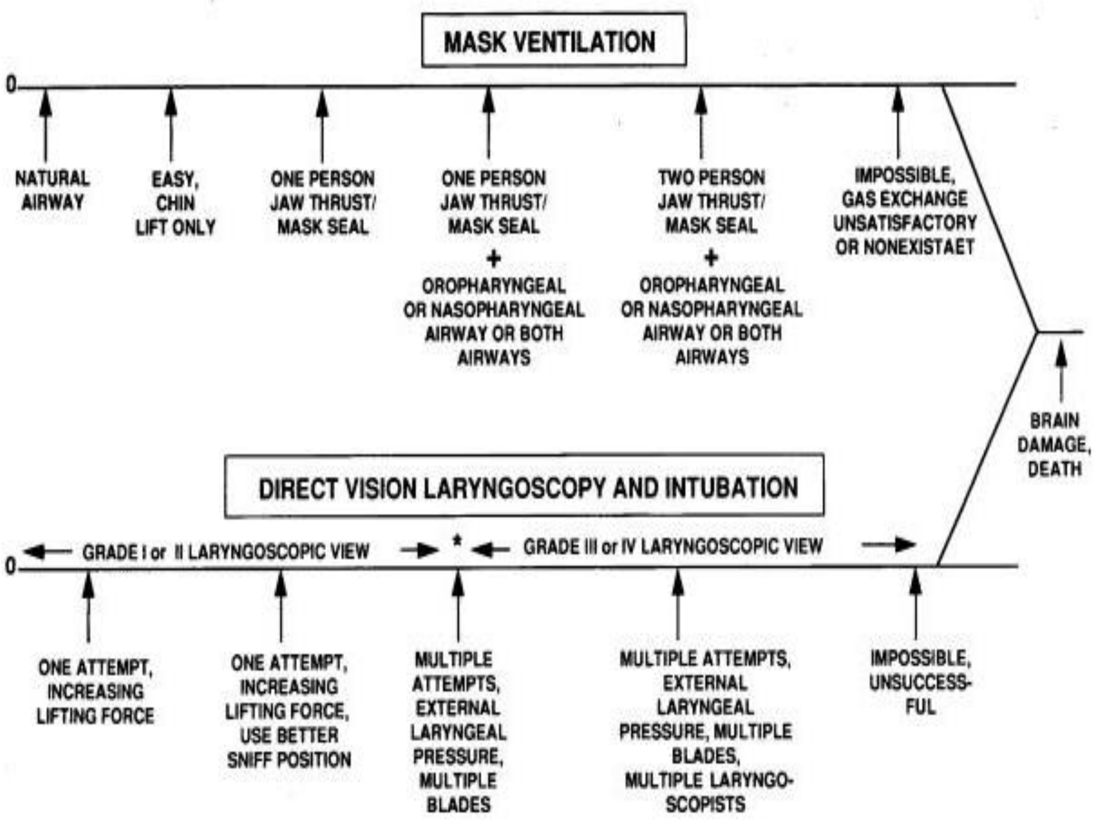
The first is the Bag and Mask ventilation in which gas exchange is maintained by applying a tight fitting mask over the patient's nose and mouth and providing oxygen for ventilation through the reservoir bag. The advantage of this method is it is a non-invasive procedure. Even though ventilation of a patient's lung can be achieved through this method, it is not considered as a definitive airway management technique. This is because any abnormality in the patient's head and neck such as completely edentulous makes the mask seal inadequate and excessive gas leak occurs. Other causes of difficult mask ventilation[60] are obstruction of airway due to falling back of tongue, excessive soft tissues in weak patients, enlarged tonsil, airway edema, spasms of larynx and bronchus, foreign body obstruction of air passage, etc,.

The second method of airway maintenance is using of supraglottic airway devices. These devices are placed above the level of vocal cords and gas exchange is maintained through them. After its first use in the year 1981, the Laryngeal Mask Airway has undergone many generations of sophisticated modulations. Advantages of the LMA are insertion is easy requiring no advanced technical skills, minimizing the increase in various pressures (intra ocular, intra cranial, blood pressure) and improved tolerance to the device while still maintaining adequate gas exchange. Even this method is not considered definitive airway management because of the aspect of presence of open communication between the air passage and food passage leading to risk of aspiration.

The third method of maintaining patent airway is Endotracheal tube insertion into the patient's trachea which is practically keeping the airway open by means of an artificial conduit for gases. This method is considered as definitive airway management.

Difficult airway is a situation in which gas exchange cannot be maintained through any one of the methods mentioned above thereby leading to respiratory related injuries. The three main causes of respiratory related injuries to the patient are inadequate ventilation, oesophageal intubation and difficult tracheal intubation. Difficult tracheal intubation accounts for 17% of the respiratory related injuries and results in significant morbidity and mortality.

DEFINITION OF DIFFERENT DEGREES OF A DIFFICULT AIRWAY



While improvements in patient monitoring and availability of airway devices have reduced the risk associated with an unpredicted difficult airway, these changes have not reduced the incidence of unexpected difficult airways in clinical practice. Since the consequences of an unanticipated difficult airway are potentially life threatening to the patient, a method of through pre operative airway assessment has become an important necessity.

The airway assessment begins with a through history regarding, previous surgeries, intubations and trauma to head and neck regions that might indicate any chance of occurrence of difficulty in intubation. A through general physical examination and examination of airway reveals information that might help in predicting occurrence of difficult intubations.

In an attempt to avoid facing the situation of unanticipated difficult airway the anesthetists developed the method of preoperative airway assessment. The assessment technique was first started in the year 1980s when Vijayalakshmi Patil[51] MD., suggested that the measure of anatomical structures present in head and neck has a role in occurrence of difficult airway. Around the same period Seshagiri Rao Mallampatti[2] MD., developed a hypothesis to predict difficult airway based on the structures that are visible in the oropharynx while the patient's mouth is wide open and tongue ids protruded out. Various other clinical predictors of difficult airway have been developed and analyzed since then like, inter incisor gap, sternomental distance, extent of neck mobility, etc. These tests have been used for analysis as single test. But the predicted value of these tests when used alone was less. Hence the next step in preoperative airway assessment was the development of grouped indices like Wilson's score, Lemon assessment, Arne's simplified score, etc. This was followed by radiographic predictors like X-ray neck in the lateral view to measure the C1 spine to occiput distance, length of the mandible and depth of mandibular space. The other radiographic predictors are Computed Tomographic imaging of airway to look for any tumors, mass or compressions. In the recent past years, many advanced indices for predicting difficult airway have developed like Flow Volume Loop, Acoustic

Response measurement, flexible bronchoscope and ultrasonogram airway assessment.

During the past few years the field of anaesthesia has been gaining eyesight, with the aid of Ultrasonogram. Ultrasonogram is a safe, non invasive and a real time imaging tool, the utility of which is being studied in recent years by anesthesiologists in various aspects. Some of the uses of ultrasonogram in the field of anesthesiology are ultrasound guided peripheral nerve blocks, vascular cannulations, regional anesthesia techniques, airway assessment, identification of lung and plural pathologies, etc. In this study the usefulness of ultrasonogram in predicting difficult airway is analyzed. The main problem that was encountered in the past using ultrasonogram for airway assessment was the difficulty in visualizing the airway structures. The reason for this was that these structures were situated superficially and were filled with air that produced a high acoustic impedance and hence resulted in production of poor image quality.

The modern ultrasound machines are made such that they have a multiarray and variable frequency transducer with cross beam imaging facility and improved lateral and spatial resolutions, so that the images obtained are high quality. A good knowledge of clinical regional anatomy when combined with a good working knowledge of principles of ultrasound, Ultrasonogram can be used as a safe and reliable tool in clinical practice.

