A PROSPECTIVE RANDOMISED STUDY TO COMPARE AND EVALUATE MACINTOSH LARYNGOSCOPE AND KING VISION VIDEO LARYNGOSCOPE FOR ROUTINE INTUBATION IN ADULTS SCHEDULED FOR ELECTIVE SURGERY

Thesis Submitted to

THE TAMIL NADU DR. MGR. MEDICAL UNIVERSITY, CHENNAI–600032.

*TAMILNADU **i**n partial fulfilment of the rules and regulations for the award of*

M.D. DEGREE EXAMINATION

in

ANAESTHESIOLOGY – Branch X

GOVERNMENT MOHAN KUMARA MANGALAM

MEDICAL COLLEGE, SALEM, TAMILNADU.

APRIL 2016

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R.Megala

Date: 28-09-2015

Place: Salem

Signature of the Candidate

DR. R. MEGALA

Government Mohan Kumaramangalam

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Place: Salem

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Date: 28-09-2015

Place: Salem

ACKNOWLEDGEMENTS

I am deeply indebted to my guide Dr. Murugesan. K, Associate Professor, Department of Anaesthesiology, Government Mohan Kumaramangalam Medical College, Salem for his untiring help and meticulous guidance throughout the course of the study. His boundless enthusiasm was a constant source of encouragement to me.

I am very grateful to Professor Dr. Sivakumar. G, Professor and Head of Department of Anaesthesiology for the kind help and invaluable guidance given to me in carrying out this study.

It is my privileged duty to thank Professor Dr Nagarajan. R and Dr. Santhanakrishnan. C, Associate Professor for their esteemed guidance in many aspects of this study.

I wish to express my heartfelt gratitude to Dr. Rameshkumar. S, Senior Assistant Professor, Department of Anaesthesiology for his constructive criticism and invaluable suggestions during every phase of the study.

My sincere thanks to the faculty members of my department, for their interest and motivation throughout the study period.

I am thankful to the residents of my department for their help and enthusiastic support at every point of the study.

I am thankful to The Dean and Ethical committee, Mohan Kumaramangalam Medical College, Salem for permitting me to do the study.

Special thanks to the sisters and OT staff for their invaluable assistance and cooperation. I will be failing in my duty if I do not express my gratitude to the patients, without whom this study would not have been possible.

I also express my sincere thanks to those who helped me with the statistical analysis and in typing this manuscript.

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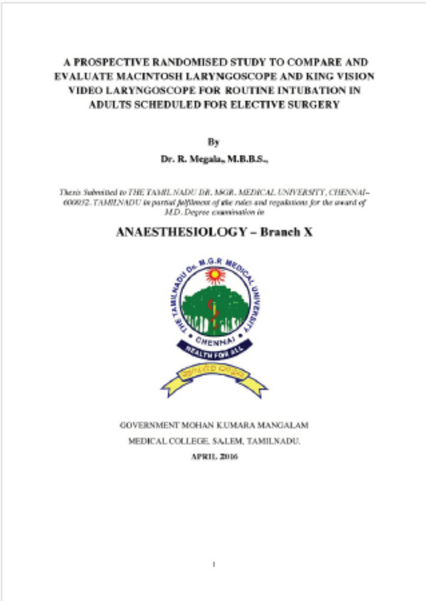
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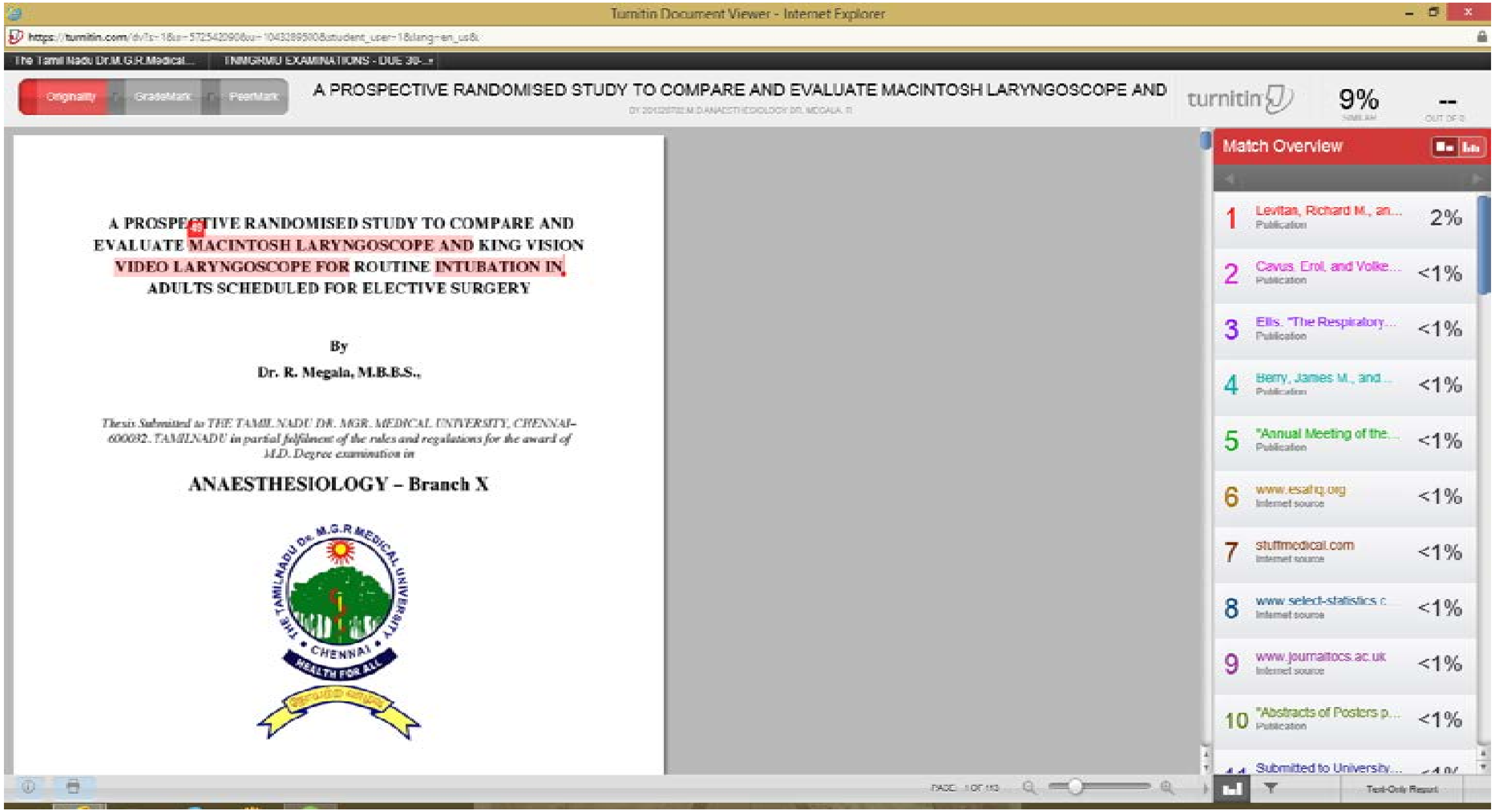
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ABSTRACT

ABSTRACT

A prospective randomised study to compare and evaluate Macintosh laryngoscope and King Vision Video laryngoscope for routine intubation in adults scheduled for elective surgery.

Megala R[1], Murugesan K[2], Sivakumar G[3]

[1]Junior Resident, [2]Associate Professor, [3]Professor & Head, Department of Anaesthesiology, Government Mohan Kumaramangalam Medical College, Salem.

Purpose: The present study compared the King Vision Video Laryngoscope (KVVL) channelled blade with Macintosh laryngoscope (ML) with regard to the laryngoscopic view, laryngoscopic time and time required to complete the tracheal intubation with head in neutral position. We aimed to investigate any disadvantages that the King Vision Video Laryngoscope may have with regard to hemodynamics when used in routine clinical practice.

Methods: Eighty patients undergoing elective surgery requiring general anaesthesia and tracheal intubation were randomly allocated to receive tracheal intubation using the King Vision Video Laryngoscope or the Macintosh laryngoscope. Following a standardised general anaesthetic, data were collected during and after laryngoscopy and endotracheal intubation.

Results: The mean tracheal intubation time (TTI) for the King Vision Video Laryngoscope and Macintosh laryngoscope respectively were 24.9 and 26.5seconds, (p =0.596). The mean duration of laryngoscopy (DOL) for the King Vision Video Laryngoscope and Macintosh laryngoscope respectively were 46.5 and 46.4 seconds (p = 0.925). Only 37.5% in ML group had Cormack Lehane grade 1 glottic view while all in KVVL had grade 1 glottic view. The percentage of patients who did not required optimisation manoeuvres were respectively 72.5% and 27.5% for KVVL and ML. The change in hemodynamic profile was comparable between both groups.

Conclusion: King Vision Video Laryngoscope has comparable efficacy related to intubation time, duration of laryngoscopy, success rate and ease of intubation. Although King Vision provided greater percentage of best laryngoscopic view with less requirement of optimising manoeuvres, it provides no added benefit with regard to fluctuation of the hemodynamic response to intubation. Therefore, we conclude that the King Vision Video Laryngoscope may be used in routine clinical practice for tracheal intubation.

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Ethical Committee Meeting held on 08.01.2015 at 11.00 A.M in the Seminar Hall, IInd Floor, Medicine Block, Govt. Mohan Kumaramangalam Medical College Hospital, Salem 01.

The following Members were attended the Meeting.

MEMBERS:

1. Dr. N. Mohan, MS.,FICS.,FAIS.,FMMC., Dean, Govt. Mohan Kumaramangalam Medical College, Salem.
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Sl. No.	Name of the Presenter with Address	Title	Name of the Guide and Address	Whether it is Approved or not.
1.	Dr. R. Megala, II Year MD., P. G. Student, GMKMC, Salem – 30.	A Prospective randomised study to compare and evaluate macintosh laryngoscope and king vision video laryngoscope for routine intubation in adults scheduled for elective surgery.	Dr. Murugesan, MD., D.A, Associate Professor of Anaesthesiology Department, GMKMC, Salem.	Approved

The Ethical Committee examined the studies in detail and is pleased to accord Ethical Committee approval for the above Post Graduate of this College to carry out the studies with the following conditions.

1. He should carry out the work without detrimental to regular activities as well as without extra expenditure to the institution to Government.
2. He should inform the institution Ethical Committee in case of any change of study procedure site and investigation or guide.
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7. He should not claim any funds from the institution while doing the work or on completion.
8. He should understand that the members of IEC have the right to monitor the work with prior intimation.

DEAN

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LIST OF ABBREVIATIONS USED

(In alphabetical order)

AA	-	Alkaline Low Voltage Battery of size 50.5 X 14.5mm
AAA	-	Alkaline Low Voltage Battery of size 45.5 X 10.5mm
ABS	-	Acrylonitrile Butadiene Styrene
ASA	-	American Society of Anaesthesiologist
AVIL	-	Angulated Video Intubating System
AWS	-	Airway Scope
BMI	-	Body Mass Index
BP	-	Blood Pressure
C1	-	First Cervical Vertebra
CCD	-	Charge Coupled Device
CI	-	Confidence Interval
CL GRADE	-	Cormack - Lehane Grade
Cm, Cms	-	Centimetre
CMAC	-	C-MAC Video Laryngoscope
CMOS	-	Complementary Metal Oxide Semi-Conductors
CPAP	-	Continuous Positive Airway Pressure
C-SPINE	-	Cervical Spine
DBP	-	Diastolic Blood Pressure
DCI	-	Direct Coupler Interface
DL	-	Direct Laryngoscopy
DOL	-	Duration of Laryngoscopy
ECG	-	Electrocardiogram
EMBASE	-	Excerpta Medica Database
EOI	-	Ease of Intubation
ETT	-	Endo Tracheal Tube
EVO2	-	Truview EVO2 Laryngoscope
ICU	-	Intensive Care Unit
IP	-	In Patient
Kg	-	Kilogram
KV	-	King Vision
KVVL	-	King Vision Video Laryngoscope
LA	-	Laryngeal Axis
LCD	-	Liquid Crystal Display
LED	-	Light Emitting Diode
LOV	-	Line of Vision
M^2	-	square meter
MAC	-	Macintosh type
MBP	-	Mean Blood Pressure
mcg	-	Microgram
Min	-	Minute
ML	-	Macintosh Laryngoscope
mmHg	-	millimetre of mercury
NPO	-	Nil Per Oral
OA	-	Oral Axis
OLED	-	Organic Light Emitting Diode
OM	-	Optimisation Manoeuvre
PA	-	Pharyngeal Axis
PI	-	Post Induction
POGO	-	Percentage of Glottic Opening
PP	-	Post Premedication
PT	-	Post Intubation time
QVGA	-	Quarter Video Graphics Array
RCA	-	Radio Corporation of America
SBP	-	Systolic Blood Pressure
Secs	-	Seconds
TTI	-	Time for Tracheal Intubation
UE	-	UE Laryngoscope
USA	-	United States of America
VGA	-	Video Graphics Array
VL	-	Video Laryngoscope

INTRODUCTION

INTRODUCTION

Airway Management, an essential skill forms the central pillar of the practice of anaesthesiology, resuscitation, critical care and emergency medicine. Maintaining a free airway during general anaesthesia is primarily achieved by cannulation of trachea via orotracheal route, a technique recognised as endotracheal intubation. Intubation isolates the respiratory tract from digestive tract, allows control of breathing, and facilitates administration of oxygen, anaesthetic gases and drugs.

Direct laryngoscopy is the easiest and most straightforward technique used for visualisation of larynx and intubation of trachea. Historically laryngoscopy involved direct line-of-sight to the larynx and most direct laryngoscopy in adults is performed with curved Macintosh blade. With direct laryngoscopy visualisation of larynx primarily depends on

- Lateral retraction of tongue,
- Forward traction of lower jaw,
- Favourable alignment of oral, pharyngeal and laryngeal axis named sniffing position involving flexion at the neck by placing head pillow and extension at the atlantooccipital joint,
- Firm External Laryngeal Manipulation.

Tube Stylets or Bougie are often needed for intubation with or without optimisation of the above said factors.

Fiberoptic endoscopic techniques and video imaging techniques provide improved view of glottis and hence successful intubation without upper airway retraction, optimal head and neck positioning, optimal external laryngeal manipulation and use of tube introducers. Unfortunately due to variable learning curve of practitioners video assisted devices prolong intubation time in easy airway and hence they are reserved for intubation of anticipated difficult airway.

Airway instrumentation or manipulation of any kind is noxious producing adverse reflex mediated changes in cardiovascular physiology. Profound alterations in heart rate and blood pressure is found to be hazardous in patients having pre-existing hypertension, coronary disease or intracranial neuropathology resulting in serious myocardial ischemia, heart failure and severe neurologic compromise due to elevated intracranial pressure. Easy visualisation without forceful retraction by optical and video assisted devices score in view of better hemodynamic stability and now they are routinely used for managing normal airway.

The King Vision video laryngoscope (King Systems Company, a division of Consort Medical, Indianapolis, Indiana, USA) is a fully portable and wireless video laryngoscope with high blade angulation allowing best visualization of larynx indirectly. The disposable blade has a tube guiding channel which improve tube passage without the use of tube stylet.

An ideal laryngoscopy must provide adequate visualization of glottis to allow correct placement of endotracheal tube with the minimum effort, less elapsed time and minimal potential for injury to the patient.

REVIEW OF LITERATURE

REVIEW OF LITERATURE

HISTORY

Direct Laryngoscopy started with **Alfred Kirstein's** 1895 article which described his "autoscope". Accidental insertion of esophagoscope into trachea by a colleague inspired him to develop his autoscope. He shortened the esophagoscope and attached an electric lamp to the handle for illumination and used a prism from Caspar's electroscope to deflect the light beam down the lumen of autoscope. But the enclosed "O" shape of autoscope limited the view of glottis which lead to redesign an open crescent shape scope. Kirstein never performed tracheal intubation but only described direct visualisation of glottis. But in 1897, **Gustav Killian,** used his autoscope for extracting a foreign body from trachea and hence he was regarded as father of bronchoscopy.

By 1910, **Chevalier Jackson** designed a U-shaped direct laryngoscope for examination and removal of foreign bodies from airway and oesophagus. In 1912, Charles Elsberg performed tracheal intubation and insufflation by using Jackson's laryngoscope. Jackson used a light bulb connected by cords to a dry cell battery for illumination, which had the problem of producing sparks and hence risk of explosion while using Ether. In 1913, **Henry Janeway** solved sparking problem by adding batteries located in handle, but his work did not became popular. In 1941, **Robert Miller** used Straight blade for direct elevation of epiglottis. In 1943, **Robert Macintosh** developed a curved blade to lift the epiglottis indirectly, which potentially reduced the risk of trauma and required lighter levels of anaesthesia. Macintosh converted the C- shape configuration in to invert Z-shape by adding a flange that was used to displace the tongue laterally creating more working space. Since its introduction Macintosh laryngoscope was popular and the most frequently used scope for intubation.

Initially intubation was performed in sitting position which was not useful in anesthetized patients. In 1913, Jackson put patients supine with head and neck fully extended to achieve “classical position” favourable to intubate anesthetized individuals. In 1933 he amended the position by placing a 10 cm thick pillow underneath the head to achieve the “sniffing the morning air” position where the head was extended on a flexed neck. He observed that intubation was easier. In 1944, **Freda Bannister** and **Ronald Macbeth** defined alignment of three axis named the oral, pharyngeal and laryngeal with the line of vision and told that “sniffing Position” was the ideal position for intubation.

As tracheal intubation became the standard for control of airway, many patients trachea could not be visualised and intubated by direct laryngoscopy which lead to development of blind nasal intubation, Magill’s forceps, retrograde intubation, and intubating as well as optical stylet. In 1954, fiberoptic technology was introduced by **Hirschowitz**, a Michigan gastroenterologist. **Shigo Ikeda**, a Japanese thoracic surgeon and “father” of fiberoptic bronchoscopy recommended the concept of using fiberoptic technology for flexible bronchoscopy. Based on Ikeda’s recommendations, Machida Endoscope Company developed the first prototype of the flexible fiberoptic bronchoscope in 1966. Ikeda reported his flexible bronchoscope in 1971. In

1972, a flexible fiberoptic bronchoscope was used for nasotracheal intubation in a patient in whom rheumatoid arthritis had precluded orotracheal intubation and Claire Stiles published reports of using flexible fiberoptic bronchoscope for tracheal intubation.

Indirect rigid laryngoscopes using fiberoptic bundles, prisms and mirrors facilitated viewing the larynx with less anatomic stress and enable vision " around the corner" of the tongue. In 1980, **Roger Bullard** designed the first indirect rigid fiberoptic laryngoscope followed by **Wu** Scope in 1994 and **Upsher** Scope in 1996. In 2006, King Systems Corporation developed the Airtraq which helped in viewing the glottis without alignment of 3 axes. In the late 1980s, the charge coupled device (CCD) video microchip became available, allowing placement of video technology inside the scope. Around 2006, CMOS camera chip of mobile phone technology was applied to laryngoscopes leading to start of new era of video laryngoscopes.

The video laryngoscope consists a blade embedded with video camera or fiberoptic bundle that captures the image of laryngeal inlet. The captured image was transmitted to a monitor mounted either on the handle or separately. **Markus Weiss**, A Swiss anaesthesiologist invented the angulated video Intubating laryngoscope (AVIL) and wrote the first paper on video laryngoscopy in 2001. But the first commercial laryngoscope Glidescope was introduced by **John Pacey** a Canadian surgeon in 2001. In 2004, **Kaplan** and **Berci** introduced direct coupler interface (DCI) that used fiberoptic bundles in a channel of the laryngoscope blade, to deliver an image to a camera located in the handle.

Miniaturization of camera chip; improved, rechargeable battery power and small liquid crystal display (LCD) monitors made video laryngoscopy a booming technology, which led to development of many video laryngoscopes. Video laryngoscopes are classified into three broad categories namely

1. Video laryngoscopes that use Macintosh based blades
2. Video laryngoscopes that use highly curved blades
3. Video Laryngoscopes with tube guiding channels

C-Mac system, A. P. Advance, McGrath MAC video laryngoscope, Truview, Glidescope direct are examples of Macintosh based type which have the option of visualizing the glottis entrance by direct laryngoscopy. McGrath Series 5 was designed with highly angled blade that pass around the tongue and allow a "look around the corner" to the glottis opening. It must be used with a malleable or rigid styletted tube in most cases. Pentax Airway Scope, King Vision and Airtraq have highly curved blade with incorporated tube guiding channel that avoids the need of tube stylet to guide the tube to glottic entrance.

FUNCTIONAL AIRWAY ANATOMY

Knowledge of normal anatomy and variations of anatomy helps with the formulation of an airway management plan. Airway can be classified into upper airway and lower airway. The upper airway consists of nasal cavity, oral cavity, pharynx and larynx. The lower airway comprises of trachea bronchial tree.

STRUCTURE AND FUNCTION OF THE UPPER AIRWAY (Fig. 1):

NASAL CAVITY:

Anatomically, the nose is divided into the external nose and the nasal cavity. The external nose contains a major part of bony frame work in the upper zone, a series of cartilages in the lower zone and a small amount of fibro - fatty tissue (ala) in the lateral margin. Bony framework is formed by nasal bones, nasal part of the frontal bone and the frontal processes of the maxillae.

The nasal cavity is subdivided into two compartments (Fig. 2). Each compartment consists of a roof, floor, medial and lateral wall. Each compartment opens anteriorly to the exterior by nares and posteriorly into nasopharynx by choanae.

Roof is formed by cribriform plate of ethmoid and body of sphenoid.

Floor is made up of palatine process of maxilla and horizontal plate of palatine bone.

Medial wall is nasal septum which comprises of septal cartilage, perpendicular plate of ethmoid and vomer.

Lateral wall is made up of superiorly by nasal surface of ethmoidal labyrinth, inferiorly and anteriorly by nasal part of maxilla and posteriorly by perpendicular plate of palatine bone. In addition, Lateral wall contains three conchae (turbinate bones) arching over each meatus. The medial aspect of ethmoid labyrinth gives rise to upper and middle conchae whereas inferior concha is from a separate bone.

Paranasal sinuses and nasolacrimal duct communicate with meatuses in the lateral wall. Sphenoid sinus opens into spheno-ethmoidal recess, posterior ethmoidal cells drains into the superior meatus, middle ethmoidal cells (bulla ethmoidalis) into middle meatus, maxillary sinus opens into hiatus semilunaris which is below bulla ethmoidalis, anterior ethmoidal cells and frontal sinus drains into the infundibulum, nasolacrimal duct opens into inferior meatus.

FUNCTIONS OF NOSE:

The nose has five important functions to perform. They are

1. Conduit for respiration
2. Combats invasion of organisms
3. Warms and humidifies the inspired air
4. Nose detects smell
5. Patent nasal passages have an influence on vocal resonance

ORAL CAVITY:

Oral cavity is made up of anteriorly by maxillary and mandibular alveolar arch and its teeth, superiorly by hard and soft palate, posteriorly by oropharyngeal isthmus, inferiorly by anterior two thirds of the tongue and its mucosa. Most of the airway procedures usually need mouth opening adequately. It is usually associated with rotation within temporomandibular joint and further opening by sliding or subluxation of condyles of mandible within temporomandibular joint. Genioglossus muscle in the tongue is most important for the anaesthesiologist, because it forms a communication between tongue and mandible. Jaw thrust manoeuvre is used to relieve airway obstruction due to posterior displacement of tongue. It works by producing sliding movement of temporomandibular joint to move the attached tongue anteriorly along with mandible.

PALATE:

Hard palate is formed by palatine part of maxilla and horizontal plates of palatine bones. Soft palate contains uvula in the middle and it is made up palatine muscles. Palatine muscles paralysis lead to regurgitation of fluids and food and nasal voice.

PHARYNX:

Pharynx – a tube like structure is made up of four layers such as mucosal, fibrous, muscular and fascial layers. It comprises three parts such as laryngopharynx, oropharynx and nasopharynx from below upwards. Anteriorly, pharynx communicates with nose above, oral cavity in the middle and larynx below. Posteriorly, it lies over the prevertebral fascia and cervical vertebrae. It extends from basilar part of occipital bone to upper end of the oesophagus.

