INTRODUCTION

Every anesthesiologist has specific way in organization of medications, airway equipment, intravenous lines, and so forth. The keyword is organization and this filters down through every aspect of the field of anesthesia. Much of training is spent learning algorithms and protocols, which are designed to bring a semblance of order into potentially chaotic situations. Airway management is a skill required for every anaesthesiologist. Difficult airway management is always a challenge. Efficient management of such clinical situations not only requires experience, but also utilization of safer techniques where feasible ***(O'Sullivan et al., 2011).***

Evaluation of the airway is as crucial as choice of drug, and addressing anatomical problems and syndromes that may compromise it. Unexpected airway management may be required. To ensure patient safety, it is crucial that the airway is safeguarded. The single most important responsibility is to protect it. An unobstructed airway, with intact protective reflexes and respiratory drive, is essential to avoid complications. In some procedures, e.g. dental, the airway may need to be shared with the surgeon management is a skill required of every anesthesiologist ***(Sevdalis et al., 2012)***.

The fundamental responsibility of anesthesiologist is to ensure adequate gas exchange for the patient. Failure to maintain oxygenation for more than a few minutes can result in

catastrophic anoxic injury. Difficulties with airway management during emergence remained among the leading causes of serious perioperative problems. It has been estimated that the inability of to successfully manage a difficult airway is responsible for as many as 30% of deaths directly attributable to anesthesia. The principal adverse outcomes associated with the difficult airway include (but are not limited to) death, brain injury, cardiopulmonary arrest, unnecessary tracheostomy, airway trauma, and damage to teeth ***(Norris et al., 2011)***.

Avoidance of airway complications requires good preparation, careful assessment, good planning and judgement, good communication and teamwork, knowledge and use of a range of techniques and devices, and a willingness to stop performing techniques when they are failing ***(Cook et al., 2011)***.

Aim of the Work

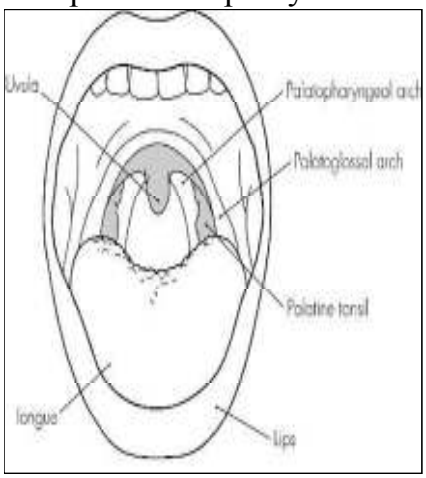
The goal of this essay is to study Complications of airway management and to discuss the strategies employed to prevent or reduce intraoperative airway management.

ANATOMY OF THE AIRWAY

A knowledge of anatomy has always played a vital role in medicine, and is especially important in the everyday practice of anesthesia. Successful airway management requires detailed understanding of upper and lower airway structure and function **(Boon et al., 2004).**

Upper Airway:

The human upper airway (fig. 1,2) has two openings: the nose and the mouth. The floor of the nose is the roof of the mouth. The nose leads to the nasopharynx and the mouth leads to the oropharynx. Both are separated anteriorly by the Palate, these two passages join posteriorly in the Pharynx. At the base of the tongue, the epiglottis separates the oropharynx and the laryngopharynx/ hypopharynx. The larynx extends from the lower part of the pharynx to the trachea ***(Harold et al., 2004).***



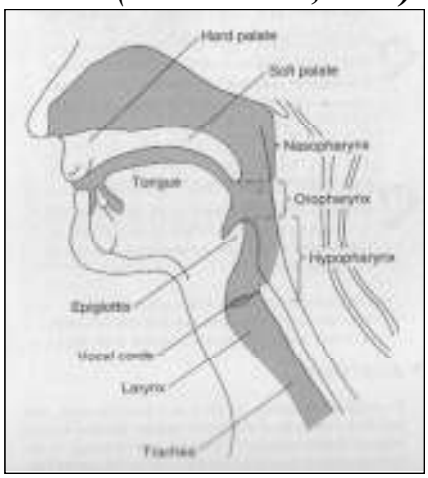


Fig. (1): Anatomy of the mouth. **Fig. (2):** Anatomy of the airway. ***(Harold et al., 2004)***

The Mouth:

The mouth is made up of the vestibule and the mouth cavity, the former communicating with the latter through the aperture of the mouth.

