

INTRODUCTION

Maxillofacial, dental, ENT and plastic surgery are commonly referred to as shared airway surgery. Surgical procedures vary from simple to complicated facial reconstruction and airway is at risk of soiling due to bleeding and debris (*Gupta et al., 2011*).

Airway surgery provides a unique challenge in that the airway is shared between the anesthetist and surgeon. Patients may experience the threat of hypoxia, retained carbon dioxide and complete airway obstruction is present pre-, intra- and postoperatively (*Welch, 2011*).

Anesthesiologists and Surgeons are working in the same anatomic field which is already compromised by the disease. Margin of safety is reduced. Close co-operation and communication between anesthesiologist and surgeon is of paramount importance (*Shruti et al., 2014*).

Managing the airway of patients with craniofacial abnormalities can potentially be difficult. It should be carried out by experienced anesthesiologists, with assistance from an otolaryngologist when necessary. A variety of different airway devices should be available if needed (*Ying-Lun Chen and Kuo-Hwa Wu, 2009*).

The choice of airway management technique is influenced by patient factors, surgical requirements and anesthetic preferences; a cuffed tracheal tube with a throat pack

provides the highest level of airway protection in shared airway surgery. Nasal intubation is often used in certain procedures as in surgery on the jaws, teeth, oral cavity and neck, intermaxillary fixation (wiring of the jaws) and assessment of dental occlusion (*Mohan et al., 2009*).

No ideal universally accepted anesthetic technique exists to cover this wide range of shared airway cases. Anesthetic techniques can be divided into three main groups: First; intubation techniques requiring the presence of either a small or large cuffed tracheal tube, second; non-intubation techniques include use of the laryngeal mask airway, apneic techniques and insufflation techniques and third; jet ventilation techniques via a supraglottic, subglottic or transtracheal routes (*Brimacombe et al., 2003*).

With a better understanding of airway pathophysiology and improved techniques in surgery and anesthesia, recent research has focused to provide new treatment options and new anesthetic technique (*Paranjpe and Mane, 2014*).

AIM OF THE WORK

This Essay aims to discuss the new modalities in anesthesia of the shared air way.

Chapter 1

ANATOMY OF THE AIRWAY

1. The Nose:

The nose is a pyramidal-shaped structure projecting from the mid-face, made up of bone, cartilage, fibro-fatty tissue, mucous membrane, and skin. It contains the peripheral organ of smell and is the proximal portion of the respiratory tract. The nose is divided into right and left nasal cavities by the nasal septum (figure 1). The inferior portion of the nose contains two apertures called the anterior nares. Each naris is bounded laterally by an ala, or wing. The posterior portions of the nares open into the nasopharynx and are referred to as choanae (*Finucane et al., 2011*).

One or both of these apertures are absent in the congenital anomaly “choanal atresia”. Infants born with this condition are at risk of suffocation as they are compulsive nose breathers at birth, so urgent surgical correction of choanal atresia is required soon after birth (*Finucane et al., 2011*).

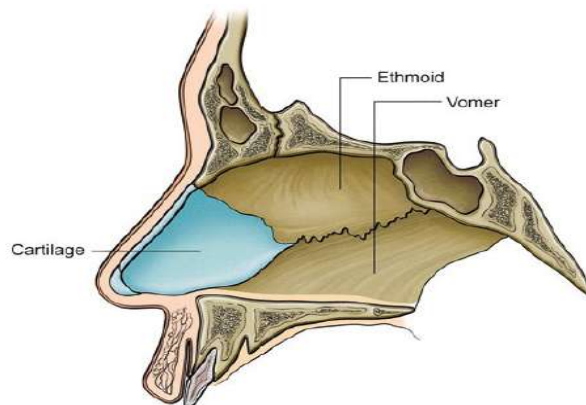


Figure (1): The nasal septum (sagittal) (*Benumof and Sniderson, 1999*).

Anatomically, each side of the nose consists of a floor, a roof, and medial and lateral walls. The septum forms the medial wall of each nostril and is made up of perpendicular plates of ethmoid and vomer bones and the septal cartilage. The bony plate forming the superior aspect of the septum is very thin and descends from the cribriform plate of the ethmoid bone. The cribriform plate may be fractured following trauma (*Benumof and Sniderson, 1999*).