Prasad et al[59] has studied the reliability of using ultrasonogram for airway assessment. They have compared the airway measurements in supra hyoid region and infra hyoid region taken by Ultrasonogram and Computed tomography. They concluded that the ultrasound measurements were comparable with those obtained from CT scan. But the correlation was found to be more in the Infra hyoid region than in the Supra hyoid region.

Many studies regarding ultrasound airway assessment have been conducted so far in many countries. In this study which is a Prospective observational type of study, conducted in Indian population, we have assessed the usefulness of ultrasonogram in predicting difficult airway by measuring the thickness of anterior neck soft tissue at three levels namely, Hyoid bone level, Thyrohyoid membrane level and Suprasternal notch level.

Sample size estimation:

The sample size estimated for this study (n=150) was decided to detect a difference with $\alpha = 0.05$. assumptions were based on previous observed outcome in the parent article and the power of study was kept as 0.90.

Analysis of demographic profile:

The patients demographic profile were analyzed for any statistical significance in the mean.

Age distribution:

We included patients in the age group of 18-80 years in our study. The development of larynx begins as early as third week of gestation. All the structures in the larynx are fully developed by the end of second trimester. In infants the larynx is at C2 – C3 vertebra level. After this as the child grows, the larynx descends down and comes to lie in the adult position C3 – C6 vertebra. In females this descend stops at an earlier age whereas in males the descend continues till puberty[61]. In males there is a significant growth in all structures of larynx after puberty. As the age advances the cartilages of larynx begin to calcify and can become complete bones. Hence in order to avoid differences in airway measurements due to age discrepancies patients younger than 18 years are not selected and old age people can present as difficult airway because of age related changes. So patients younger than 18 years were not included in the study[62].

The lowest age in Group E was 18 years and the oldest patient was 70 years. The lowest age in Group D was 19 years and highest age was 62 years. The mean of age distribution was similar in both the easy intubation and difficult intubation groups. The standard deviation of age distribution was also similar. The P value as calculated by the independent t test was insignificant. Based on age distribution both the groups were comparable.

Gender distribution :

The mean of sex distribution was similar in both the easy intubation and difficult intubation groups. The standard deviation of sex distribution was also similar. the P value as calculated by the Pearson's chi square test was insignificant. Based on sex distribution both the groups were comparable.

Height and Weight distribution:

The mean of Height distribution was similar in both the easy intubation and difficult intubation groups. The standard deviation of height was also similar. the P value as calculated by the independent t test was insignificant. Based on height distribution both the groups were comparable.

The mean and standard deviation of weight showed a significant difference among both the groups. the P value as calculated by the independent t test was significant. Based on weight distribution the patients in both the groups showed a significant difference. So this concludes that the weight of the patients have a significant contribution to the occurrence of difficult intubation.

This result is comparable with the study conducted by W.H.Kim et al. It was a prospective observational study. The incidence of difficult tracheal intubation in 123 obese (BMI≥27.5 kg m22) and 125 non-obese patients was compared. Difficult intubation was determined using the intubation difficulty scale (IDS≥5). It was concluded that obese patients had a difficult intubation.

Discussion of primary outcome :

Primary outcome measures that were assessed were the ability of the ultrasonogram to identify the occurrence of difficult intubation. Ultrasound measurements of anterior neck soft tissues were taken at three levels namely, Hyoid level, thyrohyoid membrane level and suprasternal notch level. This was based on a previous sturdy by Srikar Adikari et al.

Our study results show that the intubation was difficult with increase in thickness of the anterior neck soft tissue at the three levels namely, skin to hyoid bone thickness, skin to epiglottis at the level of thyrohyoid membrane and skin to tracheal ring at the suprasternal notch level.

This result is comparable to the study by Srikar adikari et al. In their study conducted in 50 patients, increased thickness of anterior neck soft tissue at the hyoid bone level and at the epiglottis at thyrohyoid membrane level was associated with increased difficulty in intubation.

Also this results correlates with the study by Deepak et al, where he used ultrasonogram and obtained the depth of pre epiglottic space and found that there was a strong positive correlation between the Depth of pre epiglottic space and Cormack Lehane classification.

Sub group analysis was made individually in all the three groups after dividing the groups into three subgroups based on the thickness levels.

In the hyoid group level where anterior neck soft tissue thickness was measured from skin to hyoid bone, the thickness range of 0.91 cms to 1.20 was able to detect 7.9% of cases in Group E and was able to detect 45.5% of cases in Group D. This suggests that this range has a significantly high percentage of detecting difficult intubation cases.

Similarly in the second level, that is the anterior neck soft tissue thickness from skin to epiglottis at thyrohyoid membrane level, the group was divided into three subgroups and the result showed that, the thickness range of 2.31 cms to 2.70 cms was able to identify all the 11 cases of difficult intubation. That is, it was able to detect 100% of the difficult intubation cases. Hence this range can be taken as a cutoff range at thyrohyoid membrane level in detecting difficult intubation.

In the third group, that is, the anterior neck soft tissue thickness from skin to tracheal ring at the suprasternal notch level, the group was divided into three subgroups and the thickness range of 0.91cms to 1.20 cms was able to detect 2.9% of cases in Group E and 54.5% of cases in Group D. So in this level, this range can be taken as a cut off range for detecting difficult intubation.

ROC curve analyses was made for all three levels separately, and a curve was plotted using the True positives against False positives to determine a specific cut off point that delineates between Group E and Group D. Also the sensitivity, specificity and accuracy of test (based on the Area under the curve) for each of the three levels were identified using the ROC curve. The accuracy of the test depends on how well the test separates the groups being tested. Accuracy is measured by the area under the ROC curve. An area of 1 represents a perfect test; an area of 0.5 represents a worthless test. A rough guide for classifying the accuracy of a diagnostic test is the traditional academic point system:

- 0.90 - 1 = excellent
- 0.80 - 0.90 = good
- 0.70 - 0.80 = fair
- 0.60 - 0.70 = poor
- 0.50 - 0.60 = fail

Based on the ROC curve analysis, the following were concluded.

ROC curve analysis of the thickness of anterior neck soft tissues at the hyoid bone level.

Cutoff point is 0.7850 cms.

Area under the curve is 0.761, which means that accuracy of the test is "fair"

Sensitivity was 0.636 i.e 63.6% sensitive.

Specificity was 0.683 i.e 68.3% specific.

ROC curve analysis of the thickness of anterior neck soft tissues at the thyrohyoid membrane level.

Cutoff point is 2.335 cms.

Area under the curve is 0.995, which means the accuracy of the test is "excellent"

Sensitivity was 1 i.e 100% sensitive.

Specificity was 0.993 i.e 99.3% specific.

ROC curve analysis of the thickness of anterior neck soft tissues at the thyrohyoid membrane level.

Cutoff point is 0.785 cms.

Area under the curve is 0.801, which means that the accuracy of the test is "good".

Sensitivity was 0.727 i.e 72.7% sensitive.

Specificity was 0.676 i.e 67.6% specific.

So based on primary outcome analysis it was found that ultrasonogram can be used as a safe, simple and a non invasive tool in predicting difficult intubation pre operatively by measuring the thickness of anterior neck soft tissues. Increased thickness of the soft tissues were associated with increased difficulty in intubation.

