THE IMPORTANCE OF NECK CIRCUMFERENCE TO THYROMENTAL DISTANCE RATIO (NC/TM DISTANCE RATIO) AS A PREDICTOR OF DIFFICULT INTUBATION IN OBESE PATIENTS COMING FOR ELECTIVE SURGERY UNDER GENERAL ANAESTHESIA IN A TERTIAFRY CARE HOSPITAL – A PROSPECTIVE OBSERVATIONAL STUDY.

DISSERTATION SUBMITTED IN PARTIAL FULFILLMENT OF M.D BRANCH X (ANAESTHESIOLOGY) DEGREE EXAMINATION OF THE TAMIL NADU DR. M.G.R MEDICAL UNIVERSITY, CHENNAI, TO BE HELD IN APRIL 2016
THE IMPORTANCE OF NECK CIRCUMFERENCE TO THYROMENTAL DISTANCE RATIO (NC/TM DISTANCE RATIO) AS A PREDICTOR OF DIFFICULT INTUBATION IN OBESE PATIENTS COMING FOR ELECTIVE SURGERY UNDER GENERAL ANAESTHESIA IN A TERITATRY CARE HOSPITAL – A PROSPECTIVE OBSERVATIONAL STUDY.

Dissertation submitted to the
THE TAMILNADU DR M GR MEDICAL UNIVERSITY, CHENNAI
in partial fulfillment of the requirements for the degree of
MASTER OF MEDICINE
IN
ANAESTHESIOLOGY

By
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DEPARTMENT OF ANAESTHESIA
CHRISTIAN MEDICAL COLLEGE
VELLORE
APRIL: 2016
CERTIFICATE

This is to certify that the dissertation entitled “The importance of neck circumference to thyromental distance ratio (NC/TM distance ratio) as a predictor of difficult intubation in obese patients coming for elective surgery under general anaesthesia in a tertiary care hospital- A prospective observational study” is an authentic record of research work carried out by Dr Basil Paul Manayalil under my supervision and guidance in department of Anaesthesia, Christian Medical College, Vellore in partial fulfillment of the requirements for the M.D Anaesthesiology Examination Branch X of the Tamil Nadu Dr. M.G.R Medical University to be held in April 2016 and no part thereof has been submitted for any other degree.

Vellore
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This is to certify that the dissertation entitled “The importance of neck circumference to thyromental distance ratio (NC/TM distance ratio) as a predictor of difficult intubation in obese patients coming for elective surgery under general anaesthesia in a tertiary care hospital- A prospective observational study” is a bonafide work done by Dr Basil Paul Manayalil under the direct supervision and guidance of Dr Ekta Rai, M.D,MRCA, Professor, Department of Anaesthesiology, Christian Medical College, Vellore.

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DECLARATION

I, Basil Paul Manayalil, do hereby declare that the dissertation entitled “The importance of neck circumference to thyromental distance ratio (NC/TM distance ratio) as a predictor of difficult intubation in obese patients coming for elective surgery under general anaesthesia in a tertiary care hospital- A prospective observational study” is a genuine record of research work done by me under the supervision of Dr. Ekta Rai, Professor, Department of Anaesthesia, Christian Medical College, Vellore and has not been previously formed the basis for the award of any degree, diploma, fellowship or other similar title of any University or institution.

Dr Basil Paul Manayalil

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1. INTRODUCTION

Obesity may be defined as a health condition in which excess of fat deposition occurs and has become a major health challenge. As per World Health Organization (WHO), an individual's whose body mass index (BMI) greater than or equal to 30 kg/m² is termed as obese. The study done by Misra et al. among Asians, the definition of obesity has been changed to BMI ≥ 25 kg/m² for metabolic management, but it doesn't affect the acute management of the airway, so we are considering BMI ≥ 30 kg/m² for airway assessment of obese patients. Inability to maintain oxygenation among the obese population leads to complications which can account for the 30% of the deaths.
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Dr. Basil Paul Manayallil, Dr. Ekta Rai, Anesthesiology, CMC, Vellore.

Ref: IRB Min No 9059 [OBSTERVII] dated 04.09.2014

Dear Dr. Basil Paul Manayallil,

The Institutional Review Board (Blue, Research and Ethics Committee) of the Christian Medical College, Vellore, reviewed and discussed your project entitled “The importance of neck circumference to thyromental distance ratio (NC/TM Distance Ratio) As a predictor of Difficult intubation in obese patients coming for elective surgery under general anaesthesia in a tertiary care hospital – A prospective.” on September 4th 2014.

The Committees reviewed the following documents:

1. IRB Application format
2. Curriculum Vitae’ of Dr. Basil Paul Manayallil, Dr. Ekta Rai
3. Clinical Research Form
4. Informed Consent form (English, Tamil, Telugu, Hindi, Bengali & Malayalam)
5. Information Sheet(English, Tamil, Telugu, Hindi, Bengali & Malayalam)
6. No of documents 1-5

The following Institutional Review Board (Blue, Research & Ethics Committee) members were present at the meeting held on September 4th 2014 in the CREST/SACN Conference Room, Christian Medical College, Bagayam, Vellore 632002.
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We approve the project to be conducted as presented.

The Institutional Ethics Committee expects to be informed about the progress of the project, any adverse events occurring in the course of the project, any amendments in the protocol and the patient information / informed consent. On completion of the study you are expected to submit a copy of the final report. Respective forms can be downloaded from the following link: http://172.16.11.136/Research/IRB_Policies.html in the CMC Intranet and in the CMC website link address: http://www.cmc-vellore.edu/static/research/index.html.

A sum of 3,500/- INR (Rupees Three Thousand Five Hundred only) will be granted for 9 months.

Yours sincerely

Dr. Nihal Thomas
Secretary (Ethics Committee)
Institutional Review Board

Dr. Dr. Ekta Rai, Anesthesiology, CMC, Vellore.
ACKNOWLEDGEMENTS

Initially I would like to thank “God Almighty “for giving me the energy and the drive to do this work.

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Basil Paul Manayalil
ABSTRACT

Background and objectives

This study was done to assess the ability of neck circumference to thyromental distance ratio (NC/TM distance ratio) for predicting difficult intubation among obese patients coming for surgery under general anaesthesia. It enabled us to compare NC/TM distance ratio to routinely used Mallampati score and neck circumference as reliable tests for predicting difficult intubation. This study also identified incidence of difficult intubation among obese individuals.

Patients and methods.

After approval of institutional review board and ethical committee of Christian Medical College Vellore, 250 obese patients (body mass index greater than or equal to 30) within time frame of September 2014 and March 2015 was assessed preoperatively with the help of performa after obtaining informed consent. Neck circumference / thyromental distance ratio (NC/TM distance ratio) was calculated from the performa.

Validated Intubation difficulty score (IDS score) for each obese patient was assessed intra operatively by the anaesthetist who performed intubation. The entire study population were divided into easy and difficult intubation groups based on the IDS score. IDS score greater than or equal to five was considered as difficult intubation. NC/TM
distance ratio greater than or equal to five was correlated with IDS score greater than or equal to five.

The study assessed the statistical significance of NC/TM distance ratio and difficult intubation by univariate and multivariate logistic regression analysis and its comparison with Mallampati score and neck circumference with respect to sensitivity / specificity/ positive predictive value and negative predictive value. The study also calculated the incidence of difficult intubation among obese patients

Results

Binary univariate logistic regression analysis of predictors of difficult intubation showed age greater than sixty, increased neck circumference, decreased thyromental distance, modified Mallampati test, NC/TMD ratio \( \geq 5 \) as statistically significant variables that were associated with a difficult intubation (\( p \leq 0.05 \)). Binary multivariate logistic regression analysis showed only neck circumference (\( p=0.030 \) [odd ratio 2.519(1.094-5.802)] and NC/TMD ratio (\( p<0.001 \) [odd ratio 23.680(10.638-52.713)] independently predicted difficult intubation. However NC/TMD ratio had higher specificity / PPV and larger AUC on an ROC curve compared to neck circumference. The incidence of difficult intubation among obese patients was 20.8 %.
Interpretation and Conclusions.

Among obese patients, NC/TMD ratio can be considered as a better preoperative predictor of difficult intubation and incidence of difficult intubation among them was as high as 20.8 percent.

Key words: Intubation; Obesity; Anaesthesia; Modified Mallampati test; Thyromental distance; Neck circumference, NC/TM distance ratio.
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1. **INTRODUCTION**

Obesity may be defined as a health condition in which excess of fat deposition occurs and has become a major health challenge. As per World Health Organisation (WHO), individual’s whose body mass index (BMI) greater than or equal to 30 kg per square meter of body surface is termed as obese \(^1\). The study done by Misra et al., \(^7\) among Asians, the definition of obesity has been changed to BMI ≥ 25 kg.m-2 for metabolic managements, but it doesn’t effect the acute management of the airway, so we are considering BMI ≥ 30 kg.m-2 for airway assessment of obese patients. Inability to maintain oxygenation among the obese population leads to complications which can account for the 30% of the deaths.\(^2\) The ASA (American society of anaesthesiologists) closed claim data analysis of adverse respiratory events had found out that one third of death was attributed solely to anaesthesia due to inability to maintain airway.\(^3\)

When anaesthesia malpractice claims were considered, difficult intubation was the second most frequent damaging event.\(^4\) Most catastrophes have occurred when possible difficult airway was not recognized early.\(^5\) The importance of preoperative assessment of airway to reduce anaesthesia related complications has been evaluated over the last century. In view of all above
mentioned findings several methods and techniques were developed, Cormack and Lehane scoring system, Mallampati test etc for predicting intubation difficulty.

Among non obese and obese individuals, the incidence of difficult laryngoscopy is similar (about 10%). But, there are more reports of difficult intubation among obese patients. This can be due to changes in upper airway present among them. There are some clinical predictors which increases the risk of difficult airway in obese patients. Increased neck circumference, Mallampati’s grade III or IV and diagnosis of obstructive sleep apnoea syndrome (OSAS) are some of the factors related to difficult intubation.

However, measurement of neck circumference alone may not attribute to the amount of soft tissue at various topographic regions within the neck. Using magnetic resonance imaging (MRI), Horner\textsuperscript{6} proposed that among obese patients with OSA’S, more fat was present in areas surrounding the collapsible segments of the pharynx. The study done by Ezri et al\textsuperscript{7} using ultrasonography suggested that difficult airway among obese patients can be predicted by quantifying the neck soft tissue at the level of the vocal cords and suprasternal notch. They further noted that the only measurement that fully distinguishes easy and difficult intubation was the amount of pretracheal soft tissue as quantified by ultrasonography .The above findings point out that why some obese patients are easy to intubate , while others not.
Moreover by review of literature, we found that increased neck circumference had good sensitivity and relatively low specificity as well as decreased thyromental distance had high specificity and low sensitivity for predicting difficult intubation preoperatively. So the hypothesis was that by taking the ratio between these two above indices a new predictor of difficult intubation with better statistical and clinical outcome can be generated.

So, in this dissertation we aspire to explore a preoperative predictor of difficult intubation, named ratio of neck circumference to thyromental distance which needs no special equipment, minimal time for performance and is not uncomfortable to patient. It is a non invasive test which has got better statistical significance compared to other indices.
2. **AIM OF THE STUDY**

To assess the importance of neck circumference to thyromental distance ratio (NC/TM distance ratio) as a predictor of difficult intubation in obese patients coming for elective surgery under general anaesthesia.

3. **OBJECTIVES OF THE STUDY**

**PRIMARY OBJECTIVE** - To assess the correlation between the ratio of neck circumference to thyromental distance (NC/TM distance ratio) and validated intubation difficulty score $^8$ (IDS) in obese patients coming for elective surgery under general anaesthesia.

**SECONDARY OBJECTIVES** -

1. To compare neck circumference / thyromental distance ratio (NC/TM distance ratio) with Mallampati score and neck circumference as reliable tests for predicting intubation difficulty in obese patients.

2. To find out the incidence of intubation difficulty among obese individuals coming for elective surgery under general anaesthesia.

4. **HYPOTHESIS**

The ratio of neck circumference and thyromental distance greater than or equal to five will predict difficult intubation and will have better statistical and clinical significance as compared to other standard indices of airway assessment among obese patients.
5. BACKGROUND

5.1 ANATOMY OF AIRWAY

The terminology “airway” means extra pulmonary air passage and it consists of nasal and oral cavities, pharynx, larynx, trachea and bronchi. The major functions of the airway in an awake state include filtration and conditioning of ambient air, humidification, and conduction of air to and from the lungs for gaseous exchange.

Due to suppression of nervous system which controls the vital respiratory function, the airway is converted to passive state during induction and maintenance of anaesthesia. The ability to ventilate the patient by either bag mask or to intubate is essential for the anaesthetist at this state. In order to anticipate difficult airway and to formulate a plan of safety for the patient, he/she should be well versed with airway anatomy, its application, and various methods of airway assessment.
Anatomical airway can be classified into upper airway and lower airway. Mouth, nose, oropharynx and nasopharynx constitutes upper airway. The lower airway consists of larynx, trachea, bronchial tree and alveoli.

**MOUTH**

Mouth consists of the mouth cavity and vestibule, the former communicating with the latter through the angle of mouth. The vestibule is formed by gums and teeth within and by lips and cheeks without. The cavity of the mouth is bounded by the hard and soft palate above, alveolar arch and teeth in front, oropharyngeal isthmus behind, anterior two thirds of the tongue below.

**THE PALATE**

**Hard palate**

This is made up of horizontal plates of the palatine bones and palatine processes of maxilla.

**Soft palate**

This hangs from the posterior edge of the hard palate like a curtain.

**PHARYNX**

The pharynx (muscular tube) is a common upper pathway of respiratory and alimentary tracts. Anteriorly it is in free communication with the nasal cavity, the mouth and the larynx, which divides into three parts, the nasopharynx, oropharynx and laryngopharynx respectively. Posteriorly it rests against prevertebral fascia and cervical vertebrae.
LARYNX

The larynx is the part of the respiratory tract which contains the vocal cords. A tube–shaped organ, two-inch-long, opens into the laryngeal part of the pharynx above and is continuous with the trachea below. The functions of larynx functions are:

- Deglutition
- Respiration
- Phonation

Basic structure of the larynx

The larynx is made up of four components:

- A cartilaginous skeleton.
- Ligaments and membranes.
- Extrinsic and intrinsic muscles.
- Mucosal lining

The cartilaginous skeleton is made up of

- Single Cartilages:
  - Thyroid
  - Cricoid
  - Epiglottis
- Paired cartilages:
  - Arytenoid
  - Corniculate and cuneiform
Fig: 1: Anterior view of larynx

Fig: 2: Lateral and posterior view of larynx
The laryngeal ligaments are divided into two types, extrinsic and intrinsic ligaments.

| Extrinsic Ligaments                                      | Intrinsic Ligaments                                |
|----------------------------------------------------------|----------------------------------------------------|
| Thyrohyoid membrane and ligaments                        | Elastic membrane                                   |
| Cricothyroid membrane and ligaments                      | Quadrangular membrane                              |
| Cricotracheal ligament                                   | Median cricothyroid ligament                        |
| Epiglottis                                               | Vocal ligament                                     |
|                                                          | Thyroepiglottic ligament                            |

Table 1: Laryngeal ligaments.

The muscular skeleton of larynx consists of

- The Suprahyoid Muscles
  - Digastric
  - Stylohyoid
  - Mylohyoid
  - Geniohyoid

- The Longitudinal Muscles of the Pharynx
  - Stylopharyngeus
  - Salpingopharyngeus
  - Palatopharyngeus

- The Infrahyoid Muscles
  - Sternohyoid
  - Sternothyroid
  - Omohyoid
Laryngeal inlet

It faces backward and upward and opens into the laryngeal part of the pharynx. Its opening is bounded by:

- Anteriorly: by the upper margin of epiglottis
- Posteriorly & below by arytenoid cartilages
- Laterally by aryepiglottic folds

![Fig: 3: Laryngeal inlet]

The laryngeal cavity

- It extends from laryngeal inlet to lower border of the cricoid cartilage.
- Narrow in the region of the vestibular folds (Rima vestibuli)
- Narrowest in the region of the vocal folds (Rima glottides)
The blood supply of larynx consist of

- Arteries:
  - Upper half: Superior laryngeal artery, branch of superior thyroid artery.
  - Lower half: Inferior laryngeal artery, branch of inferior thyroid artery.

- Veins:
  - Accompany corresponding arteries

- Lymphatics:
  - The lymph vessels drain into the deep cervical lymph nodes
The nerve supply of larynx consists of

- **Sensory**
  - Above the vocal cords: Internal laryngeal nerve, branch of the superior laryngeal branch of the vagus nerve.
  - Below the vocal cords: Recurrent laryngeal nerve, branch of vagus nerve.

- **Motor**
  - All intrinsic muscles, except cricothyroid is supplied by the recurrent laryngeal nerve.
  - External laryngeal nerve, a branch of the superior laryngeal branch of vagus nerve supplies cricothyroid muscle.

**Laryngoscopic anatomy**

Getting the mouth, the oropharynx and the larynx into one plane is essential to view the vocal cord at direct laryngoscopy and to proceed with intubation. Elevation of the head about 10 cms with pads under the occiput with shoulders remaining on the table aligns the laryngeal and pharyngeal axis. Flexion of the neck and extension at the atlantooccipital joint creates the shortest distance and most nearly straight line from the incisor teeth to glottic opening. This position is termed the sniffing position.
Fig: 5: Sniffing position for intubation
5.2 OBESITY AND ITS IMPLICATIONS ON ANAESTHESIA

Definition of obesity

As per World Health Organisation (WHO), individual’s whose body mass index (BMI) greater than or equal to 30 kg per square meter of body surface is termed as obese. ¹

As per Misra et al., ⁷³ for Asians, the definition of obesity has been changed to BMI ≥ 25 kg.m⁻² for metabolic managements, but it does not effect the acute management of the airway so we are considering BMI ≥ 30 kg.m⁻² for airway assessment of obese patients

Obesity respiratory pathophysiology

Associated with obesity, various pulmonary disorders are of major concern to anaesthetists. Most amongst these are obesity hypoventilation syndrome /obstructive sleep apnoea and cor-pulmonale. In addition to above, patients with morbid obesity usually have decreased pulmonary reserve even if they do not have specific pulmonary disorder. These patients also have an increased incidence of restrictive pulmonary disorder. Morbidly obese patients have reduced forced vital capacity (FVC) functional residual capacity (FRC) and total lung capacity (TLC) with decreased expiratory reserve volume and increased respiratory resistance.
**Classification of obesity** \(^1,^6\)

The International Classification of adult obesity according to BMI is described below,

| Terminology       | Body mass index (kg/m²) |
|-------------------|-------------------------|
| Overweight        | ≥25.00                  |
| Pre obese         | 25.00-29.00             |
| Obese             | ≥ 30.00                 |
| Obese class 1     | 30.00-34.99             |
| Obese class 2     | 35.00-39.99             |
| Obese class 3     | ≥ 40                    |

Table 2: Obesity classification according to body mass index (BMI).

**Obesity and its anaesthetic implications** \(^9\)

The major anaesthetic challenges in obesity are due to the pathophysiological changes of obesity. They include changes in airway, respiratory system, cardiovascular system, gastrointestinal system and pharmacological variations.
| **Cardiovascular changes in obesity** | - Increase in cardiac output and blood volume (causes cardiomegaly and left ventricular hypertrophy)  
- Decreased venous return  
- Hypertension and ischemic heart disease  
- High risk of thromboembolism, deep vein thrombosis, pulmonary embolus and arrhythmias |
| **Respiratory changes in obesity** | - Decreased compliance  
- Reduced functional residual capacity  
- Increased work of breathing  
- V/Q mismatch may lead to hypoxemia post induction |
| **Airway changes in obesity** | - Difficult mask ventilation and intubation  
- Decreased mobility of head and neck  
- Short neck and large tongue  
- Anterior position of larynx  
- Obstructive sleep apnoea |
| **Gastrointestinal changes** | - Increased gastroesophageal reflux  
- Increased risk of aspiration |
| **Pharmacological considerations in obesity** | - Increased volume of distribution  
- Increased requirement and clearance for fat soluble anaesthetics |

Table 3: Pathophysiological changes in obesity.
5.3 DIFFICULT AIRWAY AND DIFFICULT INTUBATION

Definition of difficult airway

The definition of difficult airway by ASA task force is “the clinical situation in which a conventionally trained anaesthesiologist experiences difficulty with mask ventilation, difficulty with tracheal intubation, or both.” It also involves complex association between patient factors, skills and preference of the practitioner and the clinical scenario.

Definition of difficult mask ventilation

They defined difficult mask ventilation as:

1. Situation in which unassisted anaesthesiologist is unable to maintain the oxygen saturation above 90% using 100% oxygen and positive pressure mask ventilation in a patient whose oxygen saturation was greater than 90% before anaesthetic intervention.

2. Situation in which unassisted anaesthesiologist is unable to prevent or reverse signs of inadequate ventilation during positive pressure mask ventilation.

Definition of difficult intubation.

They also defined difficult intubation when “proper insertion of the tracheal tube with conventional laryngoscopy requires more than three attempts or more than 10 minutes”.

6. **PROBLEM STATEMENT**

Obesity is associated with hypertension, ischemic heart disease, diabetes mellitus as well as difficult airway and intubation. Difficult intubation can increase the morbidity and mortality and is often associated with obesity. As per recent study by Unnikrishnan et al.,\textsuperscript{11} prevalence of obesity among Indian population is around 7\%. The pilot study done by primary investigator among patients who had preoperative anaesthesia check up in Christian medical college, Vellore showed prevalence of obesity as 11\%.

The incidence of intubation difficulty among obese individuals ranges from 11-22 percent as per various literatures published. The incidence of intubation difficulty among obese population as reported in a meta-analysis by Shiga et al.,\textsuperscript{12} and Juvin et al.,\textsuperscript{13} were 15.8 \% (95\% CI, 14.3–17.5\%) and 15.5 \% respectively. Another study by Voyagis et al.,\textsuperscript{14} examined 1833 intubations among obese patients showed 20.2 \% difficult intubation among them. As per Castro et al,\textsuperscript{15} Fotopoulou et al,\textsuperscript{60} Rita et al,\textsuperscript{70} incidence was 20.75 \%, 20 \% and 17 \% respectively. The other studies done by Gonzalez et al,\textsuperscript{20} Kim et al,\textsuperscript{18}
Shailaga et al\textsuperscript{37} recorded a little lower incidence of difficult intubation (14.3\%, 13.8\%, 11\% respectively).

In view of significant number of obese patients undergoing surgery daily for various reasons and the literature highlighting the increased incidence of difficult intubation, we decided to look for the predictor to anticipate the difficulty and been able to plan the management.
7. **JUSTIFICATION FOR THE STUDY**

The preoperative identification of difficult airway decreases anaesthesia related morbidity significantly. But there is no single bed side screening tool which provides accurate identification of difficult airway preoperatively. In our pre anaesthesia clinic we use Mallampati score as a routine screening test for assessment of airway. As per meta analysis done by Lundstrom et al., Mallampati score III or IV were found in only 35 % of patients who were difficult to intubate . He also commended that the modified Mallampati score was inappropriate as a single test to predict difficult intubation. As per review journal of Lee et al., sensitivity, specificity and area under receiver operating characteristic curve for the modified Mallampati score were 0.76, 0.77 and 0.83 respectively.

Considering this fact, a screening tool with the features mentioned below should be considered for preoperative evaluation and identification of difficult airway.

1. Cheap and non expensive
2. Bed side screening tool
3. Not involving costlier equipments/ resources
4. Not cause harm or discomfort to the patient
5. Less time consuming

6. Higher sensitivity and specificity and larger area under ROC curve

As per studies done abroad by Kim et al.,\textsuperscript{18} Abdel et al.,\textsuperscript{19} Castro et al.,\textsuperscript{15} Anahita et al.,\textsuperscript{49} NC/TM distance ratio will enable us to consider all the above mentioned features for predicting difficult intubation in obese patients. There are no Indian studies which showed significance of the same.

Moreover as per Ezri et al.,\textsuperscript{7} and Horner et al.,\textsuperscript{6} difficulty in intubating an obese patient depends upon,

1) Amount of neck soft tissue at the level of suprasternal notch and vocal cords.

2) Amount of pretracheal soft tissue.

- The measurement of neck circumference will clinically quantify amount of neck soft tissue at the level of vocal cords and suprasternal notch.

- The measurement of thyromental distance will clinically quantify amount of pretracheal soft tissue and also provides distribution of the fat in anterior neck.

The above two factors responsible for difficult intubation among obese patients as mentioned by Ezri et al.,\textsuperscript{7} and Horner et al.,\textsuperscript{6} will be taken into consideration, if we take ratio between neck circumference and thyromental
distance, rather than taking individual variables alone. So NC/TM distance ratio might show the distribution of fat in the neck better than neck circumference or thyromental distance alone.

Any screening test is considered to be optimal and superior if it provides high sensitivity and specificity with good predictive value and better accuracy. As per literature review if a single preoperative predictor is considered, it will provide decreased sensitivity and specificity. So most of the studies recommended combination of screening tests.

As per Gonzalez et al., Liaskou et al., Ezri et al., Brodsky et al., Hekiert et al., San Lee et al., increased neck circumference provided better sensitivity and poor specificity as a tool for preoperative prediction of difficult intubation. As per Adbel et al., El Ganzouri et al., Tse et al., Cattano et al., Gupta et al., Liaskou et al., Alireza et al., decreased thyromental distance showed increased specificity, but low sensitivity.