Pharynx comprises of six muscles such as

1. Superior constrictor
2. Middle constrictor
3. Inferior constrictor
4. Stylopharyngeus
5. Salpingopharyngeus
6. Palatopharyngeus

Maintaining airway patency in an awake patient is due to pharyngeal musculature. Loss of muscle tone results in airway obstruction. This is one of the most common cause of upper airway obstruction during induction of anaesthesia. Chin lift manoeuvre is used to relieve this obstruction by increasing longitudinal tension of pharyngeal muscles, thereby counteracts collapse of pharyngeal airway.

NASOPHARYNX:

It extends from the posterior end of nasal cavity to the posterior pharyngeal wall just above soft palate. Pharyngeal isthmus which separates nasopharynx from oropharynx during swallowing by active contraction and communication with the posterior pharyngeal wall. It contains Eustachian tube, pharyngeal recess that is fossa of Rosen Muller, adenoids. Nasopharynx terminates at the level of soft palate. This area is called as Velopharynx which is the primary site of airway obstruction in conscious as well as anaesthetised patients.

OROPHARYNX:

Oropharynx communicates with the nasopharynx above and laryngopharynx below. It starts from soft palate above to the tip of epiglottis below. Oropharynx lateral walls are formed by palatoglossal folds and palatopharyngeal folds (Fig. 3). Palatine tonsils which are the collections of lymphoid tissues are present in these folds. Hypertrophied palatine tonsils can cause airway obstruction.

LARYNGOPHARYNX:

The laryngopharynx, also known as hypopharynx lies between the epiglottis and the cricoid cartilage lower border at sixth cervical vertebral level. Anteriorly it faces laryngeal inlet which is bounded by aryepiglottic folds, arytenoids and cricoid cartilage. Protrusion of larynx into hypopharynx forms two pyriform recesses or pyriform fossae on either side of the larynx. Submucosal surface of pyriform fossa contains internal branch of superior laryngeal nerve. So cotton balls soaked with local anaesthetic solutions if applied on the surface of pyriform fossa will result in this nerve block. This nerve block leads to loss of sensation of larynx above the vocal cords.

LARYNX:

Larynx is made up of muscles, cartilages and ligaments. It lies at the level of fourth, fifth and sixth cervical vertebrae. Larynx is situated slightly

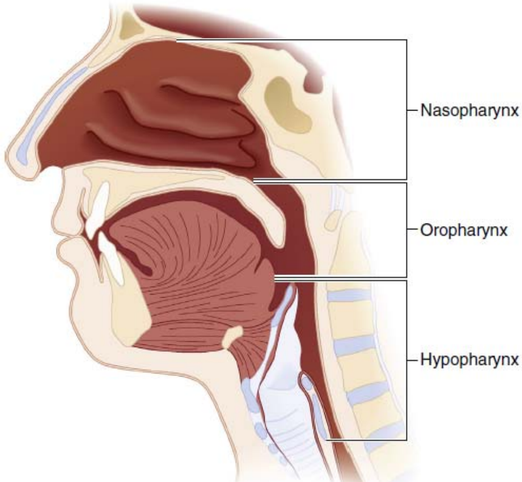


Fig. 1. Upper airway

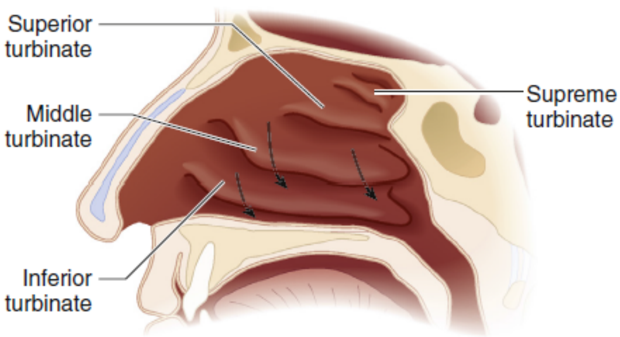


Fig. 2. Nasopharynx

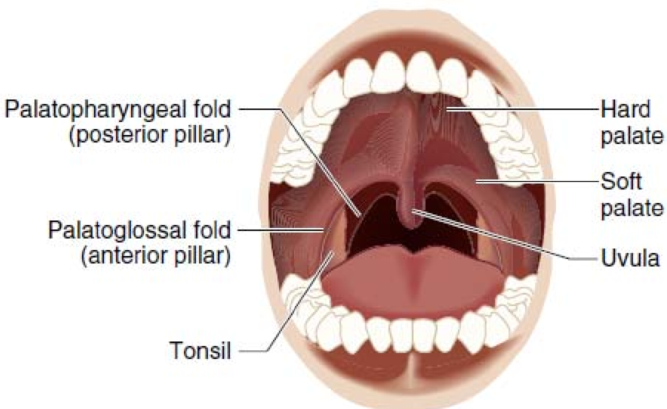


Fig. 3 Oropharynx

higher in females and children. The laryngeal inlet (Fig. 4) is covered ventrally by upper portion of epiglottis, dorsally by mucous membrane fold stretching between arytenoid cartilages and laterally by aryepiglottic folds.

Cartilages of larynx:

There are three paired and three unpaired cartilages (Fig. 5). Paired cartilages are arytenoid, cuneiform and corniculate cartilages. Unpaired cartilages are thyroid, cricoid and epiglottis. They are bounded together by ligaments, synovial joints and membranes.

Thyroid cartilage has two laminae which joins in the midline at the inferior end leaving thyroid notch at the superior end which is associated with laryngeal prominence called as Adam's apple. Adam's apple is an important bony land mark for nerve blocks of larynx and percutaneous airway techniques.

Cricoid cartilage is present at the level of sixth cervical vertebra. It has quadrilateral lamina dorsally joined ventrally by thin arch and forms complete cartilaginous signet ring. Corniculate cartilage rests over the apex of arytenoid.

Each Arytenoid cartilage has three surfaces – the medial, lateral and basal surfaces. The basal surface articulates with supero lateral portion of cricoid lamina. Arytenoid base has two extensions namely, lateral extensions which is also known as muscular process and medial extensions which is called as vocal process. Posterior and lateral cricoarytenoid muscles arise from muscular process. Vocal process gives attachment to vocal ligaments posteriorly.

Epiglottis, a flexible fibrocartilage has anterior and posterior surfaces. It appears like a leaf. Posterior surface is free and contains a tubercle in its lower portion. Anterior surface is concave and it is covered by mucous membrane that forms one median and two lateral epiglottic folds. Median epiglottic fold connects epiglottis with the tongue. Lateral epiglottic fold connects epiglottis with pharynx on either side. Between median and lateral epiglottic folds, pouch like areas called valleculae present. Proper insertion of direct laryngoscopy implies that Macintosh laryngoscopic blade tip should be placed in vallecula.

Laryngeal ligaments:

Extrinsic ligaments are thyrohyoid membrane, cricotracheal ligament, cricothyroid ligament and hyo - epiglottic ligament.

Intrinsic ligaments are capsules of synovial joints between thyroid and cricoid, arytenoid and cricoid cartilages.

Muscles of larynx (Fig. 6)**:**

Extrinsic muscles of larynx are sternothyroid, thyrohoid and inferior constrictor of pharynx. Extrinsic muscles attach larynx to nearby structures. The intrinsic muscles and their actions are:

- Posterior cricoarytenoids are abductors of the vocal cords
- Lateral cricoarytenoids & interarytenoids are adductors
- Cricothyroids are tensors of the cords,
- Thyroarytenoids are relaxors of the cords,
- Vocalis
- Aryepiglottic and thyroepiglottic muscles

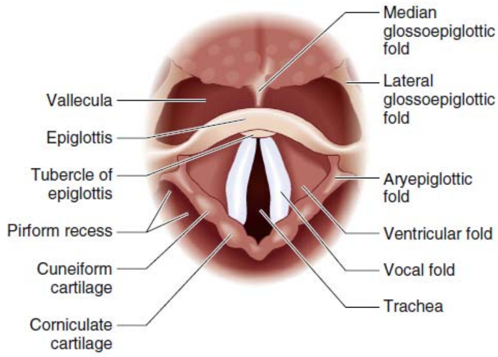


Fig. 4. Direct laryngoscopic view of glottic aperture.

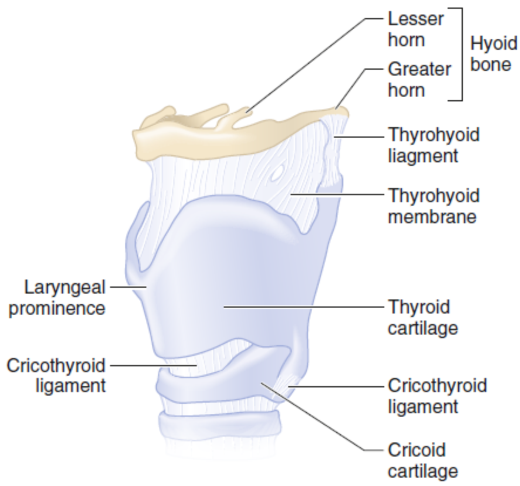


Fig. 5. Cartilages and ligaments of larynx

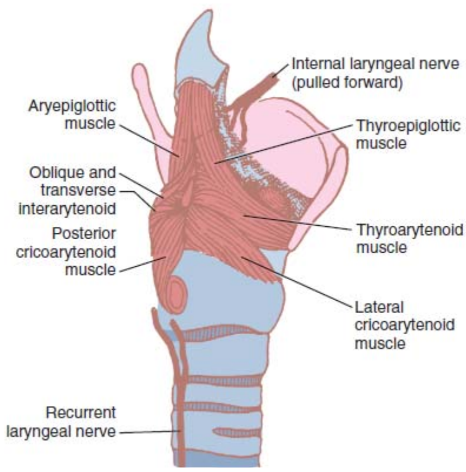


Fig.6. Muscles of larynx

PREOXYGENATION

Hypoxemia can be developed quickly during induction of anaesthesia. It may be due to

- decrease in functional residual capacity when patient lies supine,
- apnea when patient is paralysed with muscle relaxants and
- hypoventilation by direct effects of anaesthetic agents

Preoxygenation is a process of denitrogenation in the lungs by using oxygen. Patient inhale 100% oxygen during preoxygenation. So air which contains nitrogen mostly is removed from the alveoli and oxygen accumulates in all open alveoli. The time taken to desaturation of sao2 to 90% during laryngoscopy is called apnoeic time. More amount of oxygen in FRC delays the time to occur for desaturation. This increase in apnoea time, allows more duration for laryngoscopy. Longer duration of laryngoscopy increases the rate of successful intubation.

Preoxygenation is very essential for obese patients, pregnant patients, patients with anticipated difficult airway and for those patients in whom mask ventilation is contraindicated after anaesthetic induction. Preoxygenation is performed through tight fitting face mask attached to circle system or Mapleson system. 100% oxygen should be given with a flow rate of 10-12 litres per minute. To achieve maximum time to allow apnoeic period during intubation, more than 90% of end tidal oxygen concentration is necessary.

Various methods of preoxygenation:

- One method is traditional ventilation for three to five minutes using tidal volume breaths with an oxygen flow of 5 litres per minute.
- Another method is four vital capacity (deep) breaths with an oxygen flow rate of 10 to 12 litres per minute for thirty seconds.
- Various other techniques are eight vital capacity breaths, twelve to sixteen vital capacity breaths, and one vital capacity breath.

HEMODYNAMIC STRESS RESPONSE TO AIRWAY MANIPULATION

To the mechanical stimulation of airway, cardiovascular system and airway shows various responses through reflex mechanisms. Upper airway protects the lungs via cough, sneeze, reflex of glottic closure or gag reflex, swallow reflex and expiration reflexes.

Cough reflex:

Receptors are situated in the pharynx, tracheal mucosa, carina, large and small airways. Branches of vagus nerve serve as afferent nerve fibres, cough centre is upper part of brain stem and pons, vagus nerve to larynx, phrenic nerve to diaphragm, spinal motor nerves to abdominal wall muscles, internal intercostal muscle, and external intercostal muscle.

Laryngeal closure reflex:

Stimulation of receptors in the anterior surface of epiglottis and posterior one third of tongue is carried by glossopharyngeal nerve (posterior surface of epiglottis, larynx via vagal afferent) to medullary centre and the nucleus is nucleus of ambiguous and efferent is via vagus nerve. An exaggerated or maladaptive reflex response is laryngospasm. Laryngospasm can occur when secretions, blood and vomitus irritating the vocal cords, airway manipulation with instruments. In light plane of anaesthesia which causes enhanced secretions also produces laryngospasm. Laryngospasm is a life threatening complication, anaesthesiologist should recognise and manage rapidly. Laryngospasm can occur during induction, intubation and also can occur during extubation. Infants are more prone for laryngospasm. Treatment includes 100% oxygenation through tight mask, suctioning to remove blood and secretions, CPAP, jaw thrust forcibly, to make deep plane of anaesthesia, small dose of suxamethonium (0.1 – 0.5mg/kg), if severe suxamethonium of 1mg/kg should be given.

Cardiovascular response:

Trachea and larynx contain mechanoreceptors and proprioceptors. When these receptors are stimulated, the impulses are carried by glossopharyngeal and vagal nerve afferent fibres. These afferent nerve fibres are transmitted to brainstem. Brainstem in turn activates sympathetic and parasympathetic nervous systems. In adults, release of norepinephrine and epinephrine from sympathetic nerve endings leads to increase in heart rate and increase in blood pressure. Whereas in infants and children, parasympathetic activation is predominant leading to decrease in heart rate.

Tracheobronchial reflexes:

Stimulation of lower airway by foreign particle resulting in bronchoconstriction. Instrumentation of lower airway stimulates autonomic nervous system mainly via parasympathetic pathway ends up with airway smooth muscle constriction. Larger central airways are innervated with cholinergic nerve fibres predominantly. Tracheobronchial reflex arc is cholinergic vagal afferent, vagal nuclei in the brain stem as centre and the efferent is mediated via vagal nerve. Parasympathetic fibres release acetylcholine activates M3 cholinergic receptors that causes smooth muscle constriction. Intubation also causes cough that also aggravates bronchospasm. Coughing leads to reduced lung volume. The lung volume reduction in turn aggravates bronchospasm. Propofol, midazolam, etomidate can be used as induction agents. These agents cause airway smooth muscle relaxation. Sevoflurane is volatile agent has direct and indirect smooth relaxant effect.

MACINTOSH LARYNGOSCOPE

Direct laryngoscopy relies on using a rigid lighted retractor that retracts the tongue and jaw thereby creating an uninterrupted direct line of sight to view the larynx. Direct laryngoscopy in adults is mostly done with a curved Macintosh blade and less often straight Miller blade is used. Straight Miller blades have narrow lumen and are typically used in paediatric patients. In 1943 Robert Macintosh published about his new curved laryngoscope which has become universally adopted and is the benchmark against which all direct laryngoscopes are compared. Macintosh got the idea of the design by accidentally exposing the larynx indirectly after inserting a Boyle-Davis mouth gag during a tonsillectomy surgery. Macintosh's classic article in The Lancet described a novel technique of exposing the larynx by indirectly elevating the epiglottis using curved blade by placing its tip in the vallecula between the base of the tongue and epiglottis. He described the blade can be used at a lighter plane of anaesthesia because the blade stimulates the area of glossopharyngeal innervation rather than superior laryngeal nerve innervation of the epiglottis. This was important before the widespread use of neuromuscular blocking agents.

A retraction type rigid laryngoscope may be either a single piece or a handle with a detachable blade. A single piece design contains a switch located on the handle controls the illumination of bulb. The detachable type contains a hook on connection which is hinged and folding type between the blade and handle. A basic laryngoscope (fig: 7) consist of a handle, a blade and a light source.

Handle

Handle is the part of laryngoscope that is held by hand during laryngoscopy. It houses the batteries that energises the bulb when contact is made with the blade. It contains a hinge pin at the base which mates with the slot on the hook of the blade. The blade when hooked and locked on to the handle depresses a switch establishing circuit between the energy source and the light bulb which illuminates the bulb. Light bulb may also be located at the handle in which case the light is transmitted to the blade via fiberoptic bundles. Some handles connect to external light source through fiberoptic cable. In some handles the batteries and bulb can be separated as a unit allowing easy sterilisation and disinfection.

Handle are of variable sizes (fig 8). The thinner ones are used for paediatric patients and the stouter are used for adult laryngoscopy. A short handle is particularly useful in patients with short chin to chest distance like short neck, obesity and presence of huge breasts which may impede handling the laryngoscope. The blade usually connects to the base of handle at a 90 degree angle. There may be adjustable handle or angled blades that allow connection other than 90 degree angle.

Blade:

The part that is inserted into the mouth and displaces the tongue is called blade (fig. 9). It consist of a base, heel, tongue, flange, web, light source and tip.

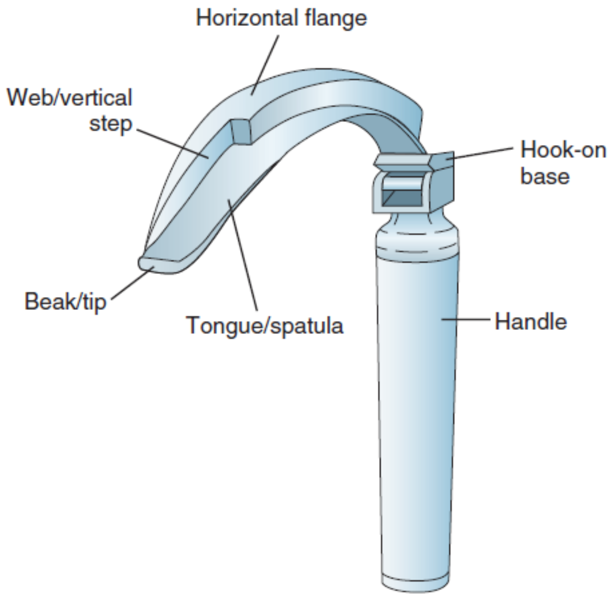


Fig 7. Basic design of Macintosh Laryngoscope

Fig 8. Laryngoscope Handles

The base lodges a slot that hooks on to the hinge pin of the handle connecting the handle and blade. The portion of the blade that comes into contact with the tongue is called spatula or tongue.

The spatula is used to displace the tongue laterally and retracts the soft tissues away from light of sight. Straight spatulas provide better laryngeal view but less working space. Curved spatulas provide good working space and easy intubation. The portion of the blade that projects out to the left side is called flange. Web is the part that connects the flange and the spatula. The height of the cross-sectional shape of blade is also known as the vertical step and the flange determines the cross sectional shape of the blade. Cross section of Macintosh blade shows reverse ‘Z’ shape that facilitates in achieving a good working space. The tip or beak is the part that holds the epiglottis or lodges into vallecula.

Most laryngoscope blades are made from steel and are chrome plated. Plastic blades are inexpensive and disposable.

Though the blade is used to retract the tissues away from line of sight there appears an area which is not visualised called blind area (fig. 10). It is defined as the length from the blade tip to the line of sight.

Light source

Based on the location of light source blades are named as Bulb-on-blade laryngoscopes and fiber-lit laryngoscopes. Bulb-on types are conventional and they have a simple electrical connection between the handle and blade. The electrical circuit is completed by opening the blade, providing the power to the bulb, which is mounted on the distal aspect of the web of the blade. Bulbs may be of halogen, xenon and LED type. LED bulbs are super-bright and use a fraction of energy than halogen or xenon bulbs, and they operate at lesser temperature. The light produced by LED bulbs are much whiter and produce good discrimination of landmarks. The yellow colour of standard bulbs is poor for distinguishing reddish yellow mucosal structures.

Fiber-lit laryngoscopes use light conducting fibres in the blade with a bulb mounted in the top of the laryngoscope handle. A spring-loaded mechanism activates the light at the handle creating electrical connection with the batteries of the handle. The best light conducting fibres are Glass fiber which is relatively expensive and its light conducting capacity deteriorates over time owing to sterilisation stress. Acrylic is inexpensive light conductor which can be easily integrated onto a laryngoscope blade. Glass fibers must be wrapped in a steel rod and then attached to the blade or threaded through a channel that runs the length of the blade, but an acrylic rod can be attached separately.

Standard handles use two C-sized alkaline batteries and the stubby handles use two AA batteries. Some companies use lithium batteries which have flatter discharge curve and they slowly diminish in power output over a long time. Alkaline batteries continue to turn on even when the light output is decreased dramatically whereas lithium batteries die quickly when output fades.

Rechargeable nickel cadmium or nickel metal hydride batteries combined with LED bulbs create brilliant white light and offer superior quality and use.

Macintosh in his communication stated that the precise shape or curve of the blade does not seem to matter much provided that the tip does not go beyond the epiglottis. He did not patent his design but gave his design to Foregger an American company and Longworth Scientific instruments a British company. Standard Macintosh blade is size 3 which was initially used only in obstetric patients. Later Macintosh size 4 was added. Manufacturers also produce Macintosh 1 and 2 which were not endorsed by Macintosh. Numerous modifications of Macintosh blades are available namely

- English Macintosh
- American Macintosh Blade
- German Macintosh Blade
- Improved Vision Macintosh blade
- Bowen-Jackson Blade
- Left handed Laryngoscope blade

English Macintosh type blade (fig. 11) is continuously curved along the whole tongue, the flange runs to the tip of the blade, and proximal flange is small. American type blade (fig. 11) are straight in the distal portion having a distal tip with no flange and bigger proximal flange. English type uses clear light bulb but American type uses frosted bulb. Increased web height and bigger

Fig 9. End on view showing Reverse ‘Z’ shape of Flange (left),
Lateral view of standard Macintosh blade (right).

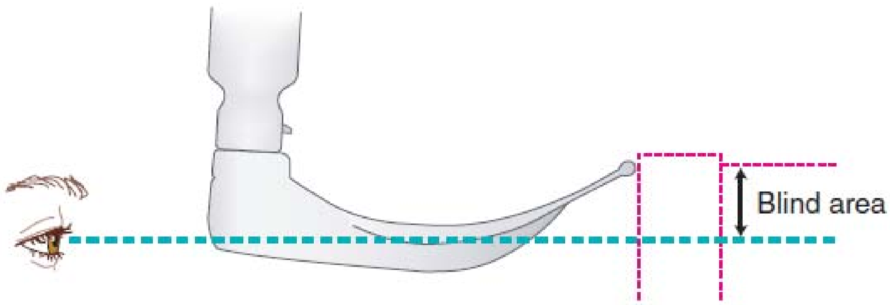


Fig 10. Blind area of Laryngoscope

Fig 11. Macintosh Blade English Profile (top), American Profile (bottom)

flange at the base creates good working space but may produce upper tooth injury when the blade is fully inserted.

German Macintosh blade contains a rectangular, large glass fibre bundle with full length flange and small bulb to tip distance. The surface is smooth which facilitates easy cleaning. In improved vision Macintosh blade the mid portion of the curve of the flange is mildly flat and the blade is little concave dorsally which reduces the crest of hill effect obstructing visualisation of larynx.

Bowen Jackson modification includes bifid beak to allow straddling of the glosso epiglottic fold. The vertical step length is small allowing its use in patients with limited mouth opening or prominent teeth. Blade forms an angle of 100 degrees that avoids contact of the blade with the chest.Left handed laryngoscope has the configuration reversed which is helpful for right handed laryngoscopy, patients placed in right lateral decubitus for intubation, patients with right-sided oro-facial abnormalities and for procedures that require tracheal tube to be fixed to the left side of mouth.

Laryngoscopy and Intubation

Orotracheal route is the commonest and simplest route to intubate the trachea under direct vision. Intubation is commonly carried out to provide general anaesthesia inside operating theatres, to provide positive pressure breaths during mechanical ventilation and resuscitation, to protect the airway by isolating the windpipe from digestive tract in comatose patients and as a conduit for toileting the lung. Preparation includes checking the availability of basic equipment like means to oxygenate, ventilate and suction the airway. Routine and emergency drugs required must be kept ready. The height of the table must be levelled to the operator's navel or xiphisternum so as to align optimal line of vision with the larynx. Head of the Patient should be placed at the edge of the table to avoid excessive leaning. A good skilled assistant should be available for help. When a patient is placed supine with head in neutral position (fig. 12), the structures that hinders in viewing the larynx include the teeth, tongue and the lower jaw. Opening the mouth moves the teeth away from line of vision and retraction of the tongue by laryngoscope will move the tongue from the path of intubation.