Based on the subgroup analysis it was found that even though ultrasonogram measurements at all three levels as mentioned above were able to detect occurrence of difficult laryngoscopy, the percentage of cases detected at the specified cut off range were not high at two of the levels (45.5% for hyoid bone level and 54.5% for suprasternal notch level). Whereas in the thyrohyoid membrane level, the specified range of 2.31 cms to 2.70 cms was able to detect all 100% of the cases. This suggests that the ability of the ultrasonographic measurement of anterior neck soft tissue thickness in predicting occurrence of difficult intubation was more accurate in the thyrohyoid membrane level.

Based on the ROC curve analysis, the measurements taken at the thyrohyoid membrane level is more accurate, more sensitive and more specific in detecting the occurrence of the difficult intubation. A cut off point of 2.33 cms at the epiglottis level completely delineated Group E and Group D.

ANALYSIS OF SECONDARY OUTCOMES

Analysis of the secondary outcome for correlation between Clinical airway assessment (Mallampatti's test) by the Chi square test showed no significant correlation between ultrasonographic airway assessment made at the 3 levels and clinical airway assessment.

Analysis of the secondary outcome for correlation between Clinical airway assessment (Interincisor gap and Thyromental distance) by the Spearman's rank correlation coefficient showed no significant correlation between ultrasonographic airway assessment made at the 3 levels and clinical airway assessment.

From this it can be concluded that Ultrasonogram can be used as an independent tool for assessing airway, which will be helpful in cases of emergency intubations and cases of cervical spine injuries requiring emergency intubation.

CONCLUSION

The prospective observational study conducted to assess the utility of ultrasonogram in predicting difficult airway preoperatively concluded that

1) Ultrasonogram can be used to predict difficult airway preoperatively by measuring anterior neck soft tissue thickness.

2) Increase in the anterior neck soft tissue thickness correlates with the increasing difficulty of intubation.

3) Measurements taken at the thyrohyoid membrane level (Epiglottis) is a better predictor of difficult airways

4) A cutoff value of 2.33cms at epiglottis level completely delineated the difficult intubation group from easy intubation group.

5) There was no significant correlation between clinical airway assessment and ultrasound airway assessment.

6) Among the demographic variables, increased weight of the patients is associated with difficult intubation.

SUMMARY

Title :

A prospective observational study to determine the usefulness of ultrasound guided airway assessment preoperatively in predicting difficult airway

Keywords :

Ultrasound, Difficult airway prediction, Airway assessment, Cormack-Lehane classification, Soft tissue thickness in neck.

Aim :

The primary aim of this study was to assess the usefulness of ultrasonogram as a preoperative assessment tool in identifying difficult airway. To compare and correlate the ultrasound view of the airway and clinical airway assessment with Cormack Lehane classification of the direct laryngoscopy

Methods :

150 patients who were to undergo elective surgery and required endotracheal intubation were included in the study. Patients with no teeth and head and neck anatomical abnormality were excluded from study. On the previous day evening of surgery, Patients were shifted to the ultrasound room in the department of anaesthesiology and clinical airway assessment which

included Mallampatti's classification, inter incisor gap and thyromental distance were measured. The ultrasound airway assessment was done to measure the thickness of soft tissues in the anterior neck at 3 levels namely (a) hyoid bone, (b) thyrohyoid membrane and (c) suprasternal notch. The patient's demographic details like age, sex, height and weight were also recorded. On the day of surgery, the attending anesthesiologist provided anesthesia to the patient according to the standardization measures explained to them by the anesthetists who performed the airway assessment. The Cormack-Lehane was recorded. Statistical analysis was done using the collected data.

Results :

The statistic analysis tools that were used in this study for comparison between demographic variables, ultrasound measurements and Cormack-Lehane classification was independent t test an Chi square test. To evaluate for correlation between clinical assessment and ultrasound assessment, Spearman's Rank correlation coefficient was used. There was no statistical significance between the demographic variables like age (P=0.613), sex (P=0.670) and height (P=0.614) of the patients and the occurrence of difficult airway. Among the demographic variables, significant correlation was found between the weight (P=0.000) and difficult airway. The ultrasound measurements made at the 3 levels (a) hyoid bone, (b) thyrohyoid membrane and (c) suprasternal notch level showed significant results. The P values for each of the levels are P=0.000, P=0.000 and P=0.000 respectively. Among the 3 levels, the measurement made at thyrohyoid membrane level (skin to epiglottis thickness) was found to be highly sensitive(100%) and specific(99.3%). A cutoff point of 2.33cms was calculated using the Receiver Operating Characteristic curve(ROC curve). This cutoff point delineates difficult airway and difficult airway. No significant correlation was found between clinical assessment and ultrasound assessment.

Conclusion :

Based on this study we concluded that ultrasound can be used as a reliable tool to identify difficult airway by measuring the thickness of soft tissues in the anterior part of neck. The measurement made at thyrohyoid membrane level is more accurate than the other 2 levels.

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INSTITUTIONAL ETHICAL COMMITTEE,

STANLEY MEDICAL COLLEGE, CHENNAI-1

Title of the Work	: A Prospective observational study to determine the usefulness of ultrasound guided airway assessment preoperatively in predicting difficult airway.
Principal investigator	: Dr. G. Mirunalini
Designation	: PG in MD (Anaesthesiology)
Department	: Department of Anaesthesiology Government Stanley Medical College, Chennai -01

The request for approval from the Instituitional Ethical Committee (IEC) was considered on the IEC meeting held on 02.07.2014 at the Council Hall, Stanley Medical College, Chennai-1 at 2PM.

The members of the Committee, the Secretary and the Chairman are pleased to approve the proposed work mentioned above, submitted by the principle investigator.

The Principal Investigatr and their team are directed to adhere to the guidelines given below:

1. You should inform the IEC in case of changes in study procedure, site investigator investigation or guide or any other changes.
2. You should not deviate from the area of the work for which you applied for ethical clearance.
3. You should inform the IEC immediately, in case of any adverse events or serious adverse reaction.
4. You should abide to the rules and regulation of the institution(s).
5. You should complete the work within the specified period and if eny extension of time is rer(uired, you should apply for permission again and do the work.
6. You should submit the summary of the work to the ethical committee on completion of the work.

K Vasantha

MEMBER SECRETARY,
IEC, SMC, CHENNAI

PLAGIARISM CERTIFICATE

சுய ஒப்புதல் படிவம்

முழுமயக்கம் கொடுக்க மூச்சுப் பெருங்குழிக்குள் குழாய் செலுத்துவதன் கடினத்தை அறுவை சிகிச்சைக்கு முன் அறிந்து கொள்வதற்கு மருத்துவ பரிசோதனை முறை மற்றும் அல்ட்ரசோனோ கிராம் முறை ஆகியவற்றை பயன் படுத்தி தெரிந்து கொள்வதற்கான ஆய்வு.

ஆய்வாளர் : மரு.கு.மிருணாளினி

முதுநிலை பட்டமேற்படிப்பு மாணவர்

மயக்கவியல் துறை

அரசு ஸ்டான்லி மருத்துவமனை

வழிக்காட்டி : பேராசிரியர் மரு.தனசேகரன்

மயக்கவியல் துறை

அரசு ஸ்டான்லி மருத்துவமனை

பெயர்   வயது

உள்ளிருப்பு எண்

இந்த மருத்துவ ஆய்வின் விவரங்கள் எனக்கு விவரங்கள் எனக்கு விளக்கப்பட்டது. என்னுடைய சந்தேகங்களை தீர்க்கவும் அதற்க்கான தகுந்த விளக்கங்களை பெறவும் வாய்ப்பு அளிக்கப்பட்டது.