In our study, two factors (i.e. neck circumference and thyromental distance) with moderate sensitivity and good specificity for predicting difficult intubation were taken into consideration. The hypothesis was that by doing so, ratio between them (i.e. NC/TM ratio) will provide better sensitivity and specificity with good predictive value / accuracy and as a excellent bedside screening tool to predict difficult intubation.
8. REVIEW OF LITERATURE

One of the primary responsibilities of the anaesthetist is to maintain airway. Major and significant adverse outcomes can arise if there is an interruption of gaseous exchange due to inability to maintain airway. It is the duty and ability of the anaesthetist to identify patients who have got risk factors not to maintain airway i.e. mask ventilation/ intubation. The identification of difficult airway is essential so that safe intubation and ventilation can be easily achieved. The prediction of potentially difficult intubation has received great importance as it plays a vital role in bringing down morbidity and mortality.

Literature review of this dissertation is subdivided as follows,

- History of intubation and difficult intubation.
- Incidence of obesity among general population.
- Incidence of intubation difficulty among obese population.
- Why was the study done among obese patients? Why do we need a preoperative difficult intubation predictor especially for obese population?
- Comparison of all standard preoperative predictors of difficult airway.
- Relevance of modified Mallampati test for difficult airway prediction.
- Relevance of decreased thyromental distance for predicting difficult airway.
- Relevance of increased neck circumference for predicting difficult airway.
- Significance of NC/TMD ratio as a difficult airway predictor.
- Comparison of different methods of scoring intubation.
- Use of intubation difficulty scale score (IDS score) to grade indirect laryngoscopy
- Summary of review of literature

A) HISTORY OF INTUBATION AND DIFFICULT INTUBATION

As per literature review, history of difficulty in maintaining airway, especially difficulty intubation recorded long way back. As per Luckhaupt et al., the first tracheal intubation in dyspnoea was described by an Arabian doctor Avicenna (980-1037) and history of per oral endotracheal intubation actually started in the 18th century. William McEwen of Glasgow first performed endotracheal intubation in 1880. Bannister et al., commented about the importance of head and neck position in direct laryngoscopy for the correct alignment of the axis of the mouth, pharynx and larynx. Gillespie et al., suggested that by flexing the neck and extending the head at the atlanto-occipital
joint will provide correct position for axis alignment and intubation. Cass et al.,\textsuperscript{32} mentioned about five causes of difficult laryngoscopy and analyzed factors which make visualization of glottis difficult. These were

1. A muscular short neck
2. A mandible with is receding and with obtuse angles.
3. Maxillary incisor teeth which is protruding
4. Temporomandibular joint arthritis which causes immobility of mandible.
5. Narrow long mouth with high arched palate.

Vander Linde et al.,\textsuperscript{33} suggested that no single anatomical factor determined the ease of direct laryngoscopy, but rather a combination of them. Syker et al.,\textsuperscript{34} in their report on confidential enquiries into maternal death in the United Kingdom between 1985-87 have highlighted the relationship between maternal death and difficulty with tracheal intubation. During the period 1976-1987 there were 76 deaths recorded directly due to anaesthesia of which 36 (47%) were related to problems at intubation\textsuperscript{35}. Keenan and Boyan\textsuperscript{36} reported that 12 of 27 cardiac arrests occurred in the perioperative period was due to inadequate provision of ventilation. Caplan et al.,\textsuperscript{3} found that 35% of 1541 liability claims were for adverse respiratory events in ASA closed claims study and approximately 75% of these undesirable events were due to 3 factors – difficult or unable to ventilate (38%), esophageal intubation (18%) and difficult or unable to intubate (17%).
B) INCIDENCE OF OBESITY AMONG GENERAL POPULATION

Obesity was recognized as a global epidemic by World Health Organization (WHO) in 1997. As per Global burden of disease study (Lancet 2013), in the past 33 years there has been a steady increase in rates of obesity and overweight in both adults (28% increase), with the number of overweight and obese people rising from 857 million in 1980 to 2.1 billion in 2013. The foresight report estimates that 36% of males and 28% of female will be obese by 2015 and it is estimated these figures will have risen to 47% and 36% respectively by 2025.

The study done by Unnikrishnan et al., showed that the overall prevalence of overweight in India was 33.5% (35.0 vs 32.0) and of obesity was 6.8% (7.8 vs 6.2) among women and men respectively.

C) INCIDENCE OF INTUBATION DIFFICULTY AMONG OBESE POPULATION

The incidence of intubation difficulty among obese individuals ranges from 11-22 percent. The incidence of intubation difficulty among obese population has been reported in a meta-analysis by Shiga et al., and Juvin et al., were 15.8% (95% CI, 14.3–17.5%) and 15.5% respectively. Another study by Voyagis et al., examining 1833 intubations among obese patients shows 20.2
% difficult intubation among them. As per Castro et al.,\textsuperscript{15} (examined 482 obese patients), incidence was 20.75%. As per Kim et al.,\textsuperscript{18} incidence was about 13.8%. The data published by Gonzalez et al.,\textsuperscript{20} shows 14.3% of difficult intubation. Shailaga et al.,\textsuperscript{37} shows a little lower rate of 11%. The study done by Fotopoulou et al.,\textsuperscript{60} found that the incidence of poor laryngoscopic view was similar between obese and lean group (10.4% vs 10.1%, $P = 0.58$), but difficult intubation was more frequent in obese group (20% vs 2%, $P < 0.001$). A prospective study in obese patients by Rita et al.,\textsuperscript{70} showed 17% of difficult intubation. There are not many validated Asian/Indian studies which shows incidence of intubation difficulty among obese population.

\textbf{D) WHY WAS THE STUDY DONE AMONG OBESE PATIENTS? WHY DO WE NEED A PREOPERATIVE DIFFICULT INTUBATION PREDICTOR ESPECIALLY FOR OBESE POPULATION?}

As per Juvin et al.,\textsuperscript{13} which studied 134 non-obese and 129 obese population, intubation difficulty was noted in 3 non-obese patients and 20 obese patients ($P=0.00001$) which accounts for 2.2% and 15.5% respectively. The mean minimal value of oxygen saturation during the intubation was 88% ± 10% (range of 50%–99%) among the 20 obese patients where intubation difficulty was noted, whereas it was 96% ±7% (range of 64%–100%) in the obese patients for where easy intubation was noted ($P = 0.0006$). The oxygen saturation values noted
during intubation were 99% ± 1% and 95% ± 8% in lean and obese patients, respectively. The high risk of desaturation as well as more difficulty in intubating obese patients warrants research to identify difficult intubation predictors among them preoperatively.

As per Lavi et al., which included 204 adult patients who underwent endotracheal intubation, obese group had high IDS scores as compared to non-obese group. (2.29 +/- 0.45 vs 1.26 +/- 0.2, $P = 0.03$). There was increased duration of intubation among obese population. (45.1 +/- 6 sec vs 36.8 +/- 2.6 sec, $P = 0.20$). The increase in IDS score and increased duration of intubation among obese population warrants careful preoperative airway assessment among them.

As per Gonzalez et al., who analyzed 70 obese and 61 non obese patients who underwent intubations, intubation difficulty was more common in obese as compared to lean patients (14.% vs 3%, $P = 0.03$)

As per Kim et al., who analyzed 123 and 125 obese and non obese patients respectively, found a higher incidence of intubation difficulty among obese group. (13.8% vs 4.8 %, $P=0.016$).

When comparing obese and non obese population, as per Shailaga et al., incidence of intubation difficulty among obese patients was slightly high. (11% vs 7%, $P = 0.049$).
The metaanalysis done by Shiga et al.,\textsuperscript{12} which look thirty-five studies (50,760 patients), the overall incidence of difficult intubation was 5.8% (4.5–7.5%, 95% CI), for normal patients excluding obese and pregnant patients, 3.1% (1.7–5.5%, 95% CI) for obstetric patients, and 15.8% (14.3–17.5%, 95% CI) for obese patients.

The study done by Fotopoulou et al.,\textsuperscript{60} among obese patients who underwent laparoscopic sleeve gastrectomy found that the poor laryngoscopic view was common between obese and lean group (10.4% vs 10.1%), but intubation difficulty (IDS>5) was more common among obese group (20% vs 2%, P< 0.001).

However, Gaszynski et al.,\textsuperscript{65} used ASA definition of intubation difficulty (more than 3 attempts or duration > 10 minutes) among 87 obese patients and reported that the incidence was similar among obese and lean patients (4.6%). But here they used ASA definition of difficult intubation, which is no longer practically recommended.

In a prospective, Canadian study\textsuperscript{47} among general surgical patients, tracheal intubation was recorded as difficult, as well as there was need of multiple laryngoscopies when the patient population was obese. (P <0.01). A higher incidence of difficult intubation (17%) was noted by Rita et al.,\textsuperscript{70} in a study of 210 obese patients.
From the literature search it can be concluded that there is increased incidence of difficult intubation among obese population as well as increased risk of desaturation while intubation, which warrants preoperative identification of difficult airway especially for them so that morbidity and mortality can be decreased. Therefore, analyzing the individual factors that are closely associated with intubation difficulty is important and is further mentioned below.

**E) COMPARISON OF ALL STANDARD PREOPERATIVE PREDICTORS OF DIFFICULT AIRWAY**

The metaanalysis done by Shiga et al.,\textsuperscript{12} which analysed 35 studies and 50,760 apparently normal patients showed the following results. This analysis mainly included Mallampati score, thyromental and sternomental distance, Wilson score, mouth opening and combination of various tests. This metaanalysis doesn’t considered neck circumference and previous history of difficult intubation as a predictive factor. The conclusion given by them were, poor to moderate sensitivity (21–62%) and moderate to fair specificity (82–97%) were provided by all the tests. They also commented that combination of Mallampatti score and thyromental distance as the most useful bedside predictive test with high positive likelihood ratio. They further concluded that, most of the screening test currently available had only poor to moderate discriminative power when used alone for predicting difficult airway. Therefore combinations of various tests add incremental predictive value in comparison to the value of individual test alone.
This metaanalysis strongly recommended the need of combination of various factors rather than one factor alone. However they try to combine Mallampati test and thyromental distance which yielded low specificity and higher sensitivity. In our study we tried to get a ratio by dividing neck circumference (proven good sensitivity) and thyromental distance (proven good specificity) with end result of better sensitivity and specificity.

The study done by Sheff SR et al.,39 done on patients undergoing bariatric surgery suggested multivariate predictors of a difficult intubation were Mallampati class 4 (odds ratio [OR] 2.76, P = .035), abnormal thyromental distance (OR 4.39, P = .001), restricted jaw mobility (OR 3.26, P = .018), and a history of a difficult intubation (OR 4.17, P = .002). Their conclusion was a high Mallampati score; decreased thyromental distance, restricted mobility of jaw, and a previous history of difficult intubation were independent predictors of intubation difficulty. However thyromental distance has low sensitivity and higher specificity. But this study had not included neck circumference as part of it.

A pilot study done by Arne Budde et al.,40 to show the importance of indirect mirror laryngoscopy commented that only three factor predicting difficult intubation were neck circumference, mallampati and indirect mirror laryngoscopy. The sample size and power of the study was low to comment on it.
Nasa V K et al.,\textsuperscript{41} studied 383 patients and gave us a conclusion as follows,

|                  | Modified MP test | Thyromental test | Neck extension |
|------------------|------------------|------------------|----------------|
| Sensitivity (%)  | 31               | 78               | 40             |
| Specificity (%)  | 96               | 98               | 99             |
| PPV (%)          | 31               | 56               | 76             |
| Accuracy (%)     | 79               | 84               | 82             |

Table 4: Accuracy of modified MP test, thyromental distance, neck extension in predicting difficulty with tracheal intubation as per Nasa V K et al.

Here modified mallampati test and thyromental distance showed high specificity and relatively low sensitivity. Further analysis revealed that area under receiver operating characteristic curve for modified mallampati test was 0.473, which is significantly less than AUC for thyromental test which was 0.753. The ROC curve is maximum for thyromental test as compared to mallampati test.

Karakus O et al.,\textsuperscript{41} who assessed 2611 patients who underwent direct laryngoscopy, found out that the sensitivity, specificity, PPV and NPV of a short TMD were 23.9, 99.4, 81.6 and 93.1\% respectively and for mallampati were 30, 98, 59, and 94. As per this study, both mallampati test and thyromental has high specificity and low sensitivity.
Savva D et al.\textsuperscript{43} studied 355 patients (322 non-obstetric and 28 obstetric) with the aid of modified Mallampati score, measurement of thyromental and sternomental distances, forward protrusion of the mandible and interincisor gap. He concluded that sternomental distance appeared to be more sensitive (82.4\%) and specific (88.6\%) than thyromental distance (64.7\% and 81.4 \%), the modified Mallampati test (64.7\% and 66.1\%) and forward protrusion of the mandible (29.4\% and 85.0\%).

The study done by Fotopoulou et al.\textsuperscript{40} among obese patients who underwent laproscopic sleeve gastrectomy found that reduced sternomental distance, decreased thyromental distance, increased body mass index and increased neck circumference, were independently correlated to intubation difficulty among obese group (IDS $\geq$ 5). So they concluded that obesity was a risk factor for intubation difficulty. Increased neck circumference, reduced sternomental and thyro-mental distance can help anesthesiologists for predicting a difficult airway.

According to a multivariate analysis done by Siriussawakul A et al.\textsuperscript{62} the independent risk factors of difficult intubation among 200 obese patients were a high modified Mallampati test, the increased neck circumference, and short inter-incisor gap.
The Noorizad et al.,\textsuperscript{63} studied about mallampati test and thyromental distance and found out that, because of its low sensitivity and PPV, it has low value in prediction of difficult intubation. However because of high specificity and NPV of these tests and capability of being performed at the bed side, these tests could be used before induction of anaesthesia. The chance of an easy endotracheal intubation increases when the patient obtain negative results.

Among obese patients, decreased mouth opening (inter-incisor gap) has not been found to be an independent predictor of intubation difficulty.\textsuperscript{13,20,22,65}. As per Juvin et al.,\textsuperscript{13}. Siyam and Benhamou\textsuperscript{66} reported an association with intubation difficulty and OSA, while in the same year Brodsky et al.,\textsuperscript{22} reported no specific correlation among them. Neligan et al.,\textsuperscript{44} reported findings which was correlating with Brodsky, failed to find a correlation between OSA and intubation difficulty.

As per literatures reviewed above, a single airway assessment technique is not adequate (clinically as well as statistically) for predicting difficult intubation. Moreover above data from literature review showed a great variability about the accuracy of various preoperative difficult intubation predictors.
F) RELEVANCE OF MODIFIED MALLAMPATI SCORE FOR PREDICTION OF DIFFICULT AIRWAY

The metaanalysis done by Lee et al.,\textsuperscript{17} included 42 studies with 34513 patients concluded that for predicting intubation difficulty, the modified Mallampati test had good accuracy as compared to original Mallampati test. (Area under the ROC curve =0.83 ±0.03 vs 0.58 ± 0.12). Hence they recommended modified Mallampati test for assessment of airway of the patients.

As per Juvin et al.,\textsuperscript{13} who studied obese and lean patients concluded that only independent risk factor for difficult intubation among obese patients was Mallampati score of III or IV.(Odds ratio 12.51; 95% CI, 2.01–77.81), but it has low specificity and positive predictive value. They pointed out the inability of the classic risk factors to predict intubation difficulty in obese patients. The high risk of desaturation as well as more difficulty in intubating obese patients warrants research to identify difficult intubation predictors among them preoperatively.

The modified mallampati score was described as a moderately good (60%) predictor of intubation difficulty among obese patients as per Lavi et al.,\textsuperscript{38}. The study failed to establish a single preoperative predictor for difficult intubation and hence warrant new predictors.
As per **Neligan et al.,**\(^{44}\) there was no correlation between the presence and severity of obstructive sleep apnoea, increased body mass index, or increased neck circumference and intubation difficulty. Only a male gender or Mallampati score of III or IV predicted difficult intubation. But this study used Cormack and Lehane grading system alone to identify difficult intubation which not covered all aspects of difficult intubation.

**Adamus M et al.,**\(^{45}\) has reviewed Mallampati et al., and found of the total 1,518 patients enrolled, compared to the original article by Mallampati, they found lower positive predictive value (0.107 vs. 0.933), higher negative predictive value (0.986 vs. 0.928), lower specificity (0.824 vs. 0.995), lower likelihood ratio (3.68 vs. 91.0) and accuracy (0.819 vs. 0.929). They concluded that, the modified Mallampati test has limited value when used as a single examination in predicting difficult intubation. But all these 1518 patients recruited were normal patients but not obese.

As per meta analysis done by **Lundstrom et al.,**\(^{16}\) Mallampati score III or IV were found in only 35 % of patients who were difficult to intubate. He also commended that and the modified Mallampati score was inappropriate as a single test to predict difficult intubation. They further concluded that the prognostic value of the modified Mallampati score was lower than that estimated by previous meta-analyses. Their assessment showed that the modified Mallampati score was
inadequate as a stand-alone test of predictor of intubation difficulty, but it may well be a part of a multivariate model.

Moon et al., commented that more difficulty in intubation are common in middle aged or elderly adults and mallampati score predicted difficult intubation in both groups. The values for malampatti score among middle age group [OR- 10.92(2.9-40.58), P value-< 0.001] and old age group [OR-14.13(3.42-58.27), P value < 0.001] respectively.

G) RELEVANCE OF DECREASED THYROMENTAL DISTANCE AS PREDICTOR OF DIFFICULT AIRWAY

(High specificity and low sensitivity)

The study done by Abdel et al., showed a high specificity (99) percent with NPV OF 92 percent and low sensitivity for decreased thyromental distance to predict difficult airway.

As per Hiremath et al., who analyzed 15 OSA and Non OSA patients found that intubation difficulty was associated with decreased thyromental distance, mandibular length and greater soft palate length ( p< 0.05). However sample size was too small to give a comment.
El Ganzouri et al.,\textsuperscript{25} illustrated decreased thyromental distance of < 6 cm, as a risk factor for intubation difficulty with sensitivity of 16.8\% and specificity of 99\%, PPV of 15 \% and NPV of 99\%.

As per Rose et al.,\textsuperscript{47} the best preoperative predictors for difficulty of tracheal intubation were decreased mouth opening (RR = 10.3), decreased thyromental distance (RR = 9.7) and the finding of three or more abnormal characteristics (RR = 9.4). Of the possible combinations for two abnormalities, four were significant (restricted neck movement in combination with mouth opening (RR = 10.9), decreased thyromental distance (RR = 8.5), decreased visualization of the hypopharynx (RR = 9.0), and decreased thyromental distance and visualization of the hypopharynx (RR = 8.1) But the study population were non obese.

Tse et al.,\textsuperscript{26} concluded that thyromental distance less than 7 had a very low sensitivity 32 \% and a low positive predictive value (PPV) of 20\% and specificity of 80 and NPV of 89 when used alone.

As per Cattano et al.,\textsuperscript{27} both mallampati score and thyromental distance shows low sensitivity, low PPV, good specificity and good NPV. All the other predictors also show the same results. The following are the results,
|                | MP III OR IV | TMD | MHD < 45 | SMD <12 | II < 35 |
|----------------|--------------|-----|----------|---------|--------|
| Sensitivity(%) | 32           | 17  | 21.5     | 13      | 23.5   |
| Specificity(%) | 90.5         | **92** | 91      | 96.5    | 93.5   |
| PPV (%)        | 08           | 05  | 5.5      | 08      | 08     |
| NPV (%)        | 98           | 98  | 98       | 98      | 98     |
| Odds ratio     | 4.5          | 2.4 | 2.7      | 4.0     | 4.3    |
| p value        | <0.001       | .017| 0.004    | <0.001  | <0.001 |

Table 5: Tests for difficult intubation as per Cattano et al.

As per Gupta et al.,\textsuperscript{28} shorter thyromental distance shows sensitivity, specificity, PPV, NPV as 73%, 97%, 32%, 99% respectively.

Liaskou et al.,\textsuperscript{21} showed thyromental distance has higher specificity (83%), high NPV (89.9%) and better area under curve (0.63) but low sensitivity (34%) and PPV (23.8%). But NC shows better sensitivity (70%) and NPV (91.1%), but low specificity (44.6%) and AUC (0.54)
Noorizad et al.,\textsuperscript{63} compared mallampati test and thyromental distance and following are the results

|                      | Modified MP test | Thyromental test |
|----------------------|------------------|-----------------|
| Sensitivity (%)      | 37.9             | 17.2            |
| Specificity (%)      | 76.9             | 86.8            |
| PPV (%)              | 12               | 9.8             |
| NPV (%)              | 93.7             | 92.7            |
| False negative (%)   | 62.1             | 82.7            |
| False positive (%)   | 23.1             | 13.2            |
| Accuracy (%)         | 73.78            | 81.48           |

Table 6: Comparison of modified MP test and thyromental test as difficult intubation predictor (Noorizad et al.).

The study concluded as thyromental distance has got high specificity and NPV, but very low sensitivity and PPV.

Alireza et al., conducted prospective, observational, single-blind study, of 350 patients and that concluded sensitivity, specificity, positive and negative predictive value, and accuracy of thyromental distance were 55\%, 88\%, 22\%, 97\%, and 86.3\%.  

- 40 -
From most of the literature review mentioned earlier, it can be concluded that decreased thyromental distance has better specificity and low sensitivity for predicting difficult intubation. But number of studies done with obese patients is limited.

**H) RELEVANCE OF INCREASED NECK CIRCUMFERENCE FOR PREDICTING DIFFICULT AIRWAY**

(High sensitivity and low specificity)

The study done by Gonzalez et al.,\cite{20} found out that increased neck circumference and increased body mass index are independently correlated to intubation difficulty \( P = 0.0012 \) [odd ratio, 1.373 (1.133–1.664)] for neck circumference and \( P = 0.0497 \) [odd ratio, 1.066 (1–1.135)] for body mass index. This study results thus confirmed the work of Brodsky et al., who demonstrated that increased neck circumference is as a stand alone predictor of intubation difficulty. It shows sensitivity of 92 percent, NPV of 99 percent and relatively low specificity for neck circumference.

The study done by Ezri et al.,\cite{7} commented that, using ultrasonographic quantification of anterior soft tissue in obese patient will predict difficult intubation. Difficult intubation patients had larger neck circumference \([P<0.001]\) and more pre-tracheal soft tissue \([P<0.001]\). The factor that separated difficult and easy laryngoscopies was the amount of soft tissue of the neck. Thus, an abundance
of pretracheal soft tissue at the level of vocal cords is a good difficult intubation predictor among them. This abundance of pretracheal soft tissue as calculated by ultrasound can be clinically correlated with measurement of neck circumference at the level of cricoid cartilage.

As per Brodsky et al.,\textsuperscript{22} who studied on hundred morbidly obese patients, neither obesity nor increased body mass index predicted problems with tracheal intubation. However, a high Mallampati score (III or IV) and large neck circumference may increase the potential for difficult intubation. Increased neck circumference was the only patient risk factor that did have a significant effect on the probability of intubation difficulty (P = 0.02). The logistic regression model predicted that the odds of a problematic intubation in a particular patient with a neck circumference 1 cm larger than that of another patient are 1.13 (95% CI, 1.02 to 1.25) times the odds of the patient with a 1-cm smaller neck circumference. With a neck circumference of 40 cm and 60 cm, the probability of a problematic intubation was approximately 5% and 35% respectively. This study strongly recommended neck circumference as a predictor of intubation difficulty among obese population.
Hekiert et al.,23 studied among obese patients who underwent tracheal intubation under general anaesthesia found out that Mallampati score was of limited utility to the anaesthetists as a difficult airway predictor. Increased neck circumference in female patients was correlated with increase in Cormack-Lehane score (p = .02).

Iyer et al.,48 analyzed patients who had undergone gastric banding concluded that severe obstructive sleep apnoea and neck circumference more than forty four centimeter were factors associated with intubation difficulty.

As per San Lee et al.,24 for patients with intubation difficulty, their neck circumferences were significantly increased (P = 0.014). Moreover, 70% of the patients with difficult intubations had neck circumferences ≥ 40 cm and 35% of the patients with easy intubation had a neck circumference ≥ 40 cm. Thus, the factor that maximally influenced the intubation difficulty was the thickness of the neck. They concluded that if the Mallampati score is III or IV and the neck circumference is greater than or equal to 40 cm, then it can be predicted that intubation will be difficult, so proper plan for intubation should be made.
As per Liaskou et al., increased neck circumference shows better sensitivity (70%) and NPV (91.1%), but low specificity (44.6%) and AUC (0.54).

Most of the studies recommended increased neck circumference as a good sensitive indicator with good NPV, but lacks better specificity for predicting difficult intubation.

I) SIGNIFICANCE OF NECK CIRCUMFERENCE/ THYROMENTAL DISTANCE RATIO (NC/TMD RATIO) AS A DIFFICULT AIRWAY PREDICTOR.

(High sensitivity, specificity and NPV)

There is no single gold standard bed side scoring system for predicting difficult intubation among obese individuals. The most commonly used bed side screening tool for detecting difficult airway is Mallampati score (in pre-anaesthesia clinic of our hospital) or a combination of multiple scoring system. There are very few studies which analysed NC/TM distance ratio as bedside tool for predicting difficult airway. Following are the studies.

Kim et al., analysed 260 patients (obese and nonobese) and intubation difficulty was analysed by using intubation difficulty score scale. The conclusion was difficult intubations were more common in the obese patients group. Intubation difficulty was independently associated with a Wilson score greater than or equal to two, NC/TMD ratio greater than equal to five and Mallampati
score III or IV. A NC/TMD ratio greater than or equal to five provided a moderate-to-fair sensitivity, specificity, and a negative predictive value. It was also recommended IDS score scale compared to Cormack and Lehane score alone for recording difficult intubation because the IDS score reflects all moments of intubation, whereas the Cormack grade only considers the moments of the laryngoscopic view. According to this study a poor laryngoscopic view did not always correlate with intubation difficulty.