But the longitudinal axis of the pharynx and the larynx are not congruent to the line of vision thereby visualisation of the cords is not easy. With head in neutral position the alignment of these airway axes with the line of vision is shown in fig 12.

Placement of a pillow of height about 5-10 cms (fig. 13) will create flexion at the lower cervical joint resulting in a neck flexion of about 35 degrees on the chest. This elevation of the head on a pillow aligns the laryngeal and pharyngeal axis but worsens the oral axis away from line of vision (fig 13).

With the neck flexed on the chest, extension of head (fig. 14) by movement at the atlanto occipital joint to about 80 degrees will bring all the three axes aligned to the line of sight enabling easy view of laryngeal aperture, facilitating introduction of tracheal tube with ease (fig 14).

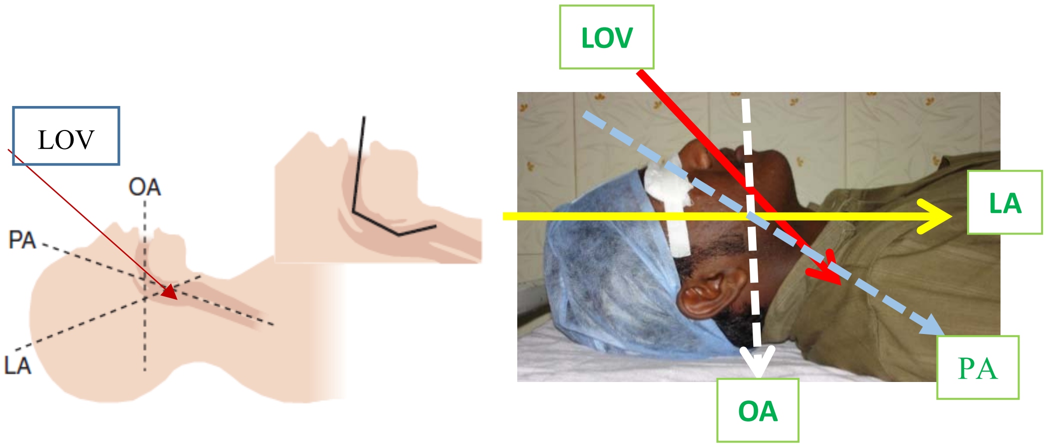


Fig 12. Head in Neutral Position, line of vision (LOV) is not aligned with Oral (OA), Pharyngeal (PA) and Laryngeal (LA) axes

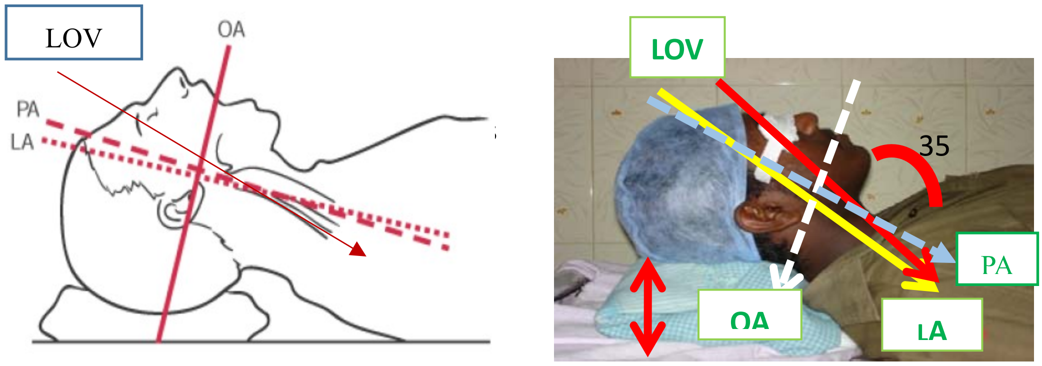


Fig 13. Head elevation on a pillow, line of vision (LOV) is aligned with Pharyngeal (PA) and Laryngeal (LA) axes, Oral (OA) worsened away from line of vision.

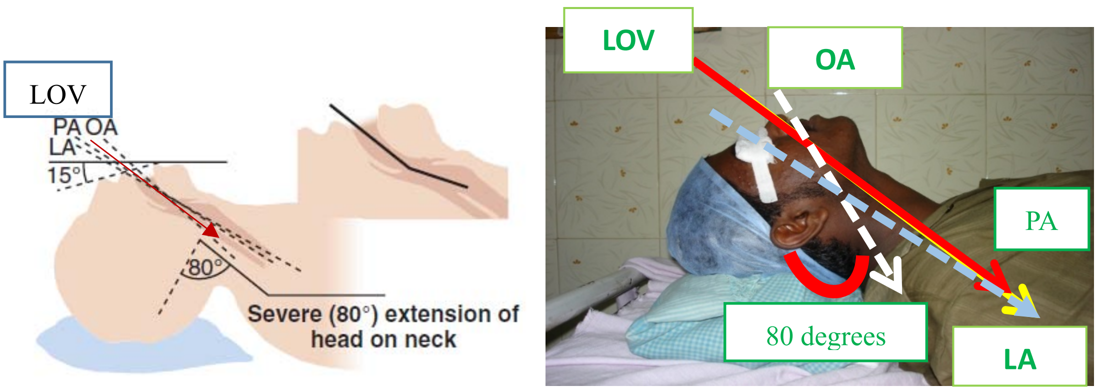


Fig 14. Head extension brings line of vision (LOV) aligned with Pharyngeal (PA) and Laryngeal (LA) axes, and Oral (OA).

After proper positioning mouth is opened either by depression of the lower jaw using thumb of right hand or extension of head by pressing the vertex by right hand. In paralysed patients scissoring the index finger placed on upper teeth and thumb of right hand over lower teeth helps to open the mouth. The laryngoscope held in left hand is passed through the right corner of the mouth and once the blade tip is at base of the tongue, the tongue is lateralised to the left by bringing the laryngoscope to midline thus creating a good working space on the right for visualisation of larynx and passage of tracheal tube. Care should be taken not to injure the lower lip or the teeth.

The laryngoscope tip is advanced further and the lower jaw is lifted away from line of vision to expose the laryngeal aperture. Flexing the wrist instead of lifting the jaw will bring the base of the blade to obstruct the line of vision and will injure the upper jaw. Once the epiglottis is seen the blade tip is inserted in to the vallecula and subsequent forward and upward movement of the blade by tensing the hyoepiglottic ligament will move the epiglottis upwards exposing the arytenoids and glottic opening.

Then the tracheal tube is passed through the right corner of the mouth with the concavity facing right and guided into trachea under direct vision.

VIDEO LARYNGOSCOPES

Invention of Complementary Metal Oxide Semi-Conductors (CMOS) have created the buzz that handle and blade type laryngoscope will be looked as a primitive instrument in near future. Video laryngoscopes make difficult oral intubations easier and they form the best alternative to the gold standard intubating device, the Fiberoptic Bronchoscope.

Intubation with video laryngoscopes have the following advantages

1. Possibility of intubation in neutral head position without aligning the airway axes to sniffing position,
2. Retraction of tissues not necessary
3. Magnified image and intubation procedure can be witnessed by many individuals,
4. Minimum force is needed to visualise the larynx and hence the pathologic response to intubation is less,
5. Small learning skill,
6. Are portable and cheap compared to fiberscopes
7. Better teaching and useful demonstration tools
8. Needs no cervical spine movement
9. Needs no or less external optimisation manoeuvres

Video laryngoscope is an instrument that helps in intubation where the target anatomy is displayed on a monitor which can be viewed by more than one person at a time and the whole procedure can be recorded. Some of them have wide viewing angle and they look more anteriorly with ease and without retraction of normal anatomy. Initial video laryngoscopes were big and complex. Developments in digital technology has led to birth of many portable video laryngoscopes and King Vision Video Laryngoscope is one among them. It uses a more traditional blade and handle assembly with screen.

KING VISION VIDEO LARYNGOSCOPE (KVVL)

King Vision Video Laryngoscope (KVVL) (fig. 15) is a handy laryngoscope available at an affordable price. It consists of an ergonomic handle and blade assembly (fig. 16) like traditional Laryngoscope. It is made of light weight polycarbonate blended with ABS (acrylonitrile-butadiene- styrene) eco efficient plastic material and is rigid enough to make its way into the upper airway.

Handle

The handle (fig. 17) is the part that contains the screen and casing that lodges the power source (fig. 18). The proximal part of the handle is wide and contains the screen/ monitor where the real time display of the target anatomy is visualised continuously. The display is made of organic light emitting diode (OLED) which provides exceptional brightness with Colour reproduction and outstanding contrast levels. OLED display permits low power consumption and

Fig. 15: King Vision Video Laryngoscope

Fig. 16: Handle Blade assembly

Fig. 17: Reusable display

displays a crisp wide panoramic image viewing angle up to 160 degrees. The display contains anti-reflective coating that enables viewing the screen even in bright atmosphere.

The video screen size measures 6.1 cm diagonal with video resolution of 320 x 240 (QVGA) pixels per frame. The video aspect ratio is 4:3 and the refresh rate of video is 30 frames per second. On the top left side of the monitor presents a LED indicator which glows green when power is adequate and glows red when the batteries are about to die. The computer management system controls auto exposure, does auto white balance and enables auto shut off when the screen is idle. The backside of the monitor contains the single power on / off switch (fig. 19). The advanced power management system shuts the display in 60 seconds after being placed on a non-moving surface. It also shut down in 20 seconds automatically if the monitor is detached from the blade. On the left side lies a video output port where a standard cable with RCA male adapter (fig. 20) can be connected to an external display.

The distal part of the handle is narrow and is called as stem which mates with the blade. It lodges three AAA alkaline batteries (fig. 21) that power the scope. The batteries usually lasts for about 90 minutes of continuous operation. There is a protective gasket between the monitor and the stem that guides locking of the blade to the monitor. The handle as a whole is reusable and weighs about 90 grams without batteries.

The display will be split (fig. 22) if the device is powered on and then the blade is connected. Static screen appears when the display is not connected to

Fig. 18: Inferior view of handle

Fig 19: Power Button

Fig 20: Video Output port and RCA Cable connector

Fig 21: Stem hosing AAA batteries

the blade but powered on. The screen is frozen when the blade is disconnected before the device is switched off.

Blade

The blade contains a cylindrical hollow proximal part (stem) (fig. 23) that slides over the stem of the handle, which after locking on to the handle establishes circuitry between the camera and the monitor. The distal part of the blade is curved and tongue like. The shape of the curvature differs from traditional retraction type blades such that they mimic the natural contour of the upper airway. This ergonomic design provides minimal lifting of soft tissues and lesser impact on teeth.

The left side of the blade accommodates the camera and optical system (fig. 24) and the right side forms the working space for introducing the endotracheal tube. The distal window of the blade has the camera located medially and the illuminating source (fig. 25) placed laterally. The window is placed about 4.5 cm from the distal tip has anti fog coating that prevents condensation of humid air over the lens which may obscure clarity.

No warm up time is needed for anti-fogging. The camera chip is made of Complementary Metal Oxide Semiconductor (CMOS). The resolution of camera is 640 x 480 VGA (Video Graphics Array). The light source is brilliant white LED.

Two types of blades are available namely the standard blade and channelled blade. Both blades come with only one size that equals the standard

Fig 22: (a) Split screen, (b) Static Screen, (c) Frozen Screen.

Fig 23: Size 3 adult blades (left), End on view of blade (Right)

Fig 24: (a) Distal tip and window, (b) Camera and light source

3 size of traditional laryngoscopes. The blades are disposable and made of polycarbonate plastic and withstand pressure up to 15 pounds.

The standard blade (fig. 26) has no guiding channel and requires the use of stylet for introducing the tracheal tube. The tracheal tube loaded with stylet must be pre- shaped alike the curvature of the blade before introduction. It is of 17 cm in length excluding the handle portion, 26 mm wide and weighs about 49 grams. The distal tip is 16 mm wide. The anterior posterior height of the blade is 13 mm.

The channelled blade (fig. 27) contains a guiding channel into which the tracheal tube is preloaded and guide in to the trachea without the use of stylet. This blade accommodates tracheal tube of size from 6.0 mm to 8.0 mm internal diameter. The blade length excluding the stem is 17 mm and 29 mm wide. It weighs about 58 grams. The distal tip of the blade is 16 mm wide and the minimum mouth opening required to accommodate the blade is 18 mm which corresponds to the anteroposterior diameter.

Technique of intubation

KVVL allows intubation to be done without aligning the airway axes as the image obtained is an indirect magnified view of larynx. First a water soluble lubricant is applied to the posterior part of the blade and into the channel and the tracheal tube is preloaded in to the channel such that the tip of the tube does not slide beyond the distal window of the blade. Next the blade is held in left hand by pinching the mid-blade (stem) with the thumb on the anterior aspect

Fig 25: White LED

Fig 26: Standard size 3 adult blade, tube curved to 60-70 degrees over the stylet (right)

Fig 27. Channelled Blade size 3 for adult preloaded with ETT (right)

and the second, third and fourth fingers encircling the posterior aspect (fig. 28). The system is powered on and care should be taken that the scope is held gently as if holding a pen but not to grab like a conventional laryngoscope.

The minimum mouth opening required to insert the channelled blade is 18 mm and the channelled blade is inserted in midline after opening the mouth by scissoring motion of fingers of right hand. The scope is held flat to facilitate introduction of the tip in to the mouth. Once the distal tip crosses the teeth the lower jaw is retracted a little creating a working space for the distal window of the blade to be passed down. In short neck persons and individuals with bulky chest the proximal part of the scope may get hindered. In such cases the scope is introduced laterally (fig. 29) and routed to midline after crossing the alveolar margin or the handle is connected after insertion of the blade. Sometimes the distal end of the channel may stuck at the level of incisors due to poor mouth opening which requires a gentle pressure on the flexible distal end of the channel with the thumb of right finger allowing entry in to the mouth.

Once the channel portion crosses the incisors the blade is then advanced down along the natural curvature of the airway by viewing the sliding down on the screen such that the flat held scope is moved down and made upright. Only gentle retraction of tongue and jaw is necessary and care should be taken not to depress the tongue towards larynx. Rigid holding and application of distraction force away from the longitudinal axis of the curvature of the airway will make the intubation process difficult, time consuming and may result in either damage to the blade or injury to the patient. Mild jaw retraction and device elevation along with midline sliding down approach is required to view the epiglottis. The blade tip is placed in the vallecula (fig. 30) and optimised to get the laryngeal view exactly at the centre of the screen. A panoramic view of laryngeal inlet is obtained allowing plenty of room to pass the tube. The device is curved either in or out, depressed or elevated, moved lateral or medial, tilted right or left and rotated inward or outward to seek optimal visualisation of target anatomy. Sometimes external movement of larynx accordingly may help in achieving best view.

The tracheal tube is advanced slowly once optimal view of the vocal cords is obtained at the centre of the screen. Most often difficulty arises in introduction of the tube due to entrapment of the tube at the right arytenoids or right ary-epiglottic fold (fig. 31).

The reasons are

1. The camera is located at the left side of the blade whereas the channel is placed a little right to the camera and hence the image, (line of camera vision and line of path of tube are little apart)
2. The device is too in, near to the vocal cords,
3. The device is not in midline but to the right,
4. The bevel of the tracheal tube is on the left.

The difficulty is solved either by withdrawing the device out a little, or applying counter clockwise twist to the tracheal tube which directs the tube tip towards the line of vision of camera and hence to the laryngeal inlet, or rotating

Fig 28: (a) Correct method of holding (b) Incorrect method of holding

Fig 29: Mouth opening and introduction of blade (left), avoiding chest during insertion (right)

Fig 30: (a) Blade tip at vallecula (b) Tube pushed in to larynx

the blade to left which centres the bevel towards the laryngeal vestibule (fig. 32, 33). Watch the cuff crossing the vocal cords and stabilise the tube laterally, remove the scope by rotating the handle towards patient’s chest. This will separate the tube from the flexible channel exiting the blade out of the mouth.

Cleaning and Disinfection

An alcohol wipe or disinfectant moistened gauze can be used to clean the camera head if the image is not clear. Care should be taken such that the lens is not scratched or the anti-fog material is removed. The blades are disposable and are not reused. The handle and display must be wiped with sterile gauze soaked in sterile water or saline to remove the debris. Next a gauze soaked in disinfectant is applied to the surface of the handle and sufficient contact time should be allowed for disinfection. The device is compatible with any alcohol based disinfectant or glutaraldehyde. After sufficient contact time it's again cleaned with sterile gauze soaked in sterile water to remove residual disinfectant and allowed to dry. Care should be taken not to wet the circuitry.

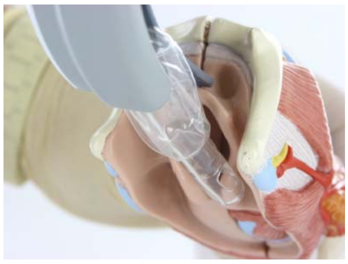


Fig 31: Tube Catch at right aryepiglottic fold

Fig 32: Anticlockwise rotation of tube at proximal end

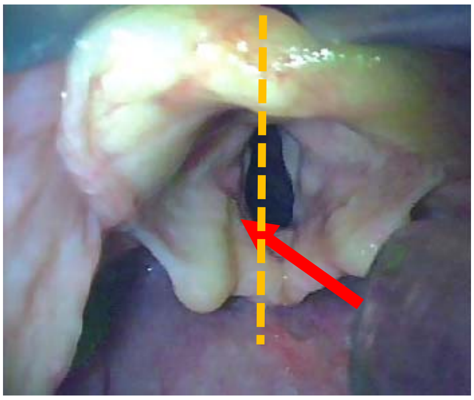


Fig 33: Tube centered and guided to laryngeal vestibule

JOURNAL REVIEW

Review of Literature with regard to use of direct versus video laryngoscopy

Xue FS et al, in 2007 did a comparative study to evaluate the hemodynamic response to orotracheal intubation using direct Macintosh laryngoscope and Glidescope. Fifty seven patients subjected to general anaesthesia were induced with Propofol, fentanyl and vecuronium followed by endotracheal intubation either with direct laryngoscope or Glidescope by single anaesthesiologist experienced with both devices. Heart rate and blood pressure recordings were taken before and immediate post induction and every min after induction up to 5 minutes. It was found that the intubation time was bit longer in video laryngoscope group. Increase in heart rate and blood pressure were similar in both groups and the stress response lasted for 1 minute in direct laryngoscope group but for up to 4 minutes with Glidescope[1].

Robitaille A et al, in 2008 performed a prospective study in twenty patients with normal C-Spine to evaluate the cervical spine movements produced by direct laryngoscope and Glidescope video laryngoscope during routine intubation under general anaesthesia after administration of neuromuscular blocking drugs. All subjects were given manual in-line stabilisation of the head preventing routine neck movements produced by laryngoscopy. Movements of cervical spine before airway manipulation, during glottic visualisation, while insertion of tracheal tube through the glottis and trachea were recorded with the help of fluoroscope. The rotation of occiput-C1 during intubation with either Macintosh or Glidescope along with quality of glottic visualisation was also studied. It was observed that the average segmental movement of spine at any level was same with both devices. The predominant movement that happened during both procedures was mainly extension of head at the level of upper cervical spine during visualisation of the glottis. The degree of rostral neck movement was same in both groups. They concluded that Glidescope produced better laryngeal and vocal cord visualisation when compared with direct laryngoscope[2].

Boedeker BH et al, in 2008 also proved that the glottic visualisation score was better with indirect laryngoscopy done with video device that look around the corner rather than viewing the glottis directly after aligning the line of sight with mouth, pharynx and larynx using Macintosh laryngoscope. This confirmed the value of video laryngoscopy for hands-on teaching of airway management skills[3].

Nouruzi-Sedeh P et al, in 2009 compared the success rate of intubation performed with direct laryngoscope and Glidescope by participants inexperienced in doing routine instrumentation of the airway. His study involved 20 intubators and 200 patients subjected to general anaesthesia. He observed that the overall success rate was 93% in Glidescope group which was higher than Macintosh group where the success rate was only 51%. The mean time taken for intubation was 89+/-35 s for direct laryngoscopy and 63+/- 30 s for video laryngoscopy. This showed that video laryngoscopy improved the success rate of intubation even in untrained persons[4].

Platts-Mills TF et al, in 2009 conducted a prospective study involving 280 patients admitted in emergency department who needed endotracheal intubation were intubated using either Macintosh blade or Glidescope video laryngoscope. He found that the first-attempt success was 81% with Glidescope and 84% with Macintosh blade. The median time to successful intubation was 42 seconds for video laryngoscopy and for direct laryngoscopy it was 30 seconds. This showed that video laryngoscopy required more time to complete intubation[5].

Nishikawa K, Matsuoka H, Saito S, in 2009 evaluated the use of pentax airway scope with regard to stress response to intubation by comparing with Macintosh direct laryngoscope. This study included 40 patients who were randomly intubated with any one of the intubating device. Before and after induction of anaesthesia the hemodynamic variable such as heart rate and blood pressure were observed and compared. Patients were also assessed for changes in bispectral index scores and presence of postoperative sore throat. It was found that there was significant increase in heart rate and blood pressure after intubation with direct laryngoscope whereas Pentax-AWS assisted intubations were not associated with stress response. There was also lesser increase in bispectral index score while using Pentax AWS. Post-operative sore throat occurred in both groups and it was statistically comparable. They suggested that Airway Scope is advantageous to prevent increase in blood pressure after intubation in neurosurgical patients[6].

Narang AT et al, 2009 enrolled 52 participants to conduct intubation using Macintosh blade and video laryngoscope on a simulation mannequin in normal and difficult airway scenarios. Three airway situations were instituted: standard, reduced mobility of neck and tongue oedema. In each scenario the residents and attending physicians carried intubation with Macintosh and Glidescope. Measurements that were observed were best glottic view grade obtained, time to view the glottic opening, time to intubate the trachea and success of intubation. During normal and limited neck mobility setting Macintosh blade proved faster intubation time of 9.4 seconds and 16.1 seconds respectively than video laryngoscope. But in tongue oedema setting Glidescope performed better with regard to obtaining the best laryngeal view in less possible time with higher intubation success rate and lesser time to intubation than direct laryngoscopy with Macintosh blade[7].

Van Zundert A et al, in 2009 evaluated the feasibility of intubating the airway without using styletted endotracheal tubes during video laryngoscopy. The scopes used for evaluation were McGrath series 5, Glidescope Ranger and V-MAC Storz Berci DCI. The study involved 450 adults patients subjected for elective surgery under general anaesthesia. The data observed were intubation time, number of attempts needed to intubate, requirement of extra tools to facilitate intubation and overall satisfaction score. The observations showed that all the three video scopes provided good view of glottic opening which was assessed using Cormack-Lehane grade. The mean intubation time was 34 seconds for Glidescope, 18 seconds for Storz and 38 seconds for McGrath.

Faster intubation was achieved with Storz blade which resulted in higher first-pass intubation. Requirement of stylet was necessary in only 7% of cases with Storz blade compared to 50% of cases with Glidescope and McGrath. This proved that video laryngoscope with Macintosh like blade scores good with easy and fast intubation without using a stylet[8].

Brown CA et al, in 2010 measured the difference in viewing the vocal cords using direct and indirect laryngoscopy in adult emergency department. He included 198 patients for the study and Karl Storz Mac blade for direct and indirect viewing of vocal cords. In 80% of patients good visualisation score was achieved with direct laryngoscope and 93% with indirect laryngoscope. Out of 40 patients who had poor glottic score during direct laryngoscope, video laryngoscope improved the score. Of 158 patients who had good glottic view with direct laryngoscope institution of video laryngoscope actually worsened the view in 4 patients. They concluded that video laryngoscope improved glottic view and hence success of intubation[9].

Bair AE et al, in 2010 assessed the performance of Karl Storz Macintosh video Laryngoscope in a simulating mannequin simulated for normal airway, limited mobility and difficulty with trismus. They found that video laryngoscopy produced improved view of vocal cords and faster intubation when compared to conventional direct laryngoscopy[10].