நான் இவ்வாய்வில் தனிச்சையகதான் பங்கேற்கிறேன். எந்த காரணத்தினாலும் எந்த கட்டத்திலும் எந்த சட்டச்சிக்களும் இன்றி இந்த ஆய்வில் இருந்து விலகிக்கொள்ளலாம் என்றும் அறிந்து கொண்டேன்.

நான் ஆய்வில் இருந்து விலகிக் கொண்டாலும் ஆய்வாளர் என்னுடைய மருத்ன்ஹுுவ அறிக்கைகளை பார்ப்பதற்கோ அல்லது உபயோகிக்கவோ என் அனுமதி தேவை இல்லை எனவும் அறிந்து கொண்டேன். என்னை பற்றிய தகவல்கள் ரகசியகமாக பாதுகாக்கப்படும் என்பதையும் அறிவேன்.

இந்த ஆய்வின் மூலம் கிடைக்கும் தகவல்களையும் பரிசோதனை முடிவுகளையும் ஆய்வாளர் அவர் விருப்பத்திற்கு ஏற்ப பயன் படுத்திக் கொள்ளவும் அதனை பரிசுரிக்கவும் முழுமனதுடன் சம்மதிக்கிறேன்.

இந்த ஆய்வில் பங்கு கொள்ள ஒப்புகொள்கிறேன். எனக்கு கொடுக்கப்பட்டுள்ள அறிவுரைகளின்படி நடந்து கொள்வதுடன் ஆய்வாளருக்கு உண்மையுடன் இருப்பேன் எனவும் உறுதி கூறுகிறேன்.

இந்த ஆய்வில் எனக்கு எவ்விதமான பரிசோதனைகளையும் சிகிச்சைகளையும் மேற்கொள்ள நான் முழுமனதுடன் சம்மதிக்கிறேன்.

இப்படிக்கு

நோயாளியின் கையொப்பம்

ஆய்வாளரின் கையொப்பம்

பெயர்

நோயாளி தகவல் தாள்

முழு மயக்க மருந்து (ஜெனரல் அனஸ்தீஸ்சியா)கொடுத்து அறுவை சிகிச்சை மேற்கொள்ளப் போகும் நோயாளிகளுக்கு ,மூச்சுப் பெருங்குழாயில் ,குழாய் செலுத்துவது இலகுவாக இருக்குமா அல்லது கடினமாக இருக்குமா என்பதை மருத்துவப் பரிசோதனைகள் மூலமாகவும் ,அல்ட்ரா சோனோ கிராம் மூலமாகவும் அறிந்து கொள்ளவே இவ் ஆய்வு செய்யப்படுகிறது .

<u>ஆராய்ச்சியின் நோக்கமும் , ஆதாரங்களும் :</u>

அறுவை சிகிச்சை செய்வதற்கு மயக்க மருந்து மிகவும் அவசியமானது . சில அறுவை சிகிச்சைகளுக்கு முழு மயக்கம் (ஜெனரல் அனஸ்தீஸ்சியா)செலுத்த வேண்டி இருக்கும் .அம்முழு மயக்கம் செலுத்த ,மூச்சுப் பெருங்குழாயில் ,குழாய் செலுத்த வேண்டி இருக்கும் .மூச்சுப் பெருங்குழாயில் குழாய் செலுத்துவதின் கடினத்தை,வாய் திறக்கும் அளவு ,கழுத்து நீட்டிப்பு அளவு ,நாக்கின் தடிமானம் மற்றும் கழுத்து தசையின் தடிமானம் ஆகியவை நிர்ணயிக்கும் . மயக்க மருந்து கொடுக்கும் முன்னர் சில மருத்துவ பரிசோதனைகளையும் ,மயக்க மருந்து கொடுத்த பின்னர் வாய்க்குள் லரிங்கோ ஸ்கோப் என்ற கருவியை செலுத்தி மூச்சுக் குழாயின் திறப்பை கண்ட பின்னரே ,மூச்சுப்

பெருங்குழாயில் ,குழாய் செலுத்த சுலபமாக இருக்குமா அல்லது கடினமாக இருக்குமா என்பதை அறிய முடியும் .இது இன்வேசிவ் (INVASIVE) முறையாகும் .இம்முறையினால் நோயாளிகளுக்கு சில பக்கவிளைவுகள் ஏற்ப்பட வாய்ப்புள்ளது .நான் இன்வேசிவ் (NON - INVASIVE)முறையான ,அல்ட்ரா சோனோ கிராம் என்னும் கருவியை பயன்படுத்தி ,நாக்கின் தடிமானம் மற்றும் கழுத்து தசையின் தடிமானம் ஆகியவற்றை அறிந்து கொண்டு ,அதன் மூலம் மூச்சுப் பெருங் குழாயில் ,குழாய் செலுத்துவதின் கடினத்தை அறிந்து கொள்ளலாம் .இப்பரிசோதனை, மயக்க மருந்து கொடுக்கும் முன்னரே செய்யப்படுகிறது .இப்பரிசோதனையை மேற்க்கொள்ளும் நோயாளிகளுக்கு எவ்வித பக்க விளைவுகளும் ஏற்ப்படாது . அல்ட்ரா சோனோ கிராம் என்னும் கருவி ,நோயாளிகளுக்கு எவ்வித பக்கவிளைவுகளும் ஏற்ப்படுத்தாமல் ,மூச்சுப் பெருங் குழாயில், குழாய் செலுத்துவதன் கடினத்தை அறிய எவ்வாறு உதவுகிறது ,என்பதை அறியவே இவ்வாய்வு ,செய்யப்படுகிறது .

<u>ஆய்வு செய்யும் முறை :</u>

அறுவை சிகிச்சைக்கு முன்னர் ,மருத்துவ பரிசோதனைகள் (மல் லம்பட்டி ஸ்கோர் ,இன்டர் இன்சிசார் டிஸ்டன்ஸ் ,தைரோ மென்டல் டிஸ்டன்ஸ்

)சிலவற்றின் மூலமாகவும் ,நாக்கின் தடிமானம் & கழுத்துஇப் பகுதி த

சைகளின் தடிமானத்த்தையும் ,அல்ட்ரா சோனோ கிராம் என்ற கருவி

யின் மூலமாக அளவிடப்படும் .

<u>உண்டாகக்கூடிய இடர்கள் :</u>

இந்த ஆய்வின் பொழுது பயன்படுத்தபடும் அல்ட்ரா சோனோ கிராம் என்ற கருவியால் ,இவ் ஆய்வை மேற்க்கொள்ளும் நோயாளிகளுக்கு எவ்வித பக்க விளைவுகளும் ஏற்ப்படாது .

<u>ஆய்வில் உங்கள் உரிமைகள் :</u>

உங்கள் மருத்துவ பதிவேடுகள் அந்தரங்கமாக வைத்துக்கொள்ளப்படும் இந்த ஆய்வின்.முடிவுகள் அறிவியல் பத்திரிக்கைகளில் வெளியிடப் படலாம் .ஆய்வில் பங்கேற்பது தன்னிச்சையானது மற்றும் காரணங்கள் எதுவும் கூறாமலேயே நீங்கள் எப்போது வேண்டுமென்றாலும் விலகிக் கொள்ளலாம் .