The other variables such as neck circumference, the NC/BMI and NC/SM were also analyzed. However these variables did not show a positive correlation with intubation difficulty. Following are the results,

|                | MP III OR IV | TMD  | SMD  | NC/TM ≥ 5.0 | NC/SM ≥ 2.4 | WILSON SCORE ≥ 2.0 | HISTOR Y OF DI |
|----------------|--------------|------|------|-------------|-------------|-------------------|----------------|
| Sensitivity (%)| 59           | 59   | 47   | 88          | 82          | 47                | 36             |
| Specificity (%)| 90           | 91   | 81   | 83          | 57          | 91                | 98             |
| PPV (%)        | 48           | 50   | 29   | 46          | 23          | 47                | 71             |
| NPV (%)        | 93           | 93   | 91   | 98          | 95          | 91                | 92             |

Table 7: Tests for difficult intubation (Kim et al).
The study itself has many limitations like not blinded adequately, lack of use of ramp position which is supposed to be the initial position for the obese patients and use of standardized scope for the first attempt instead of use of blade size depending on the need.

In our study we have given the operator to decide the technique to be used for the patient and record the score as per the used technique. There was no strict rule that intubation should be done only with one particular technique.

The study done by Anahita et al., on 657 obstetric patients has come to a conclusion that AUC of the receiver operating curve, was lower for Mallampati score (AUC = 0.497; 95% CI, 0.045-0.536) and ULBT (AUC = 0.500, 95% CI, 0.461-0.539) compared to RHTMD, NC, TMD, and NC/TMD scores ([AUC = 0.627, 95% CI, 0.589-0.664], [AUC = 0.691; 95% CI, 0.654-0.726], [AUC = 0.606; 95% CI, 0.567-0.643], [AUC = 0.689; 95% CI, 0.625-0.724], respectively.

It also shows 70 percent sensitivity and specificity with NPV of 97 % for NC/TM which other indices was not able to give. Most of the other indices provided isolated high sensitivity (MMT AND ULBT 83 /100) but extremely low specificity (27/0.33) and PPV (9.1/8.1). While the other two indices (RHT/NC) was giving high specificity (95/89), but low sensitivity (26/49).

The advantage of neck circumference/ thyromental ratio is its increased sensitivity than the other two tests, thus decreasing false-negative (3.4%) predictions. This study strongly supported the use of assessing NC/TMD ratio.
preoperatively to predict a potentially intubation difficulty as it is an easy and simple test.

But this study was done on obstetric patients and anatomical airway variation in obstetric population is being described also. The following table summarized the data of the study.

|                      | MP III OR IV | ULBT | HT/TM | NC/TM |
|----------------------|--------------|------|-------|-------|
| Sensitivity (%)      | 83           | 100  | 26    | 71.7  |
| Specificity (%)      | 27           | 0.33 | 95    | 70    |
| PPV (%)              | 09           | 8.1  | 33    | 17    |
| NPV (%)              | 95           | 100  | 94    | 97    |
| Accuracy             | 58           | 35   | 89.2  | 70    |
| Likelihood ratio     | 1.14         | 1.0  | 5.5   | 2.41  |
| Odds ratio/relative risk | 0.670/1.4   | 1.01/0.991 | 6.41/0.210 | 5.967/0.196 |
| AUC of ROC curve     | 0.497        | 0.5  | 0.627 | 0.685 |

Table 8: Importance of NC/TM distance ratio as per Anahita et al.

The study done on 482 obese patients proposed for bariatric surgery by Castro et al.,\(^{15}\) showed body mass index (p 0.02), neck circumference (p 0.002), NC/TM ratio(p < 0.001) and Mallampati scores III-IV (p =0.002) independently predicted difficult intubation , but NC/TM had a high sensitivity and better
negative predictive value. Therefore, they recommended this new measurement for difficult intubation prediction among obese population.

Another study by Abdel et al.,\textsuperscript{19} which included 50 OSA patient revealed Mallampati score was also statistically correlated to difficult intubation, but this correlation is weaker than the correlation between NC/TM and difficult intubation because P value =0.05 and odds ratio was 14.5 (in contrast to NC/TM which showed P value 0.01, odds ratio 37.5). This study had a comparison only between Mallampati score and NC/TM distance ratio. To get superiority for NC/TM over Mallampati score is difficult in this study since the number of study population (50 patients) is considered relatively small compared to other studies. Moreover this study had not evaluated other preoperative predictive parameters for difficult intubation.

J) COMPARISON OF DIFFERENT METHODS OF SCORING INTUBATION. WHY DID WE SELECT INTUBATION DIFFICULTY SCALE (IDS) SCORE?

There are multiple methods of scoring intubation is being described. The most commonly used is Cormack and J Lehane score described in 1984\textsuperscript{56} and later modified in 2007,2010\textsuperscript{57,58}. Visual analogue scale in 100 mm scale, Time on completion of intubation and Intubation difficulty scale score (IDS)\textsuperscript{8}. 
As per Adnet et al., old Cormack and Lehane score demonstrated glottic exposure alone, so it is a incomplete reflection of intubation difficulty. Adnet et al developed a scoring system which demonstrated in 311 pre hospital intubations and 315 intubations in operating rooms. He added extra points for additional attempts, additional operator, addition technique used, additional point for considerable lifting force used and use of external laryngeal pressure. But maximum three points was given to Cormack and Lehane score. (In view that glottic view is one of the essential factors to determine intubation difficulty)

The IDS score was compared with other parameters like visual analogue scale and time on completion of intubation and found out that it was well correlated with above mentioned scoring systems. But advantages of IDS was it was less subjective than visual analogue scale and categorical classification and IDS offered details about difficulty encountered during intubation that time alone does not.

The author further commented that this tool may be excellent to evaluate factors linked to difficult intubation and provide a uniform method to compare studies related to the subject. IDS score is a blend of objective and subjective criteria’s that allows quantitative and qualitative approach to the progressive nature of intubation difficulty.
K) USE OF INTUBATION DIFFICULTY SCALE TO GRADE INDIRECT LARYNGOSCOPY

As per J McElwain et al.,\textsuperscript{50, 51} who reviewed on determination of the utility of the IDS scale for use with indirect laryngoscopes concluded that, the intubation difficulty score performs better when used with the Macintosh compared with indirect laryngoscopes. Even though IDS score will have limited utility if used to compare indirect laryngoscopes and the Macintosh laryngoscope, the overall correlations justify continued use of the intubation difficulty score with indirect laryngoscopes.

The IDS score had been used to describe intubation difficulty with indirect laryngoscopes in various studies by Malik MA et al.,\textsuperscript{53} Suzuki et al.,\textsuperscript{54} but use of IDS score in indirect scopy had not been validated. The findings of the study done by McElwain et al.,\textsuperscript{50, 51} were the Intubation Difficulty Scale performed well when compared with data for duration and user rated difficulty of the intubation attempts for the both direct and indirect laryngoscopy. However, the correlation between the Intubation Difficulty Scale score and both user rated difficulty (p = 0.001) and the duration of tracheal intubation (p = 0.003) were significantly stronger for the Macintosh laryngoscope compared with the indirect laryngoscopes. In contrast, the correlation between user rated difficulty scores and the data for duration of tracheal intubation was not different between the devices.
types. These findings suggest that special precaution is needed for the use of IDS with indirect laryngoscopy. But this study doesn’t discouraged use of IDS score for indirect scopy. The following are details,

| Intubation difficulty indices | Macintosh laryngoscope (correlation) | Indirect laryngoscope (correlation) | Z-test for difference (P value, two sided) | Permutation test for difference | Interpretation |
|-------------------------------|--------------------------------------|-------------------------------------|------------------------------------------|-------------------------------|----------------|
| IDS score vs VAS difficulty   | 0.860                                | 0.697                               | 0.0001                                   | 0.0003                        | Correlation significantly increased for Macintosh vs Indirect laryngoscope |
| IDS score vs duration of intubation | 0.752                               | 0.580                               | 0.003                                    | 0.038                         | Correlation significantly elevated for Macintosh vs Indirect laryngoscope |
Visual analogue score vs duration of intubation

|                | 0.820 | 0.748 | 0.078 | 0.125 |
|----------------|-------|-------|-------|-------|
| Correlation    | not   | different | for    | Macintosh | vs    |
|                |       |        |       | Indirect | laryngoscope |
### L) SUMMARY OF REVIEW OF LITERATURE

| Factor          | Kim et al., 18 (2011) Sample size - 123 | Abdel Naim et al., 19 (2014) Sample size - 50 | Castro et al., 15 (2013) Sample size - 482 | Shiga et al., 12 (2005) Meta analysis | Juvin et al., 13 (2003) Sample size - 129 | Gonzalez et al., 20 (2008) Sample size - 70 |
|-----------------|------------------------------------------|-----------------------------------------------|-------------------------------------------|--------------------------------------|-----------------------------------------|---------------------------------------------|
| M P score III or IV | Sensitivity- 58.8 Specificity- 89.6 PPV- 47.6 NPV- 93.1 ROC curve- 0.742 P value- 0.001 | Sensitivity - 90 Specificity- 61 ROC curve- 0.74 P value- 0.039 | P value- 0.002 | Sensitivity 49.0 Specificity- 86.0 ROC curve- 0.82 | Sensitivity – 85.0 Specificity- 68.0 PPV- 29.0 NPV- 96.0 P value- 0.007 | Sensitivity- 67 Specificity- 87 PPV- 33 NPV- 96 P value- < 0.001 |
| NC/TM ratio ≥ 5 | Sensitivity- 88.2 Specificity- 83.0 PPV- 45.5 NPV- 97.8 ROC curve- 0.865 P value < 0.01 | Sensitivity- 100 Specificity= 82 ROC curve- 0.95 P value- 0.004 | Sensitivity – High Specificity- High NPV- High P value< 0.001 | Not included as part of study | Not included as part of study | Not included as part of study |
| Metric                                 | Sensitivity | Specificity | PPV  | NPV  | ROC curve | P value |
|---------------------------------------|-------------|-------------|------|------|-----------|---------|
| **TM distance**                       | Sensitivity – 58.8 | Specificity- 90.6 | PPV- 50.0 | NPV-93.2 | ROC curve- 0.858 | Not mentioned values |
| **H/o difficult intubation**          | Sensitivity– 35.7 | Specificity- 98.2 | PPV- 71.4 | NPV- 92.2 | Not mentioned values | Not mentioned values |
| **Wilson score > 2**                  | Sensitivity– 47.1 | Specificity- 91.5 | PPV-47.1 | NPV- 91.5 | ROC curve- 0.693 | P value- 0.002 |
| **Neck circumference**                | Not mentioned values | Not mentioned values | P value- 0.002 | Not mentioned values | Not mentioned values | Sensitivity – 92 | Specificity- 84 | PPV- 37 | NPV- 99 | P value- < 0.001 |

Table 10: Summary of review of literature.
As per above mentioned studies it can be concluded that NC/TM distance $\geq 5$ showed increased sensitivity / specificity / negative predictive value (NPV) and area under curve for prediction of difficult intubation among obese patients. But very limited numbers of studies have been done to show the importance of NC/TM distance ratio. Moreover importance of this screening tool among obese Indian population has not been studied at al.

Hence our study assessed the correlation between NC/TMD ratio and intubation difficulty score among obese Indian patients coming for surgery under general anaesthesia and compared NC/TM distance ratio to Mallampati score and neck circumference as reliable tests for predicting difficult intubation.
9. RESEARCH METHODOLOGY

9.1 STUDY DESIGN

Prospective observational study

9.2 SETTING AND LOCATION

Pre Anaesthesia Clinic of department of Anaesthesiology, Christian Medical College, Vellore, South India, 632004

9.3 STUDY PERIOD

September 2014- March 2015

9.4 STUDY POPULATION

- Age greater than 18 years
- ASA class I, II, III
- Patients of both gender.
- Body mass index $\geq$ 30 kg/m2
- Obstructive sleep apnoea.
- Patients undergoing surgery with tracheal intubation.
9.5 SAMPLE SIZE AND SAMPLING PROCEDURE

As per two studies done on difficult intubation among obese patients (Kim et al., and Abdel et al.,) following details of NC/TM distance ratio were taken into consideration to calculate sample size.

| Cut off values for NC/TM distance ratio | Kim et al.,\textsuperscript{18} | Abdel et al.,\textsuperscript{19} |
|----------------------------------------|-------------------------------|-------------------------------|
| Sensitivity                            | 89                            | 100                           |
| Specificity                            | 83                            | 82                            |
| P value                                | < 0.001                       | 0.004                         |
| Confidence interval                    | 95 %                          | 95 %                          |

The incidence of difficult intubation among obese individuals ranges from 15-22 percent. The incidence of difficult intubation among them has been reported in a meta-analysis by Shiga et al.,\textsuperscript{12} and Juvin et al.,\textsuperscript{13} were 15.8 % (95% CI, 14.3–17.5%) and 15.5 % respectively. Another study by Voyagis et al.,\textsuperscript{14} examining 1833 intubations among obese patients showed 20.2 % difficult intubation among them. As per Castro et al.,\textsuperscript{15} (examined 482 obese patients), incidence was 20.75 %.

The pilot study conducted for three days in our department by the investigator (details mentioned later), incidence was found to be around 22 %.
Hence for this current study, incidence of difficult intubation was taken as 22% for the calculation of study population.

So sample size for the current study can be calculated by using reference from above mentioned studies and pilot study done by investigator.

The values taken are

- Sensitivity of 90 percent
- Specificity of 83 percent.
- Confidence level of 95 percent
- Allowable error between 0.1 to 0.05
- Prevalence of 22 percent.

Based on 95% CI of true sensitivity with a allowable error of 0.1, sample size was calculated using the formula\(^{52}\)

\[
N = \frac{TP + FN}{P}
\]

\[
TP + FN = Z^2 \times [SN(1-SN)]
\]

\[
N = \frac{(1.96)^2 \times [0.90(1-0.90)]}{(0.1)^2} = 34.5
\]

\[
P = 0.22
\]

\[
N = \frac{34.5}{0.22} = 157
\]
\[ N = \text{Sample size}, \ TP = \text{True positive}, \ FN = \text{False negative}, \ SN = \text{Sensitivity}, \ SP = \text{Specificity} \ Z = \text{confidence interval (i.e. for 95\% Z = 1.96)}, \ P = \text{Prevalence}, \ W = \text{Accuracy (allowable error)} \]

Based on 95\% CI of true sensitivity with a allowable error of 0.05, sample size was calculated using the formula

\[
N = \frac{TP + FN}{P} \times \left[ \frac{SN(1 - SN)}{W^2} \right] \\
TP + FN = (1.96)^2 \times \left[ \frac{0.90 (1 - 0.90)}{0.05^2} \right] = 138.29
\]

\[ (0.05)^2 \]

\[ P = 0.22 \]

\[ N = \frac{TP + FN}{P} = 138.29 \times \frac{1}{0.22} = 628 \]

To achieve precision of 10\% for specificity we need the total sample size below using the formula

\[
N = \frac{TP + FN}{(1 - P)} \times \left[ \frac{SP(1 - SP)}{W^2} \right] \\
TP + FN = (1.96)^2 \times \left[ \frac{0.83 (1 - 0.83)}{0.1^2} \right] = 54.2
\]

\[ (0.1)^2 \]
\[ P = 0.22 \]
\[ N = \frac{TP + FN}{54.2} = 70 \]
\[ (1 - P) = 0.78 \]

So as to achieve a 95% CI of true sensitivity (true positive) with a allowable error between 0.05 and 0.1 and to achieve precision of 10% for specificity (true negative), it was decided to keep a sample size of 250 obese patients with tracheal intubation for the current study.

9.6 SELECTION OF STUDY PARTICIPANTS

9.6.1 INCLUSION CRITERIA

- Age greater than 18 years
- ASA class I, II, III
- Patients of both gender.
- Body mass index \( \geq 30 \) kg/m2
- Obstructive sleep apnoea.
- Patients undergoing surgery with tracheal intubation

9.6.2 EXCLUSION CRITERIA

- Age less than 18 years.
- ASA class greater than III
- Patients undergoing general anaesthesia without tracheal intubation and under regional anaesthesia.
- Patients with upper airway pathology such as facial and maxillary fractures.
• Upper airway tumours or cervical spine injury.
• Obstetric patients.
• Patient refusal.

9.7 PILOT STUDY

• Number of days of pilot study: Three
• Location of study: Pre - Anaesthesia Clinic, Christian Medical College, Vellore
• Total number of patients assessed for preoperative purpose: 239
• Number of obese patients: 28 out of 239 patients (11 percent of general population)
• Number of patients underwent tracheal intubation among obese patients: 18 out of 28 patients.
• Number of patients with difficult intubation (IDS score greater than or equal to five) noted: 4 out of 18 patients (22 percent among obese patients who underwent tracheal intubation).

As per the pilot study mentioned above, eleven percent of patients seen in pre anaesthesia clinic were obese and difficult intubations were recorded for twenty two percent among obese patients. By looking at these numbers, the need and feasibility of our study was arrived.
9.8 DATA COLLECTION

Data collection was done in two steps.

1. Preoperative assessment

2. Intra operative assessment

1. **Preoperative assessment** consists of performa with emphasis on

A) Demography of patient

B) Body mass index

C) Airway assessment variables includes

1. Neck circumference (cm) – measured using a measuring tape and at the cricoid cartilage level.

2. Thyromental distance (cm) - measured using a measuring tape and is termed as the distance from thyroid notch to mentum with neck fully extended.

3. The ratio of neck circumference to thyromental distance. (NC/TM distance ratio)

4. Mallampati classification without phonation\textsuperscript{55, 61}

   Class 1 – soft palate, fauces, uvula and pillars visible

   Class 2 – soft palate, fauces, and uvula visible

   Class 3 – soft palate and base of uvula visible

   Class 4 – soft palate not visible
Intra operative assessment

Difficulty of intubation was assessed by anesthetist by filing up intubation difficulty score (validated IDS score)\(^8\) after intubation. Intubation difficulty score consist of seven variables from N1 to N7. The sum of N1 to N7 gives total IDS score. Any score of greater than or equal to five was considered to be difficult intubation and score less than five considered to be easy intubation.
PROTOCOLS FOR INTUBATION

- ASA standard monitors, additional monitors as per need for patient or by jurisdiction of anaesthetist allotted for the case.

- Intravenous access.

- Pre oxygenation for three minutes with 100% oxygen.

- Head positioning: standard position. Pillow under the head with neck extended.

- Any position change other than standard position will get additional points. (For example, Ramping/stacking/change in standard position).

- The laryngoscope (Macintosh Blade size 3 for a woman, size 4 for a man) is introduced in to the right hand side of the mouth. The tongue is swept to left and the tip of the blade is advanced until a fold of skin/cartilage is visualized at twelve o’ clock.

- Any extra technique other than standard direct laryngoscopy will get additional points (For example, use of Bougie / Glide scope / Fibre optic intubation / Video assisted intubation.)

- First attempt of intubation to be done by anesthetist of at least three years of experience in anaesthesia and airway management.
GUIDELINES TO FILL UP INTUBATION DIFFICULTY SCORE SHEET

| N1   | N1 represents the number of additional intubation attempts |
|------|----------------------------------------------------------|
|      | • **Score zero for first attempt**                       |
|      | • **One point each for supplementary attempts.**         |

| N2   | N2 represents the number of additional persons directly attempting intubation (Not assisting intubation) |
|------|------------------------------------------------------------------------------------------------------|
|      | • **Score zero for one operator**                                                                    |
|      | • **One point each for supplementary operators.**                                                    |

| N3   | N3 represents number of alternative techniques used.                                                  |
|------|------------------------------------------------------------------------------------------------------|
|      | • **Score zero for standard technique**                                                               |
|      | • **One point each for alternate techniques**                                                         |
|      | ✓ Standard technique means pillow under the head and Macintosh size 3 for woman and size 4 for men.  |
|      | ✓ Alternative technique includes                                                                    |
|      |   1. Positioning of patient (Ramping/Stacking)                                                      |
|      |   2. Change of materials (Blade, ET tube, Addition of stylette, Bougie)                              |
|      |   3. Change in approach (Nasotracheal/orotracheal)                                                  |
|      |   4. Use of special instruments (Fibre optic, Glidescope, Video assisted, intubation through a laryngeal mask) |

| N4   | N4 represents the laryngoscopic view as defined by Cormack and Lehane                                 |

| N5   | N5 represents the lifting force applied during laryngoscopy                                           |
|------|-------------------------------------------------------------------------------------------------------|
|      | • **N5 = zero if little effort is necessary**                                                        |
|      | • **N5= one if subjectively increased lifting force is necessary.** (This notion is based on the operators impression that an abnormal amount of force was used compared with routine practice) |

| N6   | N6 represents the need to apply external laryngeal pressure for optimized glottis exposure           |

| N7   | N7 represents the position of vocal cords at intubation                                               |
|------|-------------------------------------------------------------------------------------------------------|
|      | • **N7= zero if abducted or not visible**                                                              |
|      | • **N7 = one if adducted (impediment to tube passage)**                                                  |
9.9 DATA MANAGEMENT AND STATISTICAL METHODS

All the study related records were kept in the sole custody of the principal investigator. Completed consent forms and questionnaires were locked in cupboards. All digital data were remained in password-protected computer file or tablet PCs. To further protect the identity of the participants, each person participating in a study was assigned a subject code number at the top of consent form, and was used whenever possible instead of that person’s name. This code number was used in the request to anesthetist who was intubating the patient. This way the principal investigators were unaware of the patient details.

Statistical methods

The study obese populations were divided into easy intubation group (IDS score < 5) and difficult intubation group (IDS score ≥ 5). The study variables were expressed as mean (standard deviation). The differences between both sexes were analyzed using Chi square test and differences between the difficult intubation and easy intubation groups was analyzed using a univariate binary logistic regression model to find out the significant risk factors for intubation difficulty.

The different variables compared were the following: age, height, weight, gender, experience of the anaesthetist, previous h/o difficult intubation, body mass index, Mallampati score, NC, TMD and NC/TM distance ratio. In the second step, in order to find out independent risk factors of intubation difficulty,
all the significant variables from the previous step were analyzed using binary multivariate logistic regression (forward-Wald model)

Receiver operating characteristic (ROC) curve were used to identify the diagnostic performance of the significant risk factors. After identifying the adequate cut-off points by selecting the maximum specificity while sensitivity ≥ 80%, the continuous variables will be transformed into binary variables to compare the accuracy of the tests. A value of P < 0.05 was considered to be as significant.

DATA ANALYSIS ACCORDING TO OBJECTIVES OF THE STUDY

1. Primary objective - To assess the correlation between the NC/TM distance ratio and validated intubation difficulty score.

2. Secondary objectives- To compare neck circumference / thyromental distance ratio with Mallampati score and neck circumference as reliable tests for predicting difficult intubation.

Analysis of primary objective

The study population as per sample size was divided into easy intubation group (IDS score < 5) and difficult intubation (IDS score ≥ 5) groups. Entered variables of all patients into both arms as
- Body mass index
- Thyromental distance (TMD)
- Neck circumference (NC)
- NC/TM distance ratio
- Mallampati score.

The above measured variables were expressed as mean (standard deviation). Binary univariate logistic regression analysis of above variables to find out significant variables and non significant variables affecting outcome. (outcome here was difficult intubation)

Binary multivariate logistic regression analysis of significant variables of univariate analysis in each patient group to find independent risk factors for intubation difficulty. This test was done to determine the power of the screening test which in dependably influences intubation difficulty. Receiver operating characteristic curve (ROC curve) analysis of each significant variable was done.

Calculation of Sensitivity / Specificity / Positive likelihood ratio / Negative likelihood ratio / Positive predictive value (PPV) / Negative predictive value (NPV) of neck circumference, thromental distance, NC/TM distance ratio and Mallampati score for predicting difficult intubation among obese patients were done. Following were details.
| VARIABLES | TOTAL NO OF OBESE PATIENTS | EASY INTUBATION GROUP (IDS LESS THAN 5) | DIFFICULT INTUBATION GROUP (IDS GREATER THAN OR EQUAL TO 5) |
|-----------|--------------------------|----------------------------------------|-------------------------------------------------|
|           | N= 250                   | N=198                                  | N= 52                                           |

- Calculation of sensitivity and specificity of NC/TM distance ratio

\[
\begin{array}{|c|c|}
\hline
\text{IDS} \geq 5 & \text{IDS} < 5 \\
\hline
\text{NC/TM} \geq 5 & a \quad \text{(True positive)} & b \quad \text{(False positive)} \\
\text{NC/TM} < 5 & c \quad \text{(False negative)} & d \quad \text{(True negative)} \\
\hline
\end{array}
\]

Sensitivity of NC/TM ratio = \( \frac{a}{a+c} \) (True positive rate)

Specificity of NC/TM ratio = \( \frac{d}{b+d} \) (True negative rate)

- Calculation of sensitivity and specificity of Mallampati score

\[
\begin{array}{|c|c|}
\hline
\text{IDS} \geq 5 & \text{IDS} < 5 \\
\hline
\text{MP SCORE} >2 & a \quad \text{(True positive)} & b \quad \text{(False positive)} \\
\text{MP SCORE} \leq 2 & c \quad \text{(False negative)} & d \quad \text{(True negative)} \\
\hline
\end{array}
\]

Sensitivity of MP score = \( \frac{a}{a+c} \) (True positive rate)
Specificity of MP score = $d/b+d$ (True negative rate)

- OTHER CALCULATIONS

Positive likelihood ratio = sensitivity/ (1 - specificity)

Negative likelihood ratio = (1-sensitivity)/specificity

Positive predictive value (PPV) = $a/a+b$

Negative predictive value (NPV) = $d/c+d$

- DEFINITIONS OF ABOVE CALCULATIONS WITH RESPECT TO IDS SCORE AND NC/TM DISTANCE RATIO

TRUE POSITIVE = A difficult intubation that had been predicted to be difficult.