The lateral walls have a bony framework attached to which are three bony projections referred to as conchae or turbinates (figure 2).

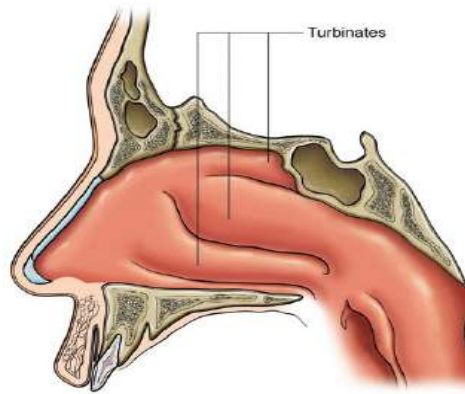


Figure (2): The lateral nasal wall (*Benumof and Sniderson, 1999*).

The upper and middle conchae are derived from the medial aspect of the ethmoid; the inferior concha is a separate structure. There are a number of openings in the lateral nasal wall that communicate with the paranasal sinuses and the nasolacrimal duct (*Benumof and Sniderson, 1999*).

2. The Oral Cavity:

The oral cavity is divided into two parts: the vestibule and the oral cavity proper (figure 3). The vestibule is the space between the lips and the cheeks externally and the gums and teeth internally. The oral cavity proper is bounded anterolaterally by the alveolar arch, teeth, and gums; superiorly by the hard and soft palates; and inferiorly by the tongue. Posteriorly, the oral cavity communicates with the palatal arches and pharynx (*Reyt, 200*).

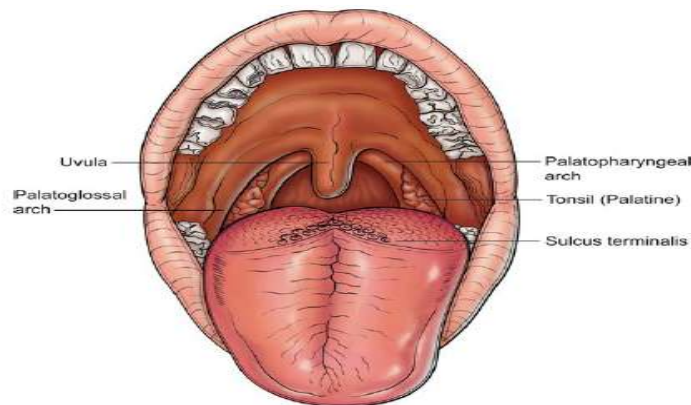


Figure (3): The oral cavity (*Reyt, 2003*).

▪ The Uvula:

In the posterior aspect of the mouth, the soft palate is shaped like the letter “M”, with the uvula as the centerpiece. This structure is a useful landmark for practitioners assessing the ease or difficulty of mask ventilation or tracheal intubation (*Reyt, 2003*).

▪ **The tonsils:**

The tonsils that we see when we look in the mouth are formally known as the palatine tonsils which are collections of lymphoid tissue engulfed by two soft tissue folds, the “pillars of the fauces.” The anterior fold is called the palatoglossal arch, and the posterior, the palatopharyngeal arch (*Reyt, 2003*).

However, tonsillar tissue is far more extensive than that. There is a collection of lymphoid tissue called the “tonsillar ring” which is situated in an incomplete circular ring around the pharynx. It is made up of the palatine tonsils (between the pillars of the fauces), the pharyngeal tonsil, (adenoids), tubular tonsils (extend bilaterally into the eustachian tubes), and the lingual tonsil (a collection of lymphoid tissue on the posterior aspect of the tongue). The lingual tonsil is situated behind the sulcus terminalis and has a cobblestone appearance (figure 4) (*Reyt, 2003*).