நோயாளியின் கையொப்பம்

நாள் இடது பெருவிரல் ரேகை

(மருத்துவரால் படித்து காட்டபட்டது)

PROFORMA

NAME: AGE/SEX: IP NO.:

DATE: DIAGNOSIS:

SURGERY:

PARAMETERS OBSERVED

Height In Centimeters	
Weight In Kilograms	
Mallampatti Classification	
Inter Incisor Gap In Centimeters	
Thyromental Distance In Centimeters	
Anterior Neck Soft Tissue Thickness At Hyoid Bone Level	
Anterior Neck Soft Tissue Thickness At Thyrohyoid Membrane (Epiglottis) Level	
Anterior Neck Soft Tissue Thickness At Suprasternal Notch Level	
Cormack Lehane Class	

MASTER CHART

S. NO	NAME	AGE/SEX	IPNO	DATE	DIAGNOSIS	SURGERY	HEIGHT	WEIGHT	MALLAMPATTI				INTER INCISOR GAP		THYRO MENTAL DISTANCE		HYOID	EPIGLOTTIS	SUPRA STERNAL NOTCH	CORMACK LEHANE			
									1	2	3	4	<4	>4	<6	>6				1	2	3	4
1	KOUSALYA	35/F	25907	2/6/2014	ADHESIVE COLITIS	LAPROSCOPIC ADHESIOLYSIS	152	61	*							*	0.88	1.99	1.2		*		
2	SUGANTHI	23/F	1428147	2/6/2014	CHOLELITHIASIS	LAPROSCOPIC CHOLECYSTECTOMY	164	69		*				*		*	1.07	1.75	0.84	*			
3	VIJAYA	45/F	25202	3/6/2014	CHOLELITHIASIS	LAPROSCOPIC CHOLECYSTECTOMY	161	65	*					*		*	1.07	1.88	0.43	*			
4	SHANTHI	42/F	14257	3/6/2014	R.OVARIAN MASS	D-LAP AND PROCEED	149	38		*				*		*	1.05	1.37	0.47	*			
5	PURUSHOTHAMAN	44/M	22547	3/6/2014	CA STOMACH	DIAGNOSTIC LAPROSCOPY	152	56			*			*		*	0.82	1.86	0.7	*			
6	MANOHARAM	60/M	29583	4/6/2014	UMBLICAL HERNIA	MESH REPAIR	183	62		*				*		*	0.64	1.84	0.68	*			
7	SHRIDAR	30/M	26841	7/6/2014	RIGHT UDT HERNIA	LAPROSCOPIC ORCHIDOPEXY AND HERNIOPLASTY	161	60		*				*		*	1	1.97	0.77		*		
8	PUSHPALATHA	50/F	26692	7/6/2014	CHOLELITHIASIS	LAPROSCOPIC CHOLECYSTECTOMY	167	61	*					*		*	1.01	1.98	0.97		*		
9	AMBUHAM	57/F	28252	7/6/2014	CHOLELITHIASIS	LAPROSCOPIC CHOLECYSTECTOMY	174	67			*		*		*		0.73	2.41	0.94			*	
10	SANGETHA	18/F	29861	7/6/2014	R.FIBROADENOMA	EXCISION BIOPSY	151	54	*					*		*	0.81	1.6	0.63	*			
11	SUGUNA	37/F	22028	7/6/2014	LEFT CA BREAST	LEFT MRM	156	58	*					*		*	0.79	1.47	0.78	*			
12	MARY JOYCE	45/F	1425175	9/6/2014	CHOLELITHIASIS	LAPROSCOPIC CHOLECYSTECTOMY	153	50	*					*		*	1.04	1.53	0.59	*			
13	BOOPATHY	22/M	29149	9/6/2014	CHOLELITHIASIS	LAPROSCOPIC CHOLECYSTECTOMY	161	62	*					*		*	0.85	1.49	0.75	*			
14	JAYA	22/F	30996	11/6/2014	FIBROADENOMA BREAST LEFT	EXCISION BIOPSY	158	60	*					*		*	0.73	1.31	0.84	*			
15	NAGARAJ	30/M	31099	12/6/2014	SUBACUTE APPENDICITIS	LAPROSCOPIC APPENDICECTOMY	154	52	*					*		*	0.92	1.46	0.51	*			
16	SARASWATHI	52/F	30060	12/6/2014	VENTRAL HERNIA	MESH REPAIR	161	80			*		*		*		1.12	2.61	1.05			*	
17	AMUTHA	42/F	27336	14/6/2014	CHOLELITHIASIS	LAPROSCOPIC CHOLECYSTECTOMY	156	60		*				*		*	0.94	1.95	0.84		*		
18	SMITHA	22/F	29814	14/6/2014	CHOLELITHIASIS	LAPROSCOPIC CHOLECYSTECTOMY	152	53	*					*		*	0.65	1.43	0.53	*			
19	MANAVALAN	70/M	31392	16/6/2014	CHOLELITHIASIS	LAPROSCOPIC CHOLECYSTECTOMY	162	64	*					*		*	0.72	1.38	0.65	*			
20	JOSHNA	21/F	31813	16/6/2014	RIGHT FIBROADENOMA	EXCISION BIOPSY	152	55	*					*		*	0.8	1.6	0.57	*			
21	THILAGAVATHY	36/F	30299	17/6/2014	ABDOMINAL PAIN FOR EVALUATIO	LAP ADHESIOLYSIS	154	55	*					*		*	0.85	1.73	0.63	*			
22	SRIMATHY	19/F	31989	18/6/2014	APPENDICITIS	LAPROSCOPIC APPENDICECTOMY	156	60		*				*		*	0.93	1.97	0.75		*		
23	SARATH KUMAR	18/M	32018	18/6/2014	APPENDICITIS	LAPROSCOPIC APPENDICECTOMY	159	61	*					*		*	0.74	1.62	0.84	*			
24	BOMMI	41/F	32336	19/6/2014	RIGHT FIBROADENOMA	EXCISION BIOPSY	152	57	*					*		*	0.65	1.42	0.61	*			
25	RAMESH	18/M	32613	19/6/2014	SUBACUTE APPENDICITIS	LAPROSCOPIC APPENDICECTOMY	166	61	*					*		*	0.67	1.54	0.63	*			
26	RAJESHWARI	55/F	31447	20/6/2014	CA STOMACH	FEEDING JEJUNOSTOMY	162	57	*					*		*	0.72	1.31	0.64	*			
27	SHAMALA	28/F	32587	20/6/2014	FATTY HERNIA LINEA ALBA	MESH REPAIR	158	54	*					*		*	0.62	1.44	0.59	*			
28	ELAIYAN	2/M	53421	21/6/2014	VENTRAL HERNIA	MESH REPAIR	154	50	*					*		*	0.61	1.56	0.49	*			
29	SARASWATHI	62/F	29874	21/6/2014	CHOLELITHIASIS	LAPROSCOPIC CHOLECYSTECTOMY	157	70		*				*		*	0.75	2.49	0.98			*	
30	NITHYA	18/F	32893	21/6/2014	LEFT FIBROADENOMA	EXCISION BIOPSY	153	58		*				*		*	0.66	2.05	0.84		*		