FALSE POSITIVE = An easy intubation that had been predicted to be difficult.

TRUE NEGATIVE = An easy intubation that had been predicted to be easy.

FALSE NEGATIVE = A difficult intubation that had been predicted to be easy.

SENSITIVITY = (True positive rate) = ($a /a+c$)

Probability that NC/TM ratio $\geq 5$ when IDS score $\geq 5$ is present

OR

Percentage of correctly predicted difficult intubations as a proportion of all intubations that were truly difficult, i.e.: True positives / (true positives + false negatives).
SPECIFICITY  = (True negative rate) = (d /b+d)

Probability that NC/TM ratio < 5 when IDS score < 5 is present.

OR
Percentage of correctly predicted easy intubations as a proportion of all intubations that were truly easy, i.e.: True negatives / (true negatives + false positives)

POSITIVE LIKELIHOOD RATIO

The ratio between the probability of NC/TM ratio ≥5 when IDS score ≥ 5 is present (true positive rate) and probability of NC/TM ratio ≥5 when IDS score < 5 is present (false positive rate)

= True positive rate / False positive rate = Sensitivity / (1-Specificity)

NEGATIVE LIKELIHOOD RATIO

The ratio between the probabilities of NC/TM ratio < 5 when IDS score ≥ 5 is present. (False negative rate) and probability of NC/TM ratio < 5 when IDS score < 5 is present. (True negative rate)

= False negative rate / True negative rate = (1-Sensitivity)/ Specificity.

POSITIVE PREDICTIVE VALUE (PPV) = (a / (a+b)

Probability that IDS score ≥ 5 when NC/TM ratio ≥5 is present.

OR

Percentage of correctly predicted difficult intubations as a proportion of all predicted difficult intubations, i.e.: True positives / (true positives + false positives)
NEGATIVE PREDICTIVE VALUE (NPV) = \( \frac{d}{c+d} \)

Probability that IDS score < 5 when NC/TM ratio < 5 is present.

OR

Percentage of correctly predicted easy intubations as a proportion of all predicted easy intubations,

i.e.: True negatives / (true negatives + false negatives)

**Analysis of secondary objective**

Classified IDS scores into three categories for the purpose of calculation of incidence of difficult intubation.

- Easy intubation- zero score

- Slight difficult intubation - score between zero and five.

- Moderate to major difficult intubation –score greater than or equal to five.

**9.10 ETHICAL CONSIDERATION**

There was no potential risks/harm to the patients in our study since it was a cross sectional observational study with noninvasive techniques. The study involved preoperative detection of difficulty in proving general anaesthesia in obese population using a simple tool which did not have any harmful effect on the subject.
10. RESULTS

A total of 328 obese patients were assessed for our study between September 2014 and March 2015 and among them, 250 patients who underwent endotracheal intubation were recruited for the study after obtaining informed consent. The patients excluded were those who underwent only regional anaesthesia, those who had regional blocks alone, those who had surgery using laryngeal mask airway and not willing to participate for the study. The SPSS software (version 16.0) was used to analyze the data. A total of 250 obese patients who underwent tracheal intubation were divided into two arms, namely easy intubation group (IDS score less than 5) and difficult intubation group (IDS score greater than or equal to 5). There were 52 and 198 patients among easy and difficult intubation groups respectively. The following are the results.

10.1 DEMOGRAPHIC DATA

The baseline data comparing age, gender, weight, height, ASA status, BMI, between easy intubation group and difficult intubation group are tabulated below. Here easy intubation group (IDS<5) is referred as group 1 and difficult intubation group (IDS≥5) as group 2.
| Factors                          | Total obese patients n = 250 | Group 1 (Easy intubation) n= 198 | Group 2 (Difficult intubation) n = 52 |
|---------------------------------|------------------------------|----------------------------------|--------------------------------------|
| Male                            | 98 (39.2%)                   | 77 (38.9%)                       | 21 (40.4%)                          |
| Female                          | 152 (60.8%)                  | 121 (61.1%)                      | 31 (59.6%)                          |
| Age (mean ± standard deviation) | 45.62 years (±13.23)         | 44.33 years (±13.19)             | 50.52 (±12.27)                      |
| Weight (mean ± standard deviation) | 80.54 kg (±10.90)            | 79.90 kg (±10.76)                | 82.99 kg (±11.18)                   |
| Height (mean ± standard deviation) | 157.23 cm (±9.63)           | 157.03 cm (±9.51)                | 157.98 cm (±10.1)                   |
| BMI (mean ± standard deviation)  | 32.55 kg/m² (±3.21)          | 32.37 kg/m² (±3.05)              | 33.28 kg/m² (±3.68)                 |
| ASA 1                           | 95 (38%)                     | 81 (40.9%)                       | 14 (26.9%)                          |
| ASA 2 and 3                     | 155 (62%)                    | 117 (59.1%)                      | 38 (73.1%)                          |

Table 11: Demographic characteristics of the study population.
38.9% of patients in Group 1 (easy intubation group) were males and 40.4% of patients in Group 2 (difficult intubation group) were males. The mean age of patients in Group 1 was 44.33 years and Group 2 was 50.52 years respectively. The mean weight in Group 1 was 79.90 kg and Group 2 was 82.99 kg. The mean height of patients in Group 1 was 157.03 cm and Group 2 was 157.98 cm. For Group 1 and 2, mean BMI was of 32.37 kg/m² and 33.28 kg/m² respectively. 40.9% patients in Group 1 belonged to ASA grade 1 while the rest were categorized as ASA 2 or 3. 26.9% of patients in Group 2 belonged to ASA grade 1 and the rest belonged to ASA class 2 or 3.

**Comorbidities:** Among the ASA 2 and 3 patients, the specific comorbidities are elaborated in the pie chart below. The category “others” includes cerebrovascular accident, bronchial asthma, intracranial mass, chronic obstructive pulmonary disease.
COMORBIDITIES AMONG OBESE PATIENTS

HTN: 53.2%
DM: 26.3%
THYROID: 26.3%
OTHERS: 17.5%
IHD: 10.3%
10.2 RESULTS OF PRIMARY OBJECTIVE

The primary objective was to assess the importance of NC/TM distance ratio to predict intubation difficulty among obese patients. A binary univariate logistic regression model was done to determine the significant risk factors among easy and difficult intubation groups. (This test is used to differentiate between significant variables and non significant variables affecting outcome).

The different variables compared were the following: age, height, weight, gender, BMI, ASA classification, and experience of the anaesthetist, Mallampati score, neck circumference, thyromental distance and NC/TMD ratio. Among these variables, age greater than 60, neck circumference, thyromental distance, Mallampati score and NC/TMD ratio were the only statistically significant variables that were associated with a difficult intubation (IDS $\geq 5$) as shown in table 12. The significance of NC/TM ratio to predict difficult intubation is highlighted in table 12 and 13 respectively.
| Variables                              | Odds ratio | 95.0 % C.I of odds ratio | p value |
|----------------------------------------|------------|--------------------------|---------|
|                                        |            | Lower | Upper |            |           |
| Age greater than sixty                 | 0.964      | 0.941 | 0.948 | 0.03*     |
| Weight                                 | 0.975      | 0.940 | 1.002 | 0.072     |
| Height                                 | 0.990      | 0.959 | 1.022 | 0.526     |
| Body mass index                        | 0.925      | 0.849 | 1.008 | 0.075     |
| Gender                                 | 1.065      | 0.571 | 1.985 | 0.844     |
| ASA classification                     | 0.532      | 0.271 | 1.045 | 0.067     |
| Experience of the anaesthetist         | 0.870      | 0.581 | 1.304 | 0.501     |
| NC ≥ 41 cm in males and ≥ 35 cm in females | 4.157   | 2.089 | 8.273 | 0.001*    |
| TMD ≤ 7 cm in males and ≤ 6.5 cm in females | 9.131  | 3.862 | 21.588 | 0.001*    |
| MP score III or IV                     | 3.396      | 1.797 | 6.418 | 0.02*     |
| **NC/TMD ≥5**                          | **28.095** | **12.778** | **61.775** | **< 0.001** |

Table 12: Binary univariate logistic regression analysis of factors related to difficult intubation (IDS ≥ 5).  * Significant correlation as P value ≤ 0.05.
For more accurate results, and to find out the independent risk factors for intubation difficulty in each group, we performed binary multivariate logistic regression analysis. This test is concerned for detection of the power of each risk factor (age greater than sixty, neck circumference, thyromental distance, Mallampati score, NC/TMD ratio) to independently influence the outcome (here the outcome was the intubation difficulty) as shown in table below,

| Variable | $\beta$ | SD  | Odds ratio | 95.0% C.I of Odds ratio | $P$ value |
|----------|---------|-----|------------|------------------------|-----------|
| NC ≥ 41 cm in males and ≥ 35 cm in females | 0.924 | 0.426 | 2.519 | 1.094, 5.802 | 0.030* |
| NC/TMD ≥ 5 | 3.165 | 0.408 | 23.680 | 10.638, 52.713 | < 0.001** |
| Constant | - 5.013 | 0.824 | 0.007 | - | < 0.001 |

Table 13: Binary multivariate logistic regression analysis to determine the independent risk factors of intubation difficulty (forward-Wald analysis)

* Significant correlation as $P$ value $\leq 0.05$. ** Highly significant correlation as $P$ value $\leq 0.01$. 
10.3 RESULTS OF SECONDARY OBJECTIVES

The first secondary objective was to compare NC/TMD ratio with other preoperative predictors of DI. The following table shows sensitivity/ specificity/ NPV/PPV and ROC curve analysis of various tests.

| Test                          | Sensitivity | Specificity | PPV  | NPV  | Area under curve of ROC |
|-------------------------------|-------------|-------------|------|------|-------------------------|
| NC ≥ 41 cm in males and ≥ 35 cm in females | 75.0        | 58.1        | 32.0 | 89.8 | 0.649                   |
| TMD ≤ 7 cm in males and ≤ 6.5 cm in females | 32.7        | 94.9        | 63.0 | 84.3 | 0.784                   |
| MP score III or IV            | 63.5        | 66.2        | 33.0 | 87.3 | 0.648                   |
| Weight                        | 75          | 15.2        | 18.8 | 69.8 | _                       |
| NC/TMD ratio ≥ 5              | 76.9        | 89.4        | 65.6 | 93.7 | 0.850                   |

Table 14: Comparison of the predictors of DI (Values expressed as percentage)

The following are the ROC Curve for various predictors of DI
The second secondary objective was to find out incidence of intubation difficulty among obese population. The difficulty of intubation was determined using IDS scale. A score of zero indicates easy intubation, score between zero to five denotes slight difficulty, score greater than or equal to five shows moderate to major difficulty and score infinity shows impossible intubation. The following pie diagram illustrates the incidence of DI among obese patients.

This pie chart clearly states that the incidence of mild to major difficulty in intubation among the obese patients is around 92%. Further categorizing the intensity of difficulty of intubation, 20.8% of the patients had the major difficult intubation whereas rest are slightly difficult.
10.4 SUBANALYSIS

The following are the sub analysis of the study which is illustrated in the table.

| VARIABLES | TOTAL % of OBSESE PATIENTS | EASY INTUBATION GROUP (%) | DIFFICULT INTUBATION GROUP (%) |
|------------|-----------------------------|----------------------------|-------------------------------|
| Experience of the anaesthetist who performed intubation | | | |
| 3-5 years | 54.0 | 57.4 | 41.2 |
| 5-9 years | 30.0 | 24.9 | 49.0 |
| > 9 years | 16.0 | 17.8 | 9.8 |
| Intubation done by first attempt | | | |
| Yes | 91.2 | 97.0 | 69.2 |
| No | 8.8 | 3.0 | 30.8 |
| Intubation done by first operator | | | |
| Yes | 92.0 | 95.5 | 78.8 |
| No | 8.0 | 4.5 | 21.2 |
| Alternative techniques used | | | |
| 1 | 37.6 | 38.4 | 34.6 |
| 2-3 | 30.4 | 23.2 | 57.7 |
| > 3 | 1.2 | 0.5 | 3.8 |
| Not used | 30.8 | 37.9 | 3.8 |
| C and L grade | | | |
| Grade 1 and 2 | 86.4 | 98.0 | 42.3 |
| Grade 3 and 4 | 13.6 | 2.0 | 57.7 |
| Use of lifting Force | | | |
| Yes | 30.4 | 18.2 | 76.9 |
| No | 69.6 | 81.8 | 23.1 |
| Use of external laryngeal pressure | | | |
| Yes | 56.4 | 46.0 | 96.2 |
| No | 43.6 | 54.0 | 3.8 |

Table 15: Sub analysis.
The following pie diagram depicts various techniques/ instruments used for assisting intubation among obese patients. The term “others” denoted use of fibreoptic intubation, Macoy, small size endotracheal tube and C-MAC.
11. DISCUSSION

This study was done among obese patients to identify the significance of NC/TMD ratio as a difficult intubation predictor, its comparison with standard DI predictors and also to calculate incidence of difficult intubation among them. Following are the discussion of the analyzed data.

A) DEMOGRAPHIC DATA

Analysis of demographic data revealed that difficult intubation was more common among females (59.6 %). Most of the patients of difficult intubation group belongs to ASA classification 2 and 3 (73.1 %). The co-morbid condition common among obese patients were in order of essential hypertension, diabetes mellitus and hypothyroidism. More than fifty percent of obese patients were diagnosed to have essential hypertension. The significance of the previous history of difficult intubation was not able to assess since, it was not well documented previously or patient was unaware of it.
B) PRIMARY OBJECTIVE.

Binary univariate logistic regression analysis of predictors of DI revealed age greater than sixty; increased neck circumference, decreased thyromental distance, Mallampati score and NC/TMD ratio ≥ 5 were associated with difficult intubation. (Refer table 12). Following that multivariate logistic regression analysis found only neck circumference and NC/TMD ratio as independent risk factors of DI. (Refer table 13) As per literature review four studies have been done to identify the importance of NC/TMD ratio namely Kim et al.,\textsuperscript{18} Abdel et al.,\textsuperscript{19} Castro et al.,\textsuperscript{15} Anahita et al.,\textsuperscript{49} The following table provides statistical importance of NC/TMD ratio by comparing above mentioned studies and present study of the author.

|                  | Current study | Kim et al\textsuperscript{18} | Abdel et al\textsuperscript{49} | Castro et al\textsuperscript{15} | Anahita et al\textsuperscript{49} |
|------------------|---------------|-------------------------------|---------------------------------|-------------------------------|---------------------------------|
| Year             | 2015          | 2011                          | 2014                            | 2013                          | 2014                            |
| Sample size      | 250           | 123                           | 50                              | 482                           | 657                             |
| Study population | Obese patients| Obese patients                | Obese with OSA                  | Obese patients               | Obstetric patients              |
| Sensitivity (%)  | 76.9          | 88.2                          | 100.0                           | High                          | 71.7                            |
| Specificity (%)  | 89.4          | 83.0                          | 82.0                            | High                          | 70.0                            |
| PPV(%)   | 65.6 | 45.5 | _   | _   | 17.0 |
|----------|------|------|-----|-----|------|
| NPV (%)  | 93.7 | 97.8 | _   | _   | 97.0 |
| **Area under ROC curve** | **0.850** | 0.865 | 0.95 | _   | 0.685 |
| **p value** | < **0.001** | < 0.001 | 0.004 | <0.001 | <0.001 |
| **Odds ratio** | **23.680** | 5.942 | 26.73 | _   | 5.967 |

Table 16: Comparison of present study and other studies with reference to NC/TMD ratio.

Our study was done on 250 obese patients while the other studies were done on less number of patients except Castro et al. All studies found out NC/TMD ratio as statistically significant ($p \leq 0.05$). Our study also found NC/TMD ratio ($p$ value-$<0.001$, [odd ratio 23.680 (10.63-52.71)] as an independent risk factor of DI which was correlating with other studies. However our study recorded lower value of sensitivity as compared to Kim et al and Abdel et al and higher value as compared to Anahita et al (study not done on obese patients). The PPV of our study was higher as compared to all other studies. Specificity/AUC/NPV and other values were comparable with other studies.
C) SECONDARY OBJECTIVES

The most commonly and routinely used preoperative difficult intubation predictors in our preanaesthesia clinic are in order of modified Mallampati test, thyromental distance followed by neck circumference. However as per literature review mentioned earlier, none of the above parameters assured all features of a screening test namely high sensitivity, specificity and PPV. Analysis of table 13 showed only neck circumference (p=0.03) and NC/TMD ratio (p= <0.001) as independent risk factors of difficult intubation. However NC/TMD ratio showed better specificity (58.1 vs 89.4) / PPV (32.0 vs 65.6) /AUC (0.649 vs 0.850) as compared to neck circumference alone. Age greater than sixty was associated with difficult intubation which could be probably as these patients had co morbidities like diabetes mellitus and limited neck movement which itself contribute to difficult intubation. The other parameters like Mallampati score, thyromental distance were associated with difficult intubation, but were not independent risk factors of DI. So, our study strongly recommends measurement of neck circumference and NC/TMD ratio as a difficult airway predictor since these two parameters can independently predict difficult intubation among obese patient.

With respect to increased neck circumference as a preoperative predictor of difficult intubation, our study correlated with findings of Gonzalez et al., Ezri et al.,7 and Brodsky et al.,22 However our study recorded low sensitivity for neck circumference as compared to Gonzalez et al., (92% vs 75%).
As per literature review, incidence of difficult intubation varied from 11 % to 22 %. There are not many Indian/Asian studies published about this. In our study all the intubations were done by anaesthetist who had minimum three years of clinical experience. Our study recorded incidence of DI among obese population as 20.8%. The following table shows comparison of various studies with present study with relevance to incidence of DI among obese patients.

| Study done among obese patients | Incidence of difficult intubation among obese patients (Expressed as percentage) |
|---------------------------------|---------------------------------------------------------------------------------|
| **Current study**               | **20.8**                                                                        |
| Shailaga et al$^{17}$           | 11.0                                                                             |
| Kim et al$^{18}$                | 13.8                                                                             |
| Gonzalez et al$^{20}$           | 14.3                                                                             |
| Juvin et al$^{13}$              | 15.5                                                                             |
| Shiga et al$^{12}$              | 15.8                                                                             |
| Rita et al$^{70}$               | 17.0                                                                             |
| Fotopoulou et al$^{60}$         | 20.0                                                                             |
| Voyagis et al$^{14}$            | 20.2                                                                             |
| Castro et al$^{15}$             | 20.75                                                                            |

Table 17: Incidence of difficult intubation among obese patients.
D) SUBANALYSIS

All the obese patients were intubated by anaesthetists who had more than three years of clinical experience in anaesthesiology. As enumerated in table no 15, the clinical experience of the anaesthetists seems comparable between the two groups and around 50 % of anaesthetists who intubated study patients had experience between 3- 5 years. The most commonly used material/equipment to aid intubation among obese patients was in order of stylette, ramping and glidescope respectively. Thirty percent of obese patients were intubated with the help of stacking/ramping. The limited use of ramping technique among obese patients was noted in this study which needs to be emphasized among the anaesthetists.

The use of indirect laryngoscopes among obese patients was as high as 18 percent and may be due easily availability of the equipments in our hospital. Among easy intubation group, most of the intubations were done by first attempt (97 %) and first operator (96.0 %) respectively. More operators and attempts were needed to intubate difficult intubation group. The Cormack and Lehane grading were 3 and 4 in 57.7 % of patients among difficult intubation group and 2 % among easy intubation group. Most of the patients required considerable lifting force and external laryngeal pressure for optimal visualization of vocal cords among difficult intubation group.
CONCLUSION

- Binary univariate logistic regression analysis of predictors of difficult intubation among obese patients revealed age greater than sixty, increased neck circumference, decreased thyromental distance, modified Mallampati test and NC/TMD ratio were associated with difficult intubation. ($p \leq 0.05$)

- Binary multivariate logistic regression analysis found only increased neck circumference ($p=0.030$) and NC/TMD ratio ($p <0.001$) as independent risk factors of difficult intubation.

- NC/TMD ratio showed better specificity (89.4 vs 58.1) / PPV (65.6 vs 32.0) / AUC (0.850 vs 0.649) as compared to neck circumference alone.

- With respect to NC/TMD ratio, our study recorded lower value of sensitivity as compared to Kim et al and Abdel et al and higher value as compared to Anahita et al. The PPV of our study was higher as compared to all other studies. Specificity/AUC of ROC /NPV and other values were comparable with other studies.

- Among obese patients, NC/TMD ratio can be considered as a better preoperative predictor of difficult intubation.

- The study recommends measurement of neck circumference and NC/TMD ratio as routine preoperative assessment of airway among obese patients.
• The incidence of intubation difficulty among obese patients was as high as 20.8%.

• The most commonly used material/equipment to aid intubation among obese patients was in order of stylette, ramping/stacking and Glidescope respectively.

• More operators and attempts were required to intubate difficult intubation group.

• The Cormack and Lehane grading were 3 and 4 in 57.7% of patients among difficult intubation group and 2% among easy intubation group.

• Most of the patients needed considerable lifting force during laryngoscopy and external laryngeal pressure for optimal visualization of vocal cords among difficult intubation group.
13. LIMITATIONS AND EFFORT DONE TO OVERCOME IT

1. IDS score may vary with experience of anaesthetist. (IDS score could have been increased if patient was intubated by anaesthetist who had less experience in airway management)

2. Subjective variability in Mallampati scoring system, measurement of neck circumference and thyromental distance

3. All the cases were not intubated by the senior anaesthetist of the operation list.

4. Use of indirect laryngoscopy for intubation eg: use of Glidescope, Fibreoptic scopy etc

Efforts done to overcome first bias

1. Intubation done by anaesthetist who had more than three years of experience

2. IDS scoring done by the anaesthetist without informing the purpose of the study. (Not completely blinded study since we were not able to completely hide the purpose of the study to the anaesthetist who performed intubation)

Effort to overcome second bias

Preoperative performa (including Mallampati score and measurement of neck circumference and thyromental distance) were collected by principal investigator or first co-investigator only.
Effort to overcome third bias

    Investigator confirmed that all patients were intubated by anaesthetist
who had at least three years of experience.

Effort to overcome fourth bias

    Use of IDS score for indirect scopy is not validated, but can be used as
per review of literature.50, 51, 53, 54.
Difficult intubation can increase morbidity and mortality related to anaesthesia and is often associated with obesity. One of the methods to achieve successful airway management during surgery is to have a preoperative anaesthetic evaluation with emphasis on difficult airway predictors. Using magnetic resonance imaging (MRI), Horner proposed that among obese patients with OSA’S, more fat was present in areas surrounding the collapsible segments of the pharynx. So distribution of fat in anterior neck may give a better suggestion of intubation difficulty than measuring circumference of neck alone.

We assumed that obese patients have a large amount of neck soft tissue that can be presented by the ratio of neck circumference to thyromental distance. Recently a new index was proposed for evaluation of difficult intubation in obese patients - the neck circumference to thyromental distance ratio. It was proposed that a NC/TM distance ratio $\geq$ five was a better method than other established indices in western population. In this study we analyzed the ability of NC/TM distance ratio greater than or equal to five to predict difficult intubation in obese Indian population. We measured the correlation between difficult intubation determined by Intubation Difficulty Scale and NC/TM ratio and its importance in predicting difficult intubation.
The methodology involved explaining the patient through an information leaflet, obtained informed consent and recruited them into study. Then a preoperative interview was conducted based on a performa covering demography and airway assessment. Intraoperative assessment of intubation was done using validated IDS scale by the anaesthetist who intubated the case. Following that univariate and multivariate analysis were done and sensitivity and specificity of each variable was calculated.

The study concluded with the following results as, NC/TMD ratio can be considered as better bedside screening tool for predicting difficult airway among obese patients in view of following reasons (I) Present study on obese Indian population showed NC/TMD ratio as independent risk factor of difficult intubation which correlated with studies done on western population. (II) It provided better sensitivity / specificity/ PPV and AUC of ROC compared to other predictors. (III) Bed side screening tool. (IV) Cheap, noninvasive, less time consuming. (V) Anesthetist and patient friendly. The study also recommend increased neck circumference as a guide to identify difficult intubation and also not promote using of modified Mallampati test and decreased thyromental distance as a stand alone predictor of intubation difficulty among obese patients.
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16. APPENDIX

16.1 LIST OF ABBREVIATIONS USED

ASA: American Society of Anesthesiologists
AUC: Area under curve
BMI: Body mass index
C & L Grading: Cormack and Lehane Grading
DI: Difficult intubation
Fig. : Figure
FN: False Negative
FP: False Positive
HT: Height
HT/TMD: Height / Thyromental distance
IDS: Intubation difficulty score
II: Inter incisor distance
MHD: Mandibulohyoid distance
MMT: Modified Mallampati Test
MP: Mallampati
N: Sample size
NC/TMD: Neck circumference / Thyromental distance
NC/SMD: Neck circumference / Sternomental distance

NPV: Negative Predictive Value

OSA: Obstructive sleep apnoea

OD: Odds Ratio

P: Prevalence

PPV: Positive Predictive Value

ROC: Receiver operating characteristic

RHTMD: Ratio of Patients Height to Thyromental Distance

RR: Relative Risk

SD: Standard Deviation

SN: Sensitivity

SMD: Sternomental Distance

SP: Specificity

TMD: Thyromental Distance

TN: True Negative

TP: True Positive

ULBT: Upper lip bite test

VAS: Visual analogue scale

W: Accuracy

WT: Weight

Z: Confidence interval
16.2 LIST OF TABLES

Table 1: Laryngeal ligaments

Table 2: Classification of obesity according to body mass index

Table 3: Pathophysiological changes in obesity

Table 4: Accuracy of modified MP test, thyromental distance, neck extension in predicting difficulty with tracheal intubation as per Nasa V K et al.