Kim YM et al, in 2011 evaluated the influence of chest compressions in intubating a patient with direct or indirect laryngoscope in novice persons. Macintosh blade, Glidescope and Airway scope were the devices studied. The intubation time and success rate were compared with or without chest compressions on a mannequin. They concluded that chest compressions did not delay the intubation time which was comparable with all the three scopes used[11].

Boedeker BH et al, in 2011 compared intubation procedure using three video laryngoscopes with Macintosh direct laryngoscope in embalmed cadavers. Data showed that success of intubation improved to 100% with video laryngoscopes when compared with 93% with direct laryngoscope. This concluded that incorporation of video laryngoscope in airway training using cadavers would help in better understanding and improved learning of basic airway management skill[12].

Kanchi M et al, in 2011 studied the hemodynamic response to intubation in 30 patients having coronary artery disease subjected to coronary artery bypass grafting using video laryngoscope. Patients were randomly allocated to two groups namely Macintosh and video laryngoscope. Time to intubate the trachea and hemodynamic changes to intubation was studied in both groups. It was found that the time taken to intubate the trachea was significantly longer with video laryngoscope when compared to direct laryngoscope. Electrocardiography was used to record adverse cardiac events like ischemia and infarction. With respect to hemodynamic alterations the changes showed no difference between uses of direct versus indirect laryngoscopy. The researchers concluded that video laryngoscope use did not produce added advantage in terms of stress response to intubation in ischemic heart disease patients[13].

Diaz-Gomez JL et al, in 2011 selected 357 patients subjected for elective general anaesthesia and grouped them in to two groups namely those having predicted difficult laryngoscopy and predicted easy laryngoscopy according to modified Mallampati class. The patients were noted of nine other possible predictors of difficulty in airway manipulation such as age, gender, body mass index, ASA physical status, cervical flexion, head extension, wideness of mouth opening, level of training obtained by anaesthesia residents and thyromental distance. Both the groups were intubated with Glidescope laryngoscope. The influence of predicted airway difficulty in Glidescope assisted intubation was analysed. The conclusion of the study was, none of the predictors appear to predict first attempt success of tracheal intubation with Glidescope[14].

Griesdale DE et al, in 2012 conducted a systematic review and meta-analysis of performance of endotracheal intubation with Glidescope video laryngoscope versus direct laryngoscope. This included 17 trials of 1998 patients in total. Analysis revealed that video laryngoscope had decreased the intubation time and improved the first attempt success rate of intubation only in the hands of untrained personnel. The experts group did not have these advantages but only had a better visualisation of glottic aperture. The grade of glottic view observed was less (easy) with video laryngoscope group particularly in a setting of difficult airway[15].

Woo CH et al, in 2012 compared the cardiovascular response to tracheal intubation using Macintosh and Pentax airway scope in severe burn victims. Burn victims pose difficult airway scenario due to airway edema. Hemodynamic variables were monitored at baseline, before intubation, immediate post intubation and 3, 5, and 10 minutes after intubation. Heart rate was increased to a greater degree with Macintosh blade but success of intubation and percentage of glottic opening were greatest with use of Pentax Airway scope[16].

Aziz MF et al, in 2012 compared the success rate for intubation of trachea in 300 patients with predicted difficult airway with the assistance of either C-Mac video laryngoscope or conventional laryngoscope. C-MAC laryngoscopy resulted in greater success rate of 93% when compared to 84% by direct laryngoscopy. Laryngoscopy time was higher in video group as 46 seconds compared to 33 seconds in direct group. Video laryngoscopy resulted in better visualisation of vocal cords by obtaining more grade I or II Cormack Lehane scores. 37% of patients in direct group required use of bougie and external laryngeal manipulation for intubation when compared to 24% in video group. The incidence of complications were comparable and not different in both groups[17].

Purugganan RV et al, in 2012 compared direct versus indirect video laryngoscopy for double-lumen tube intubation. Patients were grouped retrospectively into three groups namely DL-MAC (direct laryngoscopy with Macintosh), DL-MIL (with Miller blade), and VL group (use of McGrath or C-

MAC video Laryngoscope). It was found that Cormack Lehane grade was significantly higher with DL-MAC group than the other two groups. The percentage of difficult intubations were higher in the DL-MAC than in other 2 groups. Authors speculated that ease of double lumen intubation with video laryngoscope was due to better glottic visualisation scores[18].

Griesdale DE et al, in 2012 conducted randomized trial in forty critically ill patients who were intubated by novice providers. Intubation was done with either direct or video laryngoscope. The providers received one-hour training with mannequin regarding use of both laryngoscopes. Video laryngoscopy resulted in successful glottic visualisation in 85% of patients compared to only 30% in direct laryngoscope group. The total apneic time was higher with VL group, 221 seconds compared to 156 seconds with Macintosh group. They concluded that video laryngoscopy provided better visualisation of larynx with no improved clinical outcome[19].

Donoghue AJ et al, in 2013 compared direct and video intubation technique in simulated airway by paediatric emergency medicine care providers. The primary outcome compared was first-attempt intubation success and the secondary outcome was percentage of glottic opening score (POGO). Three simulators neonate, infant and adult were intubated by 26 providers who performed 156 intubations. The results obtained was better POGO score with video laryngoscopy in all the three groups but there was no difference in first-attempt success rate in intubating with either scope[20].

Guyette FX et al, in 2013 studied the advantage of using video laryngoscope compared with direct laryngoscopy in a critical care transport setting. The data measured were glottic view grade, first pass success, number of intubation attempts and requirement of rescue device. First pass success rate was 85.6% with video scope compared to 86.1% in direct group which was statistically comparable. The observations concluded that C-MAC laryngoscope was not superior to direct laryngoscope with regard to number of attempts needed or improved intubation although video laryngoscope provided best glottic view[21].

Bensqhir M et al, in 2013 compared direct laryngoscope with X-Lite and Airtraq for intubating patients scheduled for thyroid surgery. They measured the time required to intubate along with intubation difficulty score, glottic view grade, hemodynamic and respiratory effects. They found that direct laryngoscopy had produced greater hemodynamic variations but indirect laryngoscopes actually decreased the time to intubate the trachea[22].

Lee H in 2013 compared the hemodynamic changes and concentrations of plasma norepinephrine levels after intubation. He used two different intubation device namely Macintosh blade and Airway Scope for conducting intubation. Systolic, mean and diastolic blood pressure along with heart rate were observed before and after intubation for 10 minutes at 1 minute interval. Plasma epinephrine levels were sampled before and after intubation. He observed that the heart rate and blood pressure at 0 minute and 4 minute after intubate were statistically different between two groups but there was no difference in plasma norepinephrine levels. The difference in occurrence of sore throat was not significant with both groups[23].

Ke J, Xu Q, in 2013 compared application of tracheal intubation in snoring patients with Glidescope and Macintosh laryngoscope. The mean arterial pressure and heart rate were recorded at basal value (T0), before intubation (T1), after intubation (T2), I min after intubation (T3) and 3 minutes after tracheal intubation (T4). Glidescope produced good glottic visualisation and there was no significant difference in intubation with both groups. T2, T3 and T4 heart rate was increased with both scopes. T1 Mean blood pressure was lower than T0 value and T2, T3 values are higher. The T4 mean blood pressure declined towards basal. Overall there was no difference in hemodynamic stress stating that Glidescope had no advantage in preventing hemodynamic response in spite of obtaining a better glottic view[24].

Sylvia MJ et al, in 2013 studied the promising advantage of video laryngoscopy in simulated paediatric emergency. Sixty-nine residents were allowed to use either direct laryngoscope or video laryngoscope to intubate an uncomplicated simulated respiratory failure scenario.in DL group multiple attempts amounted to 21% compared to 17% in VL group. Median Intubation time was 30 seconds with DL group and 39 seconds with VL group. Hence proved VL had no additional success over DL in a simulated respiratory failure setting[25].

Jones BM et al, in 2013 did a retrospective analysis of 436 patients to assess the efficacy of video versus direct laryngoscopy. The video laryngoscope used was C-MAC. It was found that video laryngoscope improved the visualisation of airway structures with ease and succeeded in intubation of airways that were failed to be intubated by direct laryngoscopy. This emphasised the importance of imparting video laryngoscope as primary intubating device during emergency intubation[26].

Dashti M et al, n 2014 studied the hemodynamic changes to tracheal intubation by Glidescope and Macintosh in sixty patients who had uncontrolled hypertension. Both groups had changes in heart rate and blood pressure after intubation and at 4 minutes after intubation the parameters declined to basal levels. Intubation time was shorter with Macintosh group and fluctuations in heart rate and mean blood pressure were lower with Glidescope[27].

Arici S et al, in 2014 studied McGrath Series 5 laryngoscope and direct laryngoscope with regard to time for intubation and changes in hemodynamic data over time in 80 obstetric patients. They found that the time to insert the tracheal tube into trachea was significantly longer in McGrath group though McGrath scope provided a best view of glottis[28].

De Jong A et al, in 2014 performed meta-analysis comparing video versus direct laryngoscopy in intensive care unit. They searched PubMed, EMBASE and bibliographies of articles for randomised control trials, prospective as well as retrospective observational studies related to intubation of trachea by either DL or VL in an intensive care setting. Pooled odds ratio was generated across studies obtained. The primary outcome measured was difficulty in oro tracheal intubation. The other outcomes compared were first attempt success rate, Cormack grades3/4 and incidence of severe desaturation, cardiovascular collapse, non-tracheal intubation and damage to airway. Nine trials with 2133 subjects were analysed. They found that VL reduced the difficulty in orotracheal intubation due to improved view of larynx and decreased rate of oesophageal intubation and provided increased first-attempt success rate. But the complications were comparable in both DL and VL groups[29].

Sun y et al, in 2014 conducted meta-analysis by reviewing the published literature for paediatric intubations performed with either direct or indirect video laryngoscopy. The search engines used were Ovid, Google Cochrane library and PubMed databases. The relative risk was estimated from only fourteen prospective randomized control studies. The relative risk for success rate of the first intubation attempt was 0.96 and for associated complications was 1.11 showing no difference between two groups. Video laryngoscopes were associated with prolonged intubated time and higher incidence of failed attempts in spite of providing better laryngeal visualisation when compared to direct laryngoscopy[30].

Ibinson JW et al, in 2014 hypothesized that the first time success rate with Glidescope would be better than direct laryngoscope and did an observational study using propensity score matching. They matched 626 patients out of 3831 intubation attempts confined to the use of Miller, Macintosh and Glidescope laryngoscopy. This suggested that Glidescope intubations were more difficult than direct laryngoscopy. But the first pass success rate was 93.6%, a higher value than 80.8% success rate with direct laryngoscopy. It was also concluded that video laryngoscope increased the intubation success after a failed attempt by direct laryngoscopy, helped reducing the incidence of failed intubation[31].

Pournajafian AR et al, in 2014 conducted a randomized control trial comparing Macintosh with Glidescope regarding hemodynamic response to routine elective tracheal intubation. Ninety five healthy patients were intubated with any one of the intubating device and observed for hemodynamic changes before intubation and at 1, 3 and 5 minutes after intubation. The observers concluded that intubation time was longer with Glidescope and there were no difference between the two groups with regard to hemodynamic response at each time point[32].

Lakticova V et al, in 2015 compared the urgent intubation performed by attending intensivists and residents in a medical intensive care setting. The devices investigated were direct laryngoscope and video laryngoscope. They found that the rate of oesophageal intubation was 19% with DL group compared to 0.4% with VL group. The difficult intubation rate was 22% with Dl and only 7% with VL. Regarding complications the occurrence of airway trauma, hypotension, hypoxia and death were not statistically different between both groups. The final conclusion was video laryngoscope decreased the rate of oesophageal intubation, failed intubation and difficult intubation[40].

Akbar SH, Oioi JS, in 2015 compared the intubation profile and hemodynamic fluctuations between C-MAC video laryngoscope and Macintosh direct laryngoscope with immobilised cervical spine. They concluded that C-MAC video laryngoscope showed better intubation profile with regard to shorter intubation time of 32.7 seconds when compared with 38.8 seconds by Macintosh laryngoscope in a setting of immobilised cervical spine. Macintosh laryngoscope needed more optimisation manoeuvres but there was no significant difference in hemodynamic fluctuations measured over time with both groups[41].

Amini S, Shakib M, in 2015 studied cardiovascular response to endotracheal intubation in seventy parturient subjected to general anaesthesia with use of either Glidescope or Macintosh Laryngoscope. Intubation time, changes in heart rate and blood pressure over time were monitored after intubation for five minutes at every one minute interval. This study revealed that Glidescope preserved the hemodynamic changes within first three minutes after intubation in patients who underwent elective caesarean section[42].

Silverberg MJ et al, in 2015 observed that in critically ill patients who required endotracheal intubation the success rate is less due to urgency, uncontrolled atmosphere, highly unstable hemodynamics and varied expertise of the care givers. They hypothesized that indirect laryngoscopy by decreasing the stress of intubating person would provide better outcome superior to direct intubation technique. A total of 117 patients in a single critical care setting were randomized to get intubated with one of the intubating device. First-attempt success was the primary outcome observed. In Glidescope group the first attempt success was 74% compared to 40% in direct laryngoscope group.

Glidescope also achieved 82% first attempt success in all unsuccessful cases of direct laryngoscopy. Complication rates were similar with both intubating devices[43].

Lee DH et al, in 2015 collected data regarding tracheal intubations performed during in-hospital cardio pulmonary resuscitations and retrospectively analysed the performance of direct and video laryngoscopy in such scenario. Video laryngoscope was used in 121 patients and direct laryngoscope in 108 patients. With video laryngoscope the success at first attempt was found as 71.9% and 52.8% with direct laryngoscope, the success rate was higher with experienced providers. But the 28 day mortality after successful resuscitation was not statistically different between both groups. The authors concluded that use of indirect video laryngoscopy during CPR was independently associated with first attempt success of intubation[44].

Lambert RC et al, in 2015 assessed the feasibility of including video laryngoscopes in basic emergency airway management among oral and maxilla facial surgery residents and consultants. A total 48 care providers were allowed to intubate a mannequin using either direct or indirect laryngoscopy. The outcomes collected were time to view cords, glottic view grade, time to pass the tube into trachea and total intervention time. The outcomes showed that glottic view grade was better with video laryngoscope as well as the time to view the cords was also lesser with VL. But the time taken for intubation was found to be shorter with direct laryngoscope with no difference in total intervention time[45].

Ahmad N et al, in 2015 studied the influence of Glidescope on intra ocular pressure and hemodynamic variables. They found that the rise in intraocular pressure was less with Glidescope when compared with Macintosh whereas the hemodynamic changes after intubation were similar with both direct and indirect laryngoscopy groups[47].

Abdelgawad AF et al, in 2015 compared cardiac output, blood pressure and heart rate changes to the use of different indirect laryngoscopies in normotensive and hypertensive subjects. The devices used are Macintosh laryngoscope, UE video laryngoscope and UE video intubation stylet. Cardiac index, stroke volume index, heart rate, systolic blood pressure and diastolic blood pressure were monitored with LidcoRapid monitor. In normotensive patients there was no significant difference in observations made with regard to cardiac output, stroke volume, heart rate and blood pressure among the three devices. Whereas in hypertensive subjects the hemodynamic alterations after intubation are significantly less with the UE laryngoscope and UE intubating stylet than Macintosh direct laryngoscope[48].

Shresha S et al, in 2015 compared Truview EVO2 laryngoscope with direct laryngoscope to assess intubation ease in maxillofacial surgeries. They found that video laryngoscope provided better view of airway than the direct laryngoscope and required shorter time to intubate the trachea. The hemodynamic parameters, complications and necessity of optimising manoeuvres were comparable and similar with both devices. This proved that video laryngoscopes perform better than direct laryngoscope in the setting of difficult airway in patients with maxillofacial trauma[49].

Mort TC and Braffett BH, in 2015 did a study to prove that video laryngoscopy combined with airway exchange catheter would reduce airway complications and hemodynamic compromise in high-risk patients who require tracheal tube exchange. Three hundred and twenty eight ICU patients who needed tracheal tube change were evaluated with direct laryngoscope and if the observation resulted in a poor view, video laryngoscope assessment of the airway followed by tube exchange was done with aid of airway exchange catheter. Airway examination with direct and indirect laryngoscope were noted and compared along with the number of attempts, occurrence of complications and necessity of rescue tools. These data were compared and analysed with a control group of historical patients who had tube exchange done with the aid of direct laryngoscope and airway exchange catheter. About 88% of patients had full view of airway structures on Video examination and the first-pass success rate for tube exchange was 91.5% with indirect laryngoscope compared to 67.7% with direct laryngoscope. The researchers concluded that video laryngoscopy improved full visualisation of airway, enabled tube exchange with minimum number of attempts and in less possible time with least airway complications and hemodynamic compromise. They emphasized that video laryngoscopy would be valuable in assessing and assisting tube exchange without producing greater complications[51].

Review of literature with regard to use of King Vision Video Laryngoscope

Akihisa Y et al, compared the intubation ease and performance in manikin among 31 nurses as participants using king vision channelled blade, King Vision non-channelled blade and Macintosh laryngoscope. The participants made six consecutive attempts with each blade. In his randomised study he observed that the median intubation time was 16.9 seconds with Macintosh blade, 20.5 seconds with king vision channelled blade and 60 seconds with King Vision Non-Channelled blade. The overall success of intubation was 91.4% with Macintosh, 86.6% with King Vision Channelled and only 47.3% with usage of king vision non-channelled blade. No oesophageal intubation attempts were made with the use of king vision blades, but about 9.67% of Macintosh intubations were oesophageal. The difficulty of intubation was greater with non-channelled blade of king vision. With this they suggested that King Vision Channelled blade performs similar with Macintosh blade and it could be a better alternative to Macintosh blade for intubation by novice persons[33].

El-Tahan MR et al, used King Vision Laryngoscope for fiberoptic intubation in a critical tracheal stenosis scenario and found that King Vision Laryngoscope was superior to Glidescope in assisting fiberoptic intubation in such cases[34].

Burnett AM et al, conducted a cross over study among paramedics of four different EMS agencies to compare King Vision Video Laryngoscope and Storz CMAC video Laryngoscope. First attempt success, overall success and success by attempt were compared between two groups over a period of 12 months. Out of 107 patients 41 were intubated with King Vision and 66 got intubated with CMAC. It was found that the first attempt success, overall success and success by attempt were significantly higher with CMAC when compared with King Vision. In about 80% cases direct laryngoscopy was instituted and proved that success rate with Video laryngoscopy is not superior but same as direct laryngoscopy[35].

Yun Bj et al, chose seven tactical experienced paramedics and compared the performance of King Vision with Airtraq optical Laryngoscope and direct laryngoscope in a total of 84 intubations. The parameters studied were time to successful ventilation, first pass success rate, Cormack-Lehane grade and intubator height. He found that the Cormack Lehane score was grade I or II with optical and video laryngoscope but with direct laryngoscope the score was poor. It was also observed that there was no significant difference in time to successful ventilation and first pass success rate between three scopes. The paramedics while using direct laryngoscopy tend to peep in and keep their head low which did not happened much while using Airtraq and King Vision[36].

Murphy LD et al, and Kovacs Gj et al compared Macintosh laryngoscope with King Vision Channelled blade with respect to intubation time and success rate in simulated normal and difficult airway. They studied intubation in four scenarios: normal manikin airway, normal cadaver airway, difficult manikin airway and difficult cadaver airway. They also observed the glottic view and percentage of glottic opening in using the study scope by 32 paramedics. They found that in normal manikin scenario intubation with King Vision was 3.4 seconds faster than Macintosh. In difficult airway scenario this was increased to 11.3 seconds. But this difference in speed of intubation between the two scopes were not present in difficult manikin and normal cadaveric airway scenarios. While intubating difficult airway scenario 10 out of 32 participants failed to intubate using direct laryngoscope, whereas the intubations done with King Vision were successful in all scenarios. They concluded that King Vision scores superior in intubation of difficult airway[37].

Gaszynska E and Gaszynski T did awake intubation successfully using King Vision Video Laryngoscope in two patients who had obstruction of glottis by supraglottic mass[38].

Okabe T et al, conducted a randomised trial in 60 patients who required insertion of nasogastric tube under general anaesthesia. 30 subjects got inserted blindly and 30 nasogastric tube insertions were done with the assistance of King Vision Laryngoscope. In blind group the mean time taken for insertion of nasogastric tube was 65.9 seconds which did not differ statistically with KV group where the mean time of insertion was 52.5 seconds. With KV group the success rate of placing the nasogastric tube was 100% but it was only 90% with blind group. One case in blind had malposition of nasogastric into trachea which was corrected using king vision. Airway trauma and hence bleeding were similar with both groups[39].

Alvis BD and team did a randomised controlled trial to evaluate McGrath MAC video laryngoscope and King Vision video laryngoscope with related to intubation ease and success in sixty six anticipated normal airway. The outcomes that were measured are success on first attempt, time to intubation, change in pulse oximetry values, number of attempts and assist manoeuvres needed. It was found that the mean time for successful intubation for McGrath MAC group was 17 seconds and for King Vision group was 38 seconds. The first attempt success rate was 100% with McGrath MAC group and only 89% for King Vision group. Three patients in King Vision group had desaturation episodes but no case in McGrath MAC group had fall in SPO2. Both groups had no statistically significant difference with regard to achievement of a good glottic view, number of attempts required for success, manoeuvers necessary for optimisation. They concluded that McGrath MAC video Laryngoscope was found to be superior to King Vision in intubating normal airway by persons who have shorter experience with usage of video laryngoscopes[46].

Ruetzler K et al, compared five video laryngoscopes with direct laryngoscope. The video laryngoscopes studied were C-MAC with blade 3, Airtraq size 2, King Vision, McGrath series 5 and Glide scope. The participants were 10 residents, 12 senior staff physicians and 5 anesthesia nurses, all had good experience with direct laryngoscope but had not used video laryngoscopes. After 60 minutes training with video laryngoscopes they performed intubation on a normal manikin as well as difficult manikin with cervical collar in a random sequence with the scopes mentioned. The primary outcome measured was time to intubation. The secondary outcomes observed were time to view the glottis, intubation attempts, success rate and ease of intubation. In manikin with normal airway the time to intubation was 16 seconds with Macintosh but was highest with McGrath scope (34 seconds). The success rate was 100% with Macintosh and Glidescope, 96.7% with C-MAC, 88.9% with Airtraq, 77.8% with King Vision and only 44.4% with McGrath. In difficult manikin scenario the time to intubation ranged between 20.3 seconds to 26.7 seconds with Airtraq and McGrath respectively. The rate of successful intubation was 100% with C-MAC, 96.7% with Glidescope, 85.2% with Airtraq and Macintosh, 81.5% with King Vision and 70.4% with McGrath. They concluded that in a normal airway direct laryngoscopy is convincing than video laryngoscopes and in difficult setting C-MAC and Glidescope scores better intubating profile than direct laryngoscope and other video laryngoscopes[50].

El-Tahan MR and Doyle DJ did successful awake tracheal intubation in a patient of anticipated difficult airway diagnosed to have huge lymphocele using both fiberoptic bronchoscope and King Vision Video Laryngoscope[52].

Jarvis JL et al, did a retrospective analysis of electronic records and analysed the first pass success, overall success, and success per attempt with use of King Vision video laryngoscope and Macintosh laryngoscope. This analysis of 514 patient records showed that the first pass success was 74.2%, overall success was 91.5% and success per attempt was 71.2% with KV group compared to 43.8%, 64.9% and 44.4% respectively with direct laryngoscopy group. This showed superiority of King Vision for tracheal intubation by paramedics in a suburban setup where historically the success rate was low[53].

AIM & OBJECTIVES

AIM AND OBJECTIVES

AIM

To evaluate and compare the use of curved Macintosh laryngoscope (Direct laryngoscopy) with King Vision Video Laryngoscope's channelled blade (indirect rigid Laryngoscope) as intubating devices in adult patients posted for elective surgery under general anaesthesia.

OBJECTIVES

To compare the safety and efficacy in using direct laryngoscope (curved Macintosh blade) and King vision video laryngoscope by experienced anaesthesiologists for elective intubation with head placed in neutral position under general anaesthesia.