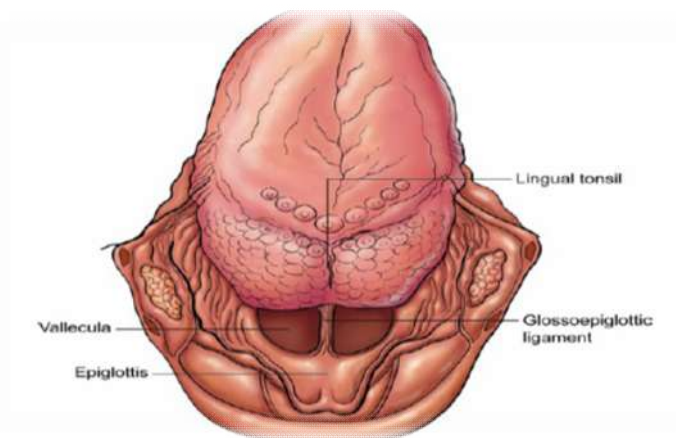


Figure (4): Posterior view of the tongue showing the lingual tonsil and the epiglottis (*Reyt, 2003*).

Hypertrophy of the pharyngeal tonsil “adenoids” can obstruct the nasal airway, necessitating mouth breathing. Hearing may be impaired when the tubular tonsils become infected. Hypertrophy of the lingual tonsil may cause airway obstruction, difficult mask ventilation, and difficult tracheal intubation (*Jones and Cohle, 1993*).

▪ **The tongue:**

The tongue is a muscular organ used for speech, taste, deglutition, and oral cleansing. It is divided into three parts: the root, the body, and the tip. The posterior aspect of the tongue is divided into two parts by a fibrous ridge called the sulcus terminalis. The tongue is attached to the hyoid bone, mandible, styloid processes, soft palate, and walls of the pharynx. In an unconscious patient, the oropharyngeal musculature tends to relax and the tongue is displaced posteriorly, occluding the airway.

Since the tongue is a major cause of airway obstruction, it is an important anatomical consideration in airway management. Its size in relation to the oropharyngeal space is an important determinant of the ease or difficulty of tracheal intubation (*Reyt, 2003*).

▪ **Nerve Supply to the Tongue:**

The sensory and motor innervation of the tongue is quite diverse and includes fibers from a number of different sources. Sensory fibers for the anterior two thirds are provided by the lingual nerve. Taste fibers are furnished by the chorda tympani

branch of the nervus intermedius from the facial nerve. Sensory fibers for the posterior third come from the glossopharyngeal nerve. The major motor nerve supply of the tongue is from the hypoglossal nerve which passes above the hyoid bone and is distributed to the lingual muscles. Since this nerve is very superficial at the angle of the mandible, it is prone to injury during vigorous manual manipulation of the airway (figure 5) (*Reyt, 2003*).

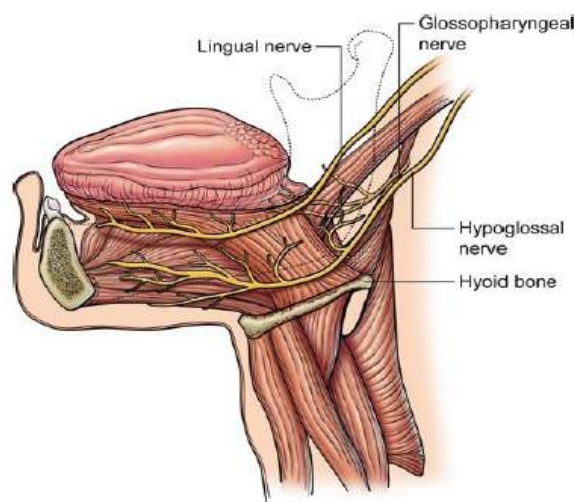


Figure (5): Motor innervations of the tongue (*Reyt, 2003*).

3. The pharynx:

The pharynx is a musculo-membranous passage between the choanae, the posterior oral cavity, the larynx, and esophagus. It extends from the base of the skull to the inferior border of the cricoid cartilage anteriorly and the lower border of C6 posteriorly. It is approximately 15 cm long. Its widest

point is at the level of the hyoid bone and the narrowest at the lower end here it joins the esophagus (*Finucane et al., 2011*).