The Palate:

The palate forms the roof of the mouth and the floor of the nasal cavity.

The Nose:

The peripheral olfactory organ or organ of smell consists of two parts: an outer, ***the external nose,*** which projects from the center of the face; and an internal, ***the nasal cavity,*** which is divided by a septum into right and left nasal chambers.

(Harold et al., 2004)

Anatomy of the pharynx:

The pharynx is that part of the digestive tube which is placed behind the nasal cavities, mouth, and larynx which divide it into three parts, termed the nasopharynx, oropharynx and laryngopharynx, respectively. It is a musculomembranous tube, somewhat conical in form, with the base upward, and the apex downward, extending from the under surface of the skull to the level of the cricoid cartilage in front, and that of the sixth cervical vertebra behind ***(Mikhail et al., 2006).***

Anatomy of the larynx:

The larynx or organ of voice is placed at the upper part of the air passage. It is situated between the trachea and the root of the tongue. On either side of it lie the great vessels of the neck. Its vertical extent corresponds to the fourth, fifth, and sixth cervical vertebræ, but it is placed somewhat higher in the female and also during childhood ***(Andreas, 2001).***

Size of the larynx: is almost the same in boys and girls till puberty. After puberty the anteroposterior diameter of the larynx virtually doubles in males.

Dimensions of larynx:

Table (1): Dimensions of larynx:

Sex	Length	Transverse Diameter	Antero Posterior Diameter
Male	44mm	43mm	36mm
Female	36mm	41mm	26mm

(Andreas, 2001)

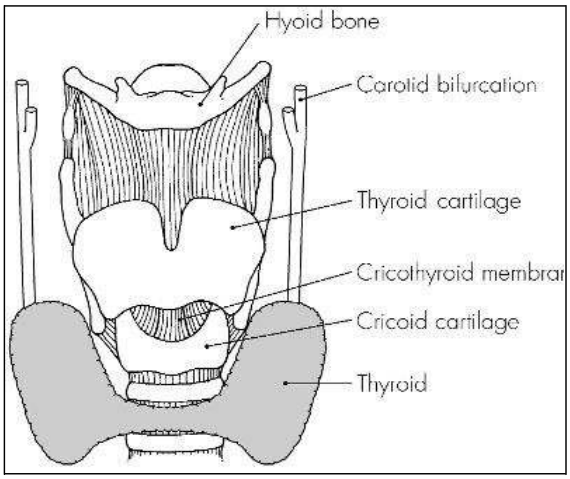


Fig. (3): Anatomy of larynx ***(Andreas, 2001).***

Laryngeal framework:

The framework of the larynx is formed by cartilages. These cartilages are linked by ligaments and membranes (fig. 4,5). They move in relation to one another by the action of two groups of muscles i.e. Intrinsic and Extrinsic muscles. The mucosal lining of the larynx is continuous above with that of pharynx and below with that of trachea ***(Andreas, 2001)***.

Cartialges of larynx:

Are nine in number, three single and three paired.

1. Thyroid cartilage: Is more or less shaped like a shield. It is the largest of the laryngeal cartilages.

Ligaments attached to the thyroid cartilage:

***Thyroepiglottic ligament*:** is a slender elastic ligament connecting.

Vestibular ligament: Also known as the **false vocal cord**.

Vocal ligament: Also known as the **true vocal cord** is responsible for the generation of voice.