The outcome is measured in terms of

- Time to intubate the trachea
- Total time taken for laryngoscopy
- Ease/difficulty of intubating experience
- The best laryngeal view obtained
- Number of intubation attempts
- Number and nature of optimisation manoeuvres required for successful intubation of trachea
- Hemodynamic alterations that happens after intubation

MATERIALS & METHODS

METHODOLOGY

STUDY DESIGN:

Prospective Randomised study

SOURE OF DATA:

Patients scheduled for elective surgery under general anaesthesia at Govt. Mohan Kumaramangalam Medical College Hospital, Salem

PARTICIPANTS:

Care givers who participated in the study were experienced anaesthesiologists and anaesthesiology residents. All participants received introduction and demonstration of King vision Laryngoscope and were trained on adult intubating mannequin. All of them had done at least 100 successful airway intubation with conventional laryngoscope and had minimum of 2 years of experience in handling direct laryngoscope. Caregivers cannot be blinded to the intervention.

MATERIALS:

Investigated Devices

1. Macintosh Laryngoscope with 3 size curved blade (English Profile)
2. King Vision Video Laryngoscope with Channelled blade

Materials used for assessment and data measurement

1. Weighing machine calibrated to 1 kg
2. Height measuring scale calibrated to 0.5 cm

3. Measuring tape calibrated to 0.5 cm
4. Stopwatch capable of lap measurements
5. Phillips Intellivue Muti-Parameter Monitor MP 20 and MP 40 capable to record parameters at 1 minute interval

STUDY PERIOD:

January 2015 - August 2015

PILOT STUDY:

Done with 8 patients in October 2014 submitted to Institute Ethical Committee in December 2014 and approval obtained.

SAMPLE SIZE DETERMINATION:

Time to intubation was considered as the primary outcome for the purpose of sample size calculation. To be able to detect a mean difference of at least 2 minutes difference between the two study groups, with an alpha error of 0.05 and 80% power of study, with population variance of 10, the required sample size was calculated using the following formula.

Sample size $n = (Z_{\alpha/2}+Z_{\beta})^{2} * 2 * \sigma^2 / d^2$,

Where $Z_{\alpha/2}$ is the critical value of the Normal distribution at α of 0.05 = 1.96

Z_{β} is the critical value of the Normal distribution for 80% power (at β=0.2) = 0.84

σ^2 is the population variance= 10 and

d is the different you would like to detect. = 2

By using the above mentioned parameters, the required sample size would be 40 subjects in each of the two study groups. Hence 40 subjects were included in each group in the final analysis.

TOTAL SAMPLE SIZE:

Eighty (N=80)

STUDY GROUPS:

Group ML: Intubation done using Standard Macintosh Laryngoscope (n=40)

Group KVVL: Intubation done using King Vision Video Laryngoscope with Channelled blade (n=40)

INCLUSION CRITERIA:

- American Society of Anesthesiologists physical status class I-II
- Patients aged 18-65 years
- Scheduled for elective surgery under general anesthesia
- Mallampati Class I & II airway

EXCLUSION CRITERIA:

- Expected or known difficult airway
- Mallampati Class III/IV airway
- History of cervical spine injury
- Previous throat surgery

- Previous oral surgery
- Gastro-esophageal reflux disease
- Pregnancy
- Need for rapid sequence induction
- Emergent surgery
- Body mass index higher than 35 kg/m2
- Without incisor teeth
- Mouth opening less than 3 cms
- American Society of Anesthesiologists physical status class III and above
- Patients age <18 and >65 years

ASSESSMENT AND PREPARATION:

All patients were assessed in pre-assessment clinic well before surgery. Careful history taking, general and systemic examinations were done to rule out severe comorbidities. BMI calculations were made. A meticulous airway assessment was done to exclude patients with difficult airway by giving attention to Inter Incisor gap, Modified Mallampati airway classification, Neck movements, Thyromental distance, Sternomental distance and examination of dentition.

Mouth opening: Patients sitting in front of the assessor at same eye level were asked to open the mouth as wide as possible with head in neutral position. The gap between the incisors measured.

Inter Incisor gap is normally > 5cms in normal airway and < 3.5 cms predicts difficult passage of laryngoscope into the mouth.

Samsoon and young modified Mallampati classification:

Patient's oral cavity examined in sitting position at the level of the examiner eye with wide mouth opening and protruded tongue without vocalization.

Class I - soft palate, fauces, uvula, pillars

Class II – soft palate, fauces, uvula are seen

Class III – only soft palate and base of uvula seen

Class IV - soft palate is not visible.

Class 3 and 4 examination predicts difficulty.

Patil's test: The distance from thyroid notch to mentum with patient sitting, head extended and mouth closed was measured. A distance less than 6.5cms predicts difficult retraction of tongue due to less mandibular space.

Savva's test: the distance from sternal notch to mentum with patient sitting, head extended and mouth closed was measured. A distance less than 12.5cms predicts difficult cannulation of trachea.

The Temporomandibular joint mobility checked to ensure possibility of anterior traction of lower jaw.

Blood Hemoglobin, Blood Sugar, Urea & creatinine, Urine routine, Serum sodium and potassium; Chest X-ray and ECG were checked.

Subjects were explained about the investigation in vernacular language and consent for participation in the study was obtained both informed and in written.

They were advised

- Nil by mouth 8 hours prior to surgery
- Premedication with 10 mg of T. Diazepam on the night before surgery.

RANDOMIZATION:

Patients were randomly allocated to one of two groups (n=40 for each) namely, Macintosh, (ML) King Vision, (KVVL) by drawing sequentially numbered sealed opaque envelopes that contained a software-generated randomization code before general anaesthesia. Subjects were blinded to the intervention.

PROCEDURE:

The investigator gave the allotted laryngoscope to the intubator before premedication and took the role of recording the observations and data entry.

In the operation theatre, the operating table was levelled to the umbilicus of the intubating person and the patients were placed in supine position without head pillow so that the head was placed in neutral position. Electrocardiograph, Non-invasive Blood Pressure, Pulse Oximeter and Capnograph monitors were connected and basal Heart rate, Systolic and Diastolic blood pressure readings were recorded. The data was collected by an independent investigator.

Patients were premedicated with Inj. Fentanyl 2mcg/Kg IV and Inj. Midazolam 30mcg/Kg IV and preoxygenation was carried out using 100% oxygen using closed circuit with 7 litres of total gas flow. Three minutes after premedication, Heart rate and Blood pressure were recorded as Post Premedication (PP) values.

All patients were given intravenous Inj. Propofol 2 mg/kg for induction of anaesthesia until loss of consciousness. Inj. Vecuronium 0.1 mg/kg was administered after loss of verbal response as intubating muscle relaxant. Anaesthesia was maintained using 1% Halothane in seven litres flow of oxygen via a bag-mask for 4 minutes before attempted on endotracheal intubation.

Three minutes after Propofol, the Post induction (PI) values of heart rate and blood pressure were recorded and the measuring interval was set to one minute gap. The investigated device and stopwatch were prepared at this point and intubation was carried out with the respective device.

ML Group

Macintosh Laryngoscope was held in left hand by the intubator and the stopwatch was started by the investigator. After opening the mouth by scissoring technique the scope was passed in to the right corner of mouth and at once the blade tip was advanced to the base of the tongue, the tongue was lateralised by the flange so that the blade was in the midline creating a good working space to view the pharynx. On advancing once the epiglottis was in view lower jaw was retracted anterior and the blade tip was placed in the vallecula and the jaw was lifted up enabling the view of glottis. The best view of glottis was graded according to Cormack Lehane grading system and the endotracheal tube (7.5 size) was threaded into the trachea. Poor or non glottic visualisation required optimising manoeuvres like peep in/down, bent back/down by the intubator; application of external laryngeal pressure, head extension, and neck flexion by the supporting staff or use of stillette or bougie for intubation.

KVVL group

King Vision connected with channelled blade was preloaded with 7.5 size endotracheal tube without lubrication, switched on and held in left hand along with timer started. Mouth was split open by scissoring technique and the distal blade tip was introduced in mid line. Mild traction of lower jaw allowed the channel portion of the blade inside the mouth. By looking on to the display the scope was gently advanced along the curvature of the tongue judiciously until the epiglottis come into view. Tip of the blade was kept in the vallecula and the scope was lifted gently superiorly to view the entire glottic aperture. The image of the glottis was placed at the center of the display with care taken not to get a very close view which would produce difficulty in passing the tube because of arytenoid catch. Then the endotracheal tube was threaded down in to trachea. Up and down; medial to lateral: right to left tilt: in and out; and inward and outward rotation of the scope were done to get obtain optimal image. Elevation or depression of larynx were done by the supporting staff to align the image. Anticlockwise /clockwise proximal twist of ETT was done to facilitate passage and slip in of the tube.

Immediate post intubation (PT) hemodynamic parameters were recorded as PT0 values and thereafter as PT (time) values up to fifteen minutes at two minute intervals. Values at PT 30 minutes were also recorded.

Intubation time more than 180 seconds or desaturation to less than 93% was considered as failed attempt.

MEASURED OUTCOMES:

Time to tracheal intubation, defined as the time when the study device passes the central incisors to the time when the tip of the tracheal tube passed through the glottis was noted in seconds.

The duration of laryngoscopy, defined as the time from holding of the scope to the appearance of as the first upward deflection on the capnograph, was recorded in seconds.

The best view obtained during laryngoscopy using modified Cormack and Lehane classification was recorded.

Original Cormack and Lehane system	1 Full view of the glottis	2 Partial view of the glottis or arytenoids		3 Only epiglottis visible	4 Neither glottis nor epiglottis visible
View at laryngoscopy					
Modified system	1 As for original Cormack and Lehane above	2a Partial view of the glottis	2b Arytenoids or posterior part of the vocal cords only just visible	3 As for original Cormack and Lehane above	4 As for original Cormack and Lehane above

Fig. 34: Cormack Lehane grading of glottic view (Yentis modification)

Number of attempts needed to cannulise the trachea were recorded.

The anaesthesiologists rated the ease of intubation using a 100 mm, 11 point visual analog scale.

0	10	20	30	40	50	60	70	80	90	100
Very easy < ------------- >Extremely difficult										

Change in hemodynamic parameters (heart rate, systolic diastolic and mean blood pressures) were recorded pre and post intubation.

Parameters	Prior Intubation			Post Intubation (PT)*									
	Basal	PP*	PI*	PT 0	PT 1	PT 3	PT 5	PT 7	PT 9	PT 11	PT 13	PT 15	PT 30
HR													
SBP													
DBP													
MBP													

*PP – post premedication, PI-Post Induction, PT- Post Intubation

Any injury and complications that happened were recorded.

STATISTICAL ANALYSIS:

Type of laryngoscope used for intubation was the explanatory variable. Various procedure related and hemodynamic parameters were considered as primary outcome variables. Socio-demographic variables of the study subjects, intubator's experience etc. were considered as potential confounders. Initially the socio demographic parameters were compared between the two study groups, using frequencies and percentages for categorical variables, mean and standard deviation for quantitative variables. The association between type of laryngoscope and the outcome variables was assessed by calculating the percentage or mean differences. The statistical significance of the differences was assessed by using chi square test or independent sample student t-test, as appropriate.95% CI of the parameters was also presented. IBM statistics, version 21 and Microsoft Excel 2013 were used for statistical analysis.

OBSERVATION &
RESULTS

OBSERVATION AND RESULTS

A total of 80 participants were included in the study, with 40 subjects in each group i.e. KVVL and ML. The baseline socio demographic and anthropometric parameters were compared between the two treatment groups. There was no statistically significant difference in proportion of males or females between the two study groups. (Table 1)

Table 1: Comparison of gender distribution between the two groups.

Gender	Group		Chi Square Value	p Value
	KVVL (N=40)	ML (N=40)		
Female	19 48.7%	20 51.3%	.050	.823
Male	21 51.2%	20 48.8%		

Even though the mean age of the participants was slightly higher in ML group (40.70years), compared to KVVL group (38.45 years), the difference was not statistically significant**.** The mean values of all the anthropometric parameters i.e. weight, height and BMI were comparable between the two study groups, with no statistically significant difference. (Table 2)

Table 2: Comparison of age and anthropometric parameters.

Parameter	Mean	Mean Difference	p Value	95% CI	
				Lower	Upper
I. Age					
ML	40.70	2.250	.357	-2.587	7.087
KVVL	38.45				
II. Weight					
ML	62.68	0.075	.962	-3.013	3.163
KVVL	62.60				
III. Height					
ML	164.48	0.000	1.000	-2.331	2.331
KVVL	164.48				
IV. BMI					
ML	23.12	0.036	.927	-0.744	0.816
KVVL	23.08				

The average Mallampati scores were comparable between the two study groups (Mean difference, 0.075, p-value 0.50), with no statistically significant difference. The mean intubator's experience was 2.35 years higher in KVVL group, compared to ML group (P value 0.005), which was statistically significant. (Table 3)

Table 3: Comparison of Mallampati score and intubator's experience and anthropometric parameters.

Parameter	Mean	Mean Difference	p Value	95% CI	
				Lower	Upper
Mallampati Score					
ML	1.48	0.075	.505	-0.148	0.298
KVVL	1.40				
Intubators Experience in years					
ML	7.10	-2.350	.005	-3.986	-0.714
KVVL	9.45				

All the intubators, who intubated in both the groups, were KVVL trained intubators. Head was kept in neutral position and the tables was kept at level in all the participants in two study groups. (Table 4)

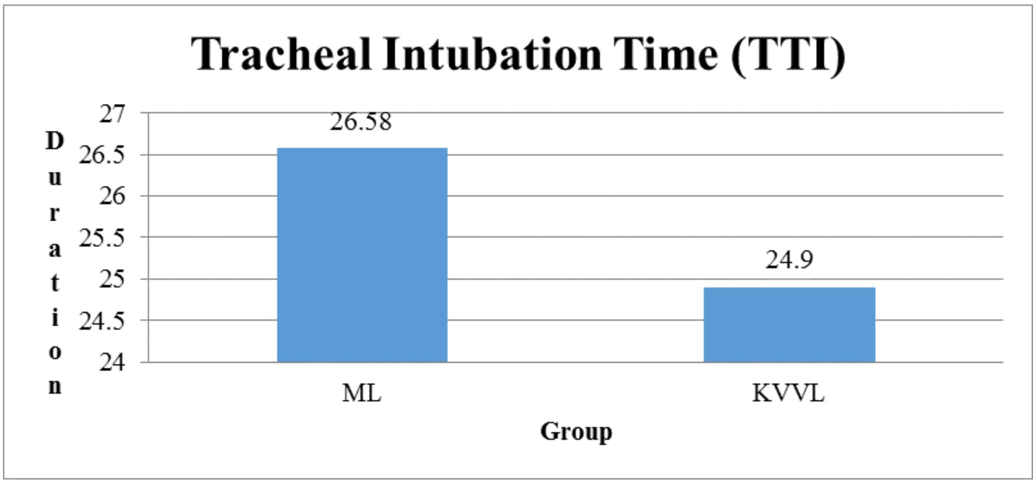
Table 4: Comparison of training and procedure related aspects between two study groups.

Parameter	Group	
	ML	KVVL
KVVL Trained	40 (50.0%)	40 (50.0%)
Neutral Head Position	40 (50.0%)	40 (50.0%)
Table kept at level	40 (50.0%)	40 (50.0%)

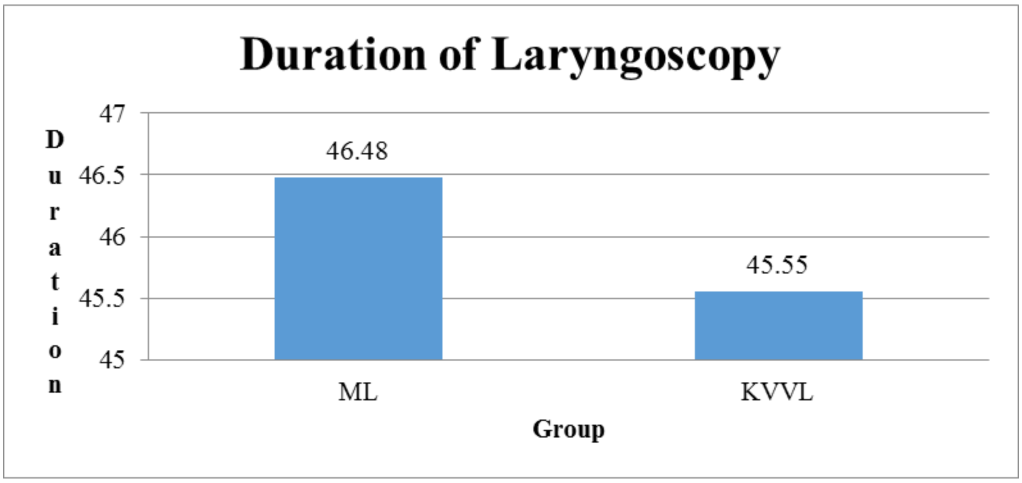
The mean tracheal intubation time was slightly higher (1.67 seconds), in ML group, compared to KVVL group. The mean duration of laryngoscopy was also slightly higher (0.92 sec) ML group. But both these differences were very minimal and were statistically not significant. All the cases in the KVVL group were intubated in first attempt in KVVL group, but some of the patients in ML group had required more than 1 attempt, which resulted in slightly higher mean number of attempts (1.05 vs 1.0) in ML group, compared to KVVL group, but this difference was very minimal and not statistically significant. The mean ease of intubation score was slightly higher (8.0) in ML group, compared to KVVL group, which was statistically not significant. (Table 5)

Table 5: Comparison of procedure related parameters between the two study groups.

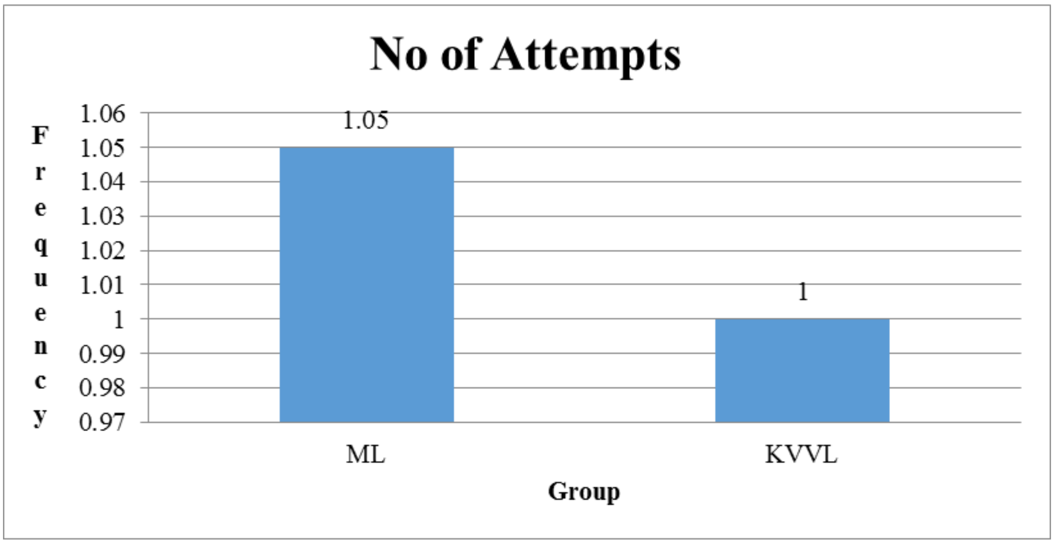
Parameter	Mean	Mean Difference	p Value	95% CI	
				Lower	Upper
Tracheal Intubation Time (TTI) in Seconds					
ML	26.58	1.675	.596	-4.596	7.946
KVVL	24.90				
Duration of Laryngoscopy (DOL) in seconds					
ML	46.48	0.925	.793	-6.079	7.929
KVVL	45.55				
No of Attempts					
ML	1.05	0.050	.156	-0.019	0.119
KVVL	1.00				
Ease of Intubation Score					
ML	24.00	8.000	.065	-0.512	16.512
KVVL	16.00				



Graph 1: Bar diagram of mean tracheal intubation time (in seconds) in the two study groups.



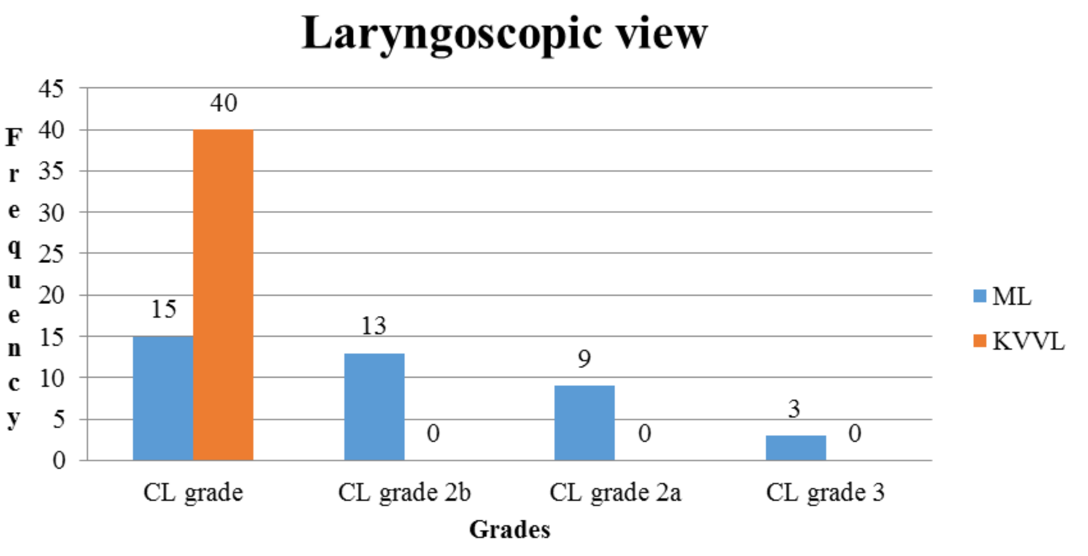
Graph 2: Bar diagram of mean duration of laryngoscopy (in seconds) in the two study groups.



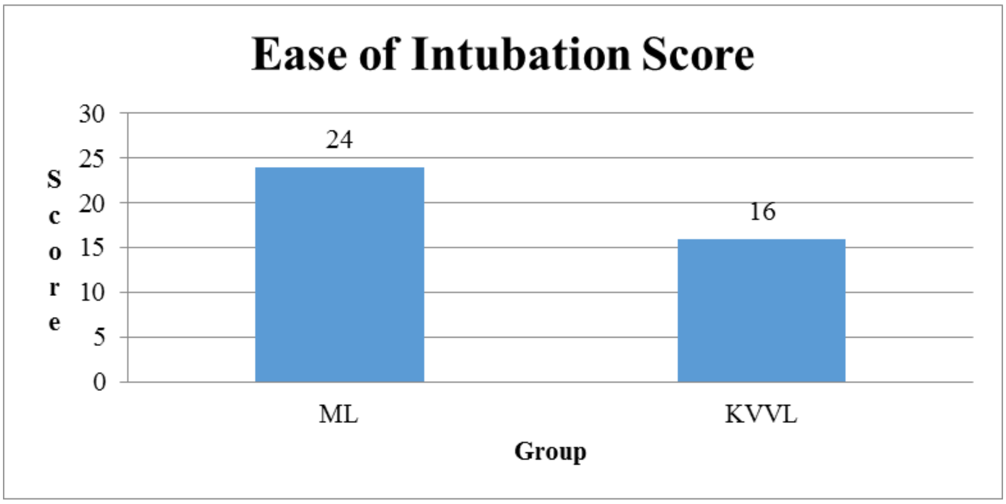
Graph 3: Bar diagram of mean number of attempts in the two study groups

Parameter	Group	
	ML	KVVL
CL Grade 1	15 (27.3%)	40 (72.7%)
CL Grade 2b	13 (100.0%)	0 (0.0%)
CL Grade 2a	9 (100.0%)	0 (0.0%)
CL Grade 3	3 (100.0%)	0 (0.0%)

Table 6: Descriptive analysis of laryngoscopic view



Graph 4: Bar diagram of laryngosopic view of the two study groups



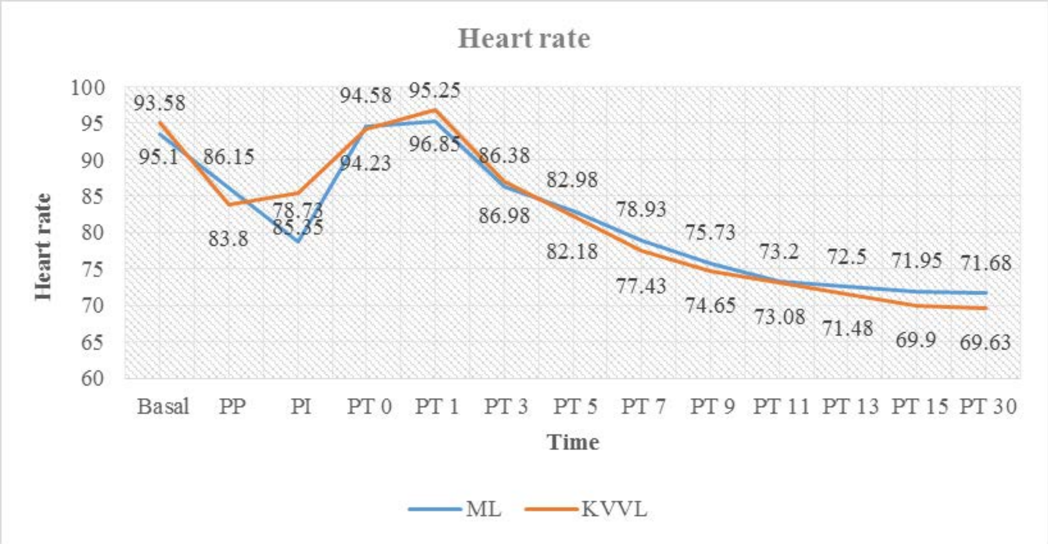
Graph 5: Bar diagram of mean ease of intubation score in the two study groups

Table 7: Comparison of heart rate between the two study groups.