In a normal conscious patient, the gag reflex may be elicited by stimulating the posterior pharyngeal wall. The afferent and efferent limbs of this reflex are mediated through the glossopharyngeal and vagus nerves (figure 6,7) (*Finucane et al., 2011*).

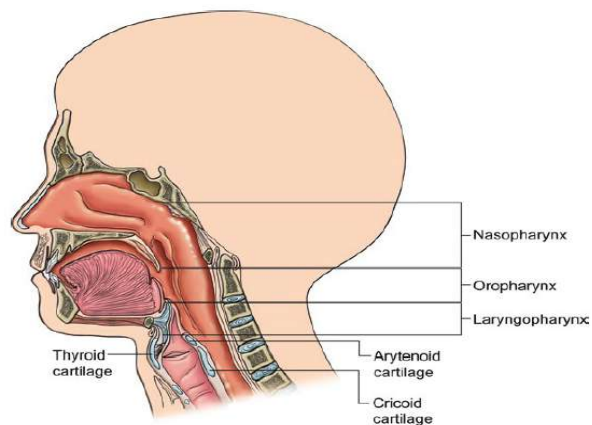


Figure (6): The pharynx (sagittal) (*Finucane et al., 2011*).

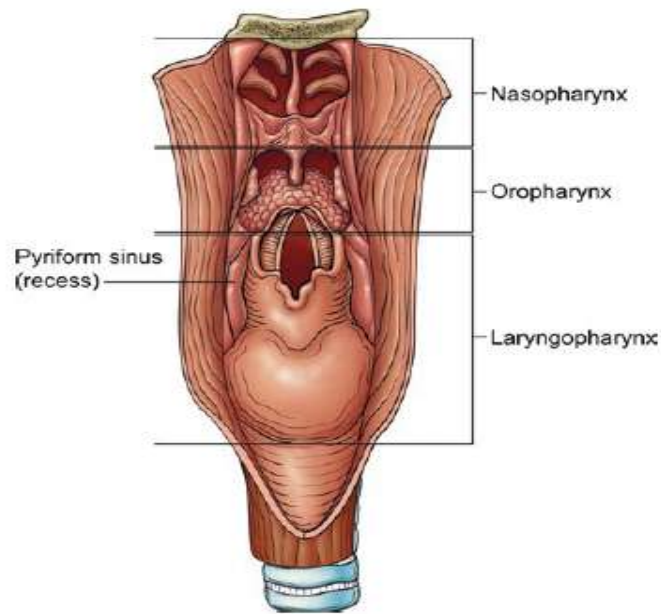


Figure (7): The pharynx (posterior) (*Finucane et al., 2011*).

▪ **Prevertebral Fascia:**

The prevertebral fascia extends from the base of the skull down to the third thoracic vertebra, where it continues as the anterior longitudinal ligament. It also extends laterally as the axillary sheath. Abscess formation, hemorrhage following trauma, or tumor growth may cause swelling in this area and lead to symptoms of airway obstruction (*Finucane et al., 2011*).

▪ **Retropharyngeal Space:**

The retropharyngeal space (RPS) is a potential space lying between the prevertebral fascia and the buccopharyngeal fascia, posterior to the pharynx in the midline. It is confined above by the base of the skull and inferiorly by the superior mediastinum and contains lymph nodes and fat. Pus from infected teeth can enter

this space and reach the thorax. Infectious material may penetrate the prevertebral fascia and enters RPS causing difficulty swallowing and airway obstruction. Tumors may also invade this space and compromise the airway. It is very difficult to access the RPS clinically; therefore, we are very dependent on imaging techniques (CT and MRI) to make a diagnosis of airway obstruction caused by infection or tumor in this space (**Davis, 1990**).

4. The Larynx:

The larynx is a box-like structure situated in the anterior portion of the neck and lies between C3 and C6 in the adult. The larynx is shorter in women and children and is situated at a slightly higher level. It occupies a volume of 4-5 cc in adults and is made up of cartilages, muscles, mucous membranes, nerves, blood vessels, and lymphatics. The average length of the larynx is 44 mm in the male and 36 mm in the female. The average antero-posterior diameter is 36 mm in the male and 26 mm in the female and the average transverse diameter is 36 mm in the male and 26 mm in the female.