31	DHANALAKSHMI	29/F	32798	21/6/2014	LEFT FIBROADENOMA	EXCISION BIOPSY	161	65		*				*		*	0.73	1.97	77		*		
32	SUJATHA	35/F	33047	23/6/2014	CHOLELITHIASIS	LAPROSCOPIC CHOLECYSTECTOMY	163	80			*		*			*	1.04	2.64	0.97			*	
33	DEVARAJ	39/M	32891	23/6/2014	EPIGASTRIC HERNIA	MESH REPAIR	159	57	*					*		*	0.82	1.44	0.74	*			
34	PUSHPAVANAM	58/F	29367	24/6/2014	CA CERVIX	LAPROSCOPIC HYSTERECTOMY	170	74	*					*		*	0.84	1.55	0.68	*			
35	PUSHPA	45/F	33148	24/6/2014	INCISIONAL HERNIA	MESH REPAIR	166	67	*					*		*	0.6	1.63	0.75		*		
36	JOTHY	18/F	33281	24/6/2014	RIF PAIN	LAPROSCOPIC APPENDICECTOMY	154	59	*					*		*	0.54	1.52	0.54	*			
37	SHANTHI	26/F	30542	25/6/2014	LEFT OVARIAN MASS	LAPROSCOPIC OVARIAN CYSTECTOM	161	67	*					*		*	0.71	1.99	0.67		*		
38	SATHICK BASHA	19/M	32806	25/6/2014	LEFT GYNACOMASTIA	WEBSTERS PROCEDURE	156	51	*					*		*	0.53	1.45	0.56	*			
39	HARISH	22/M	1434096	26/6/2014	LEFT GYNACOMASTIA	WEBSTERS PROCEDURE	153	55	*					*		*	0.52	2.14	0.63		*		
40	MOHANA	28/F	143465	27/6/2014	RIGHT FIBROADENOMA	EXCISION BIOPSY	167	63	*					*		*	0.77	2.26	0.67		*		
41	SUNDARI	48/F	33282	28/6/2014	UV PROLAPSE	LAPROSCOPIC HYSTERECTOMY	156	55	*					*		*	0.64	1.35	0.69	*			
42	GAYATHRI	18/F	1.4E+07	28/6/2014	RIF PAIN	LAPROSCOPIC APPENDICECTOMY	149	52	*					*		*	0.51	1.88	0.57		*		
43	RAFIQ	19/M	143363	28/6/2014	LEFT GYNACOMASTIA	WEBSTERS PROCEDURE	155	68			*			*		*	0.78	2.65	0.86			*	
44	ELLAMAL	52/F	31775	1/7/2014	CHOLELITHIASIS	LAPROSCOPIC CHOLECYSTECTOMY	172	69	*					*		*	0.88	1.41	0.86	*			
45	DEVI	25/F	1435479	1/7/2014	RIF PAIN	LAPROSCOPIC APPENDICECTOMY	162	58	*					*		*	0.68	1.5	0.72	*			
46	VIMAL	25/M	35257	1/7/2014	RIF PAIN	LAPROSCOPIC APPENDICECTOMY	148	53	*					*		*	0.58	1.48	0.59	*			
47	SAROJINI	33/F	143405	2/7/2014	PELVIC MASS	LAVH	156	49	*					*		*	0.61	1.37	0.61	*			
48	BASKAR RAO	39/M	1435041	2/7/2014	RIF PAIN	LAPROSCOPIC APPENDICECTOMY	165	71		*				*		*	0.89	1.56	0.69	*			
49	SELVI	28/F	1435214	2/7/2014	LEFFT FIBROADENOMA	EXCISION BIOPSY	151	45		*				*		*	0.64	1.6	0.53	*			
50	PANDIAMAL	42/F	1434817	3/7/2014	RIGHT CA BREAST	RIGHT MRM	161	58		*				*		*	0.68	1.98	0.64		*		
51	KOMALA	38/F	1435339	3/7/2014	SUBACUTE APPENDICITIS	LAPROSCOPIC APPENDICECTOMY	157	56	*					*		*	0.72	1.89	0.68		*		
52	MURUGAN 29/M	29/M	1434386	3/7/2014	EPIGASTRIC HERNIA	MESH REPAIR	167	71		*				*		*	0.74	1.99	0.72		*		
53	KANDAN	43/M	1434105	4/7/2014	LEFT GYNACOMASTIA	WEBSTERS PROCEDURE	159	60	*					*		*	0.68	1.71	0.63	*			
54	DHANARAJ	24/M	34285	7/7/2014	SUBACUTE APPENDICITIS	LAPROSCOPIC APPENDICECTOMY	162	65	*					*		*	0.69	1.58	0.82	*			
55	NIVEDA	28/F	232412	7/7/2014	LEFT FIBROADENOMA	EXCISION BIOPSY	163	51	*					*		*	0.71	1.64	0.71	*			
56	SASIKALA	19/F	36412	7/7/2014	RIGHT FIBROADENOMA	EXCISION BIOPSY	158	71			*			*		*	0.89	2.41	0.72			*	
57	HARIBABU	51/M	1434911	8/7/2014	BILATERAL HERNIA INGUINAL	BIL HERNIOPLASTY	153	56	*					*		*	0.68	2.04	0.68		*		
58	PANEERSELVAM	47/M	32288	8/7/2014	CA STOMACH	GASTROJEJUNOSTOMY WITH GASTRE	165	60	*					*		*	0.74	1.61	0.71	*			
59	GOVINDHAN	60/M	32490	11/7/2014	CA STOMACH	GASTROJEJUNOSTOMY WITH GASTRE	157	58	*					*		*	0.71	2.12	0.69		*		
60	SAROJINI	46/F	36011	11/7/2014	CHOLELITHIASIS	LAPROSCOPIC CHOLECYSTECTOMY	159	60		*				*		*	0.76	1.64	0.72	*			