Table 5: Tests for difficult intubation as per Cattano et al

Table 6: Comparison of modified MP test and thyromental test as difficult intubation predictor (Noorizad et al)

Table 7: Tests for difficult intubation (Kim et al)

Table 8: Importance of NC/TM distance ratio as per Anahita et al.

Table 9: Use of IDS score for indirect laryngoscopy

Table 10: Summary of review of literature

Table 11: Demographic characteristics of the study population

Table 12: Binary univariate logistic regression analysis of factors related to difficult intubation

Table 13: Binary multivariate logistic regression analysis performed in each patient group to determine the independent risk factors of DI (forward-Wald analysis)

Table 14: Comparison of the predictors of DI (Values expressed as percentage)
Table 15: Sub analysis

Table 16: Comparison of present study and other studies with reference to NC/TMD ratio

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16.3 LIST OF FIGURES

Fig: 1: Anterior view of larynx

Fig: 2: Lateral and posterior view of larynx

Fig: 3: Laryngeal inlet

Fig: 4: Laryngeal cavity

Fig: 5: Sniffing position for intubation

Fig: 6: Modified Mallampati score

Fig: 7: Measurement of thyromental distance and neck circumference.

Fig: 8: Cormack and Lehane grading of laryngoscopic view.

16.4 CLINICAL RESEARCH FORMS

Preoperative assessment of obese patients.

Intubation difficulty score sheet

Informed consent

Patient information sheet
# PREOPERATIVE ASSESSMENT OF OBESE PATIENT

| NAME | |
|------|---|
| HOSPITAL NUMBER /STUDY CODE NUMBER | |
| AGE | |
| GENDER (MALE=M, FEMALE=F) | |
| ASA CLASSIFICATION (ONE=1/TWO=2/THREE=3/FOUR=4/FIVE=5) | |
| DIAGNOSIS | |
| SURGERY PROPOSED | |
| TYPE OF SURGERY (ELECTIVE=1, EMERGENCY=2) | |
| COMORBIDITIES (DM=1/HTN=2/IHD=3/THYROID=4) | |
| PREVIOUS H/O DIFFICULT INTUBATION YES=Y NO=N | |
| HEIGHT (CM) | |
| WEIGHT (KG) | |
| BODY MASS INDEX (KG/M2) | |
| NECK CIRCUMFERENCE (CM) (Measured at the level of cricoids cartilage) | |
| THYROMENTAL DISTANCE (CM) (The distance between thyroid cartilage and mentum with neck fully extended) | |
| NECK CIRCUMFERENCE/THYROMENTAL DISTANCE RATIO | |
| MODIFIED MALLAMPATI SCORE WITHOUT PHONATION | |

Name of investigator:

Date and time:

Signature: 

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# INTUBATION DIFFICULTY SCALE SCORE

| SL.NO | FACTORS                                                                                           | SCORE |
|-------|--------------------------------------------------------------------------------------------------|-------|
| N1    | NUMBER OF ADDITIONAL INTUBATION ATTEMPTS                                                        |       |
| N2    | NUMBER OF ADDITIONAL OPERATORS                                                                   |       |
| N3    | NUMBER OF ALTERNATIVE INTUBATION TECHNIQUES USED                                                  |       |
| N4    | LARYNGOSCOPIC VIEW AS DEFINED BY CORMACK AND LEHANE                                               |       |
|       | GRADE 1: N4 =0.                                                                                    |       |
|       | GRADE 2: N4 =1.                                                                                    |       |
|       | GRADE 3: N4 =2.                                                                                    |       |
|       | GRADE 4, N4 =3                                                                                    |       |
| N5    | LIFTING FORCE APPLIED DURING LARYNGOSCOPE.                                                       |       |
|       | N5 =0 IF INCONSIDERABLE.                                                                          |       |
|       | N5 =1 IF CONSIDERABLE                                                                             |       |
| N6    | NEEDED TO APPLY EXTERNAL LARYNGEAL PRESSURE FOR OPTIMIZED GLOTTIC EXPOSURE.                       |       |
|       | N6 =0 IF NO EXTERNAL PRESSURE OR ONLY THE SELLICK MANEUVER WAS APPLIED.                           |       |
|       | N6 =1 IF EXTERNAL LARYNGEAL PRESSURE WAS USED.                                                    |       |
| N7    | POSITION OF THE VOCAL CORDS AT INTUBATION.                                                       |       |
|       | N7 =0 IF ABDUCTED OR NOT VISIBLE.                                                                 |       |
|       | N7 =1 IF ADDUCTED                                                                                 |       |
| TOTAL | N1 TO N7                                                                                         |       |

Name of investigator:

Date and time:

Signature:

Reference: Adnet F, Borron S, Racine S, et al. The intubation difficulty scale (IDS): proposal and evaluation of a new score characterizing the complexity of endotracheal intubation. Anaesthesiology 1997; 87: 1290–7
INFORMED CONSENT

Study Title: THE IMPORTANCE OF NECK CIRCUMFERENCE TO THYROMENTAL DISTANCE RATIO (NC/TM DISTANCE RATIO) AS A PREDICTOR OF DIFFICULT INTUBATION IN OBESE PATIENTS COMING FOR ELECTIVE SURGERY UNDER GENERAL ANAESTHESIA – A PROSPECTIVE OBSERVATIONAL STUDY

Study Number: __________

Subject’s Initials: __________________

Subject’s Name: _________________________________________

Date of Birth / Age: ___________________________

(i) I confirm that I have read and understood the information sheet dated __________ for the above study and have had the opportunity to ask questions. [ ]

(ii) I understand that my participation in the study is voluntary and that I am free to withdraw at any time, without giving any reason, without my medical care or legal rights being affected. [ ]

(iii) I understand, the Ethics Committee and the regulatory authorities will not need my permission to look at my health records both in respect of the current study and any further research that may be conducted in relation to it, even if I withdraw from the trial. I agree to this access. However, I understand that my identity will not be revealed in any information released to third parties or published. [ ]

(iv) I agree not to restrict the use of any data or results that arise from this study provided such a use is only for scientific purpose(s). [ ]

(v) I agree to take part in the above study. [ ]

Signature (or Thumb impression) of the Subject/Legally Acceptable

Date: _____/_____/______

Signatory’s Name: _________________________________ Signature:

Or
INFORMED CONSENT

Representative: ______________________________

Date: _____/_____/_____

Signatory’s Name: ______________________________

Signature of the Investigator: ____________________

Date: _____/_____/_____

Study Investigator’s Name: _______________________

Signature or thumb impression of the Witness: __________________________

Date: _____/_____/_____

Name & Address of the Witness: ______________________________
NECK CIRCUMFERENCE / THYROMENTAL DISTANCE RATIO – PREDICTOR OF DIFFICULT INTUBATION

1) WHAT IS OBESITY?

Obesity is a medical condition in which excess body fat has accumulated to the extent that it may have a negative effect on health, leading to reduced life expectancy and/or increased health problems. People are considered obese when their body mass index (BMI), a measurement obtained by dividing a person's weight by the square of the person's height, exceeds 30 kg/m$^2$.

2) WHAT IS GENERAL ANAESTHESIA?

General anesthesia is a medically induced coma and loss of protective reflexes resulting from the administration of one or more general anesthetic agents. A variety of medications may be administered, with the overall aim of ensuring sleep, amnesia, analgesia, relaxation of skeletal muscles, and loss of control of reflexes of the autonomic nervous system.

3) WHAT IS ENDOTRACHEAL INTUBATION AND DIFFICULT INTUBATION?

Tracheal intubation, is the placement of a flexible plastic tube into the trachea (windpipe) to maintain an open airway or to serve as a conduit through which to administer certain drugs. An intubation is called difficult if a formally trained anesthesiologist needs more than 3 attempts or more than 10 min for a successful endotracheal intubation.

4) WHAT ARE THE CONSEQUENCES OF OBESITY?

- Coronary heart disease (Heart attack)
- Type 2 diabetes mellitus (High blood sugar level)
- Cancers (Endometrial, breast, and colon)
- Hypertension (High blood pressure)
- Dyslipidemia (for example, high total cholesterol or high levels of triglycerides)
- Stroke (Paralysis of body)
- Obstructive Sleep apnoea and respiratory problems
- Osteoarthritis (A degeneration of cartilage and its underlying bone within a joint)
1) WHAT IS THIS STUDY ABOUT?
Obese patients can have above mentioned consequences as well as experience difficulty in intubation (difficulty to provide general anesthesia) This study is about preoperative prediction of difficult intubation by measuring the ratio of neck circumference / distance between thyroid cartilage and chin thereby reducing incidence of difficulty in providing general anesthesia by taking extra precautions/ additional equipment to maintain airway. Neck circumference and thyromental distance are measured using a measuring tape as part of evaluation of airway preoperatively .These measurements are considered for assessing probability of intra operative difficult intubation..

2) WHAT IS NECK CIRCUMFERENCE/ THYROMENTAL DISTANCE? HOW IS IT MEASURED?
Neck circumference is measured using a measuring tape at the middle portion of neck and thyromental distance is measured as the distance from thyroid notch to chin when neck is fully extended.

3) WHAT ARE THE RISKS AND BENEFITS TO ME IF I TAKE PART?
There are no risks involved in this study. The benefits are it will detect difficulty in providing general anesthesia among obese patients preoperatively and will provide a new bedside screening test .

4) CAN I WITHDRAW FROM THE STUDY AFTER SIGNING CONSENT FORM?
You can always withdraw from the study at any point of time

5) WILL MY NAME AND PERSONAL DETAILS BE PUBLISHED/GIVEN TO A THIRD PARTY?
Your name and personal details will be kept confidential. There will not be a passage of your personal information to third party.
TAMIL CONSENT FORM

1. அயராலை தொடருந்து வேலைத் தொடர்புகள் மீண்டும் தேர்வுகளை முன்னேக்க வேண்டும். முன்னேக்கும் தொடர்புகள் மீண்டும் தேர்வுகளை முன்னேக்க வேண்டும்.

2. செயற்படுத்தப்பட்ட செய்யலுடன் அமர்ந்து வருவது வருவாய் வருவாய் வருவாய் வருவாய் வருவாய் வருவாய் வருவாய் வருவாய் வருவாய் வருவாய் வருவாய் வருவாய் வருவாய் வருவாய் வருவாய் வருவாய் வருவாய் வருவாய் வருவாய் வருவாய் வருவாய் வருவாய் வருவாய் வருவாய் வருவாய் வருவாய் வருவாய் வருவாய் வருவாய் வருவாய் வருவாய் வருவாய் வருவாய் வருவாய் வருவாய் வருவாய் வருவாய் வருவாய் வருவாய் வருவாய் 

3. அயராலை தொடருந்து வேலைத் தொடர்புகள் மீண்டும் தேர்வுகளை முன்னேக்க வேண்டும். முன்னேக்கும் தொடர்புகள் மீண்டும் தேர்வுகளை முன்னேக்க வேண்டும்.

முன்னேக்கும் தொடருந்து வேலைத் தொடர்புகள் மீண்டும் தேர்வுகளை முன்னேக்க வேண்டும்.

முன்னேக்கும் தொடருந்து வேலைத் தொடர்புகள் மீண்டும் தேர்வுகளை முன்னேக்க வேண்டும்.

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HINDI CONSENT FORM

अध्ययन श्रीकृत: "मां आपेक्षिक संबंधी के लिए अपने बालकों, नौकरों के प्रस्तुत सेविकों, और सिकंदर इद्रौलिन के स्वास्थ्यवेत्ता के रूप में दूसरे अनुपालन (केवल / दूसरे अनुपालन) वाह्य संबंधी, परिपूर्ण का कार्य - एक संबंधित अवलोकन अध्ययन" 

अद्यावधी संख्या: 
रोजरी के प्रभावकार: 
शेषी का नाम: 
अज्ञात की तिथि / आयु: 
(i) ही मे उपलब्धि अध्ययन को पढ़ा और समझा है। इसके लिए यह बाटलीस पृष्ठ पर सबकुछ का अवलोकन किया गया है। 
(ii) इस अध्ययन से केवल आपकी स्वास्थ्यवेत्ता स्वास्थ्यवेत्ता है और मे यह समझा हूँ कि, अपने विकल्प दैनिकण्य या प्रभावित किया आ सभी अन्य अवलोकन (किन्तु अवलोकन तथा, किसी भी अवलोकन तथा, किसी भी सांस्कृतिक या वापस लेने के लिए सक्षम है। 
(iii) में विकल्प के परिपूर्ण के अध्ययन प्रयोग, प्रयोग की ओर से कम में उत्तर लेते हैं। अन्तिम स्थिति और निदानकर श्रेणी अवलोकन अवलोकन के संबंध में और किसी दूसरे के लिए मे ही अवलोकन की अप्रतिम नहीं देती है। 
(iv) इसका अध्ययन से केवल अन्य दूसरे अनुपालन के केवल आपकी परिपूर्ण का अवलोकन किया गया है। 

P.T.O.
(v) उपरोक्त अध्ययन के लिए सहीलेखे के लिए सहीलेख हैं।
विद्या/काल्पनिक उपवर पर स्टाफर के हस्ताक्षर (या अगुरुके का निर्देश)
दिनांक:
हस्ताक्षरकर्ता का नाम:
हस्ताक्षर:
या

प्रतिनिधि:
दिनांक:
हस्ताक्षरकर्ता का नाम:
अन्तरिक्ष का हस्ताक्षर:
दिनांक:
अध्ययन आरंभकर्ता का नाम:
माफ़ का हस्ताक्षर या अगुरुके का निर्देश:
दिनांक:
माफ़ का नाम और पता:
MALAYALAM CONSENT

...
Informed Consent

విస్తరించిన సహాయాను: మరియు విస్తరించిన సహాయాను తీవ్రమైన రోగాలు వంటి విశేషాలతో చేయబడింది. భాగం చేయబడింది
నివాసాన్ని రాయాడాను తీవ్రమైన రోగాలు వంటి విశేషాలతో చేయబడింది.

(ii) తీవ్రమైన రోగాలు వంటి రోగాలు వంటి విశేషాలతో చేయబడింది. భాగం చేయబడింది
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(iii) తీవ్రమైన రోగాలు వంటి రోగాలు వంటి విశేషాలతో చేయబడింది. భాగం చేయబడింది
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(iv) తీవ్రమైన రోగాలు వంటి రోగాలు వంటి విశేషాలతో చేయబడింది. భాగం చేయబడింది
నివాసాన్ని రాయాడాను తీవ్రమైన రోగాలు వంటి విశేషాలతో చేయబడింది.

(v) తీవ్రమైన రోగాలు వంటి రోగాలు వంటి విశేషాలతో చేయబడింది. భాగం చేయబడింది
నివాసాన్ని రాయాడాను తీవ్రమైన రోగాలు వంటి విశేషాలతో చేయబడింది.

Date of Birth / Age:

(i) 

(ii) 

(iii) 

(iv) 

(v) 