Parameter	Mean	Mean Difference	p Value	95% CI	
				Lower	Upper
HR Basal					
ML	93.58	-1.525	.679	-8.828	5.778
KVVL	95.10				
HR PP					
ML	86.15	2.350	.527	-5.016	9.716
KVVL	83.80				
HR PI					
ML	78.73	-6.625	.267	-18.419	5.169
KVVL	85.35				
HR PT 0					
ML	94.58	.350	.923	-6.867	7.567
KVVL	94.23				
HR PT 1					
ML	95.25	-1.600	.664	-8.897	5.697
KVVL	96.85				
HR PT 3					
ML	86.38	-.600	.886	-8.883	7.683
KVVL	86.98				
HR PT 5					
ML	82.98	.800	.824	-6.340	7.940
KVVL	82.18				
HR PT 7					
ML	78.93	1.500	.625	-4.578	7.578
KVVL	77.43				
HR PT 9					
ML	75.73	1.075	.714	-4.735	6.885
KVVL	74.65				
HR PT 11					
ML	73.20	.125	.965	-5.473	5.723
KVVL	73.08				
HR PT 13					
ML	72.50	1.025	.706	-4.367	6.417
KVVL	71.48				
HR PT 15					
ML	71.95	2.050	.417	-2.955	7.055
KVVL	69.90				
HR PT 30					
ML	71.68	2.050	.375	-2.525	6.625
KVVL	69.63				

The mean heart rate at baseline, during and after procedure was compared between the study groups. No statistically significant difference was observed in heart rate between the two study groups, at any point time. (Table 6)

Graph 6: Trend diagram; comparing the mean heart rate between the two study groups



The mean Systolic BP at baseline, during and after procedure was compared between the study groups. No statistically significant difference was observed in Systolic BP between the two study groups, at any point time. (Table 7)

Table 8: Comparison of Systolic BP between the two study groups.

Parameter	Mean	Mean Difference	p Value	95% CI	
				Lower	Upper
SBP Basal					
ML	137.93	-0.975	.850	-11.174	9.224
KVVL	138.90				
SBP PP					
ML	121.60	2.65	.375	-71.416	27.216
KVVL	118.95				
SBP PI					
ML	94.15	-2.400	.406	-8.117	3.317
KVVL	96.55				
SBP PT 0					
ML	129.25	-3.375	.598	-16.068	9.318
KVVL	132.63				
SBP PT 1					
ML	127.70	-2.575	.643	-13.592	8.442
KVVL	130.28				
SBP PT 3					
ML	117.25	3.450	.384	-4.394	11.294
KVVL	113.80				
SBP PT 5					
ML	109.78	3.800	.285	-3.222	10.822
KVVL	105.98				
SBP PT 7					
ML	105.98	4.775	.119	-1.255	10.805
KVVL	101.20				
SBP PT 9					
ML	105.13	3.600	.213	-2.110	9.310
KVVL	101.53				
SBP PT 11					
ML	103.00	2.225	.405	-3.070	7.520
KVVL	100.78				
SBP PT 13					
ML	102.10	2.250	.380	-2.819	7.319
KVVL	99.85				
SBP PT 15					
ML	103.13	3.900	.120	-1.037	8.837
KVVL	99.23				
SBP PT 30					
ML	111.08	**2.800**	**.292**	**-2.457**	**8.057**
KVVL	108.28				

The mean Diastolic BP at baseline, during and after procedure was compared between the study groups. No statistically significant difference was observed in diastolic BP between the two study groups, at any point time. (Table 8)

Graph 7: Trend diagram; comparing the systolic blood pressure between the two study groups

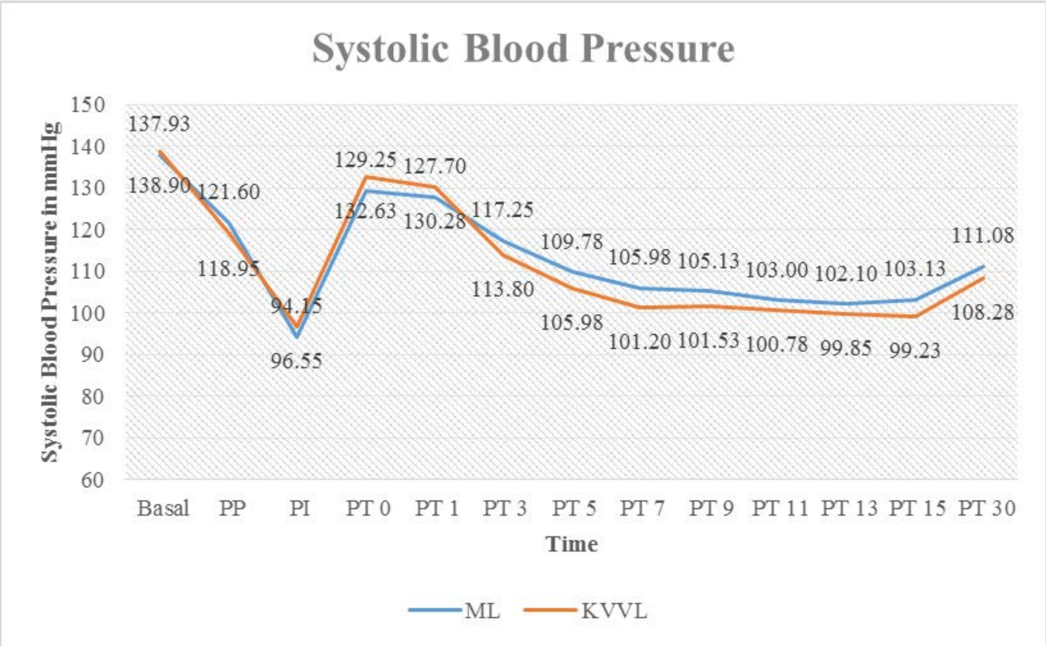
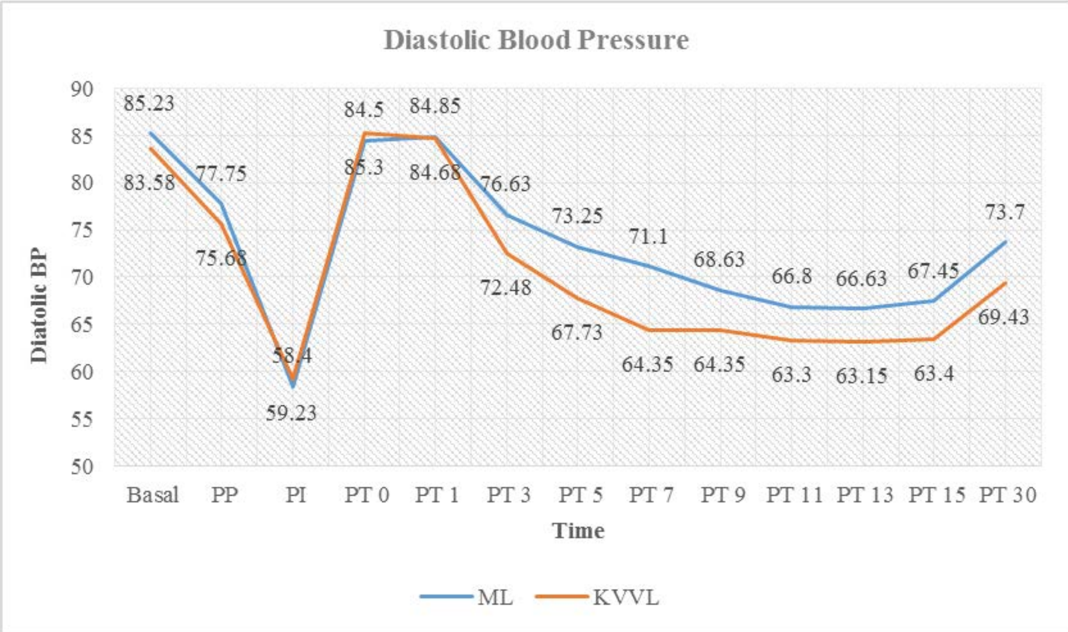


Table 9: Comparison of diastolic BP between the two study groups.

Parameter	Mean	Mean Difference	p Value	95% CI	
				Lower	Upper
DBP Basal					
ML	85.23	1.650	.568	-4.076	7.376
KVVL	83.58				
DBP PP					
ML	77.75	2.075	.385	-2.655	6.805
KVVL	75.68				
DBP PI					
ML	58.40	-0.825	.750	-5.955	4.305
KVVL	59.23				
DBP PT 0					
ML	84.50	-.800	.852	-9.290	7.690
KVVL	85.30				
DBP PT 1					
ML	84.85	0.175	.966	-8.079	8.429
KVVL	84.68				
DBP PT 3					
ML	76.63	4.150	.198	-2.219	10.519
KVVL	72.48				
DBP PT 5					
ML	73.25	5.525	.054	-0.104	11.154
KVVL	67.73				
DBP PT 7					
ML	71.10	6.750	.008	1.813	11.687
KVVL	64.35				
DBP PT 9					
ML	68.63	4.275	.081	-0.533	9.083
KVVL	64.35				
DBP PT 11					
ML	66.80	3.500	.122	-0.961	7.961
KVVL	63.30				
DBP PT 13					
ML	66.63	3.475	.121	-0.944	7.894
KVVL	63.15				
DBP PT 15					
ML	67.45	4.050	.077	-0.448	8.548
KVVL	63.40				
DBP PT 30					
ML	73.70	4.275	.071	-0.368	8.918
KVVL	69.43				

Graph 8: Trend diagram; comparing the diastolic blood pressure between the two study groups

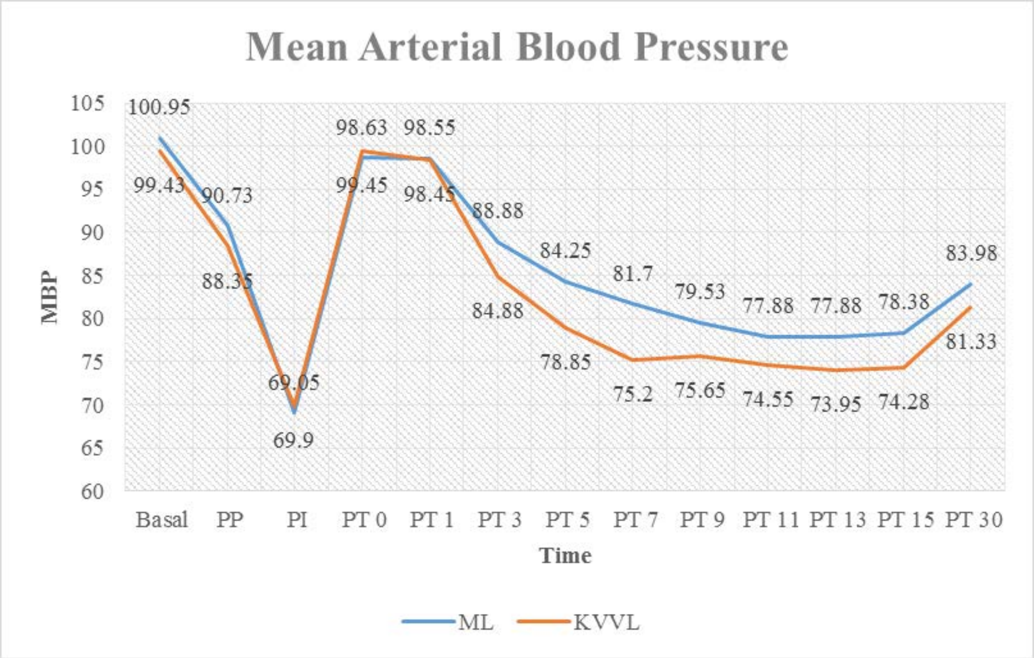


The mean arterial BP at baseline, during and after procedure was compared between the study groups. No statistically significant difference was observed in mean arterial BP between the two study groups, at any point time. (Table 9)

Table 10: Comparison of MEAN ARTERIAL BP between the two study groups.

Parameter	Mean	Mean Difference	p Value	95% CI	
				Lower	Upper
MBP Basal					
ML	100.95	1.525	.660	-5.344	8.394
KVVL	99.43				
MBP PP					
ML	90.73	2.375	.360	-2.760	7.510
KVVL	88.35				
MBP PI					
ML	69.05	-0.850	.752	-6.183	4.483
KVVL	69.90				
MBP PT 0					
ML	98.63	-.825	.865	-10.473	8.823
KVVL	99.45				
MBP PT 1					
ML	98.55	0.100	.982	-8.705	8.905
KVVL	98.45				
MBP PT 3					
ML	88.88	4.000	.253	-2.914	10.914
KVVL	84.88				
MBP PT 5					
ML	84.25	5.400	.076	-0.588	11.388
KVVL	78.85				
MBP PT 7					
ML	81.70	6.500	.016	1.244	11.756
KVVL	75.20				
MBP PT 9					
ML	79.53	3.875	.138	-1.279	9.029
KVVL	75.65				
MBP PT 11					
ML	77.88	3.325	.174	-1.501	8.151
KVVL	74.55				
MBP PT 13					
ML	77.88	3.925	.086	-0.574	8.424
KVVL	73.95				
MBP PT 15					
ML	78.38	4.100	.079	-0.486	8.686
KVVL	74.28				
MBP PT 30					
ML	83.98	2.650	.281	-2.212	7.512
KVVL	81.33				

Graph 9: Trend diagram; comparing the mean arterial pressure (MBP) between the two study groups



No optimization manoeuvre was required, in 11 patients in ML groups, whereas 29 patients in KVVL group, did not require any optimization manoeuvre. Anticlockwise rotation of ETT was the most common manoeuvre required in KVVL group (9 subjects), followed by External Elevation of Larynx (2 subjects). Bending down (4 subjects) and external laryngeal pressure with peep in (3 subjects) were the most common manoeuvres required in ML group apart from various other manoeuvres as listed in the (Table 10).

Table 11: Comparison of Optimizing Manoeuvres done between the two study groups.

Parameter	Group	
	ML	KVVL
None	11 (27.5%)	29 72.5%
Anticlockwise rotation of ETT	0 0.0%	9 100.0%
Bent Back	1 100.0%	0 0.0%
Bent Back, External Laryngeal Pressure	1 100.0%	0 0.0%
Bent down	4 100.0%	0 0.0%
Bent down, External Laryngeal Pressure	2 100.0%	0 0.0%
External Elevation of Larynx	0 0.0%	2 100.0%
External Laryngeal Pressure	10 100.0%	0 0.0%
External Laryngeal Pressure, bent back	2 100.0%	0 0.0%
External Laryngeal Pressure, Head Extension	1 100.0%	0 0.0%
External Laryngeal Pressure, Head Extension, Bent Back	1 100.0%	0 0.0%
External Laryngeal Pressure, Head Extension, Bent Back , Bougie used	1 100.0%	0 0.0%
External Laryngeal Pressure, Peep in	3 100.0%	0 0.0%
Intubator Bent down, External Laryngeal Pressure, Bougie used	1 100.0%	0 0.0%
Peep in	1 100.0%	0 0.0%
Peep in, External Laryngeal Pressure	1 100.0%	0 0.0%

The mean heart rate increased by 3.17% at 1 minute after intubation from baseline value in ML group and about 2.92% in KVVL group. The change in heart rate from post induction value to immediate post intubation (PT0) was 22.2% in ML group and 15.9% in KVVL group: to 1 min after intubation (PT1) was 23.1% with ML and 19.7% with KVVL group. Both groups were comparable and the p value was > 0.05. (Table. 11)

Table 12: Percentage change in Heart rate

Parameter	Mean % change	Difference in mean %	p Value	95% CI of the difference	
				Lower	Upper
Percentage change from Basal to PT0					
ML	2.9033	3.01	0.423	-4.43	10.46
KVVL	-0.1113				
Percentage change from Basal to PT1					
ML	3.1750	0.251	0.945	-6.98	7.487
KVVL	2.9231				
Percentage change of from Basal to PT3					
ML	-6.9564	-0.31	0.994	-8.431	8.369
KVVL	-6.9254				
Percentage change from PI to PT0					
ML	22.2652	6.30	0.188	-3.13	15.73
KVVL	15.9646				
Percentage change from PI to PT1					
ML	23.1545	3.410	0.495	-6.49	13.31
KVVL	19.7444				
Percentage change of from PI to PT3					
ML	10.8273	3.05	0.532	-6.62	12.73
KVVL	7.7705				

From Post induction value, the systolic blood pressure increased up to 38.6% at immediate post intubation PT0, 37.1% at 1 minute after intubation and 25.7 % at 3 minutes after intubation in ML patients, which was 37.8% at PT0, 36.3% at PT1 and 19% at PT3 in KVVL patients. But there was no statistical difference found in the change in systolic Blood pressure between two groups. (Table. 12)

Table 13: Percentage change of systolic BP

Parameter	Mean % change	Difference in mean %	p Value	95% CI	
				Lower	Upper
Percentage change from Basal to PT0					
ML	-5.50	-2.10	0.61	-10.43	6.23
KVVL	-3.39				
Percentage change from Basal to PT1					
ML	-6.51	-1.80	0.64	-9.56	5.96
KVVL	-4.71				
Percentage change of from Basal to PT3					
ML	-13.8998	2.65	0.39	-3.44	8.75
KVVL	-16.5516				
Percentage change of from PI to PT0					
ML	38.6495	0.77	0.907	-12.26	13.81
KVVL	37.8781				
Percentage change from PI to PT1					
ML	37.1291	0.82	0.89	-11.68	13.34
KVVL	36.3005				
Percentage change from PI to PT3					
ML	25.7485	6.74	0.12	-1.87	15.35
KVVL	19.008				

The change in diastolic blood pressure from post induction value (PI) was 48.4% at immediate post intubation, 48.7% at one minute after intubation and 33.3% at 3 minutes after intubation in ML group. In KVVL group this change was 46.7%, 46.2% and 25.5% respectively. But there was no difference observed statistically. The percent increase in diastolic blood pressure comparison listed in Table 13.

Table14: Percentage change of Diastolic B.P

Parameter	Mean % change	Difference in mean %	p Value	95% CI	
				Lower	Upper
Percentage change from Basal to PT0					
ML	.0504	-3.20	0.50	-12.63	6.22
KVVL	3.2513				
Percentage change from Basal to PT1					
ML	.5372	-1.60	0.71	-10.14	6.94
KVVL	2.1372				
Percentage change from Basal to PT3					
ML	-9.4225	2.90	0.40	-3.97	9.79
KVVL	-12.3321				
Percentage change from PI to PT0					
ML	48.4486	1.65	0.83	-14.22	17.53
KVVL	46.7937				
Percentage change from PI to PT1					
ML	48.7927	2.55	0.74	-13.05	18.16
KVVL	46.2389				
Percentage change from PI to PT3					
ML	33.6825	8.15	0.19	-4.13	20.44
KVVL	25.5262				

The change in average mean arterial blood pressure from post induction value (PI) to immediate post intubation (PT0) was 32.8%, 32.8% at 1 minute after intubation (PT1) and 22% at 3minutes after intubation with ML group. This change was 32.8%, 32.2% and 17.2% respectively in KVVL group. No difference was observed in statistical data with both groups. (Table. 14)

The increase in blood pressure was found to be prolonged up to 3 minute value after which blood pressure declined in ML group, whereas in KVVL group the decline started after one minute value.

Table15: Percentage change of MBP

Parameter	Mean % change	Difference in mean %	p Value	95% CI	
				Lower	Upper
Percentage change from Basal to PT0					
ML	-1.5511	-2.75	0.54	-11.70	6.18
KVVL	1.2079				
Percentage change from Basal to PT1					
ML	-1.5418	-1.76	0.66	-9.86	6.33
KVVL	.2218				
Percentage change from Basal to PT3					
ML	-11.3634	2.17	0.49	-4.17	8.52
KVVL	-13.5354				
Percentage change from PI to PT0					
ML	32.8870	0.040	0.99	-9.40	9.48
KVVL	32.8470				
Percentage change from PI to PT1					
ML	32.8950	0.694	0.88	-8.48	9.87
KVVL	32.2003				
Percentage change from PI to PT3					
ML	22.0295	4.83	0.193	-2.49	12.16
KVVL	17.1950				

DISCUSSION

DISCUSSION

Intubation, a basic medical skill helps in rescuing life. It is the fundamental procedure mastered, taught and practiced throughout entire life by an anaesthesiologist. Only air can move into the trachea without distress. Even food particle during deglutition directly moves from the base of tongue straight in to cricopharynx. Accidental ingestion of water, food or any foreign matter produces violent discomfort leading to cough, spasm of airway, tachyarrhythmia, hypertension and even bradycardia and arrest.

Instrumenting the airway in a person who is awake stimulates the autonomic nervous system to the highest extreme, which stresses the vital organs to maximum producing deleterious consequences. Protective airway reflexes cannot be abolished by any means but only can be blunted by deeper levels of anaesthesia. Labelled as lifesaving skill, Intubation if not done properly can equally produce morbidity and mortality.

An ideal intubating apparatus should be

1. Simple and easy to use
2. Provide perfect view of glottis with less effort
3. Should achieve tracheal cannulation in least possible time,
4. Minimal apnoeic period
5. Should not produce physical trauma
6. Must complete the process in a single attempt

7. Importantly, it should produce less or no autonomic hemodynamic response and
8. Should be cheap and easy to maintain.

Macintosh laryngoscope is used for intubation for about 72 years and is regarded as the primary standard for cannulation of trachea. For the past 20 years science has invented several alternatives to this standard. King Vision Video Laryngoscope is one such device added to the competition. One uses direct vision and other gives magnified indirect image. Macintosh needs uniocular vision but King Vision gives comfortable binocular vision. Anaesthesiologists have mastered and are using Macintosh with greater ease and comfort for years where as King Vision is a new gadget to handle and involves a different technique of insertion. The viewing angle of Macintosh is only about 15 degrees compared to 160 degrees for King Vision. Conventionally intubation is attempted after proper alignment of airway axes by Macintosh blade. King vision looks around the corner and hence does not need special positioning of head and neck. Macintosh scores in easy airway and King Vision by producing panoramic perfect image scores in difficult airway.

This study is designed to evaluate Macintosh and King Vision laryngoscopes in terms of efficacy and safety for intubation of predicted normal airway in neutral position by experienced anaesthesiologists after obtaining demonstration and hands on training to use King Vision on an intubating Mannequin.