2. ***Cricoid cartilage:*** Is the only complete cartilage in the whole of the respiratory pathway. It is shaped like a signet ring.
3. ***Arytenoid cartilages:*** Are small paired cartilages placed close together on the upper and lateral borders of the cricoid lamina. These cartilages are pyramidal shaped.
4. ***Corniculate cartilages:*** are small conical nodules of fibroelastic cartilage articulating with the apices of arytenoid cartilage.
5. ***Cuneiform cartilages:*** are two small elongated fibroelastic cartilage one in each margin of the aryepiglottic fold.
6. ***Epiglottis:*** It is a leaf shaped fibroelastic cartilage which projects upwards behind the tongue and the body of the hyoid bone.

(Boon et al., 2004)

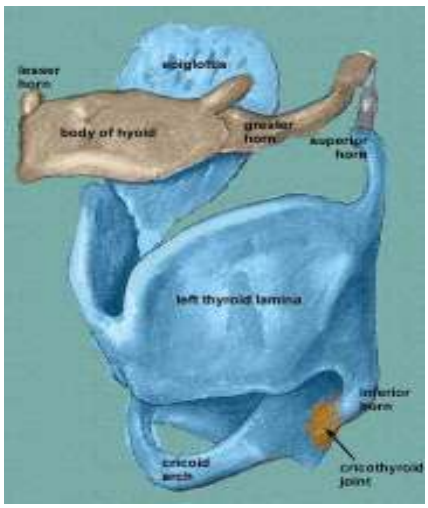


Fig. (4): Anterolateral view of laryngeal cartilages.

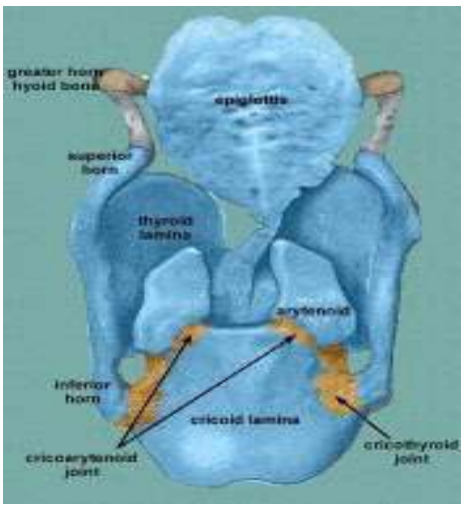


Fig. (5): Posterolateral view of laryngeal cartilages.

(Andreas, 2001)

Rima glottis:

Is an elongated fissure present between the two vocal folds. The region between the vocal folds accounts for three-fifths of the length of the aperture and is termed as the intermembranous part. The reminder of the rima glottis lie between the vocal processes of arytenoid cartilage. This portion is hence termed as the intercartilagenous part ***(Snell, 2000).***

Muscles of larynx:

A) Intrinsic muscles of larynx:

The intrinsic muscles of the larynx (fig. 7,8,9) interconnect the laryngeal cartilages. They are divided into:

- Those that open and close the glottis: **Lateral and posterior cricoarytenoid muscles, transverse and oblique arytenoids**.
- Those that control the tension of vocal ligaments:

Thyroarytenoids, vocalis and cricothyroids.

- Those that alter the shape of the inlet of the larynx: **Aryepiglotticus and the thyroepiglotticus**. Except transverse arytenoid, all these muscles are paired.

B) Extrinsic muscles of larynx:

The extrinsic muscles of the larynx connect the laryngeal cartialges to the hyoid bone above and trachea below. They are sternothyroid, thryohyoid and inferior constrictor of the pharynx.

(Snell, 2000)

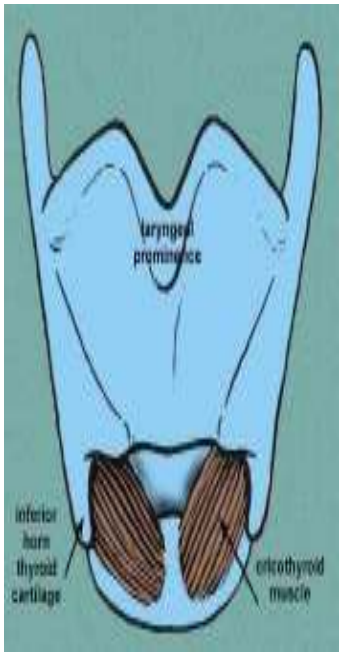


Fig. (6): Cricothyroid.