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| Case No | IP.No | Code No | Diagnosis                   | Surgery                                      | Age | Gender | ASA | Type of surgery | Comorbidities   | H/o DI | HT(cm) | WT(kg) | BMI | NC (cm) | TMD(cm) | NC/TMD ratio | MP score | IDS Score |
|---------|-------|---------|------------------------------|----------------------------------------------|-----|--------|-----|-----------------|----------------|--------|--------|--------|-----|--------|--------|---------------|----------|-----------|
| 1       | 017899G | 1       | Umbilical Hernia            | Laproscopic Hernioplasty                     | 49  | M      | 1   |                  |                |        |        |        |     |        |        |               | 3.72     | 1         |
| 2       | 32156A  | 2       | Left CSF Rhinorrhoea        | Endoscopic CSF Leak Repair                   | 57  | F      | 2   | 1 HTN          |                |        |        |        |     |        |        |               | 5.53     | 1         |
| 3       | 40866B  | 3       | Right Brachial Plexus Plasty| ECRIL To EDC Transfer                        | 20  | M      | 1   |                  |                |        |        |        |     |        |        |               | 10       | 0         |
| 4       | 01677GI | 6       | Carcinoma Ovary            | Staging Laprotyoma                           | 64  | F      | 2   | 1 DM/HTN       |                |        |        |        |     |        |        |               | 4.5      | 1         |
| 5       | 415138F | 9       | Right CSF Rhinorrhoea       | Endoscopic CSF Leak Repair                   | 36  | F      | 2   | 1 THYROID      |                |        |        |        |     |        |        |               | 5.2      | 3         |
| 6       | 565086B | 14      | Umbilical Hernia            | Laproscopic Hernia Repair                    | 45  | F      | 1   |                  |                |        |        |        |     |        |        |               | 4.5      | 3         |
| 7       | 109835F | 12      | Left Shoulder capsulitis    | Left shoulder HSD                             | 50  | F      | 2   | 1 THYROID      |                |        |        |        |     |        |        |               | 5.38     | 3         |
| 8       | 880800F | 20      | Incisional Hernia           | Open Mesh Repair                             | 33  | F      | 1   |                  |                |        |        |        |     |        |        |               | 3.88     | 2         |
| 9       | 914758F | 18      | Hepatocellular Carcinoma    | Biopsy + Splenectomy                          | 65  | M      | 2   | 1 OTHERS       |                |        |        |        |     |        |        |               | 4.05     | 2         |
| 10      | 015404a | 17      | Cervical Myelopathy         | Cervical discotomy                           | 43  | M      | 2   | 1 HTN          |                |        |        |        |     |        |        |               | 5.11     | 1         |
| 11      | 006510G | 19      | Epipigastic Hernia          | Open Mesh Repair                             | 27  | M      | 1   |                  |                |        |        |        |     |        |        |               | 4.6      | 1         |
| 12      | 643134A | 16      | L4L5 IVDP                   | L4L5 PLIF                                    | 59  | F      | 2   | 1 HTN          |                |        |        |        |     |        |        |               | 4.6      | 3         |
| 13      | 019916G | 15      | L3 Plasmocytoma             | L4 Biopsy                                   | 39  | F      | 1   |                  |                |        |        |        |     |        |        |               | 5.71     | 3         |
| 14      | 021615G | 21      | Right VC Polyv              | ML Scopy+Biopsy                              | 34  | F      | 1   |                  |                |        |        |        |     |        |        |               | 4.23     | 3         |
| 15      | 861277F | 13      | Right Cingulate Gynus Glioma| Craniotomy                                  | 36  | F      | 1   |                  |                |        |        |        |     |        |        |               | 3.62     | 2         |
| 16      | 527955D | 22      | L4 L5 Canal Stenosis        | Discectomy                                   | 53  | M      | 2   | 1 HTN/OTHERS    |                |        |        |        |     |        |        |               | 5.41     | 1         |
| 17      | 920913F | 28      | Left PCA Aneurysm           | Clipping Of Aneurysm                         | 53  | F      | 2   | 1 HTN          |                |        |        |        |     |        |        |               | 3.7      | 1         |
| 18      | 590374A | 25      | Incisional Hernia           | Laproscopic Hernia Repair                    | 39  | F      | 2   | 1 DM          |                |        |        |        |     |        |        |               | 4.37     | 4         |
| 19      | 868037F | 23      | Incisional Hernia           | Laproscopic Hernia Repair                    | 49  | F      | 2   | 1 HTN/THYROID  |                |        |        |        |     |        |        |               | 4.58     | 4         |
| 20      | 337337F | 27      | CA Thyroid Status Total     | Laproscopic Hernia Repair                    | 49  | M      | 2   | 1 HTN/THYROID  |                |        |        |        |     |        |        |               | 4.58     | 2         |
| 21      | 040071G | 30      | Right Supratentorial Meningioma| Right Parietal Craniotomy                  | 50  | M      | 1   |                  |                |        |        |        |     |        |        |               | 4.2      | 2         |
| 22      | 432244F | 34      | Bilateral COM Mucosal       | Right Revision CMT Under GA                  | 58  | M      | 2   | 1 DM/HTN       |                |        |        |        |     |        |        |               | 4.15     | 2         |
| 23      | 883072F | 29      | pituitary Microadenoma      | TNTS                                         | 18  | F      | 1   |                  |                |        |        |        |     |        |        |               | 0.9      | 0         |
| 24      | 024066G | 35      | B/L Sinonasal Polyposis     | Fess Under GA                                | 29  | M      | 1   |                  |                |        |        |        |     |        |        |               | 0.9      | 0         |
| 25      | 519699D | 8       | ITP                         | Open Spleenectomy                            | 25  | F      | 2   | 1 ITP          |                |        |        |        |     |        |        |               | 3.2      | 0         |
| 26      | 088306d | 36      | Left Shoulder Dislocation   | Bankart Repair                               | 35  | M      | 2   | 1 THYROID      |                |        |        |        |     |        |        |               | 3.8      | 1         |
| 27      | 290676C | 26      | Papillary Carcinoma Thyroid | Total Thyroidectomy+L/MRND                   | 34  | F      | 1   |                  |                |        |        |        |     |        |        |               | 3.8      | 2         |
| 28      | 893830F | 46      | Left CA Breast              | Left MRM                                     | 44  | F      | 1   | 1 DM          |                |        |        |        |     |        |        |               | 3.7      | 3         |
| 29      | 837586F | 47      | CA Breast Right Post MACT   | Right MRM                                    | 44  | F      | 1   |                  |                |        |        |        |     |        |        |               | 4.18     | 2         |
| Patient ID | Age | Gender | Diagnosis/Procedure | Other Conditions | Procedure Details | Age | Gender | Diagnosis/Procedure | Other Conditions | Procedure Details | Age | Gender | Diagnosis/Procedure | Other Conditions | Procedure Details |
|------------|-----|--------|---------------------|-----------------|------------------|-----|--------|---------------------|-----------------|------------------|-----|--------|---------------------|-----------------|------------------|
| 30 | 589107B | 40 | Right Breast Cancer | | Bilateral Simple Mastectomy+Rt SLND | 42 | F | 2 | 1 | DM | N | 158 | 75 | 30 | 35 | 10 | 3.5 | I | 2 |
| 31 | 880169F | 41 | Right carcinoma Breast Post NACT | | Right MRM | 62 | F | 2 | 1 | HTN | N | 159 | 81 | 32 | 46 | 7 | 6.5 | IV | 2 |
| 32 | 690588B | 42 | Follicle Neoplasm Lt.Vocalcord | | Total Thyroidectomy | 55 | M | 2 | 1 | DM/HTN | N | 163 | 81 | 30.5 | 40.5 | 8 | 5.06 | II | 7 |
| 33 | 885757F | 44 | Right CSOM mucosal Posterior Mediastinal Mass | | Right CMT Under GA | 31 | F | 1 | 1 | 0 | N | 151 | 71 | 31.1 | 34.5 | 8 | 4.31 | II | 2 |
| 34 | 006009G | 38 | Esophageal | | Posterior Mediastinal Mass | 38 | M | 2 | 1 | THYROID | N | 170 | 94 | 32.5 | 43.5 | 10 | 4.35 | II | 1 |
| 35 | 230697F | 45 | Right Renal Calculus | | Total Nephrectomy | 38 | M | 2 | 1 | HTN | N | 170 | 90 | 31.1 | 40 | 10 | 4 | I | 2 |
| 36 | 015388G | 52 | Follicle Neoplasm Lt.Vocalcord Total Thyroidectomy | | Excision | 45 | M | 1 | 1 | 0 | N | 162 | 82 | 31.2 | 40 | 10 | 4 | I | 2 |
| 37 | 0585757F | 44 | Right CSOM mucosal Posterior Mediastinal Mass | | Total Thyroidectomy | 30 | F | 1 | 1 | 0 | N | 160 | 89 | 34.8 | 41.5 | 10 | 4.15 | III | 2 |
| 38 | 587025A | 31 | Right Parotid Pleomorphic Adenoma | | Total Parotidectomy | 27 | M | 1 | 1 | 0 | N | 164 | 85 | 31.6 | 41 | 9.5 | 4.35 | II | 3 |
| 39 | 018078G | 50 | Right Parotid Pleomorphic Adenoma | | Right Superficial Parotidectomy | 25 | F | 2 | 1 | THYROID | N | 155 | 85 | 35.4 | 36 | 9 | 4 | I | 2 |
| 40 | 150511G | 41 | Incisional Hernia | | Recurrent Right Thalamic Pilocytic Astrocytoma | 27 | M | 2 | 1 | HTN | N | 155 | 72 | 30 | 41.5 | 9.5 | 4.36 | II | 0 |
| 41 | 858844D | 56 | Incisional Hernia | | Incisional Hernia Mesh | 54 | F | 2 | 1 | DM | N | 156 | 78 | 32.1 | 33 | 9 | 3.66 | II | 3 |
| 42 | 055151G | 53 | Pituitary Microadenoma | | Pituitary Microadenoma | 43 | M | 2 | 1 | OTHERS | N | 162 | 92 | 36.6 | 43 | 8.5 | 5.05 | III | 6 |
| 43 | 057022G | 62 | CAD,TVD,NLV,SR,DM,NHTN | | CABG | 60 | M | 3 | 1 | DM/HTN/SHD | N | 156 | 76 | 31.2 | 38.5 | 10 | 3.85 | II | 2 |
| 44 | 846179F | 57 | Thyroidectomy | | Total Thyroidectomy | 38 | F | 2 | 1 | HTN | N | 150 | 75 | 33.3 | 37 | 10 | 3.7 | II | 3 |
| 45 | 749544F | 58 | Multinodular Goitre Symptomatic | | Total Thyroidectomy | 66 | F | 2 | 1 | HTN | N | 156 | 104 | 42.7 | 39 | 9 | 4.33 | II | 7 |
| 46 | 918798F | 70 | Lumbar Canal Stenosis | | L4-5 IVDP | 57 | F | 2 | 1 | HTN/OTHERS | N | 162 | 84 | 32 | 36 | 8.5 | 4.23 | II | 4 |
| 47 | 608974A | 66 | DNS With Chronic Sinusitis | | DNS With Chronic Sinusitis | 19 | M | 1 | 1 | 0 | N | 182 | 101 | 30.5 | 41.5 | 11 | 3.77 | I | 1 |
| 48 | 859949D | 69 | DNS With Chronic Sinusitis | | DNS With Chronic Sinusitis | 43 | F | 2 | 1 | THYROID | N | 146 | 78 | 36.6 | 35 | 9 | 3.88 | II | 2 |
| 49 | 912003F | 68 | Symptomatic Cholelithiasis | | Symptomatic Cholelithiasis | 58 | F | 1 | 1 | 0 | N | 140 | 62 | 31.6 | 31.5 | 9.5 | 3.31 | II | 0 |
| 50 | 302834C | 65 | Thalamic Mass | | Thalamic Mass | 53 | F | 2 | 1 | HTN | N | 145 | 85 | 40.4 | 36.5 | 8.5 | 4.29 | II | 4 |
| 51 | 057400G | 60 | Right Elbow Stiffness | | Right Elbow Arthroplasty | 41 | F | 1 | 1 | 0 | N | 148 | 66 | 30.1 | 31.5 | 10 | 3.15 | I | 0 |
| 52 | 543791G | 67 | Right Clavicle Fracture | | Right Clavicle Fracture | 43 | F | 1 | 1 | 0 | N | 155 | 75 | 31.2 | 34 | 9.5 | 3.57 | I | 3 |
| 53 | 574333C | 51 | Cholelithiasis | | Lap Cholecystectomy | 46 | M | 2 | 1 | DM/RHD | N | 175 | 93 | 30.4 | 42 | 8 | 5.25 | II | 5 |
| 54 | 039854G | 39 | Calcific Ax,Trace MR,NLV,SR | | AVR | 53 | M | 3 | 1 | RHD | N | 156 | 76.5 | 31.4 | 36.5 | 8.5 | 4.29 | II | 3 |
| 55 | 352965B | 73 | Paraumbilical Hernia | | Paraumbilical Hernia | 37 | F | 1 | 1 | 0 | N | 155 | 75 | 31.2 | 32 | 8.5 | 3.76 | II | 4 |
| 56 | 059944G | 61 | Left XGP | | Left XGP | 59 | M | 2 | 1 | 0 | N | 158 | 77 | 30.8 | 40.5 | 8 | 5.06 | III | 5 |
| 57 | 412272B | 75 | Right COM-Mucosal | | Right Tympanoplastic Repair | 38 | F | 1 | 1 | 0 | N | 148 | 69 | 31.5 | 33 | 8.5 | 3.88 | I | 0 |
| 58 | 424687A | 74 | Grade 4 Facial Palsy | | Facial Nerve Decompression | 50 | F | 2 | 1 | DM/HTN | N | 140 | 80 | 40.8 | 35.5 | 8 | 4.4 | IV | 3 |
| 59 | 830420F | 76 | B/L Aductor palsy | | Laser Cordotomy | 41 | F | 2 | 1 | THYROID | N | 150 | 69 | 30.7 | 32.5 | 9 | 3.61 | II | 4 |
| 60 | 932684B | 81 | B/L Aductor palsy | | Laser Cordotomy | 47 | F | 2 | 1 | DM | N | 153 | 72 | 30.7 | 38.5 | 7 | 5.13 | III | 5 |
| 61 | 685299B | 82 | P2L2 Completed Family | | Laparoscopic Sterilization | 30 | F | 1 | 1 | 0 | N | 157 | 85 | 34.5 | 36 | 7 | 5.14 | II | 5 |
|   |   |   |   |   |   |   |   |   |   |   |
|---|---|---|---|---|---|---|---|---|---|---|
| 63 | 901719D 30 Paraumbilical Hernia | Open Paraumbilical Hernia Hernial Repair | 30 | F | 2 | 1 | HTN | N | 152 | 88 | 38.1 | 40 | 9 | 4.44 | III | 1 |
| 64 | 036516G 78 Paraumbilical Hernia | Hernial Repair | 54 | F | 3 | 1 | DM/HTN/BDH | N | 152 | 90 | 39 | 42 | 7.5 | 5.6 | III | 3 |
| 65 | 051171G 63 CAD,DPV,AF | CABG | 75 | F | 3 | 1 | HTN/BDH | N | 161 | 80 | 30.9 | 40.5 | 10.5 | 3.85 | II | 3 |
| 66 | 901436F 80 Perpulmonary Carcinoma | Whipples Procedure | 54 | M | 1 | 1 | 0 | N | 168 | 86 | 30.5 | 42 | 8 | 5.25 | IV | 5 |
| 67 | 704276F 86 ITP | Splenectomy | 35 | F | 2 | 1 | THYROID/OTHERS | N | 162 | 86 | 32.8 | 40 | 7.5 | 5.33 | III | 6 |
| 68 | 626313B 88 Thyroid Nodale | Total Thyroidectomy | 54 | F | 2 | 1 | HTN | N | 145 | 73 | 34.7 | 32.5 | 8.5 | 3.82 | III | 2 |
| 69 | 045433G 87 Papillary Carcinoma Thyroid | Total Thyroidectomy | 35 | F | 1 | 1 | 0 | N | 172 | 92 | 31.1 | 37.5 | 9 | 4.16 | II | 1 |
| 70 | 053218G 91 Left Presypalatine Mass | Caldwell Luc Surgery | 33 | F | 1 | 1 | 0 | N | 152 | 71 | 30.7 | 35.5 | 10 | 3.55 | I | 0 |
| 71 | 328027C 63 CAD,DVP,AF | CABG | 75 | F | 2 | 1 | OTHERS | N | 152 | 70 | 30.3 | 35.5 | 9.5 | 3.73 | II | 3 |
| 72 | 049816G 85 Left Vertebral Mass | MSOC and Excison | 51 | F | 2 | 1 | DM | N | 150 | 71 | 31.7 | 35.5 | 10 | 3.55 | III | 4 |
| 73 | 017795G 90 Hypertrophic Pachymeningites | Biopsy of Posterior Fosses | 58 | F | 2 | 1 | THYROID | N | 148 | 67 | 30.6 | 32 | 8 | 4 | II | 3 |
| 74 | 838252F 89 Gynecomastia | B/L Webster's Procedure | 28 | F | 1 | 1 | 0 | N | 177 | 95 | 30.3 | 36.5 | 9 | 4.22 | I | 0 |
| 75 | 056777G 84 Left VUI Calculus | Left PCNL | 46 | F | 1 | 1 | 0 | N | 148 | 75 | 34.2 | 36.5 | 9 | 4.05 | III | 0 |
| 76 | 856270B 93 Left COM-Mucosal Disease | Left CMT | 36 | M | 2 | 1 | HTN | N | 177 | 97 | 31 | 41 | 9.5 | 4.31 | I | 1 |
| 77 | 065874G 94 Right Vocal Cord Polyp | ML Scopy/Excision | 40 | M | 1 | 1 | 0 | N | 167 | 86 | 30.8 | 39.5 | 9 | 4.38 | II | 2 |
| 78 | 056947G 72 ACHD,OS ASD | ASD Closure | 43 | M | 2 | 1 | OTHERS | N | 148 | 70 | 32 | 37.5 | 10.5 | 3.54 | II | 1 |
| 79 | 025580G 98 Left LN Malign Nodale In Multinodular Goitre | Total Thyroidectomy | 64 | F | 2 | 1 | DM/HTN/THYROID | N | 156 | 73 | 30 | 31.5 | 8.5 | 3.7 | II | 2 |
| 80 | 810688F 97 Solitary Nodale Left Multinodular Goitre | Total Thyroidectomy | 35 | F | 1 | 1 | 0 | N | 159 | 86 | 34 | 34.5 | 9.5 | 3.63 | II | 4 |
| 81 | 021271G 101 Left Solitary Nodale Thyroid | Total Thyroidectomy | 32 | F | 1 | 1 | 0 | N | 146 | 65 | 30.5 | 31.5 | 8.5 | 3.7 | I | 1 |
| 82 | 037602G 99 Solitary Thyroid | Completion Right Thyroidectomy | 47 | F | 2 | 1 | THYROID | N | 162 | 82 | 31 | 36.5 | 9 | 3.78 | II | 2 |
| 83 | 865811F 100 Solitary Nodale Right | Total Thyroidectomy | 38 | M | 1 | 1 | DM | N | 168 | 87 | 30.8 | 35 | 8 | 4.3 | II | 4 |
| 84 | 034465G 103 Paraumbilical Hernia Divercation recti,Fatty Apron | Mesh Repair and Abdominoplasty | 34 | F | 1 | 1 | 0 | N | 154 | 74 | 31 | 35.5 | 8.5 | 4.17 | III | 4 |
| 85 | 676671F 105 PAH,WIV,SF | ASD Closure | 35 | F | 3 | 1 | OTHERS | N | 155 | 73.5 | 30.6 | 36.5 | 8.5 | 4.29 | II | 2 |
| 86 | 044909G 107 CAD,TVD,DM,HTN,NLY,SR | CABG | 67 | F | 2 | 1 | DM/HTN | N | 140 | 63 | 32.1 | 32.5 | 9 | 3.61 | III | 5 |
| 87 | 855221D 102 Stricture Urethra Stage II Urethroplasty | C4-6 Laminectomy and Posterior longitudinal Ligament | 66 | M | 1 | 1 | 0 | N | 152 | 72 | 31.2 | 36 | 7.5 | 4.8 | IV | 2 |
| 88 | 241445B 110 Left Staphem Calculus | Left PCNL | 49 | M | 1 | 1 | 0 | N | 161 | 89 | 34.5 | 38.5 | 6.5 | 5.92 | III | 5 |
| 89 | 895375F 112 Calcific AR,NLV,IVD 49/34,AA23 | AVR | 56 | F | 3 | 1 | HTN | N | 157 | 95 | 38.5 | 37.5 | 9 | 4.16 | I | 1 |
| 90 | 058271G 113 Left Akoolec Growth | MLS Excision | 44 | M | 2 | 1 | DM | N | 169 | 90 | 31.5 | 42.5 | 10 | 4.25 | I | 0 |
| 91 | 229995B 119 CA Lower Illad Esophagus | IVOR Lewis Oesophagectomy | 55 | M | 2 | 1 | DM | N | 165 | 89 | 32.7 | 41.5 | 6.5 | 6.38 | III | 9 |
| 92 | 253042F 115 Right Excision | Stage II Urethroplasty | 56 | M | 2 | 1 | DM | N | 168 | 87 | 30.8 | 38.5 | 9 | 4.22 | III | 3 |
| 93 | 853988F 117 Left Breast, Post NACT | Left MRM | 41 | F | 1 | 1 | 0 | N | 152 | 80 | 34.6 | 35.5 | 9.5 | 3.73 | II | 0 |
| 94 | 615596F 120 Multinodular Goitre | Total Thyroidectomy | 52 | F | 1 | 1 | 0 | N | 155 | 80 | 33.3 | 34.5 | 9 | 3.83 | II | 3 |
| 95 | 032248G 118 Carcinoma of Thyroid | Total Thyroidectomy | 75 | F | 3 | 1 | HTN/THYROID | N | 142 | 79 | 39.2 | 34.5 | 8 | 4.3 | III | 2 |
| Patient ID | Procedure | Diagnosis | Age | Gender | ASA | BMI | Other Conditions | WBC | Hemoglobin | Platelets | INR | PTT | Mortality |
|------------|-----------|-----------|-----|--------|-----|-----|-----------------|-----|-------------|-----------|-----|-----|-----------|
| 96         | Adhesive Intestinal Obstruction | Laparoscopy Adhesiolysis Proceed | 49 | F | 2 | 1 | 0 | N | 146 | 64 | 30 | 31.5 | 9 | 3.5 | I | 2 |
| 97         | Appendicitis | Lap Appendectomy | 32 | F | 1 | 1 | 0 | N | 155 | 81 | 33.7 | 38.5 | 9 | 4.27 | III | 1 |
| 98         | Left Parietal Recurrent Convexity Meningioma | Laparoscopic Dual Mesh Repair and Incisional Hernia and Panniculectomy | 50 | F | 2 | 1 | DM | N | 147 | 69.5 | 32.2 | 37.5 | 8.5 | 4.41 | III | 2 |
| 99         | Large Incisional Hernia | Laparoscopic Dual Mesh Repair and Panniculectomy | 67 | F | 2 | 1 | DM/HTN | N | 141 | 70 | 35.2 | 36 | 8.5 | 4.23 | III | 3 |
| 100        | Incisional Hernia and Panniculectomy | Laparoscopic Cholecystectomy | 45 | F | 1 | 1 | 0 | N | 152 | 71 | 30.7 | 34.5 | 8.5 | 4.05 | II | 3 |
| 101        | Symptomatic Cholelithiasis | Laparoscopic Cholecystectomy | 59 | F | 1 | 1 | 0 | N | 149 | 67 | 30.2 | 37.5 | 8.5 | 4.17 | II | 3 |
| 102        | Cholelithiasis | Laparoscopic Cholecystectomy | 39 | F | 2 | 1 | HTN | N | 149 | 69 | 31.1 | 35.5 | 9.5 | 3.73 | IV | 3 |
| 103        | Symptomatic Cholelithiasis | Laparoscopic Cholecystectomy | 76 | F | 2 | 1 | DM/HTN | N | 143 | 64 | 31.3 | 31.5 | 6 | 5.25 | II | 5 |
| 104        | Left Petrous Meningioma | Craniotomy + Excision | 34 | F | 2 | 1 | OTHERS | N | 145 | 71 | 33.8 | 35.5 | 9 | 3.98 | III | 1 |
| 105        | Appendicitis | Lap Appendectomy | 45 | F | 1 | 1 | 0 | N | 153 | 85 | 36.3 | 38.5 | 10 | 3.85 | III | 2 |
| 106        | Left Parietal Recurrent Convexity Meningioma | Laparoscopic Dual Mesh Repair and Panniculectomy | 52 | F | 2 | 1 | HTN | N | 158 | 99 | 39.7 | 36.5 | 8.5 | 4.29 | III | 4 |
| 107        | Left Inguinal Hernia | Laparoscopic Hernia Repair | 42 | M | 1 | 1 | 0 | N | 162 | 82 | 31.2 | 39 | 7 | 5.57 | II | 5 |
| 108        | Right Carcinoma Parotid | Right Conservative Parotectomy | 43 | M | 1 | 1 | 0 | N | 173 | 96 | 32.1 | 39 | 9 | 4.33 | II | 4 |
| 109        | C3 Central Vertebrocompression | C3 Central Corpectomy II | 35 | F | 1 | 1 | 0 | N | 152 | 70 | 30.3 | 34.5 | 8.5 | 4.5 | III | 4 |
| 110        | Left Renal Mass | Right Lap. Partial Nephrectomy | 50 | F | 2 | 1 | HTYROID | N | 147 | 65 | 30.1 | 32.5 | 8.5 | 3.82 | III | 4 |
| 111        | CABG | CABG | 45 | M | 3 | 1 | IHD | N | 161 | 78.5 | 30.3 | 36.5 | 9.5 | 3.84 | II | 7 |
| 112        | Left CP Angle Epidemoid | Left RMSOC and Excision | 35 | M | 1 | 1 | 0 | N | 175 | 97 | 31.7 | 41.5 | 10.5 | 3.95 | III | 1 |
| 113        | Gall Bladder Polyp | Laparoscopic Cholecystectomy | 43 | F | 2 | 1 | OTHERS | N | 148 | 66 | 30.1 | 31.5 | 8.5 | 3.7 | I | 1 |
| 114        | Intratarticular Fracture | Laparoscopic Cholecystectomy | 41 | F | 1 | 1 | 0 | N | 153 | 84 | 35.9 | 34.5 | 8 | 4.31 | I | 1 |
| 115        | CSF Leak | Laparoscopic Cholecystectomy | 30 | F | 1 | 1 | 0 | N | 162 | 92 | 35.1 | 35 | 9 | 3.88 | I | 4 |
| 116        | Urethral Structure | Substitution Urethroplasty | 56 | M | 2 | 1 | DM | N | 160 | 77 | 30.1 | 32.5 | 7 | 4.64 | II | 4 |
| 117        | CAP, TFD, DM, N/LV, SR | CABG | 55 | F | 3 | 1 | IHD | N | 146 | 64 | 30 | 33.5 | 6.5 | 5.15 | II | 5 |
| 118        | Incisional Hernia | Incisional Hernia Open Mesh Repair | 64 | F | 2 | 1 | HTN | N | 151 | 76 | 33.3 | 35.5 | 6.5 | 5.46 | II | 4 |
| 119        | CABG | CABG | 147 | M | 17 | 3 | 1 | OTHERS | N | 154 | 74 | 31.2 | 39.5 | 9 | 4.38 | II | 1 |
| 120        | Lap. Diversion Colectomy | Lap. Diversion Colectomy | 55 | F | 2 | 1 | DM/HTN | N | 148 | 67 | 30.6 | 32.5 | 7.5 | 4.3 | II | 2 |
| 121        | L4L5 Disc Prolapse | L4L5 Laminectomy | 47 | F | 2 | 1 | HTYROID | N | 145 | 70 | 33.3 | 34.5 | 6.5 | 5.3 | II | 8 |
| 122        | Bilateral Pancreatitis | Laparoscopic Cholecystectomy | 66 | M | 2 | 1 | HTN | N | 174 | 91 | 30.1 | 38.5 | 9 | 4.27 | II | 1 |
| 123        | Cervical Compression | Laparoscopic Cholecystectomy | 44 | F | 2 | 1 | HTN | N | 152 | 71 | 30.3 | 33.5 | 8.5 | 3.94 | II | 1 |
| 124        | Dominant Nodule in Multinodular Goitre | Total Thyroidectomy | 48 | F | 1 | 1 | 0 | N | 152 | 71 | 30.7 | 34.5 | 8.5 | 4.05 | II | 2 |
| 125        | Voluntary Kidney Donor | Laparoscopic Donor Nephrectomy | 56 | M | 1 | 1 | 0 | N | 160 | 78 | 30.5 | 38.5 | 7 | 5.5 | I | 2 |
| 126        | Left S1 Infractivo Spondylothesis | L5-S1 Left Sided TLIF | 46 | F | 2 | 1 | DM | N | 152 | 73 | 31.6 | 35.5 | 9 | 3.94 | II | 0 |
| 127        | Right Bladder | Radical Cystectomy + Leal Conduit | 70 | M | 2 | 1 | HTN | N | 161 | 91 | 35.1 | 38 | 8.5 | 4.47 | III | 3 |
| 128        | Recurrent Incisional Hernia and Panniculectomy | Laparoscopic Incisional Hernia Repair | 50 | F | 2 | 1 | HTN | N | 148 | 68 | 31 | 34.5 | 8 | 4.31 | II | 1 |
| Code   | Name                          | Procedure                                                                 | Sex | Age | 1000 | VASA  | VASA  | VASA  | VASA  | VASA  |
|--------|-------------------------------|----------------------------------------------------------------------------|-----|-----|------|-------|-------|-------|-------|-------|
| 129    | 840619F                      | Abdominal Panniculitis Repair and Panniculectomy                          | M   | 55  | 2    | 1     | IHD/THYROID | N | 151 78 | 34.2 35.5 8 4.17 II 8 |
| 130    | 064587G                      | T11-S1 Lumpectomy and Excision with MEP and Root Stimulation             | M   | 37  | 1    | 1     | 0     | N | 155 82 | 34.1 43.5 10.5 4.14 III 3 |
| 131    | 706323B                      | Papillary Carcinoma Thyroid                                              | F   | 55  | 2    | 1     | DM    | N | 170 137 47.4 43.5 8 5.43 III 3 |
| 132    | 055319G                      | Cholelithiasis                                                            | F   | 37  | 2    | 1     | HTN   | N | 158 75 30 33.5 8.5 3.94 II 1 |
| 133    | 056794G                      | Left Cerebral Meningioma                                                  | F   | 25  | 2    | 1     | THYROID| N | 154 76 32 34.5 9 3.83 II 1 |
| 134    | 070075G                      | Right Renal calculi                                                       | F   | 44  | 1    | 1     | 0     | N | 147 75 34.7 35.5 7 5.07 II 6 |
| 135    | 061742G                      | Intraduital                                                               | G   | 22  | 2    | 1     | THYROID| N | 142 71 35.2 31 6.5 4.7 II 3 |
| 136    | 067212G                      | Segmental Laminectomy and Excision of Tumour In Prone With MEP            | M   | 39  | 2    | 1     | OTHERS | N | 152 75 32.5 35 8 4.37 II 2 |
| 137    | 070021G                      | Right Recurrent Phylloides Tumour                                         | F   | 53  | 2    | 1     | THYROID| N | 173 109 36.4 38 7 5.42 III 5 |
| 138    | 011276C                      | Gall Stones Lateral Ventral Border of Tongue                               | G   | 63  | 2    | 1     | DM/HTN/THYROID | N | 149 81 36.5 34 6.5 5.23 II 4 |
| 139    | 076018G                      | Laparoscopic Cholecystectomy                                               | M   | 30  | 1    | 1     | 0     | N | 170 95.5 33 43.5 10.5 4.14 IV 1 |
| 140    | 077517G                      | Laryngeal Biopsy                                                          | F   | 47  | 2    | 1     | HTN/THYROID | N | 158 75 30 34 8 4.25 III 1 |
| 141    | 834830F                      | Laryngeal Biopsy                                                          | G   | 26  | 2    | 1     | OTHERS | N | 179 97 30.3 39.5 10 3.95 IV 3 |
| 142    | 749778A                      | Cholecystitis                                                              | G   | 40  | 2    | 1     | THYROID| N | 150 70 31.1 33 8.5 3.86 II 1 |
| 143    | 069189G                      | Right Humerus Nonunion                                                     | G   | 57  | 1    | 1     | 0     | N | 162 92 35.1 45.5 8.5 5.35 III 0 |
| 144    | 748586G                      | L Gall Fracture Arm                                                        | F   | 57  | 2    | 1     | DM    | N | 170 90 31.1 39.5 9 4.38 II 4 |
| 145    | 288485D                      | Recurrent Rhinosporiodiosis                                                | M   | 22  | 1    | 1     | 0     | N | 162 81 30.9 39.5 9.5 4.15 III 1 |
| 146    | 073225G                      | Incision Herniation                                                        | G   | 38  | 1    | 1     | 0     | N | 165 85 31.2 40.5 11.5 3.52 II 1 |
| 147    | 079160G                      | Lateral Incision Excision                                                  | M   | 48  | 2    | 1     | DM/HTN | N | 162 80 30.5 40.5 7 5.78 III 5 |
| 148    | 075015G                      | Lateral Incision Excision                                                  | G   | 68  | 3    | 1     | DM/HTN/THYROID | Y | 145 64 30.4 34 6.5 5.23 III 8 |
| 149    | 146427F                      | Recurrent CSF Rhinorhema Post Tissue Adenoma Excision                      | F   | 62  | 2    | 1     | HTN   | N | 164 89.5 33.3 39.5 7 5.64 III 5 |
| 150    | 069383G                      | Right Dominant Nodule Thyroid                                              | M   | 74  | 1    | 1     | 0     | N | 150 69 30.7 34.5 7.5 4.6 II 2 |
| 151    | 924832F                      | T-11-L1 Lumpectomy And Excision Of Tumour In Prone With MEP monitor        | G   | 48  | 2    | 1     | DM    | N | 160 95 37.1 35 8.5 4.11 III 2 |
| 152    | 046386G                      | Left NFK With Left Urinary Calculi                                          | F   | 39  | 1    | 1     | 0     | N | 145 85 38.5 35.5 9 3.94 II 7 |
| 153    | 285237B                      | In Lateral                                                                | G   | 67  | 2    | 1     | DM/HTN | N | 164 92 34.2 39.5 9 4.38 III 3 |
| 154    | 076644G                      | Right Pariental Nephrecty                                                  | M   | 57  | 2    | 1     | HTN   | N | 165 84 30.9 37.5 9 4.16 II 4 |
| 155    | 075885G                      | CABG/IVSA/IABP                                                            | M   | 34  | 3    | 1     | IHD   | N | 160 80 31.3 36.5 8 4.56 III 1 |
| 156    | 076274G                      | Pituitary Adenoma                                                         | F   | 45  | 2    | 1     | THYROID| N | 159 76 30.1 33.5 8 4.18 III 1 |
| 157    | 090347G                      | Right Vocal Cord Polyp                                                    | G   | 47  | 2    | 1     | THYROID| N | 152 75 32.5 31 6.5 4.76 I 3 |
| 158    | 928741F                      | Laparoscopic Cholecystectomy                                               | F   | 33  | 1    | 1     | 0     | N | 155 74 30.8 34.5 8 4.31 II 4 |
| 159 | 904246D | 208 | L4-L5 Lumbar Canal Stenosis | L4-L5 Decompression | 36 | F | 1 | 1 | 0 | N | 157 | 82 | 33.3 | 35 | 9 | 3.88 | II | 0 |
| 160 | 837810D | 215 | Acute Apendicitis | Lap.Apendectomy | 36 | M | 1 | 1 | 0 | N | 157 | 75 | 30.4 | 35 | 9 | 3.94 | II | 4 |
| 161 | 058715G | 213 | CAD-TVD | CABG | 64 | M | 3 | 1 | HTN/IBD | N | 160 | 78 | 30.5 | 43.5 | 7 | 6.21 | III | 6 |
| 162 | 163878D | 217 | Left Femur Implant In situ | Implant Exit | 45 | M | 2 | 1 | THYROID | N | 175 | 98 | 32 | 40 | 9 | 4.44 | I | 4 |
| 163 | 539360D | 205 | L4-L5 Disc Prolapse | L4-L5 Discetomy | 41 | M | 1 | 1 | 0 | N | 175 | 98 | 32 | 42.5 | 8 | 5.31 | III | 11 |
| 164 | 076112G | 211 | Right Renal Mass | Right Radical Nephrectomy | 55 | M | 2 | 1 | DM/HTN | N | 172 | 92 | 31.1 | 39 | 9 | 4.33 | II | 0 |
| 165 | 082942G | 210 | Right Renal Mass | Right Open Partial Nephrectomy | 37 | F | 2 | 1 | OTHERS | N | 157 | 78 | 31.6 | 36.5 | 9 | 4.05 | II | 4 |
| 166 | 628475F | 224 | Right Nodule Thyroid | Total Thyroidectomy | 58 | M | 2 | 1 | HTN/THYROID | Y | 170 | 88 | 30.4 | 41 | 7 | 5.85 | IV | 5 |
| 167 | 634944F | 219 | L5-S1 Disc Prolapse | L5-S1 Discetomy | 22 | M | 1 | 1 | 0 | N | 160 | 77 | 30.1 | 40.5 | 9.5 | 4.26 | IV | 1 |
| 168 | 738422C | 222 | Incisional Hernia | Laproscopic Hernia Repair | 54 | F | 1 | 1 | 0 | N | 141 | 61 | 33.6 | 38 | 9 | 4.42 | I | 1 |
| 169 | 083338G | 221 | Right Vocal Cord Polyp | ML Scropy Biopsy | 41 | M | 2 | 1 | THYROID | N | 161 | 87 | 33.6 | 38 | 9 | 4.32 | II | 1 |
| 170 | 083547G | 220 | Right Carcinoma Breast | Right MRM | 44 | F | 1 | 1 | 0 | N | 144 | 64 | 30.9 | 35 | 8 | 4.37 | II | 2 |
| 171 | 977546D | 172 | Right Distal Femur\* | Right Distal Femur Megaprostetics | 63 | F | 2 | 1 | HTN | N | 145 | 110 | 52.3 | 39 | 7 | 5.57 | III | 2 |
| 172 | 339837F | 223 | Status Loop Colosty | Colosty Closure | 39 | M | 1 | 1 | 0 | N | 170 | 87 | 30.1 | 39 | 9 | 4.33 | I | 2 |
| 173 | 540671D | 229 | Symptomatic Gall Stones | Laparoscopic Cholecystectomy | 28 | F | 1 | 1 | 0 | N | 144 | 63 | 30.4 | 33 | 9 | 3.6 | II | 3 |
| 174 | 091823G | 225 | Bilateral Submucous Fibrosis | Nasoalial Flap/SSG | 23 | M | 1 | 1 | 0 | N | 166 | 87 | 31.6 | 38.5 | 9 | 4.27 | IV | 1 |
| 175 | 796615F | 227 | Recurrent Incisional Hernia | Laparoscopic Open Mesh Repair | 40 | F | 1 | 1 | 0 | N | 155 | 86 | 35.8 | 35 | 8.5 | 4.11 | I | 3 |
| 176 | 081017G | 240 | Ovarian Cyst | Laproscopic cystectomy | 25 | F | 1 | 1 | 0 | N | 150 | 68 | 30.2 | 31 | 8.5 | 3.64 | II | 2 |
| 177 | 065390F | 241 | Carcinoma Ovary | Staging Laprotomy | 56 | F | 2 | 1 | DM/HTN | N | 155 | 72 | 30 | 35 | 9 | 3.88 | II | 3 |
| 178 | 076154G | 242 | Submucous Fibroid | TAH-BSO | 64 | F | 2 | 1 | HTN/THYROID | N | 160 | 93.2 | 36.4 | 38 | 6.5 | 5.84 | III | 5 |
| 179 | 895435F | 231 | L5-S1 Left Paracental Disc Prolapse | L5 Laminectomy and Discetomy | 47 | M | 1 | 1 | 0 | N | 173 | 90 | 30.1 | 36 | 7 | 5.14 | IV | 2 |
| 180 | 871670F | 235 | Solitary Thyroid Nodule | Total Thyroidectomy | 30 | M | 1 | 1 | 0 | N | 180 | 104 | 32.1 | 39 | 8.5 | 4.58 | II | 2 |
| 181 | 084511G | 233 | Left Glomus Tumour | Fm Left Ear With Biopsy Under Hypotensive GA | 45 | F | 2 | 1 | OTHERS | N | 153 | 86 | 36.7 | 31 | 6.5 | 4.76 | II | 4 |
| 182 | 591525C | 243 | Incisional Hernia | Incisional Hernia Mesh Repair | 38 | F | 1 | 1 | 0 | N | 155 | 80 | 33.3 | 34 | 8 | 4.25 | I | 4 |
| 183 | 770477D | 236 | Multinodular Goitre | Total Thyroidectomy | 54 | F | 2 | 1 | THYROID | N | 155 | 72 | 30 | 31 | 6.5 | 4.76 | II | 3 |
| 184 | 344062C | 230 | OREF/Reverse Arthroplasty | Right Proximal Humerus Near4Part Csh Carpectomy with Fusion II R&QD | 74 | M | 2 | 1 | THYROID | N | 172 | 89 | 30.1 | 33 | 9 | 3.66 | III | 3 |
| 185 | 828398D | 249 | C6-7 Disc Prolapse | Left Frontal Glioma | 60 | M | 2 | 1 | HTN | N | 169 | 94 | 32.9 | 39 | 7 | 5.57 | III | 3 |
| 186 | 891522F | 252 | ITP Spleen | Laparoscopic Splenectomy | 43 | M | 2 | 1 | OTHERS | N | 167 | 92 | 33 | 41 | 9 | 4.31 | III | 5 |
| 187 | 082235G | 247 | Right Adrenal Mycoilpoma | Right paraspinal Open Adrenalecetomy | 40 | M | 2 | 1 | HTN | N | 165 | 82 | 30.1 | 39 | 9 | 4.33 | II | 3 |
| 188 | 065104G | 251 | ACHD,SVASD15mm-Rshunt,NL,Stroad(Fevi0.9) Minor CAD | SV,ASD Closure | 50 | F | 3 | 1 | HTN | N | 144 | 63 | 30.4 | 34.5 | 9 | 3.83 | III | 3 |
| 189 | 917425F | 232 | CAD,JVD,IVL,HTN,SR | CABG+/-OFF PUMP | 70 | F | 3 | 1 | HTN | N | 147 | 66 | 30.5 | 33.5 | 7 | 4.78 | III | 4 |
| 190 | 096863G | 248 | Right Frontal Glioma | Right Frontal Gliomectomy | 37 | M | 2 | 1 | OTHERS | N | 172 | 108 | 36.5 | 43.5 | 9.5 | 4.57 | II | 1 |
| Code | Name                          | Procedure                                      | Age | Gender | Race | Diagnosis                          | Procedure Details                                                                 | Vital Signs | Complications | Other Details       | Severity | Risk | Notes  |
|------|-------------------------------|-----------------------------------------------|-----|--------|------|-----------------------------------|-----------------------------------------------------------------------------------|-------------|---------------|-------------------|----------|------|--------|
| 191  | 978940C                       | L4-5 Canal Stenosis                           | 71  | M      | 1    | HTN                               | L4 Laminectomy In Prone REQD                                                      | 167 85 30.5 42 8                                  | 5.25        | IV         | 4                 |
| 192  | 975226D                       | Resolved Appendicitis                         | 30  | M      | 2    | HTN/IBD                           | Lap Appendectomy                                                                 | 169 86 30.1 40 9                                  | 4.44        | III        | 2                 |
| 193  | 409875F                       | Right Ulna Implant Failure                    | 54  | M      | 2    | HTN                               | Right Ulna Redo ORIF                                                             | 171 95 32.5 38 7                                  | 5.42        | II         | 4                 |
| 194  | 075028G                       | Right Calcii                                  | 56  | F      | 2    | DM/HTN                           | PCNL                                                                           | 147 79 36.6 35.5 8                                  | 4.43        | II         | 0                 |
| 195  | 977546D                       | Right Pathological                           | 63  | M      | 1    | HTN                               | Right DDS/CS/P                                                                   | 145 80 38 36 6.5                                  | 5.53        | II         | 5                 |
| 196  | 932076F                       | Intestinal Obstruction                        | 58  | F      | 2    | DM/HTN                           | Laprotoomy Proceed                                                              | 145 64 30.4 35 6.5                                  | 5.38        | III        | 3                 |
| 197  | 815101F                       | Left Chronic Otitis Media                     | 48  | F      | 1    | HTN                               | Left Tymanoplasty                                                               | 145 64 30.4 33 8                                  | 4.125       | II         | 1                 |
| 198  | 050214G                       | Left Inverted Papilloma                       | 38  | M      | 2    | HTN                               | Maxillectomy                                                                   | 185 106 31 43 7.5                                  | 5.73        | II         | 5                 |
| 199  | 113244G                       | Left Vocal Cord Polyp                         | 43  | M      | 1    | HTN                               | ML Scopy+Biopsy                                                                 | 160 79 30.9 38 9                                  | 4.22        | I          | 2                 |
| 200  | 048341G                       | Lip Revision                                  | 17  | M      | 1    | HTN                               | Lip Revision                                                                    | 152 70 30.3 31 8                                  | 3.875       | I           | 1                 |
| 201  | 088859G                       | Right Temporal Glioma                         | 29  | F      | 1    | HTN                               | Right Temporal Craniotomy                                                      | 160 80 31.3 34.5 8                                  | 4.31        | II         | 2                 |
| 202  | 931794F                       | Left Vocal Cord Polyp                         | 52  | M      | 3    | DM/HTN                           | CABG                                                                           | 164 90 33.5 38 9                                  | 4.22        | II         | 2                 |
| 203  | 058729G                       | Left Occipital Convexity                      | 34  | F      | 2    | OTHERS                           | Left Parient Occipital Craniotomy and Excision of Meningioma in Lateral       | 151 69 30.3 31 7.5                                  | 4.13        | III        | 1                 |
| 204  | 095959G                       | CAD,TVD,DM/HTN,NLV,47/3,SU                   | 68  | M      | 3    | DM/HTN                           | CABG                                                                           | 159 76 30.1 38 10                                  | 3.8         | III        | 1                 |
| 205  | 189989F                       | Incisional Hernia                             | 29  | F      | 2    | THYROID                          | Laparoscopic Mesh Repair                                                        | 155 80 33.3 36 7                                  | 5.14        | III        | 5                 |
| 206  | 358991F                       | C3-4 Intracranial Extramedullary             | 68  | M      | 2    | IID/Others                       | Right C3 Hemilaminectomy And Excision in Lateral Position                    | 155 82 34.1 37.8 8                                  | 4.625       | I           | 3                 |
| 207  | 405190D                       | Paraumbilical Hernia                          | 34  | F      | 1    | HTN                               | Laparoscopic Hernioplast                                                         | 149 94 42.3 38 7                                  | 5.42        | II         | 5                 |
| 208  | 682778D                       | CABG                                          | 55  | M      | 3    | IHD                              | Left Juxta Lateral Concavity and Excision of Meningioma                        | 162 80 30.5 38 10                                  | 3.8         | II         | 1                 |
| 209  | 496984F                       | Breast Reduction                              | 31  | F      | 1    | HTN                               | Breast Reduction                                                                | 158 86 34.4 37 7                                  | 5.28        | III        | 6                 |
| 210  | 454113B                       | Right Ear Post Op Revision MRM               | 25  | F      | 1    | HTN                               | Right Tymplasty with Ossiculoplasty Under GA                                   | 161 80 30.9 30 8.5                                 | 3.52        | II         | 1                 |
| 211  | 103120G                       | Left Giant Vestibular Schiavannomia          | 40  | F      | 1    | HTN                               | Craniotomy and Excision of Laminectomy                                         | 142 75 37.2 36 7                                   | 5.14        | II         | 2                 |
| 212  | 028826G                       | Cricocnoma Rectum Post LCCRT                 | 50  | M      | 1    | HTN                               | Laparoscopic Abdominoperineural Excision                                       | 168 85 30.1 42 9                                  | 4.66        | IV         | 5                 |
| 213  | 055697G                       | Multihardal Gaitre                            | 40  | F      | 1    | HTN                               | Total Thyroidectomy                                                             | 155 72 30 32 8                                    | 4           | II         | 1                 |
| 214  | 487054D                       | Left VC Polyp                                 | 56  | F      | 2    | DM/HTN                           | ML Scopy Excision Under GA                                                      | 153 73 31.2 36 9                                  | 4           | II         | 2                 |
| 215  | 054301G                       | Hashimoto Thyroiditis With Pressure Symptom   | 42  | F      | 2    | THYROID                          | Total Thyroidectomy                                                             | 152 70 30.3 35 8.5                                 | 4.11        | II         | 1                 |
| 216  | 865852F                       | TypeII A Chalasia                             | 41  | F      | 2    | HTN                               | Laparoscopic Heller's Myotomy                                                   | 155 85 35.4 37 8                                  | 4.625       | II         | 3                 |
| 217  | 7819688                       | Pituary Microdroma                            | 22  | F      | 2    | OTHERS                           | Laparoscopic Hernioplast                                                        | 165 82 30.1 36.5 7                                 | 5.21        | IV         | 5                 |
| 218  | 113301G                       | Left Sinososal Inverted Papilloma            | 43  | M      | 1    | HTN                               | Left Frontoparietal Carniatomy And Excision With White Matter                  | 168 86 30.5 40 10                                  | 4           | II         | 3                 |
| 219  | 801619B                       | Left Cingulate Gyrus Gloma                   | 55  | F      | 2    | OTHERS                           | Left Frontoparietal Carniatomy And Excision With White Matter                  | 151 77 33.8 32.5 7                                 | 4.64        | II         | 0                 |
| 220  | 04986G                        | Left Breast Cancer                           | 55  | M      | 2    | DM                              | Left MRM                                                                         | 155 73 30.4 35.5 8                                  | 4.43        | II         | 5                 |
| 221  | 008872F                       | Papillary Carcinoma Thyroid with Lymph Nodes | 38  | F      | 2    | DM                              | Thyroidectomy+CCND+Frozen                                                       | 153 74 31.6 36 7                                   | 5.14        | II         | 2                 |
| Patient ID | Date of Operation | Diagnosis/Procedure                                                                 | Age (yrs) | Sex | Race | Other Factors | Surgery Type | Duration of Surgery (min) | Operative Time (hrs) | Other Details |
|-----------|-------------------|------------------------------------------------------------------------------------|-----------|-----|------|--------------|--------------|--------------------------|-------------------|--------------|
| 222       | 078873G           | Paraumbilical Hernia                                                               | 295       | F   | 0    |              | Laparoscopic | 30 F 2 1 OTHERS N 150 74 32.9 32.5 7 4.64 II 1 |                    |              |
| 223       | 067376G           | Right Suspicious Thyroid Nodule                                                   | 294       | M   | 2    |              | Total Thyroidectomy | 38 M 2 1 THYROID N 156 73 30 38 10 3.8 I 0 |                    |              |
| 224       | 030277G           | Multinodular Goitre                                                                | 292       | F   | 2    |              | Total Thyroidectomy | 45 F 2 1 HTN N 144 70 33.8 33 8 4.125 II 1 |                    |              |
| 225       | 103271G           | CAD,TVD,D,M,HTN,LY,SF                                                            | 301       | F   | 3    |              | CABG         | 65 F 3 1 DM/HTN/THYROID N 150 74 32.9 36 6 6 IV 7 |                    |              |
| 226       | 778188F           | Left Forearm Both Bones Cross Union                                               | 297       | F   | 1    |              | Left Forearm Cross Union Excision +/- ORIF With Bone Grafting | 41 F 1 1 0 N 155 78 32.5 36 8 4.5 II 1 |                    |              |
| 227       | 104729G           | T-9-T-10 Calcified Disc                                                           | 299       | M   | 2    |              | Radical Left Lower Lobectomy | 56 F 2 1 THYROID N 151 69 30.3 30 8 3.75 II 2 |                    |              |
| 228       | 451903D           | Bilateral Sinonasal Polyposis                                                     | 300       | F   | 2    |              | Fiss Under GA | 58 M 2 1 HTN N 162 80 30.5 42 8 5.25 III 3 |                    |              |
| 229       | 353632D           | Multinodular Goitre                                                                | 298       | F   | 2    |              | Left Frontoparietal Craniosite And Excision of Meniogoma | 64 M 2 1 HTN N 170 92 31.8 41.5 8 5.1875 IV 5 |                    |              |
| 230       | 098343G           | Sigmoid Structure                                                                  | 296       | F   | 2    |              | Laparoscopic Sigmoid colectomy | 65 M 2 1 HTN N 150 70 31.1 41 8 5.125 II 2 |                    |              |
| 231       | 110509G           | Incarcerated Incisional Hernia                                                    | 309       | F   | 2    |              | Incisional Hernia Mesh | 48 F 2 1 OTHERS N 138 63 33.1 33 8.5 3.88 II 1 |                    |              |
| 232       | 914416F           | Incisional Hernia                                                                | 318       | F   | 2    |              | Open Incisional Hernia | 43 F 1 1 0 N 156 74 30.4 36 8.5 4.23 II 3 |                    |              |
| 233       | 975226D           | Resolved Appendicitis                                                             | 305       | M   | 2    |              | Laparoscopic Appendicitis | 30 M 1 1 0 N 162 88 33.5 40 10 4 II 1 |                    |              |
| 234       | 097114G           | C3-C4 Disc Hernia                                                                 | 317       | M   | 2    |              | C3-C4 Disc Herniectomy | 49 M 2 1 HTN N 164 81 30.1 39.5 11 3.59 IV 1 |                    |              |
| 235       | 708190B           | Syntomatic Gallstone                                                              | 316       | M   | 2    |              | Laparoscopic Cholecystectomy | 50 F 2 1 HTN N 157 83 33.7 36 7 5.14 II 6 |                    |              |
| 236       | 224329F           | C3-C4 Disc Hernia                                                                 | 315       | M   | 2    |              | Total Thyroidectomy | 36 F 1 1 0 N 157 75 30.4 36 8 4.5 III 5 |                    |              |
| 237       | 075302G           | C5-C6 Prolapse Intervertebral Disc                                               | 312       | F   | 2    |              | C5-C6 Prolapse Intervertebral Disc | 45 M 2 1 OTHERS N 175 93 30.4 42 8 5.25 III 1 |                    |              |
| 238       | 380832B           | Lateral Cervical Node Biopsy                                                      | 313       | F   | 2    |              | Left Cervical Node Biopsy | 73 F 2 1 HTN/THYROID N 143 64 31.3 36 6 6 III 9 |                    |              |
| 239       | 932216F           | Cervical Spine Spindle                                                           | 319       | M   | 1    |              | L4L5 PLIF | 26 M 1 1 0 N 163 80 30.1 36 8.5 4.23 IV 3 |                    |              |
| 240       | 114700G           | Posterior Chest Wall Tumor Spindle                                               | 320       | M   | 1    |              | Excision | 35 M 1 1 0 N 179 103 32.1 43 9.5 4.52 III 5 |                    |              |
| 241       | 110733G           | Morbid Obesity                                                                   | 323       | M   | 1    |              | Laparoscopic Sleeve Gastrareloyte | 45 F 1 1 0 N 143 71 34.7 38.5 7.5 5.13 III 3 |                    |              |
| 242       | 112675G           | Right Cervical Node Biopsy                                                       | 327       | M   | 1    |              | Right Cervical Node Biopsy | 49 M 1 1 0 N 166 84 30.4 38 9 4.32 III 3 |                    |              |
| 243       | 249530C           | Cervical Spine Spindle                                                           | 328       | M   | 1    |              | Septoplasty Under GA | 19 M 1 1 0 N 171 88 30.1 36.5 10 3.65 II 0 |                    |              |
| 244       | 109375F           | L4L5 PLIF                                                                      | 329       | M   | 1    |              | PLIF | 28 M 1 1 0 N 163 80 30.1 40 8 5 III 4 |                    |              |
| 245       | 066290G           | Multinodular Goitre                                                               | 324       | M   | 2    |              | Total Thyroidectomy | 47 F 2 1 HTN N 143 71 34.7 32 7.5 4.26 III 2 |                    |              |
| 246       | 040092G           | Gall stones                                                                     | 178       | F   | 2    |              | Lymphocele Repair | 64 F 2 1 DM/HTN/THYROID N 138 65 34.1 31.5 9 3.5 II 4 |                    |              |
| 247       | 835008F           | Fistula in ano                                                                  | 330       | F   | 3    |              | EUA and LOF in prone | 19 M 1 1 0 N 167 100 35.9 40 10 4 III 3 |                    |              |
| 248       | 764041F           | Insalination hernia                                                              | 331       | F   | 2    |              | Lymphocele mesh repair | 65 F 2 1 HTN/IBD N 154 74 31.2 36 8 4.5 IV 2 |                    |              |
### MASTER CHART FOR INTUBATION DIFFICULTY SCORE (IDS SCORE)