Intubation requires opening of mouth, passage of laryngoscope, viewing of vocal folds and finally insertion of tracheal cannula. This skilled art, seems easy is found difficult in case of abnormal morphology of the upper airway, improper positioning of the patient, and suboptimal height of the table. In this study all these factors are eliminated by choosing subjects with predicted normal anatomy, placing the patient's head at the edge of the table and levelling it at navel level of the intubator.

Blinding of the operator was not possible and hence limitation of the study.

Demographic Variables

ML group included 19 female and 21 male patients and KVVL group contained 20 males and females. Sex of the subjects were comparable in both groups. The mean age, weight height and Body mass index, all showed no difference between two groups.

Subjects in both groups belonged to ASAPS I or II category

Airway predictors

All 80 subjects belonged to either class I or II Mallampati airway, having adequate mouth opening, normal thyromental and sternomental distance.

EFFICACY OUTCOMES

The mean **tracheal intubation time** (TTI) was 26.58 seconds in ML group and 24.90 seconds in KVVL group. In general the intubation time is longer with video laryngoscopes than direct Macintosh blade.

Akihisa Y et al[34], compared intubation by novice persons on mannequin using KVVL and ML and found that the mean intubation time was faster with Macintosh group by 3.6 seconds. Study by Ruetzler K et al[50], also favours faster intubation time by ML. Jarvis JL et al[53], analysed electronic records and found that first pass success and success per attempt was high and significant by paramedics in using KVVL than ML.Yun Bj et ai[36], found no difference between ML and KVVL groups. Murphy LD et al[37], published that intubation time was 3.4 seconds faster with KVVL than ML by paramedics on a manikin.

Many studies demonstrated much lesser intubation time by ML compared to our study. Though there is no statistically significant difference between two groups in our study the intubation time for ML is longer than KVVL in spite of huge experience of the intubators in using ML. All intubations are done in neutral position of head and neck and this may be the cause for the little prolongation of intubation time for ML. This also highlights the lesser learning curvature for using KVVL.

Duration of Laryngoscopy (DOL)

The mean duration of laryngoscopy is 46.48 seconds in ML group and 45.55 seconds in KVVL group. Both were comparable and not different. In ML group the difference between mean TTI and mean DOL is 20 seconds and the reason for this is extended time taken to optimise the laryngeal view by optimising manoeuvres. In KVVL group the difference between mean TTI and mean DOL is 21 seconds either due to initial struggle in introducing the distal window of the scope beyond the incisor or tube catch at the right arytenoid which required optimisation by anticlockwise rotation of ETT.

No of attempts:

All cases in KVVL group were intubated in first attempt, but two patients in ML group required two attempts for success. Though this is not significant statistically the possible reason is poor visualisation of glottis and non-alignment of the airway axes.

Ease of Intubation

We have used verbal numerical scale for assessing the ease of intubation. The mean score is 24 with ML and 16 with KVVL group. Though statistically not significant the possible reasons can be, made-difficult access by non-alignment of line of sight to larynx for ML scope, and getting a clear panoramic binocular view of airway with ease for KVVL scope.

View of Laryngeal inlet

All subjects in KVVL group showed vivid, wide, magnified, true colour and binocular view of vocal folds (Cormack Lehane Grade I) without using greater retraction force. The intubators did not bend, peep or stressed to do laryngoscopy with KVVL. This was possible because of the anatomical curvature of the blade and the location of camera was almost near the larynx enabling to look around the corner.

In ML group 15 subjects had Cormack Lehane grade 1 view, 9 with grade 2a, 13 persons with grade 2b and 3 patients had grade 3 laryngeal view. This had stressed the intubators to bend back or down, peep in/down and request external laryngeal pressure and/or bougie.

Optimisation tasks

Nine patients in KVVL group required anticlockwise rotation of ETT to negotiate arytenoid catch and two patients required external elevation of larynx to overcome impingement of ETT at anterior commissure. Two subjects required catch of epiglottis by blade tip due to presence of overhanging epiglottis hindering the glottic view and these two case were not included in the study as they could confound the hemodynamic variables.

Only 11 patients in ML group did not need any optimising manoeuvre. 23 patients required external laryngeal pressure for optimised viewing of vocal folds. In 18 patients the intubator stressed himself by bending down/back to align his/her visual axis with the laryngeal axis. Two patients had poor view score and needed use of bougie for tracheal cannulation. Two patients required second attempt for successful intubation.

SAFETY OUTCOMES

Two patients in KVVL group had lower lip abrasion due to entrapment of the lip between the blade and lower jaw. The reason was improper method of holding the scope, holding it rigid to produce retraction force similar to direct laryngoscopy. This could be avoided by gaining a little more experience and familiarity in using KVVL.

Cardiovascular Parameters

Heart rate

The heart rate in both groups decreased from basal value after premedication with fentanyl and midazolam and lowered further after induction with Propofol. It rose almost to basal value immediate post intubation in both groups. Post intubation the heart rate increased to 23.1% maximum at 1 min after intubation with ML and 19.7% with KVVL from the previous reading. And then started declining to reach post induction value at about three to five minutes in both groups. Both groups were comparable and found not significant.

Blood Pressure

In both groups Systolic, diastolic and mean blood pressure decreased to lower value from basal to premedication and to post induction (lowest). After intubation they all increased to basal value from post induction value at PT0 to peak at PT1 then started declining to remain stable by about 7 minutes after intubation. Both groups were comparable and none of the p value was significant.

Although King Vision laryngoscope provided good laryngeal view with more comfort and confidence to the intubating person its safety profile is comparable with and not superior to the age old direct laryngoscope.

CONCLUSION

CONCLUSION

The observations of the present study concludes that

1. King Vision Video Laryngoscope, a rigid channelled indirect laryngoscope provides always the best and full view of the laryngeal inlet.
2. King Vision Video Laryngoscope eliminates the need for placing the patient in sniffing the morning air position, a routine need for conventional laryngoscopy
3. King Vision laryngoscope avoids additional manipulation of the airway by a technical assistant or self-alignment of the caregiver to the line of intubation of larynx
4. Intubation time and laryngoscopy time are comparable to the age old evidence tested conventional laryngoscopy
5. King Vision Video Laryngoscope has a comparable similar safety profile with Macintosh laryngoscope with respect to deleterious cardiovascular changes produced by rigid manipulation of airway. Although less retraction, traction is force required, it provides no special advantage in reducing the morbidity in patients with marginal cardiovascular reserve.

SUMMARY

SUMMARY

King Vision Video Laryngoscope has a comparable safety profile with Macintosh laryngoscope and is an equally efficient tool that can be recommended for elective intubation for patients under general anaesthesia. With less need for retraction and absolutely no need for head positioning it provides a full panoramic laryngeal assessment with shorter learning curve, enabling recording of demonstration and easy practical medical teaching.

However the high purchase cost of the equipment, drop fragile optics and circuitry along with huge recurring cost spent for the disposable blade may preclude its general use.

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ANNEXURES

<u>ஆராய்ச்சி ஒப்புதல் படிவம்</u>

ஆராய்ச்சி தலைப்பு:

அறுவை சிகிச்சைக்காக முழுமயக்கம் தர செயற்கை சுவாச குழாய் பொருத்திட வேண்டி இருவேறு மிடறு நோக்கும் கருவிகளான மெக்கின்டோஸ் (Macintosh Laryngoscope) மற்றும் கிங் விஷன் கானொளி (King Vision Video Laryngoscope) கருவிகளின் திறனாய்வும் ஒப்பீடும்.

பெயர்	:	தேதி	:
வயது	:	உள்நோயாளி எண்	:
பாலினம்	:	ஆய்வு சேர்க்கை எண்	:

மயக்கம் அளிக்க ஏதுவாக செயற்கை சுவாச குழாயை வாய் வழி பொருத்திட மிடறு நோக்கும் கருவியாக மெக்கின்டோஸ் அல்லது கிங் விஷன் கானொளி கருவி எனக்கு பயன்படுத்தப்படும் என்பதை அறிந்தேன். இக்கருவிகளின் நன்மை மற்றும் விளைவுகள் எனக்கு விளக்கப்பட்டு புரிந்து கொண்டேன்.

இந்த ஆய்வின் நோக்கம் மற்றும் விவரங்கள் முழுமையாக எனக்கு தெளிவாக விளக்கப்பட்டது. இவ்வாய்வில் இருந்து நான் எந்த நேரமும் பின்வாங்கலாம் என்பதையும் அதனால் எனக்கு எந்த பாதிப்பும் இல்லை என்பதையும் தெளிவாக புரிந்து கொண்டேன்.

முடிவுகளை அல்லது கருத்துகளை வெளியிடும் போதோ அல்லது ஆய்வின் போதோ என்னுடைய பெயரையோ அல்லது அடையாளங்களையோ வெளியிட மாட்டார்கள் என்பதையும் அறிந்து கொண்டேன்.

இந்த ஆய்வில் எவ்வித நிர்பந்தமும் இன்றி எனது சொந்த விருப்பத்தின் பேரில் நான் பங்கு பெறுகின்றேன்.

நான் சுயநினைவுடனும் முழு சுதந்திரத்துடனும் இந்த மருத்துவ ஆராய்ச்சியில் சேர்ந்துக்கொள்ள சம்மதிக்கின்றேன்.

ஆராய்ச்சியாளர் ஒப்பம்

பங்கேற்பாளர் ஒப்பம்

(அ)

இடது பெருவிரல் ரேகை

PROFORMA

Name: **Age**: years **Sex**: M/F **IP. No**:

Weight: **Height:** **ASAPS**: **Surgery**: **Date**:

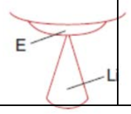
Randomisation Code/ Envelope No :
Laryngoscope used : **ML** (Macintosh)/ **KVVL** (King Vision)

Checks:

Consent : NPO Status :
Mallampati Score :
Mouth Opening :
ThyroMental Distance :
SternoMental Distance :
Intubator's experience in Years :
Intubator : Trained with KVVL in Manikin/ not trained
Head position : Neutral/ others
Table height Levelled for intubator :

Measured Outcomes:

Time to Tracheal Intubation :
Duration of Laryngoscopy :
Laryngoscopic View :

Modified Cormack Lehane Classification	1	2a	2b	3	4
View					

No of Attempts :
Ease of Intubation :

0	10	20	30	40	50	60	70	80	90	100

Optimisation Manoeuvres : None
Neck flexion / head extension /
Intubator Bent down / Bent back / Peep in
External laryngeal pressure/ elevation of larynx
Stillete/ Bougie/ Anticlockwise rotation of ETT

Injuries :

Parameters	Prior Intubation			After Intubation (Time) - PT*									
	Basal	PP*	PI*	PT 0	PT 1	PT 3	PT 5	PT 7	PT 9	PT 11	PT 13	PT 15	PT 30
HR													
SBP													
DBP													
MBP													

*PP – post premedication, PI-Post Induction, PT- Post Intubation

MASTER CHART – ML GROUP

S. No	Group	Age	Sex	Weight	Height	BMI	Mallampati Score	Intubators Experience in years	KVVL Trained or Not	Head Position	Table Levelled or not	Tracheal Intubation Time (TTI) in Secs	Duration of Laryngoscopy (DOL) in secs	Laryngoscopic View	No Of Attempts	Ease of Intubation Score (10,20,..100)	Injuries
1	ML	42	M	67	168	23.74	2	8	Yes	Neutral	Yes	48	75	CL Grade 2a	2	60	NIL
2	ML	30	F	56	159	22.15	2	7	Yes	Neutral	Yes	29	96	CL Grade 3	1	30	NIL
3	ML	42	M	68	170	23.53	2	13	Yes	Neutral	Yes	36	82	CL Grade 1	1	30	NIL
4	ML	50	M	69	171	23.60	1	10	Yes	Neutral	Yes	10	80	CL Grade 1	1	40	NIL
5	ML	55	M	60	166	21.77	1	14	Yes	Neutral	Yes	5	67	CL Grade 2b	1	30	NIL
6	ML	42	M	72	168	25.51	2	12	Yes	Neutral	Yes	31	72	CL Grade 1	1	50	NIL
7	ML	60	M	63	163	23.71	2	12	Yes	Neutral	Yes	17	59	CL Grade 2b	1	60	NIL
8	ML	50	M	71	169	24.86	2	4	Yes	Neutral	Yes	27	43	CL Grade 2a	1	40	NIL
9	ML	32	F	53	160	20.70	1	7	Yes	Neutral	Yes	32	28	CL Grade 1	1	40	NIL
10	ML	29	M	62	170	21.45	1	9	Yes	Neutral	Yes	26	48	CL Grade 2b	1	0	NIL
11	ML	34	F	50	156	20.55	1	9	Yes	Neutral	Yes	19	30	CL Grade 1	1	50	NIL
12	ML	22	F	51	159	20.17	1	6	Yes	Neutral	Yes	26	44	CL Grade 2b	1	0	NIL
13	ML	55	M	67	169	23.46	2	5	Yes	Neutral	Yes	19	45	CL Grade 2a	1	20	NIL
14	ML	61	F	68	159	26.90	2	3	Yes	Neutral	Yes	18	44	CL Grade 3	1	60	NIL
15	ML	47	F	68	160	26.56	2	3	Yes	Neutral	Yes	19	36	CL Grade 2b	1	10	NIL
16	ML	50	F	53	160	20.70	2	11	Yes	Neutral	Yes	38	40	CL Grade 2b	1	40	NIL
17	ML	28	M	60	164	22.31	1	2	Yes	Neutral	Yes	54	36	CL Grade 2a	1	20	NIL
18	ML	35	F	54	158	21.63	2	3	Yes	Neutral	Yes	63	40	CL Grade 2b	1	30	NIL
19	ML	60	F	72	168	25.51	2	3	Yes	Neutral	Yes	74	30	CL Grade 2b	2	60	NIL
20	ML	31	M	62	167	22.23	2	3	Yes	Neutral	Yes	61	54	CL Grade 3	1	30	NIL
21	ML	30	F	71	169	24.86	2	8	Yes	Neutral	Yes	20	46	CL Grade 2a	1	20	NIL
22	ML	50	M	72	168	25.51	1	7	Yes	Neutral	Yes	17	40	CL Grade 2b	1	30	NIL
23	ML	58	m	71	166	25.77	1	7	Yes	Neutral	Yes	13	31	CL Grade 1	1	0	NIL
24	ML	48	F	63	160	24.61	2	10	Yes	Neutral	Yes	20	46	CL Grade 1	1	20	NIL
25	ML	35	F	60	164	22.31	1	9	Yes	Neutral	Yes	13	31	CL Grade 1	1	0	NIL
26	ML	35	F	63	164	23.42	2	9	Yes	Neutral	Yes	34	50	CL Grade 2b	1	40	NIL
27	ML	34	M	72	169	25.21	1	7	Yes	Neutral	Yes	14	40	CL Grade 1	1	0	NIL
28	ML	33	M	76	182	22.94	1	11	Yes	Neutral	Yes	14	29	CL Grade 1	1	0	NIL
29	ML	35	F	60	162	22.86	1	10	Yes	Neutral	Yes	26	44	CL Grade 1	1	10	NIL
30	ML	43	M	69	170	23.88	2	11	Yes	Neutral	Yes	30	52	CL Grade 2a	1	20	NIL
31	ML	52	F	54	163	20.32	1	11	Yes	Neutral	Yes	15	34	CL Grade 1	1	0	NIL
32	ML	56	M	66	163	24.84	1	5	Yes	Neutral	Yes	30	56	CL Grade 2b	1	20	NIL
33	ML	29	M	60	169	21.01	1	3	Yes	Neutral	Yes	23	44	CL Grade 2a	1	10	NIL
34	ML	25	M	62	168	21.97	1	2	Yes	Neutral	Yes	18	32	CL Grade 1	1	0	NIL
35	ML	24	M	56	166	20.32	1	3	Yes	Neutral	Yes	16	26	CL Grade 1	1	0	NIL
36	ML	56	F	57	156	23.42	2	4	Yes	Neutral	Yes	29	42	CL Grade 2b	1	30	NIL
37	ML	42	M	62	165	22.77	2	5	Yes	Neutral	Yes	27	52	CL Grade 2b	1	30	NIL
38	ML	27	F	55	156	22.60	1	4	Yes	Neutral	Yes	23	46	CL Grade 2a	1	20	NIL
39	ML	23	F	56	158	22.43	1	9	Yes	Neutral	Yes	8	22	CL Grade 1	1	0	NIL
40	ML	38	F	56	157	22.72	1	5	Yes	Neutral	Yes	21	47	CL Grade 2a	1	10	NIL

MASTER CHART – HEART RATE OBSERVATIONS – ML GROUP

S. No	Group	HR Basal	HR PP	HR PI	HR PT 0	HR PT 1	HR PT 3	HR PT 5	HR PT 7	HR PT 9	HR PT 11	HR PT 13	HR PT 15	HR PT 30	OPTIMISING MANOEVRE
1	ML	90	87	76	93	91	78	77	79	74	74	72	72	78	Intubator Bent down, External Laryngeal Pressure, Bougie used
2	ML	89	80	81	91	108	120	109	104	91	90	84	76	74	External Laryngeal Pressure, Peep in
3	ML	96	82	78	93	100	74	78	74	72	67	64	62	75	Bent Back, External Laryngeal Pressure
4	ML	103	114	101	125	131	131	134	129	114	105	99	96	90	None
5	ML	70	63	52	77	75	75	75	77	71	54	51	76	54	External Laryngeal Pressure, bent back
6	ML	73	70	61	84	80	60	60	52	54	52	50	52	53	External Laryngeal Pressure, bent back
7	ML	88	84	82	105	97	96	88	80	77	72	72	72	73	External Laryngeal Pressure
8	ML	90	87	76	93	96	78	77	78	79	74	74	75	82	External Laryngeal Pressure
9	ML	132	119	87	100	101	103	93	84	76	75	76	76	65	External Laryngeal Pressure
10	ML	108	98	95	118	116	90	84	85	78	77	75	76	74	None
11	ML	91	80	74	110	112	88	83	83	80	79	81	82	84	External Laryngeal Pressure
12	ML	123	120	113	84	82	81	82	82	84	83	84	84	85	None
13	ML	88	61	62	56	54	56	56	54	54	54	53	52	60	External Laryngeal Pressure
14	ML	62	61	58	81	83	52	53	59	55	59	58	57	61	External Laryngeal Pressure
15	ML	82	85	72	86	82	73	66	68	66	60	60	60	59	None
16	ML	78	69	108	78	57	56	56	57	52	53	52	53	52	External Laryngeal Pressure, Peep in
17	ML	79	72	79	98	96	91	97	85	77	82	81	80	85	None
18	ML	77	73	71	81	80	71	69	66	62	60	63	64	64	External Laryngeal Pressure, Head Extension
19	ML	91	89	72	106	101	89	71	72	70	71	70	70	69	External Laryngeal Pressure, Head Extension, Bent Back , Bougie
20	ML	77	73	71	81	80	71	66	65	62	60	64	64	63	External Laryngeal Pressure, Head Extension, Bent Back
21	ML	106	100	86	121	120	128	121	107	109	97	91	89	80	Bent Back
22	ML	81	76	62	114	94	88	80	71	70	52	54	56	51	Bent Down
23	ML	74	78	62	105	102	76	79	74	71	64	63	61	54	Bent Down
24	ML	99	83	84	86	91	94	92	92	89	90	91	87	87	None
25	ML	110	106	92	113	102	101	102	103	100	100	99	99	92	None
26	ML	97	97	89	98	108	111	106	101	96	93	90	87	76	External Laryngeal Pressure
27	ML	106	99	107	114	111	114	109	96	95	91	94	91	86	Bent down
28	ML	74	73	70	93	79	75	75	73	73	72	67	64	71	None
29	ML	120	105	94	107	105	106	106	96	91	87	84	80	77	External Laryngeal Pressure
30	ML	97	91	71	70	82	89	92	77	74	74	75	72	69	External Laryngeal Pressure
31	ML	106	100	69	97	98	97	89	79	77	75	76	74	70	Bent down
32	ML	91	80	74	90	93	77	74	72	72	73	73	71	78	Bent down, External Laryngeal Pressure
33	ML	86	70	66	78	84	68	71	60	54	53	53	51	54	External Laryngeal Pressure, Peep in
34	ML	97	93	84	90	92	81	78	76	74	76	75	74	80	None
35	ML	101	94	90	96	94	84	83	82	80	80	81	76	79	None
36	ML	116	100	84	108	121	90	82	76	75	74	74	70	72	Bent down, External Laryngeal Pressure
37	ML	124	96	74	90	108	80	60	62	64	63	63	65	76	Peep in, External Laryngeal Pressure
38	ML	89	70	74	91	104	103	102	86	78	74	72	74	79	External Laryngeal Pressure
39	ML	76	70	70	80	90	76	68	67	67	68	70	70	66	None
40	ML	106	98	78	102	110	84	76	74	72	71	72	68	70	Peep in

MASTER CHART – BLOOD PRESSURE OBSERVATIONS – ML GROUP

Systolic Blood Pressure

S. No	BASAL	PP	PI	PT0	PT1	PT3	PT5	PT7	PT9	PT11	PT13	PT15	PT30
1	134	118	103	163	146	136	112	108	107	108	106	105	116
2	130	118	93	130	111	128	117	119	113	109	105	108	112
3	132	112	87	101	129	100	91	84	92	86	89	89	107
4	135	105	72	132	148	109	107	97	92	94	89	90	114
5	120	104	78	112	112	114	106	110	107	96	98	112	83
6	150	130	110	135	139	117	118	111	113	106	115	110	114
7	130	115	86	182	178	152	137	137	138	114	110	109	110
8	136	118	111	154	146	139	121	111	112	105	108	110	124
9	146	121	84	112	106	102	100	96	89	100	98	94	101
10	124	110	85	121	116	97	95	94	95	97	96	99	115
11	144	120	99	133	125	119	99	100	103	112	109	110	124
12	106	112	86	93	93	92	86	88	87	89	88	89	90
13	117	107	80	74	116	107	92	93	91	91	90	90	110
14	189	164	103	172	156	102	159	116	113	117	118	121	139
15	134	107	82	140	128	113	116	118	122	96	94	92	102
16	170	140	128	83	82	82	80	85	87	83	82	82	104
17	113	106	94	112	100	88	102	100	102	104	106	115	109
18	108	117	92	115	110	109	97	96	94	92	90	90	128
19	148	163	87	210	189	160	100	100	104	107	108	110	108
20	108	117	92	115	112	109	97	96	94	92	90	90	128
21	151	132	99	140	141	136	125	119	117	116	112	112	102
22	137	132	89	191	148	143	122	127	117	103	97	102	90
23	166	114	80	121	117	116	109	101	106	103	98	97	103
24	126	108	92	133	120	101	106	100	105	110	112	115	111
25	145	129	96	136	123	120	120	118	108	115	112	113	116
26	165	141	104	143	180	163	149	129	117	115	106	109	95
27	125	119	101	128	137	128	122	112	105	96	107	100	115
28	151	126	95	119	117	112	105	99	107	110	110	106	113
29	134	116	99	123	112	104	114	108	109	107	110	115	109
30	131	121	100	121	129	127	113	115	109	111	106	101	117
31	169	126	83	118	113	111	105	104	99	98	97	111	112
32	140	120	100	121	134	126	114	108	106	110	108	107	110
33	108	100	90	114	116	106	104	104	103	99	101	98	110
34	136	118	86	123	118	108	110	103	107	104	104	110	120
35	116	108	90	98	100	100	96	92	94	94	94	95	100
36	156	147	101	149	150	140	127	116	118	118	120	114	126
37	171	136	110	150	138	128	110	116	121	109	104	110	124
38	146	124	99	118	129	116	108	107	107	103	105	105	110
39	126	104	100	112	120	118	100	99	99	103	94	96	116
40	144	139	100	123	124	112	100	103	96	98	98	94	106