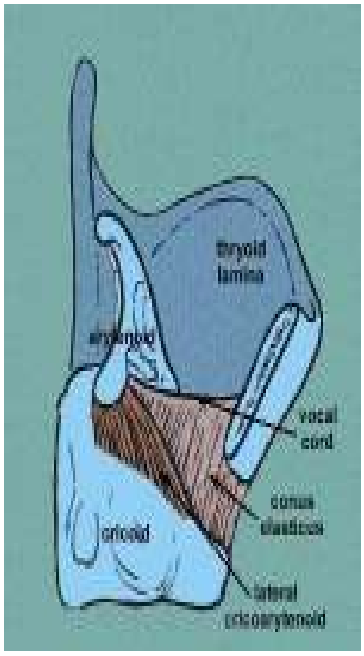


Fig. (7): Muscles of larynx.

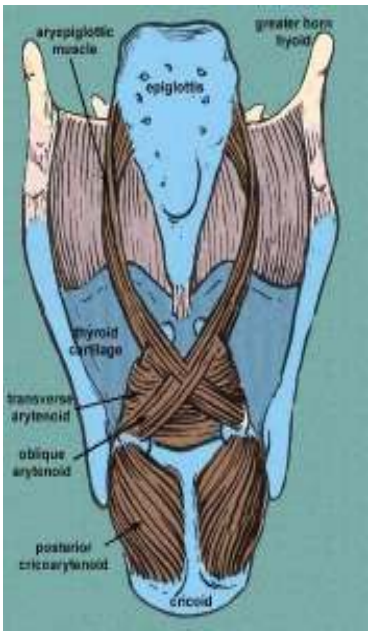


Fig. (8): Intrinsic Muscles of larynx.

(Snell, 2000)

Nerve supply:

The larynx is supplied by branches of vagus nerve i.e. superior and recurrent laryngeal nerves.

Superior laryngeal nerve:

Arises from the inferior vagal ganglion. It also receives a branch from the superior cervical sympathetic ganglion. Descending lateral to the pharynx, behind the internal carotid and at the level of greater horn of hyoid bone, divides into a small external laryngeal branch and a larger internal laryngeal nerve branch. The external laryngeal nerve provides motor supply to the cricothyroid muscle, while the internal laryngeal nerve pierces the thyrohyoid membrane above the entrance of the superior laryngeal artery and divides into sensory and secretomotor branches ***(Boon et al., 2004).***

The recurrent laryngeal nerve (RLN):

Is a myelinated nerve. It is a component of the vagus nerve. The vagus nerve has a superior ganglion at the level of the jugular foramen. This ganglion is also known as jugular ganglion. This ganglion contains cell bodies of parasympathetic and sensory fibres that run in the vagus. The vagus nerve has an inferior ganglion also known as the nodose ganglion immediatly below the jugular foramen. The vagal supply to the pharyngeal plexus and the superior laryngeal nerve arise from this ganglion. The course taken by the vagus nerve differs

between the right and the left sides. The approximate length of the left recurrent laryangeal nerve is 12 cms, where as the right nerve measures about 6 cms only. Considering the extra length and the distance the left recurrent laryngeal nerve has to travel, it is the common nerve affected by diseases / disorders / trauma etc. The blood supply to the recurrent laryngeal nerve comes from the inferior thyroid artery. The feeding branches are usually anterior to the nerve. Distally, the inferior laryngeal artery, a terminal branch of the inferior thyroid artery, supply the recurrent laryngeal nerve ***(Boon et al., 2004).***