61	VETRIVEL	42/M	1431318	12/7/2014	CHOLELITHIASIS	LAPROSCOPIC CHOLECYSTECTOMY	154	50	*					*		*	0.68	1.49	0.64	*			
62	DURKA	23/F	147789	12/7/2014	RIF PAIN	LAPROSCOPIC APPENDICECTOMY	161	56	*					*		*	0.74	1.38	0.61	*			
63	MENAKA	38/F	1437677	12/7/2014	PELVI MASS	LAVH	171	75	*					*		*	0.89	1.71	0.74	*			
64	VENKATESAN	28/M	1436085	14/7/14	SUBACUTE APPENDICITIS	LAPROSCOPIC APPENDICECTOMY	156	55	*					*		*	0.71	1.9	0.81		*		
65	KANNAKI	46/F	1.4E+07	14/7/14	CBD STRICTURE	LAPROSCOPIC CHOLECYSTECTOMY	165	70	*					*		*	0.81	2.08	0.74		*		
66	PANDARI	45/F	1437301	14/7/14	ABDOMINAL PAIN FOR EVALUATIO	DIAGNOSTIC LAPROSCOPY	165	72			*			*	*		0.82	2.46	0.79			*	
67	DHANABAKIAM	50/F	32880	14/7/14	CA BREAST RIGHT	RIGHT MRM	148	41	*					*		*	0.6	1.38	0.55	*			
68	KANIYAMMAL	45/F	35081	14/7/14	LEFT PHYLLOIDE TUMOUR	LEFFT MRM	156	53	*					*		*	0.71	1.51	0.61	*			
69	SAKUNTHALA	45/F	36071	15/7/14	RIGHT CA BREAST	RIGHT MRM	161	61	*					*		*	0.61	1.61	0.7	*			
70	LAKSHMI	24/F	1432584	15/7/14	BILATERAL AXILLARY LIPOMA	EXCISION BIOPSY	155	77			*		*		*		1.08	2.54	0.94			*	
71	SOMMAIYA PRAKASH	42/M	1437678	16/7/14	BIL AXILLARY LIPOMA	EXCISION BIOPSY	153	59		*				*		*	0.78	1.54	0.99	*			
72	VISHALI	18/F	1438726	16/7/14	BIL FIBROADENOMA	BIL EXCISION BIOPSY	159	56	*					*		*	0.81	1.68	0.81	*			
73	KUMAR	30/M	37355	17/7/14	POST ILEOSTOMY STATUS	ILIOSTOMY CLOSURE	151	50	*					*		*	0.68	1.71	0.72	*			
74	PREMA	28/F	39033	18/7/14	RIGHT FIBROADENOMA	EXCISION BIOPSY	167	61	*					*		*	0.69	1.48	0.64	*			
75	DHANALAKSHMI	30/F	1437054	19/7/14	GALLBLADDER POLYP	LAPROSCOPIC CHOLECYSTECTOMY	162	55	*					*		*	0.74	1.98	0.78		*		
76	SHAKILIA BANU	19/F	1439227	19/7/14	RIF PAIN	LAPROSCOPIC APPENDICECTOMY	159	55	*					*		*	0.74	2.06	0.71		*		
77	KANNIYAPPAN	52/M	1437040	19/7/14	RIGHT INGUINAL HERNIA	LAPROSCOPIC HERNIOPLSTY	158	55	*					*		*	0.76	1.56	0.64	*			
78	VALLI	28/F	39094	21/7/14	CHOLELITHIASIS	LAPROSCOPIC CHOLECYSTECTOMY	160	61	*					*		*	0.81	1.61	0.72	*			
79	SANGEETHA	23/F	143946	21/7/14	SUBACUTE APPENDICITIS	LAPROSCOPIC APPENDICECTOMY	154	50	*					*		*	0.68	1.58	0.66	*			
80	NIVEDA	18/F	1439991	23/7/14	SUBACUTE APPENDICITIS	LAPROSCOPIC APPENDICECTOMY	150	61		*			*		*		0.72	2.49	0.7		*		
81	DINESH	25/M	1439451	23/7/14	SUBACUTE APPENDICITIS	LAPROSCOPIC APPENDICECTOMY	170	68		*				*		*	0.88	2.09	0.89		*		
82	PATTUKANI	44/F	1437345	24/7/14	RIGHT CA BREAST	RIGHT MRM	157	62		*				*		*	0.81	1.99	0.81		*		
83	KALYANI	20/F	1440623	25/7/14	RIGHT FIBROADENOMA	EXCISION BIOPSY	153	57	*					*		*	0.74	2.01	0.68		*		
84	SUDHARSHAN	18/M	1435871	25/7/14	DERMOID CYST SCALP	EXCISION BIOPSY	165	61	*					*		*	0.78	1.49	0.78	*			
85	VINODHINI	22/F	1440802	25/7/14	LEFT FIBROADENOMA	EXCISION BIOPSY	156	55	*					*		*	0.68	1.51	0.71	*			
86	SHARMILA	18/F	1440556	25/7/14	RIF PAIN	LAPROSCOPIC APPENDICECTOMY	160	55	*					*		*	0.72	1.54	0.74	*			
87	MEENA	35/F	1439374	26/7/14	RIF PAIN	LAPROSCOPIC APPENDICECTOMY	158	57	*					*		*	0.71	1.53	0.68	*			
88	SHIVANI	38/F	1439382	26/7/14	FIBROID UTERUS	LAVH	161	60		*				*		*	0.68	2.01	0.69		*		
89	SARALA	45/F	1440592	26/7/14	CA BREAST RIGHT	RIGHT MRM	167	70	*					*		*	0.87	1.89	0.85		*		
90	JOTHY	40/F	1438582	30/7/14	ABDOMINAL MASS	DIAGNOSTIC LAPROSCOPY	160	65	*					*		*	0.88	1.99	0.78		*		

91	JANABEE	64/F	1435757	31/7/14	LEFT CA BREAST	LEFT MRM	163	70		*				*		*	1.02	2.04	0.87		*	
92	MURUUGESAN	37/M	1440297	31/7/14	ABDOMINAL PAIN FOR EVALUATIO	D LAP AND PROCEED	165	71	*					*		*	0.89	1.47	0.89	*		
93	CHINNATHAYI	70/F	1435842	1/8/2014	RIGHT CA BREAST	RIGHT MRM	162	61	*					*		*	0.67	1.51	0.74	*		
94	RANI	40/F	1442074	1/8/2014	LIPOMA BACK	EXCISION BIOPSY	161	55	*					*		*	0.75	2.13	0.67		*	
95	MORTHY	62/M	1440645	1/8/2014	CHOLELITHIASIS	LAPROSCOPIC CHOLECYSTECTOMY	148	51	*					*		*	0.65	1.62	0.61		*	
96	AYSHA	38/F	1437951	2/8/2014	ABDOMINAL PAIN FOR EVALUATIO	DIAGNOSTIC LAPROSCOPY	155	74			*			*	*		0.97	2.61	0.78			*
97	SHALINI	18/F	1442134	2/8/2014	RECURRENT APPENDICITIS	LAPROSCOPIC APPENDICECTOMY	156	59		*				*		*	0.76	2.07	0.83		*	
98	THILAGAVATHY	56/F	1440308	2/8/2014	CHOLELITHIASIS	LAPROSCOPIC CHOLECYSTECTOMY	155	51	*					*		*	0.81	1.49	0.76	*		
99	MUMTAJ BEGAM	33/F	1442081	3/8/2014	BENIGN BREAST LUMP	EXCISION BIOPSY	162	65		*				*		*	0.62	1.7	0.84	*		
100	RAMA	23/F	1441963	4/8/2014	RIGHT FIBROADENOMA	EXCISION BIOPSY	153	50		*				*		*	0.51	2.1	0.72		*	
101	VADIVEL	54/M	1440854	5/8/2014	INCISIONAL HERNIA	MESH REPAIR	155	52	*					*		*	0.83	1.96	0.74		*	
102	KANNIYAMMAL	43/F	1435081	6/8/2014	POST MRM PHYLLOIDES TUMOUR	LEFT MARGINAL RESECTION	154	58		*				*		*	0.72	1.38	0.85	*		
103	SASIKALA	29/F	1443850	6/8/2014	CHOLELITHIASIS	LAPROSCOPIC CHOLECYSTECTOMY	156	62	*					*		*	0.64	1.53	0.76	*		
104	RAMANI	27/F	257708	6/8/2014	CHOLELITHIASIS	LAPROSCOPIC CHOLECYSTECTOMY	161	67	*					*		*	0.81	1.67	0.84	*		
105	MUNUSAMY	45/M	1441063	11/8/2014	POST ILEOSTOMY STATUS	ILEOSTOMY CLOSURE	165	58	*					*		*	0.57	1.58	0.74	*		
106	HARI	22/M	1442224	11/8/2014	APPENDICULAR CARCINOID	RIGHT HEMICOLECTOMY	150	55	*					*		*	0.72	2.18	0.86		*	
107	MOHAMED RAFIQ	44/M	1441668	11/8/2014	RIF PAIN	LAPROSCOPIC APPENDICECTOMY	153	57		*				*		*	0.84	1.65	0.97	*		
108	MEERA	60/F	1440621	11/8/2014	OVARIAN CYST	LAPROSCOPIC CYSTECTOMY	167	65	*					*		*	0.55	2.25	0.85		*	
109	DEVAN	61/M	33314	12/8/2014	CHOLELITHIASIS	LAPROSCOPIC CHOLECYSTECTOMY	156	52		*				*		*	0.86	2.14	0.86		*	
110	DEVI	32/F	1442565	12/8/2014	CHOLELITHIASIS	LAPROSCOPIC CHOLECYSTECTOMY	158	62	*					*		*	0.63	1.79	0.73	*		
111	ANJU	29/F	1442580	12/8/2014	PARAOVARIAN CYST	LAPROSCOPIC CYSTECTOMY	151	49	*					*		*	0.67	1.67	0.75	*		
112	NATESAN	21/M	1444538	13/8/14	CHOLELITHIASIS	LAPROSCOPIC CHOLECYSTECTOMY	149	53	*					*		*	0.85	2.13	0.76		*	
113	RAMADOSS	40/M	1442853	13/8/14	CHOLELITHIASIS	LAPROSCOPIC CHOLECYSTECTOMY	162	65	*					*		*	0.98	1.56	0.82	*		
114	MAHALAKSHMI 55/F	55/F	1442380	13/8/14	CHOLELITHIASIS	LAPROSCOPIC CHOLECYSTECTOMY	150	56	*					*		*	0.85	1.78	0.74	*		
115	SOWMYA	22/F	1444704	14/8/14	RIGHT FIBROADENOMA	EXCISION BIOPSY	164	67	*					*		*	0.66	1.99	0.86		*	
116	VADUVAMMAL	60/F	1.4E+07	14/8/14	RIGHT CA BREAST	RIGHT MRM	157	51		*				*		*	0.75	1.96	0.84		*	
117	GOVINDAMMAL	50/F	1443075	14/8/14	LEFT CA BREAST	LEFT MRM	162	60	*					*		*	0.84	1.45	0.85	*		
118	DEVAKI 60/F	60/F	1426090	14/8/14	CHOLELITHIASIS	LAPROSCOPIC CHOLECYSTECTOMY	153	53	*					*		*	0.74	1.44	0.72	*		
119	RENUKA	37/F	1443467	15/8/14	FIBROID UTERUS	LAVH	168	67		*				*		*	0.76	1.67	0.76	*		
120	REVATHY	21/F	1444939	15/8/14	RIGHT FIBROADENOMA	EXCISION BIOPSY	156	55		*				*		*	0.67	1.53	0.84	*		