| Case No | IP No  | Code No | Experience | Additional intubation | Additional operators | Additional Techniques | C and L grade | Lifting force | External pressure | Total score | Alternative technique |
|---------|--------|---------|------------|-----------------------|----------------------|----------------------|--------------|--------------|-------------------|-------------|-----------------------|
| 1       | 017899G| 1       | 4          | 1                     | 0                    | 1                    | 3            | 1            | 1                 | 6           | Bougie               |
| 2       | 321365A| 2       | 6.5        | 0                     | 0                    | 2                    | 2            | 1            | 1                 | 5           | Ramping / Bougie     |
| 3       | 408616H| 3       | 6          | 0                     | 0                    | 0                    | 1            | 0            | 0                 | 0           | 0                    |
| 4       | 016771G| 6       | 6          | 0                     | 1                    | 3                    | 1            | 1            | 1                 | 5           | Stylette             |
| 5       | 415138F| 9       | 6          | 1                     | 0                    | 3                    | 1            | 1            | 1                 | 5           | 0                    |
| 6       | 565086H| 14      | 3          | 0                     | 0                    | 3                    | 1            | 1            | 0                 | 4           | 0                    |
| 7       | 109835F| 12      | 4.5        | 0                     | 0                    | 3                    | 3            | 1            | 1                 | 7           | Ramping / Stylette / Long Blade |
| 8       | 880800F| 20      | 6          | 0                     | 0                    | 1                    | 2            | 1            | 1                 | 4           | Stylette             |
| 9       | 914758F| 18      | 19         | 0                     | 0                    | 1                    | 1            | 0            | 0                 | 2           | stylette             |
| 10      | 015404A| 17      | 4          | 0                     | 0                    | 1                    | 1            | 0            | 0                 | 2           | Ramping              |
| 11      | 006510G| 19      | 6          | 0                     | 0                    | 2                    | 1            | 0            | 1                 | 3           | 0                    |
| 12      | 643134A| 16      | 7          | 0                     | 0                    | 1                    | 3            | 1            | 0                 | 4           | Ramping              |
| 13      | 019916G| 15      | 4          | 1                     | 1                    | 3                    | 1            | 1            | 1                 | 8           | 0                    |
| 14      | 021615G| 21      | 5          | 0                     | 0                    | 1                    | 2            | 1            | 0                 | 3           | Stylette             |
| 15      | 861277F| 13      | 3          | 0                     | 0                    | 1                    | 2            | 0            | 0                 | 2           | 0                    |
| 16      | 527955D| 22      | 4          | 0                     | 0                    | 3                    | 2            | 1            | 1                 | 6           | 0                    |
| 17      | 920913F| 28      | 15         | 0                     | 0                    | 3                    | 3            | 1            | 1                 | 7           | Ramping / Glide Scope / Stylette |
| 18      | 590374A| 25      | 4          | 0                     | 0                    | 2                    | 2            | 1            | 0                 | 4           | Stylette / Glidescope |
| 19      | 868037F| 23      | 3          | 0                     | 0                    | 2                    | 2            | 0            | 1                 | 4           | 0                    |
| 20      | 337337F| 27      | 3          | 0                     | 0                    | 1                    | 2            | 0            | 0                 | 2           | Glide Scope / Stylette |
| 21      | 040071G| 30      | 12         | 0                     | 0                    | 2                    | 1            | 0            | 0                 | 2           | 0                    |
| 22      | 432244F| 34      | 3          | 0                     | 0                    | 2                    | 2            | 1            | 1                 | 5           | Ramping / Stylette   |
| 23      | 883072F| 29      | 4          | 0                     | 0                    | 0                    | 2            | 0            | 0                 | 1           | 0                    |
| 24      | 024086G| 35      | 3          | 0                     | 0                    | 2                    | 1            | 0            | 1                 | 3           | Ramping / Stylette   |
| 25      | 519699D| 8       | 6          | 0                     | 0                    | 0                    | 1            | 0            | 0                 | 0           | 0                    |
| 26      | 080306D| 36      | 3          | 1                     | 1                    | 0                    | 1            | 1            | 1                 | 4           | 0                    |
| 27      | 290676C| 26      | 12         | 0                     | 0                    | 1                    | 2            | 0            | 0                 | 2           | 0                    |
| 28      | 893830F| 46      | 4          | 0                     | 0                    | 0                    | 2            | 0            | 0                 | 1           | 0                    |
| 29      | 837586F| 44      | 4          | 0                     | 0                    | 1                    | 2            | 0            | 0                 | 2           | Stylette             |
| No. | Code    | Value | Stylette/Ramping/Long Blade | Stylette/Ramping | Stylette | Ramping/Stylette | Stylette/Ramping/Long Blade | Stylette/Ramping/Small Size Tube | Glide Scope/Stylette/Ramping/Small Size Tube | Ramping/Stylette/GlideScope/Stylette |
|-----|---------|-------|-------------------------------|------------------|----------|-----------------|-----------------------------|---------------------------------|------------------------------------------|--------------------------------|
| No. | Code      | Description                             |
|-----|-----------|-----------------------------------------|
| 63  | 901719D   | 0 0 0 1 0 1 0 1                      |
| 64  | 036516G   | 0 0 1 2 0 1 3                        |
| 65  | 051171G   | 0 0 1 2 1 0 3 Stylette               |
| 66  | 901436F   | 1 1 0 2 1 1 5 0                      |
| 67  | 704276F   | 0 2 2 1 1 6 Ramping/Stylette         |
| 68  | 626313B   | 0 0 1 2 0 2 1 0                      |
| 69  | 045433G   | 0 0 0 1 0 1 1 0                      |
| 70  | 03218G    | 0 0 0 1 0 0 0 0                      |
| 71  | 328027C   | 0 0 1 2 0 1 3 Stylette               |
| 72  | 049816G   | 0 0 2 1 1 1 4 Glide Scope/stylette  |
| 73  | 017795G   | 0 0 2 0 0 3 Glide Scope/stylette    |
| 74  | 838252F   | 0 0 1 0 0 0 0 0                      |
| 75  | 056777G   | 0 0 0 1 0 0 0 0                      |
| 76  | 856270H   | 0 0 1 1 0 0 1 Ramping               |
| 77  | 065874G   | 0 0 1 1 0 0 2 Long Blade             |
| 78  | 056947G   | 0 0 0 2 0 0 1 Glide Scope/stylette  |
| 79  | 025308G   | 0 0 1 0 0 0 2 Ramping/stylette      |
| 80  | 810688F   | 0 0 1 1 0 0 2 Stylette              |
| 81  | 021271G   | 0 0 1 1 0 0 1 Ramping/stylette      |
| 82  | 037662G   | 0 0 2 1 0 0 2 Ramping/stylette      |
| 83  | 865811F   | 0 0 2 2 0 1 Glide Scope/stylette    |
| 84  | 034465G   | 0 0 2 1 1 1 4 Long Blade/stylette   |
| 85  | 676612F   | 0 0 2 0 0 1 Glide Scope/stylette    |
| 86  | 044909G   | 0 0 1 1 0 0 2 Stylette              |
| 87  | 855282D   | 0 0 2 2 0 1 Ramping/stylette        |
| 88  | 241445H   | 0 0 2 3 0 1 5 Ramping/stylette      |
| 89  | 895175F   | 0 0 1 1 0 0 1 Ramping               |
| 90  | 058271G   | 0 0 1 0 0 0 0 0                      |
| 91  | 229956B   | 1 4 3 1 1 9 Ramping/Bougie/Glide Scope/Fibreoptic |
| 92  | 253042F   | 0 0 2 1 0 1 3 Stylette/Ramping      |
| 93  | 853988F   | 0 0 1 0 0 0 0 0                      |
| 94  | 615596F   | 0 0 3 1 0 0 3 Ramping/Glide Scope/stylette |
| 95  | 032248G   | 0 0 2 1 0 0 2 Glide Scope/stylette  |
| Position | Code | Quantity | Value1 | Value2 | Value3 | Value4 | Value5 | Value6 | Value7 | Value8 | Value9 | Value10 |
|----------|------|----------|--------|--------|--------|--------|--------|--------|--------|--------|--------|---------|
| 96       | 253092C | 123 | 7      | 0      | 0      | 1      | 1      | 0      | 1      | 2      |        | Stylette |
| 97       | 926201F | 126 | 12     | 0      | 0      | 1      | 1      | 0      | 0      | 1      |        | Ramping  |
| 98       | 497266C | 106 | 4      | 0      | 0      | 0      | 2      | 0      | 1      | 2      |        | 0       |
| 99       | 061825G | 125 | 7      | 0      | 0      | 3      | 1      | 0      | 0      | 3      |        | Ramping/GlideScope/Stylette |
| 100      | 385500F | 129 | 3      | 0      | 0      | 1      | 2      | 0      | 1      | 3      |        | Stylette |
| 101      | 504769B | 128 | 3      | 0      | 0      | 2      | 1      | 0      | 1      | 3      |        | Ramping/Stylette |
| 102      | 874001D | 124 | 7      | 0      | 0      | 3      | 1      | 0      | 0      | 3      |        | Ramping/GlideScope/Stylette |
| 103      | 364290A | 127 | 3      | 0      | 0      | 2      | 2      | 0      | 1      | 5      |        | Ramping/Stylette |
| 104      | 063890G | 135 | 8      | 0      | 0      | 0      | 2      | 0      | 0      | 1      |        | 0       |
| 105      | 798933F | 122 | 4.5    | 0      | 0      | 0      | 2      | 0      | 1      | 2      |        | 0       |
| 106      | 610953F | 133 | 6      | 0      | 0      | 3      | 1      | 0      | 1      | 4      |        | GlideScope/Stylette/Ramping |
| 107      | 751845B | 134 | 6      | 0      | 0      | 2      | 3      | 0      | 1      | 5      |        | Ramping/Stylette |
| 108      | 064368G | 132 | 4      | 0      | 0      | 3      | 1      | 0      | 1      | 4      |        | Long Blade/Stylette/Ramping |
| 109      | 057713G | 111 | 8      | 1      | 0      | 1      | 2      | 0      | 1      | 4      |        | Stylette |
| 110      | 069156G | 137 | 3      | 0      | 0      | 2      | 2      | 0      | 1      | 4      |        | Ramping/Stylette |
| 111      | 068192G | 139 | 4      | 2      | 1      | 1      | 3      | 0      | 1      | 7      |        | Macoy   |
| 112      | 682247F | 138 | 11     | 0      | 0      | 0      | 2      | 0      | 1      | 0      |        |         |
| 113      | 519447B | 143 | 6      | 0      | 0      | 1      | 1      | 0      | 0      | 1      |        | Stylette |
| 114      | 070439G | 141 | 6      | 0      | 0      | 0      | 2      | 0      | 0      | 1      |        | 0       |
| 115      | 041640G | 145 | 6      | 0      | 0      | 2      | 2      | 0      | 1      | 4      |        | Macoy/Stylette |
| 116      | 986980A | 149 | 12     | 1      | 1      | 0      | 2      | 0      | 0      | 4      |        | 0       |
| 117      | 074707G | 146 | 6      | 0      | 0      | 2      | 2      | 1      | 1      | 5      |        | Ramping/GlideScope |
| 118      | 491408F | 148 | 6      | 0      | 0      | 2      | 2      | 0      | 1      | 4      |        | Ramping/Stylette |
| 119      | 066110G | 147 | 6      | 0      | 0      | 0      | 1      | 0      | 1      | 1      |        | 0       |
| 120      | 080731G | 152 | 4      | 0      | 0      | 2      | 1      | 0      | 0      | 2      |        | Ramping/Stylette |
| 121      | 248845F | 151 | 4      | 2      | 1      | 1      | 3      | 1      | 1      | 8      |        | Bougie  |
| 122      | 870231D | 156 | 6      | 0      | 0      | 1      | 1      | 0      | 0      | 1      |        | Long Blade |
| 123      | 070955G | 157 | 4      | 0      | 0      | 1      | 1      | 0      | 0      | 1      |        | Stylette |
| 124      | 883347F | 158 | 12     | 0      | 0      | 1      | 1      | 1      | 0      | 2      |        |         |
| 125      | 817231F | 154 | 3.5    | 0      | 0      | 0      | 2      | 1      | 0      | 2      |        | 0       |
| 126      | 897393F | 161 | 3      | 0      | 0      | 0      | 1      | 0      | 0      | 0      |        | 0       |
| 127      | 693539C | 163 | 12     | 0      | 0      | 1      | 2      | 0      | 1      | 3      |        | C-MAC   |
| 128      | 014175G | 168 | 3      | 0      | 0      | 0      | 1      | 1      | 0      | 1      |        | 0       |