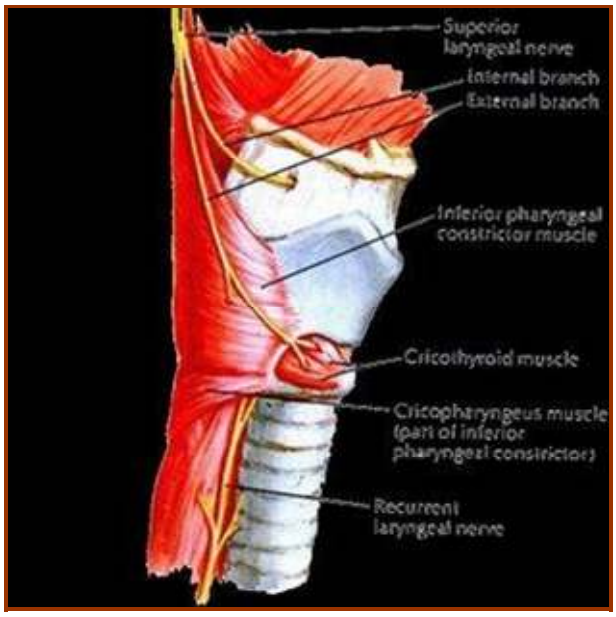


Fig. (9): Nerve supply of the larynx ***(Boon et al., 2004).***

Actions of Laryngeal Muscles:

The major function of the larynx is to keep the airway open. This means keeping the space between the vocal cords (rima glottidis) open. The second important function is vocalization and this is a very complicated procedure that requires a variety of parts of the body to function together ***(Andreas, 2001)***.

Functions of larynx:

The larynx functions are deglutition (swallowing), respiration (breathing), and phonation (voice production). The production of voice can be thought of in terms of three components: the production of airflow, the generation and resonance of sound and the articulation of voice ***(Andreas, 2001)***.

Laryngoscopic anatomy:

To view the larynx at direct laryngoscopy and then to pass a tracheal tube depends on getting the mouth, the oropharynx and the larynx into one plane. Flexion of the neck brings the axes of the oropharynx and the larynx in line but the axis of the mouth still remains at right angles to the others; their alignment is achieved by full extension of the head at the atlanto-occipital joint. At laryngoscopy, the anesthetist first views the base of the tongue, the valleculae and the anterior surface of the epiglottis. The larynx then comes into view,

bounded in front by the posterior aspect of the epiglottis, with its prominent epiglottic tubercle. The aryepiglottic folds are seen on either side running posteromedially from the lateral aspects of the epiglottis; they are thin in front but become thicker as they pass backwards where they contain the cuneiform and corniculate cartilages. The vocal cords appear as pale, glistening ribbons that extend from the angle of the thyroid cartilage backwards to the vocal processes of the arytenoids. Between the cords is the triangular (apex forward) opening of the rima glottidis, through which can be seen the upper two or three rings of the trachea ***(Andreas, 2001).***

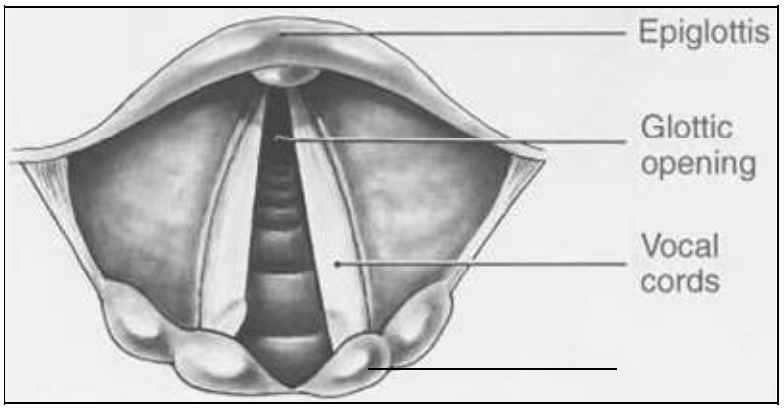


Fig. (10): Laryngoscopic anatomy ***(Andreas, 2001).***