121	VALARMATHY	38/F	1444423	16/8/14	ADHESIVE COLITIS	LAPROSCOPIC ADHESIOLYSIS	161	60		*				*		*	0.76	2.16	0.83		*		
122	CHITHRA DEVI	21/F	1442683	16/8/14	CHOLELITHIASIS	LAPROSCOPIC CHOLECYSTECTOMY	165	81			*		*			*	0.81	2.68	0.96			*	
123	SELVAM	56/M	1443657	16/8/14	CA STOMACH	GASTROJEJUNOSTOMY WITH GASTRE	157	57		*				*		*	0.53	2.22	0.82		*		
124	SANTHANAM	50/F	1443326	18/8/14	LEFT CA BREAST	LEFT MRM	170	65	*					*		*	0.75	1.48	0.85	*			
125	NANDINI	19/F	1444953	18/8/14	RIGHT FIBROADENOMA	EXCISION BIOPSY	158	55	*					*		*	0.86	1.66	0.62	*			
126	CHANDHRA 45/F	45/F	1443090	18/8/14	RIGHT HYPOCHONDRAIC PAIN	LAPROSCOPIC CHOLECYSTECTOMY	167	62	*					*		*	0.74	1.75	0.81	*			
127	MOORTHY	40/M	1443761	19/8/14	HYDATID CYST LIVER	OPEN CYSTECTOMY	154	57	*					*		*	0.63	1.54	0.76	*			
128	ROSY	40/F	1436322	19/8/14	RIGHT ADNEXAL MASS	RIGHT OVARIAN CYSTECTOMY LAPR	161	62	*					*		*	0.74	1.66	0.88	*			
129	PUNITHA	28/F	1444237	20/8/14	CHOLELITHIASIS	LAPROSCOPIC CHOLECYSTECTOMY	158	61	*					*		*	0.85	1.54	0.78	*			
130	PURUSHOTHAMAN	30/M	1442984	20/8/14	ADHESIVE COLITIS	LAPROSCOPIC ADHESIOLYSIS	153	55	*					*		*	0.64	1.89	0.85		*		
131	KRISHNAMOORTHY	40/M	1442856	20/8/14	CHOLELITHIASIS	LAPROSCOPIC CHOLECYSTECTOMY	161	67	*					*		*	0.75	1.57	0.79	*			
132	SIVAGANAGAI	45/F	1444438	21/8/14	ABDOMINAL PAIN FOR EVALUATIO	DIAGNOSTIC LAPROSCOPY	162	63	*					*		*	0.83	1.69	0.88	*			
133	SAROJA	57/F	1444147	23/8/14	HYDATID CYST LIVER	OPEN CYSTECTOMY	159	66	*					*		*	0.75	1.48	0.77	*			
134	BAKIYAM	37/F	1446228	23/8/14	RIGHT FIBROADENOMA	EXCISION BIOPSY	158	61	*					*		*	0.61	1.42	0.75	*			
135	SERIN	60/F	1443229	23/8/14	CHOLELITHIASIS	LAPROSCOPIC CHOLECYSTECTOMY	157	59	*					*		*	0.72	1.92	0.84		*		
136	DEVARAJ	40/M	1446791	25/8/14	RIGHT GYNACOMASTIA	WEBSTERS PROCEDURE	169	71	*					*		*	0.54	1.48	0.86	*			
137	SAKUNTHALA	48/F	1440659	25/8/14	CA RECTUM	APR	156	60	*					*		*	0.76	1.51	0.72		*		
138	PONNAMAL	48/F	1443304	25/8/14	CA BREAST RIGHT	RIGHT MRM	154	51		*				*		*	0.48	1.6	0.67	*			
139	SATHYABAMA	70/F	1441953	25/8/14	CHOLELITHIASIS	LAPROSCOPIC CHOLECYSTECTOMY	161	65		*				*		*	0.74	1.98	0.86		*		
140	DEVAKI	58/F	1445346	26/8/14	LEFT CA BREAST	LEFT MRM	145	49		*				*		*	0.51	1.95	0.58		*		
141	VENKATESAN	67/MM	1445011	26/8/14	RIGHT INGUINAL HERNIA	LAPROSCOPIC HERNIOPLASTY	160	64	*					*		*	0.63	2.01	0.74		*		
142	SHAKILA BEGUM	60/F	1446636	27/8/14	RIGHT CA BREAST	RIGHT MRM	165	64	*					*		*	0.68	1.57	0.75	*			
143	SAKTHIVEL	50/M	1446666	27/8/14	RIGHT INGUINAL HERNIA	LAPROSCOPIC HERNIOPLASTY	162	63	*				*			*	0.74	2.12	0.66		*		
144	TAMILARASI	28/F	1445732	27/8/14	CHOLELITHIASIS	LAPROSCOPIC CHOLECYSTECTOMY	155	58		*				*		*	0.76	2.09	0.69		*		
145	PERIYAMUTHU	36/F	1447459	28/8/14	ABDOMINAL PAIN FOR EVALUATIO	DIAGNOSTIC LAPROSCOPY	154	56	*					*		*	0.61	1.72	0.69	*			
146	SHANMUGANANTHAM	38/M	1447619	28/8/14	CHOLELITHIASIS	LAPROSCOPIC CHOLECYSTECTOMY	156	55	*					*		*	0.65	1.71	0.71	*			
147	LATHA	47/F	1494954	30/8/14	CHOLELITHIASIS	LAPROSCOPIC CHOLECYSTECTOMY	174	90		*				*		*	0.91	2.61	0.89			*	
148	JEGADESHWARI	31/F	1448126	1/9/2014	LEFT OVARIAN CYST	LAPROSCOPIC CYSTECTOMY	170	73	*					*		*	0.88	1.56	0.82	*			
149	SHANTHA 37/F	37/F	1446215	1/9/2014	CHOLELITHIASIS	LAPROSCOPIC CHOLECYSTECTOMY	158	64		*				*		*	0.77	1.7	0.81		*		
150	VASUDEVAN	67/MM	1434482	1/9/2014	CHOLELITHIASIS	LAPROSCOPIC CHOLECYSTECTOMY	163	61		*				*		*	0.61	1.59	0.71	*			