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| 129 | 840619F | 162 | 9 | 1 | 1 | 2 | 3 | 1 | 1 | 8 | Ramping/Stylette |
|-----|--------|-----|---|---|---|---|---|---|---|---|------------------|
| 130 | 064587G | 164 | 8 | 0 | 0 | 1 | 2 | 0 | 1 | 3 | Stylette |
| 131 | 706323B | 166 | 4 | 0 | 0 | 3 | 1 | 0 | 0 | 3 | Ramping/GlideScope/Stylette |
| 132 | 055319G | 165 | 3 | 0 | 0 | 0 | 1 | 1 | 0 | 1 | 0 |
| 133 | 056794G | 175 | 4 | 0 | 0 | 0 | 2 | 0 | 0 | 1 | 0 |
| 134 | 070075G | 174 | 5 | 0 | 0 | 3 | 2 | 1 | 1 | 6 | Long blade/Ramping/Stylette |
| 135 | 061782G | 173 | 3 | 0 | 0 | 1 | 1 | 0 | 1 | 3 |
| 136 | 067121G | 179 | 3 | 0 | 0 | 1 | 1 | 1 | 0 | 2 | Stylette |
| 137 | 077021G | 177 | 6 | 0 | 0 | 3 | 2 | 1 | 0 | 5 | Ramping/Stylette/C-MAC |
| 138 | 011276C | 183 | 6 | 0 | 0 | 1 | 2 | 1 | 1 | 4 | Stylette |
| 139 | 076018G | 181 | 12 | 0 | 0 | 1 | 1 | 0 | 0 | 1 | Ramping |
| 140 | 077517G | 188 | 4.5 | 0 | 0 | 0 | 2 | 0 | 0 | 1 | 0 |
| 141 | 834830F | 189 | 4.5 | 0 | 0 | 1 | 2 | 0 | 0 | 1 | 3 | Ramping |
| 142 | 749778A | 186 | 6 | 0 | 0 | 1 | 1 | 0 | 0 | 1 | Stylette |
| 143 | 069169G | 180 | 3.5 | 0 | 0 | 0 | 1 | 0 | 0 | 0 | 0 |
| 144 | 748596F | 197 | 12 | 0 | 0 | 1 | 2 | 1 | 1 | 4 | Bougie |
| 145 | 288445D | 190 | 4.5 | 0 | 0 | 0 | 2 | 0 | 0 | 1 | 0 |
| 146 | 073225G | 185 | 3.5 | 0 | 0 | 0 | 2 | 0 | 1 | 2 | 0 |
| 147 | 079160G | 184 | 7.5 | 0 | 0 | 3 | 2 | 0 | 1 | 5 | Ramping/GlideScope/Stylette |
| 148 | 075015G | 182 | 9 | 1 | 0 | 2 | 4 | 1 | 1 | 8 | Long Blade/GlideScope |
| 149 | 146427F | 194 | 6 | 0 | 0 | 2 | 2 | 1 | 1 | 5 | Ramping/Stylette |
| 150 | 069387G | 196 | 6 | 0 | 0 | 2 | 1 | 0 | 0 | 2 | GlideScope/Stylette |
| 151 | 924832F | 193 | 3.5 | 0 | 0 | 2 | 1 | 0 | 0 | 2 | Ramping/Stylette |
| 152 | 046369G | 191 | 7 | 0 | 1 | 1 | 4 | 1 | 1 | 7 |
| 153 | 285272B | 187 | 8.5 | 0 | 0 | 1 | 2 | 0 | 0 | 1 | 3 |
| 154 | 076644G | 198 | 4 | 0 | 0 | 1 | 2 | 1 | 1 | 4 | GlideScope |
| 155 | 075885G | 200 | 18 | 0 | 0 | 2 | 0 | 0 | 0 | 1 | 0 |
| 156 | 076274G | 204 | 4 | 0 | 0 | 0 | 2 | 0 | 0 | 1 | 0 |
| 157 | 090347G | 207 | 5 | 0 | 0 | 1 | 0 | 2 | 0 | 1 | 3 | 0 |
| 158 | 928741F | 216 | 3.5 | 0 | 0 | 1 | 2 | 1 | 1 | 4 | Ramping |
| 159 | 964246D | 208 | 4 | 0 | 0 | 0 | 1 | 0 | 0 | 0 | 0 |
| 160 | 837810D | 215 | 3.5 | 0 | 0 | 1 | 2 | 1 | 1 | 4 | GlideScope |
| 161 | 08715G | 213 | 9 | 1 | 0 | 2 | 2 | 1 | 1 | 6 | Long Blade/GlideScope |
| 162 | 186387D | 217 | 8 | 0 | 0 | 1 | 2 | 1 | 1 | 4 | Stylette | Long |
| 163 | 539360D | 205 | 6 | 3 | 1 | 3 | 3 | 1 | 1 | 11 | Blade/Hougie/GlideScope |
| 164 | 076112G | 211 | 9 | 0 | 0 | 0 | 1 | 0 | 0 | 0 | 0 |
| 165 | 082942G | 210 | 4 | 0 | 0 | 1 | 2 | 1 | 1 | 4 | Ramping |
| 166 | 628475F | 224 | 4 | 0 | 0 | 1 | 3 | 1 | 1 | 5 | Stylette |
| 167 | 634944F | 219 | 3 | 0 | 0 | 1 | 1 | 0 | 0 | 1 | Stylette |
| 168 | 738422C | 222 | 5.5 | 0 | 0 | 0 | 1 | 0 | 0 | 1 | 1 |
| 169 | 083338G | 221 | 3.5 | 0 | 0 | 1 | 1 | 0 | 0 | 1 | Ramping |
| 170 | 083547G | 220 | 4 | 0 | 0 | 1 | 2 | 0 | 0 | 0 | 2 | Stylette |
| 171 | 977546D | 172 | 3 | 0 | 0 | 1 | 2 | 0 | 0 | 2 | 0 |
| 172 | 339837F | 223 | 5 | 0 | 0 | 1 | 1 | 0 | 0 | 1 | Ramping |
| 173 | 540671D | 229 | 5 | 0 | 0 | 1 | 2 | 0 | 1 | 3 | Stylette |
| 174 | 091823G | 225 | 12 | 0 | 0 | 1 | 1 | 0 | 0 | 1 | Fibro-Optic |
| 175 | 796615F | 227 | 6 | 0 | 0 | 2 | 2 | 0 | 0 | 3 | GlideScope/Ramping |
| 176 | 081017G | 240 | 4 | 0 | 0 | 0 | 1 | 1 | 1 | 1 | 2 | 0 |
| 177 | 005390F | 241 | 3 | 0 | 0 | 1 | 2 | 0 | 0 | 2 | Stylette |
| 178 | 076154G | 242 | 4 | 0 | 0 | 3 | 1 | 1 | 1 | 5 | GlideScope/Stylette/Ramping |
| 179 | 895435F | 231 | 4 | 0 | 0 | 1 | 2 | 0 | 0 | 2 | Stylette |
| 180 | 871670F | 235 | 6 | 0 | 0 | 1 | 1 | 0 | 1 | 2 | Ramping |
| 181 | 084511G | 233 | 18 | 0 | 0 | 2 | 2 | 0 | 1 | 4 | Long Blade/Stylette |
| 182 | 591523C | 243 | 5.5 | 0 | 0 | 2 | 2 | 0 | 0 | 4 | Stylette/Ramping |
| 183 | 770477D | 236 | 3 | 0 | 0 | 1 | 1 | 1 | 1 | 3 | Long Blade |
| 184 | 344062C | 230 | 3 | 0 | 0 | 1 | 2 | 0 | 1 | 3 | Stylette |
| 185 | 828389D | 249 | 5 | 0 | 0 | 2 | 1 | 0 | 1 | 3 | GlideScope/Stylette |
| 186 | 891852F | 252 | 5 | 0 | 0 | 2 | 2 | 1 | 1 | 5 | Ramping/Long Blade |
| 187 | 082323G | 247 | 5 | 0 | 0 | 1 | 2 | 0 | 1 | 3 | Stylette |
| 188 | 065104G | 251 | 12 | 0 | 0 | 0 | 2 | 1 | 1 | 3 | 0 |
| 189 | 917425F | 232 | 9 | 0 | 0 | 3 | 1 | 1 | 1 | 4 | 0 |
| 190 | 096883G | 248 | 4 | 0 | 0 | 0 | 2 | 0 | 0 | 1 | 0 |
| 191 | 978904C | 250 | 4 | 0 | 0 | 1 | 3 | 0 | 1 | 4 | Stylette |
| 192 | 975226D | 255 | 6 | 0 | 0 | 0 | 2 | 0 | 1 | 2 | 0 |
| 193 | 409875F | 253 | 6 | 0 | 0 | 3 | 1 | 0 | 1 | 4 | GlideScope/Stylette/Ramping |
| 194 | 075028G | 254 | 4 | 0 | 0 | 0 | 1 | 0 | 0 | 0 | 0 |
|   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| 195 | 977546D | 257 | 6 | 0 | 0 | 3 | 2 | 0 | 1 | 5 | GlideScope/Stylette/Ramping |
| 196 | 932076F | 257 | 6 | 0 | 0 | 2 | 1 | 0 | 1 | 3 | Ramping/Stylette |
| 197 | 815101F | 260 | 4 | 0 | 0 | 0 | 1 | 0 | 1 | 1 | 0 |
| 198 | 050214G | 259 | 4 | 0 | 0 | 1 | 3 | 1 | 1 | 5 |
| 199 | 113244G | 261 | 3.5 | 0 | 1 | 0 | 1 | 0 | 1 | 2 | 0 |
| 200 | 044341G | 256 | 20 | 0 | 0 | 2 | 0 | 1 | 2 | 0 |
| 201 | 080859G | 257 | 10 | 0 | 0 | 2 | 1 | 0 | 2 | 0 |
| 202 | 931794F | 258 | 9 | 0 | 0 | 2 | 0 | 1 | 2 | 0 |
| 203 | 058782G | 264 | 4 | 0 | 0 | 2 | 0 | 0 | 1 | 0 |
| 204 | 095959G | 265 | 4 | 0 | 0 | 2 | 0 | 0 | 1 | 0 |
| 205 | 180688F | 269 | 20 | 0 | 0 | 1 | 3 | 1 | 1 | 5 |
| 206 | 358991F | 263 | 9 | 0 | 0 | 2 | 0 | 1 | 3 | Bougie |
| 207 | 405150D | 268 | 12 | 0 | 0 | 2 | 2 | 1 | 1 | 5 |
| 208 | 682778D | 280 | 9 | 0 | 0 | 0 | 1 | 0 | 1 | 1 |
| 209 | 469684F | 277 | 9 | 0 | 0 | 1 | 4 | 1 | 1 | 6 |
| 210 | 454113B | 285 | 4 | 0 | 0 | 0 | 1 | 0 | 1 | 1 |
| 211 | 103120G | 279 | 12 | 0 | 0 | 1 | 1 | 1 | 0 | 2 | Stylette |
| 212 | 028826G | 282 | 9.5 | 0 | 0 | 1 | 3 | 1 | 1 | 5 |
| 213 | 055697G | 283 | 6 | 0 | 0 | 0 | 1 | 1 | 0 | 1 |
| 214 | 487054D | 286 | 4 | 0 | 0 | 0 | 1 | 1 | 1 | 2 |
| 215 | 054301G | 284 | 3 | 0 | 0 | 0 | 2 | 0 | 0 | 1 |
| 216 | 865852F | 281 | 5 | 0 | 0 | 0 | 2 | 0 | 1 | 3 |
| 217 | 781988F | 288 | 6 | 0 | 0 | 2 | 3 | 0 | 1 | 5 | Bougie/Ramping |
| 218 | 113301G | 290 | 3 | 0 | 0 | 0 | 2 | 1 | 1 | 3 |
| 219 | 801619B | 287 | 6 | 0 | 0 | 0 | 1 | 0 | 0 | 0 |
| 220 | 049966G | 296 | 6 | 0 | 0 | 2 | 3 | 0 | 1 | 5 | Ramping/Long Blade |
| 221 | 008872F | 293 | 4 | 0 | 0 | 1 | 2 | 0 | 0 | 2 | Bougie |
| 222 | 078873G | 295 | 6 | 0 | 0 | 1 | 1 | 0 | 0 | 1 | Bougie |
| 223 | 067376G | 294 | 3 | 0 | 0 | 0 | 1 | 0 | 0 | 0 |
| 224 | 030277g | 292 | 3 | 0 | 0 | 0 | 2 | 0 | 0 | 1 |
| 225 | 103271G | 301 | 9 | 2 | 0 | 1 | 3 | 1 | 1 | 7 | Bougie |
| 226 | 778188F | 297 | 3 | 0 | 0 | 1 | 1 | 0 | 0 | 1 | Stylette |
| 227 | 104729G | 299 | 9 | 0 | 0 | 2 | 2 | 0 | 0 | 3 | Bougie/Ramping |
| Row | Code          | Value | Column 1 | Column 2 | Column 3 | Column 4 | Column 5 | Column 6 | Column 7 | Column 8 | Column 9 | Column 10 | Column 11 | Description                |
|-----|---------------|-------|----------|----------|----------|----------|----------|----------|----------|----------|----------|-----------|-----------|-----------------------------|
| 228 | 431903D       | 308   | 4        | 0        | 0        | 0        | 2        | 0        | 1        | 2        | 0        | 3         | Ramping               |
| 229 | 335632D       | 304   | 4        | 0        | 0        | 1        | 2        | 1        | 0        | 3         | Ramping/Stylette           |
| 230 | 098343G       | 298   | 6        | 0        | 0        | 2        | 2        | 1        | 1        | 5         | Ramping/Stylette           |
| 231 | 442190C       | 310   | 4.5      | 0        | 0        | 0        | 2        | 0        | 1        | 2         | 0         | Ramping/Stylette           |
| 232 | 475869B       | 311   | 3        | 0        | 0        | 1        | 3        | 0        | 1        | 4         | Bougie                  |
| 233 | 101509G       | 309   | 5.5      | 0        | 0        | 1        | 1        | 0        | 0        | 1         | Bougie                  |
| 234 | 914416F       | 318   | 4.5      | 0        | 0        | 1        | 2        | 0        | 1        | 3         | Ramping/Stylette           |
| 235 | 975326D       | 305   | 6        | 0        | 0        | 0        | 2        | 0        | 0        | 1         | Ramping/Stylette           |
| 236 | 097114G       | 317   | 12       | 0        | 0        | 0        | 2        | 0        | 0        | 1         | Ramping/Stylette           |
| 237 | 708190B       | 316   | 6        | 0        | 0        | 0        | 2        | 3        | 1        | 1         | 6         | Ramping/Stylette           |
| 238 | 224329F       | 315   | 9        | 1        | 0        | 1        | 2        | 1        | 1        | 5         | 0         | Ramping/Stylette           |
| 239 | 075302G       | 312   | 6        | 0        | 0        | 1        | 1        | 0        | 0        | 1         | Ramping/Stylette           |
| 240 | 380832B       | 313   | 20       | 2        | 2        | 1        | 3        | 1        | 1        | 9         | 0         | Ramping/Stylette           |
| 241 | 932216F       | 319   | 3        | 0        | 0        | 1        | 2        | 0        | 1        | 3         | 3         | GlideScope              |
| 242 | 114700G       | 320   | 6        | 1        | 0        | 0        | 3        | 1        | 1        | 5         | 0         | Ramping/Stylette           |
| 243 | 110733G       | 323   | 7        | 0        | 0        | 1        | 2        | 1        | 0        | 3         | 0         | Ramping/Stylette           |
| 244 | 112675G       | 327   | 7        | 0        | 0        | 1        | 3        | 0        | 0        | 3         | 0         | Ramping/Stylette           |
| 245 | 249510C       | 328   | 4        | 0        | 0        | 0        | 1        | 0        | 0        | 0         | 0         | Ramping/Stylette           |
| 246 | 109375F       | 326   | 3        | 0        | 1        | 1        | 2        | 0        | 1        | 4         | 0         | Ramping/Stylette           |
| 247 | 066250G       | 324   | 3        | 0        | 1        | 1        | 1        | 1        | 0        | 2         | 0         | Ramping/Stylette           |
| 248 | 040922G       | 178   | 6        | 0        | 0        | 3        | 1        | 0        | 1        | 4         | 3         | Ramping/Stylette           |
| 249 | 833008F       | 330   | 6        | 0        | 0        | 1        | 2        | 0        | 1        | 3         | 0         | Ramping/Stylette           |
| 250 | 764041F       | 331   | 4        | 0        | 0        | 1        | 1        | 0        | 1        | 2         | 0         | Ramping/Stylette           |