Diastolic Blood Pressure

S. No	BASAL	PP	PI	PT0	PT1	PT3	PT5	PT7	PT9	PT11	PT13	PT15	PT30
1	90	84	72	109	102	94	80	78	76	78	74	74	80
2	84	74	58	83	83	86	88	84	70	67	70	68	73
3	87	73	55	61	75	69	60	57	58	58	56	59	74
4	94	73	54	85	101	88	75	66	61	60	57	56	74
5	70	63	51	76	84	77	78	78	76	67	64	81	55
6	92	84	74	91	104	90	83	74	69	74	78	72	74
7	80	66	50	114	123	101	99	89	90	65	61	60	66
8	90	84	78	105	100	98	83	80	76	71	72	69	87
9	83	70	48	73	70	71	70	70	70	71	70	67	71
10	88	80	53	97	86	68	69	68	66	66	66	69	85
11	99	83	66	96	89	80	74	74	69	80	79	80	84
12	65	64	46	62	61	50	52	53	49	52	53	42	49
13	71	73	53	60	74	70	71	70	63	61	62	69	70
14	72	71	70	85	80	67	83	74	73	68	72	74	82
15	81	74	49	56	69	52	93	92	73	59	60	61	71
16	110	100	93	52	47	48	46	50	51	50	52	53	69
17	76	64	42	71	68	40	54	58	61	62	64	82	75
18	69	77	56	77	74	66	64	66	66	60	61	60	96
19	84	77	49	110	106	84	68	70	64	72	74	76	74
20	69	77	56	77	77	66	64	65	66	60	60	60	97
21	92	94	74	100	104	86	84	75	70	70	73	77	64
22	81	76	51	124	100	91	86	78	87	68	64	66	61
23	93	77	49	93	90	74	78	75	69	65	63	64	70
24	83	80	55	80	89	74	66	70	70	72	74	85	81
25	101	92	60	94	87	81	84	84	80	77	78	81	84
26	95	96	70	98	128	115	96	89	83	82	79	78	64
27	90	81	66	96	99	96	90	76	70	68	71	70	83
28	94	90	58	82	81	73	70	68	78	77	74	71	77
29	88	77	59	85	78	75	78	79	78	81	81	76	78
30	71	71	49	94	83	80	60	61	56	65	62	57	73
31	95	91	52	79	78	76	69	76	69	67	69	70	74
32	84	72	58	78	80	74	70	68	64	66	62	64	70
33	64	60	50	72	74	66	65	63	60	60	62	64	70
34	108	78	46	94	80	74	70	67	68	66	65	66	76
35	74	70	47	58	60	61	54	52	54	51	50	51	59
36	98	93	52	101	99	97	84	82	78	76	78	70	84
37	84	70	68	89	80	80	72	72	78	70	70	72	81
38	88	79	59	64	70	74	66	64	63	63	64	66	58
39	86	74	70	78	80	79	68	64	63	65	60	60	71
40	86	78	70	81	81	74	66	65	60	62	61	58	64

Mean Blood Pressure

S. No	BASAL	PP	PI	PT0	PT1	PT3	PT5	PT7	PT9	PT11	PT13	PT15	PT30
1	104	95	83	128	116	108	91	88	87	88	85	84	92
2	99	89	70	94	92	100	98	96	84	81	82	81	86
3	102	86	66	74	93	79	70	66	69	67	67	69	85
4	108	84	60	101	116	95	86	76	71	71	68	67	87
5	87	77	60	88	93	89	87	89	86	77	75	91	64
6	111	99	86	106	116	99	95	86	84	85	90	85	87
7	97	82	62	137	141	118	112	105	106	81	77	76	81
8	105	95	89	121	115	112	96	91	88	82	84	83	99
9	104	87	60	86	83	81	80	78	76	81	80	76	81
10	100	90	64	105	99	78	78	77	76	76	78	79	95
11	114	96	77	108	100	93	82	81	80	91	90	90	97
12	75	74	55	69	69	60	59	60	57	61	60	52	59
13	81	80	59	63	83	79	75	74	69	68	72	73	81
14	103	93	78	105	101	75	101	86	81	80	81	85	97
15	91	83	54	76	73	66	99	99	84	68	70	68	78
16	130	113	105	62	59	59	57	62	63	61	62	63	81
17	84	73	54	83	80	51	66	67	71	72	74	89	82
18	78	87	62	85	85	75	71	72	68	67	69	68	64
19	98	96	58	143	133	109	79	80	77	84	85	87	85
20	78	87	62	85	88	75	71	75	68	67	68	68	104
21	112	107	82	113	116	103	98	90	86	85	86	89	77
22	100	95	64	146	116	108	98	94	97	80	75	78	71
23	117	89	59	102	99	88	88	84	81	78	75	75	81
24	97	89	67	98	99	83	79	80	82	85	87	95	91
25	116	104	72	108	99	94	96	95	89	90	89	92	95
26	118	111	81	113	145	131	114	102	94	93	88	88	74
27	102	94	78	107	112	107	101	88	82	77	83	80	94
28	113	102	70	94	93	86	82	78	88	88	86	83	89
29	103	90	72	98	89	85	90	89	88	90	91	89	88
30	84	80	60	100	92	91	72	72	68	76	72	68	83
31	120	103	62	92	90	88	81	85	79	77	78	84	86
32	100	86	74	90	93	77	74	72	72	73	73	71	78
33	78	75	60	88	90	81	78	76	75	72	74	73	80
34	110	90	58	103	94	84	80	80	81	79	78	81	90
35	88	80	60	72	75	74	70	65	66	65	64	65	70
36	115	110	65	120	121	110	98	93	92	90	93	84	98
37	111	91	82	110	101	97	83	85	90	83	82	83	96
38	106	90	75	85	92	90	79	79	78	77	77	78	75
39	97	81	76	90	94	92	79	76	76	75	73	72	80
40	102	96	81	97	97	85	77	77	72	74	74	73	78

MASTER CHART – KVVL GROUP

S. No	Group	Age	Sex	Weight	Height	BMI	Mallampati Score	Intubators Experience in years	KVVL Trained or Not	Head Position	Table Levelled or not	Tracheal Intubation Time (TTI) in Secs	Duration of Laryngoscopy (DOL) in secs	Laryngoscopic View	No Of Attempts	Ease of Intubation Score (10,20,..100)	Injuries
1	KVVL	41	M	65	164	24.17	2	15	Yes	Neutral	Yes	27	56	CL Grade 1	1	0	NIL
2	KVVL	45	F	63	165	23.14	1	13	Yes	Neutral	Yes	25	59	CL Grade 1	1	0	NIL
3	KVVL	27	F	52	156	21.37	1	14	Yes	Neutral	Yes	17	30	CL Grade 1	1	0	NIL
4	KVVL	40	F	67	163	25.22	2	13	Yes	Neutral	Yes	72	90	CL Grade 1	1	10	NIL
5	KVVL	30	F	51	158	20.43	1	14	Yes	Neutral	Yes	30	53	CL Grade 1	1	60	NIL
6	KVVL	34	F	63	162	24.01	1	12	Yes	Neutral	Yes	11	47	CL Grade 1	1	20	NIL
7	KVVL	26	M	57	165	20.94	1	15	Yes	Neutral	Yes	20	62	CL Grade 1	1	20	NIL
8	KVVL	35	M	76	174	25.10	1	14	Yes	Neutral	Yes	12	27	CL Grade 1	1	20	NIL
9	KVVL	43	F	55	160	21.48	1	10	Yes	Neutral	Yes	16	33	CL Grade 1	1	0	NIL
10	KVVL	48	F	60	162	22.86	2	12	Yes	Neutral	Yes	33	56	CL Grade 1	1	0	NIL
11	KVVL	52	F	60	164	22.31	1	5	Yes	Neutral	Yes	21	33	CL Grade 1	1	20	NIL
12	KVVL	56	F	61	163	22.96	1	13	Yes	Neutral	Yes	14	35	CL Grade 1	1	30	NIL
13	KVVL	55	M	67	172	22.65	2	10	Yes	Neutral	Yes	18	26	CL Grade 1	1	0	NIL
14	KVVL	50	M	62	169	21.71	1	11	Yes	Neutral	Yes	27	43	CL Grade 1	1	10	NIL
15	KVVL	25	F	52	160	20.31	1	2	Yes	Neutral	Yes	42	54	CL Grade 1	1	20	NIL
16	KVVL	45	F	59	162	22.48	2	10	Yes	Neutral	Yes	62	94	CL Grade 1	1	20	NIL
17	KVVL	37	F	52	160	20.31	2	7	Yes	Neutral	Yes	16	33	CL Grade 1	1	70	NIL
18	KVVL	45	M	70	173	23.39	2	4	Yes	Neutral	Yes	16	33	CL Grade 1	1	10	NIL
19	KVVL	26	F	50	158	20.03	1	7	Yes	Neutral	Yes	10	43	CL Grade 1	1	70	NIL
20	KVVL	30	M	73	173	24.39	2	5	Yes	Neutral	Yes	27	43	CL Grade 1	1	20	NIL
21	KVVL	31	M	64	166	23.23	1	8	Yes	Neutral	Yes	31	52	CL Grade 1	1	10	Lower lip Abrasion
22	KVVL	46	F	72	167	25.82	1	9	Yes	Neutral	Yes	18	36	CL Grade 1	1	0	NIL
23	KVVL	37	F	62	159	24.52	1	9	Yes	Neutral	Yes	19	47	CL Grade 1	1	0	NIL
24	KVVL	47	M	76	175	24.82	2	10	Yes	Neutral	Yes	41	62	CL Grade 1	1	40	NIL
25	KVVL	35	F	60	159	23.73	1	11	Yes	Neutral	Yes	15	36	CL Grade 1	1	0	NIL
26	KVVL	39	M	68	167	24.38	1	11	Yes	Neutral	Yes	11	28	CL Grade 1	1	0	NIL
27	KVVL	27	M	62	166	22.50	2	3	Yes	Neutral	Yes	26	44	CL Grade 1	1	20	NIL
28	KVVL	24	F	54	162	20.58	1	10	Yes	Neutral	Yes	22	32	CL Grade 1	1	0	NIL
29	KVVL	30	M	68	164	25.28	1	15	Yes	Neutral	Yes	23	40	CL Grade 1	1	10	NIL
30	KVVL	26	M	70	168	24.80	2	11	Yes	Neutral	Yes	12	33	CL Grade 1	1	0	NIL
31	KVVL	44	M	70	169	24.51	1	11	Yes	Neutral	Yes	17	45	CL Grade 1	1	10	Lower lip Abrasion
32	KVVL	52	M	60	167	21.51	1	11	Yes	Neutral	Yes	29	47	CL Grade 1	1	10	NIL
33	KVVL	59	M	69	169	24.16	2	10	Yes	Neutral	Yes	27	46	CL Grade 1	1	10	NIL
34	KVVL	35	M	61	166	22.14	1	14	Yes	Neutral	Yes	33	54	CL Grade 1	1	40	NIL
35	KVVL	46	F	59	161	22.76	2	11	Yes	Neutral	Yes	21	40	CL Grade 1	1	0	NIL
36	KVVL	40	M	56	166	20.32	2	4	Yes	Neutral	Yes	16	34	CL Grade 1	1	10	NIL
37	KVVL	21	F	60	156	24.65	1	5	Yes	Neutral	Yes	24	43	CL Grade 1	1	20	NIL
38	KVVL	31	M	67	165	24.61	1	3	Yes	Neutral	Yes	36	57	CL Grade 1	1	20	NIL
39	KVVL	36	F	60	156	24.65	2	3	Yes	Neutral	Yes	38	60	CL Grade 1	1	40	NIL
40	KVVL	42	M	71	168	25.16	2	3	Yes	Neutral	Yes	21	36	CL Grade 1	1	0	NIL

MASTER CHART – HEART RATE OBSERVATIONS – KVVL GROUP

S. No	Group	HR Basal	HR PP	HR PI	HR PT 0	HR PT 1	HR PT 3	HR PT 5	HR PT 7	HR PT 9	HR PT 11	HR PT 13	HR PT 15	HR PT 30	OPTIMISING MANOEVRE
1	KVVL	70	64	74	71	89	82	83	73	69	65	64	64	62	None
2	KVVL	54	52	50	53	52	53	54	64	56	54	54	56	73	None
3	KVVL	110	96	91	105	99	102	103	90	88	85	85	84	80	None
4	KVVL	76	70	56	66	78	74	59	61	56	60	51	53	55	None
5	KVVL	123	100	91	94	114	106	103	92	92	88	86	86	72	None
6	KVVL	88	79	73	73	91	88	82	81	81	81	73	68	69	None
7	KVVL	99	96	94	87	84	80	82	80	74	76	75	74	66	None
8	KVVL	84	84	88	85	80	76	74	80	79	74	72	71	69	None
9	KVVL	106	103	106	121	119	21	121	113	106	98	93	95	96	None
10	KVVL	127	106	82	114	96	96	82	76	75	70	67	66	60	None
11	KVVL	80	73	84	90	84	76	75	74	74	72	72	70	70	None
12	KVVL	98	90	97	98	93	97	89	85	82	82	80	81	78	Anticlockwise rotation of ETT
13	KVVL	78	78	77	75	78	80	74	72	68	68	65	65	62	None
14	KVVL	102	96	88	112	104	91	83	78	76	75	72	72	70	Anticlockwise rotation of ETT
15	KVVL	84	74	114	135	142	140	102	82	88	90	87	74	74	Anticlockwise rotation of ETT
16	KVVL	97	91	93	108	93	94	98	98	96	96	93	94	87	None
17	KVVL	110	94	82	117	98	89	74	72	68	69	67	55	53	External Elevation of Larynx
18	KVVL	86	83	77	102	106	100	74	70	60	62	66	62	83	None
19	KVVL	88	109	90	106	108	106	91	85	84	83	82	82	81	External Elevation of Larynx
20	KVVL	106	104	96	108	110	112	99	97	96	96	90	84	76	Anticlockwise rotation of ETT
21	KVVL	101	90	78	84	90	76	70	71	69	70	68	67	68	None
22	KVVL	97	76	70	68	76	73	69	64	61	59	52	54	54	None
23	KVVL	96	82	71	85	98	82	73	65	66	64	64	64	70	None
24	KVVL	92	73	65	101	112	86	77	71	62	58	58	56	61	Anticlockwise rotation of ETT
25	KVVL	73	79	77	73	79	79	77	77	76	78	79	78	73	None
26	KVVL	84	70	62	74	82	70	68	62	60	61	59	60	58	None
27	KVVL	96	80	76	84	98	80	76	74	72	71	72	70	74	None
28	KVVL	120	100	93	118	126	116	110	90	89	89	88	84	80	None
29	KVVL	92	9	284	88	91	86	78	75	70	68	70	71	69	Anticlockwise rotation of ETT
30	KVVL	116	104	90	100	96	84	74	66	65	66	66	64	60	None
31	KVVL	90	78	74	98	94	91	89	92	78	63	62	63	65	None
32	KVVL	86	76	73	90	86	83	77	67	65	64	62	62	61	None
33	KVVL	67	75	64	81	79	73	72	64	61	63	64	65	66	None
34	KVVL	99	80	75	106	111	110	92	74	69	65	66	60	64	Anticlockwise rotation of ETT
35	KVVL	89	88	69	84	89	87	87	83	82	76	79	73	67	None
36	KVVL	103	90	84	96	100	82	80	76	74	72	72	70	70	Anticlockwise rotation of ETT
37	KVVL	96	80	66	94	101	74	73	75	71	70	68	68	67	None
38	KVVL	116	100	90	108	121	94	90	78	76	74	72	70	76	None
39	KVVL	131	96	80	116	124	100	84	82	84	81	80	78	80	Anticlockwise rotation of ETT
40	KVVL	94	84	70	101	103	90	69	68	68	67	64	63	66	None

MASTER CHART – BLOOD PRESSURE OBSERVATIONS – KVVL GROUP

S. No	Systolic Blood Pressure												
	BASAL	PP	PI	PT0	PT1	PT3	PT5	PT7	PT9	PT11	PT13	PT15	PT30
1	130	120	84	112	104	97	99	93	89	88	84	82	95
2	202	138	119	136	123	116	108	108	106	105	106	105	112
3	126	118	96	136	118	99	95	91	91	87	86	94	95
4	159	134	98	136	143	113	99	88	88	90	86	82	110
5	149	96	80	107	118	108	104	100	92	96	95	93	90
6	120	103	92	100	108	107	88	83	88	72	77	80	91
7	128	116	91	135	116	104	99	101	98	96	98	97	125
8	116	103	95	131	115	109	108	103	98	95	102	94	91
9	124	118	93	109	83	82	83	78	93	95	94	103	121
10	184	134	91	192	180	133	114	111	110	114	110	100	124
11	135	109	85	108	103	90	89	90	91	90	90	96	108
12	160	124	114	131	129	121	108	105	102	98	94	96	102
13	94	84	67	71	81	89	77	68	70	75	72	75	90
14	143	138	92	161	152	99	92	87	88	91	94	90	112
15	103	107	68	113	125	96	91	87	96	109	100	99	106
16	144	116	103	149	154	131	121	120	116	115	107	111	111
17	160	161	150	235	188	163	162	161	163	160	156	149	149
18	114	96	96	125	116	107	97	94	92	93	92	91	111
19	99	95	90	103	101	102	89	90	90	93	92	95	92
20	145	132	104	149	136	123	113	110	117	116	116	119	120
21	130	110	100	111	116	101	96	95	94	94	95	96	106
22	193	142	114	134	124	120	112	105	102	99	93	92	98
23	130	120	106	127	122	117	119	112	110	110	106	100	115
24	120	108	81	182	192	133	113	104	103	98	100	100	102
25	124	113	104	124	113	109	104	99	94	100	102	103	103
26	110	106	90	104	116	100	96	94	95	92	93	94	100
27	141	110	92	122	136	116	106	104	106	100	101	104	110
28	135	110	106	131	153	142	140	123	125	120	118	116	126
29	126	117	109	124	133	114	110	108	104	101	102	101	99
30	120	116	94	116	122	100	104	102	103	100	99	101	110
31	145	126	109	143	130	127	118	117	111	110	105	108	120
32	191	146	85	103	124	128	123	100	102	107	105	104	95
33	170	137	112	176	160	127	120	112	114	112	110	106	122
34	135	124	101	156	165	137	130	118	119	114	110	109	112
35	158	144	77	132	119	113	99	93	99	92	96	88	114
36	156	135	100	148	121	110	100	103	98	101	103	100	110
37	100	96	90	104	110	100	94	90	92	90	91	88	94
38	140	116	100	136	150	114	96	98	103	102	99	97	110
39	162	130	100	174	191	145	120	104	108	110	111	112	120
40	126	110	84	119	121	110	103	99	102	101	104	99	110

S. No	Diastolic Blood Pressure												
	BASAL	PP	PI	PT0	PT1	PT3	PT5	PT7	PT9	PT11	PT13	PT15	PT30
1	93	80	57	77	75	72	71	61	59	59	57	59	66
2	98	78	72	78	74	65	80	75	75	74	76	74	70
3	60	77	57	92	69	53	51	49	41	42	44	46	45
4	80	77	45	100	75	62	52	43	46	46	46	49	60
5	98	55	47	71	82	80	66	77	59	60	60	59	60
6	78	83	49	76	67	62	62	51	75	50	41	46	57
7	78	72	50	84	72	57	54	52	54	53	54	51	84
8	74	66	60	102	85	77	66	67	64	58	65	63	54
9	79	82	75	77	66	59	60	56	66	67	66	73	83
10	103	94	48	124	134	94	74	74	74	76	71	58	84
11	82	94	54	80	79	59	60	60	59	59	56	64	70
12	86	94	74	82	83	77	73	72	70	73	74	72	75
13	63	94	45	46	51	56	51	47	45	47	48	48	57
14	94	94	60	107	108	70	66	64	67	68	73	70	78
15	67	94	32	63	79	62	56	54	56	69	66	65	69
16	89	94	68	98	98	92	88	84	82	79	76	79	80
17	110	94	99	161	154	94	96	97	107	108	103	100	99
18	82	94	67	89	80	77	67	64	63	63	60	60	80
19	44	94	49	64	60	57	47	47	48	53	52	55	58
20	97	94	51	80	76	63	55	60	71	66	65	69	76
21	78	94	56	68	72	60	54	54	52	50	52	58	62
22	126	94	74	63	76	72	72	68	64	63	60	60	64
23	84	94	70	89	85	84	83	77	74	73	80	69	78
24	81	94	54	112	119	85	78	74	74	61	72	78	75
25	82	94	69	82	79	74	69	66	64	61	62	66	68
26	68	94	52	58	66	54	50	51	50	49	51	50	60
27	76	94	54	74	88	64	62	60	61	60	59	60	66
28	88	94	68	79	106	101	100	89	83	80	78	78	83
29	78	94	66	75	73	70	73	69	62	62	62	61	60
30	79	94	56	64	70	60	62	64	62	61	61	62	66
31	93	94	67	102	89	85	81	81	67	66	68	69	80
32	89	94	51	69	81	86	77	60	64	66	65	66	64
33	80	94	64	90	81	73	69	63	69	67	66	63	66
34	92	94	64	108	105	88	82	79	81	77	70	75	71
35	92	94	40	75	65	76	70	66	63	62	66	60	75
36	92	94	70	104	99	84	66	65	62	61	64	62	68
37	64	94	50	68	70	54	50	50	51	50	50	50	54
38	78	94	54	86	91	70	60	58	57	57	56	54	62
39	94	94	70	116	121	101	90	66	68	71	70	74	78
40	74	94	61	79	84	70	66	60	65	65	61	61	72

S. No	Mean Blood Pressure												
	BASAL	PP	PI	PT0	PT1	PT3	PT5	PT7	PT9	PT11	PT13	PT15	PT30
1	104	90	62	85	81	78	77	67	66	66	64	65	74
2	119	90	82	91	84	79	86	81	81	80	84	82	81
3	74	86	66	102	80	64	60	58	52	53	54	58	57
4	99	90	59	109	90	74	63	53	56	56	56	57	76
5	112	69	58	84	94	91	78	83	70	72	72	70	70
6	87	88	58	81	77	72	68	60	78	54	50	53	64
7	91	85	63	101	84	75	69	70	69	68	69	68	100
8	84	74	68	109	91	84	75	75	72	67	73	70	63
9	94	94	81	88	72	67	68	63	75	76	75	83	96
10	130	107	62	147	149	107	87	86	86	89	84	72	97
11	100	84	64	89	87	69	70	70	71	69	67	75	83
12	111	96	87	98	98	92	85	83	81	81	81	80	84
13	73	65	52	54	61	67	60	54	53	56	56	57	68
14	106	101	67	120	117	77	72	70	72	74	78	77	89
15	80	80	44	79	102	74	66	68	69	85	77	77	83
16	107	103	80	115	117	105	99	96	93	91	86	90	90
17	127	126	116	186	161	117	117	118	126	125	117	116	116
18	93	77	76	101	92	87	77	74	73	74	71	71	90
19	57	58	59	72	71	68	57	57	57	62	64	65	66
20	109	89	64	97	92	77	68	76	83	77	81	80	87
21	95	80	70	82	85	74	68	67	66	65	66	70	76
22	148	102	87	87	92	88	85	80	77	75	71	71	75
23	100	87	82	102	101	96	95	90	89	85	87	79	88
24	84	83	61	139	133	101	89	80	83	72	77	84	81
25	94	91	77	94	91	84	77	76	72	70	69	75	76
26	82	87	63	74	84	69	65	64	64	62	62	63	72
27	98	77	65	88	103	81	76	73	76	72	73	74	78
28	98	80	77	92	117	111	109	96	93	92	88	87	92
29	90	84	76	86	87	79	80	78	71	74	75	75	73
30	92	84	69	81	86	73	76	76	75	73	72	75	80
31	110	99	81	116	103	99	93	93	82	81	80	82	93
32	123	103	62	80	95	100	92	73	77	80	78	78	74
33	92	97	75	106	113	84	81	74	82	77	76	73	91
34	106	96	76	124	125	104	98	92	94	89	83	86	85
35	114	104	52	94	83	87	80	75	75	72	76	69	88
36	113	100	80	116	107	92	77	75	73	72	75	74	82
37	76	71	64	81	85	69	64	63	64	63	63	62	67
38	98	80	65	103	111	82	70	71	72	72	70	68	76
39	116	97	80	132	140	115	99	78	81	84	83	86	92
40	91	80	66	93	97	83	78	72	77	77	75	74	80