The larynx is one of the most powerful sphincters in the body and is an important component of the airway. Functionally, the larynx was designed as a protective valve to prevent food and other foreign substances from entering the respiratory tract. With evolution, the larynx became a highly sophisticated organ of speech when used in combination with the lips, the tongue and the mouth and is one of the

distinguishing features of mankind separating us from other primates (*Finucane et al., 2011*).

The voice change in males occurs at puberty in most cases when the cartilages become larger. The “Adam’s apple” is more prominent in males following puberty because the angle made between the thyroid laminae is smaller in males and the antero-posterior diameter of the laminae is greater. This gender difference is usually evident by the 16th year (*Finucane et al., 2011*).

Fractures of the larynx may occur during various sporting activities including boxing, karate, kick boxing, and other major contact sports. This injury may also occur during attempted strangulation from any cause and from compression by a seat belt following motor vehicle accidents. The symptoms and signs of a fractured larynx include: laryngeal distortion, hoarseness, aphonia, aberrant vocalization, airway obstruction, choking, cyanosis, and death.

▪ **Laryngeal Cartilages:**

The larynx consists of three single cartilages (epiglottis, thyroid, and cricoid); and three paired cartilages (arytenoids, corniculates, and cuneiforms).

A- Single Cartilages:

1) Epiglottis:

The epiglottis, a well-known landmark to those performing tracheal intubation, is shaped like a leaf. At its lower

end, it is attached to the thyroid cartilage by the thyroepiglottic ligament. Its upper, rounded part is free and lies posterior to the tongue, and is attached by the median glossoepiglottic ligament. The epiglottis is attached to the hyoid bone anteriorly by the hyoepiglottic ligament. Small depressions on either side of this ligament are referred to as the valleculae. There is a recognizable bulge in the midportion of the posterior aspect of the epiglottis called the tubercle (figure 8).

During swallowing, as the laryngeal muscles contract, the downward movement of the epiglottis and the closure and upward movement of the glottis prevent food from entering the larynx (*Ellis et al., 2004*).

When the epiglottis becomes acutely inflamed and swollen (in association with acute epiglottitis), life threatening airway obstruction may occur. The epiglottis has no function in the process of swallowing, breathing or phonation (*Finucane et al., 2011*).

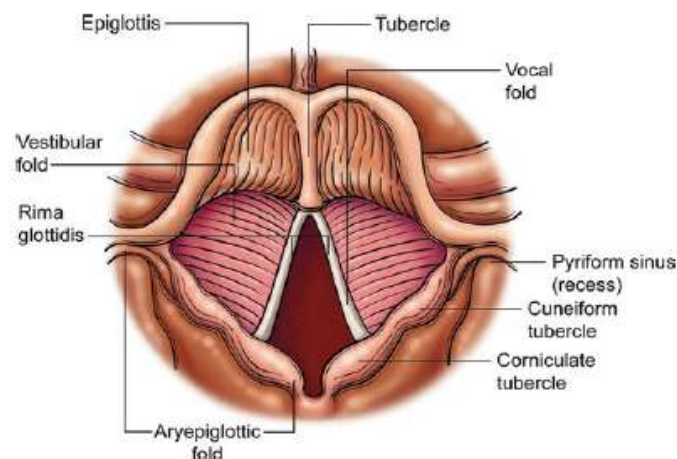


Figure (8): The larynx (superior) (*Ellis et al., 2004*).

2) Thyroid Cartilage:

The thyroid cartilage is a shield like structure. Anteriorly, the two plates come together to form a notch that is more prominent in men than in women. At the posterior aspect of each lamina there are horns on the superior and inferior aspects. The inferior horn has a circular facet that allows it to articulate with the cricoid cartilage.

3) Cricoid Cartilage:

The cricoid cartilage is shaped like a signet ring, with the bulky portion placed posteriorly. It has articular facets for its attachment with the thyroid cartilage and the arytenoids. It is separated from the thyroid cartilage by the cricothyroid ligament, or membrane (figure 9).

The inferior portion of the thyroid cartilage is connected to the superior border of the cricoid cartilage by the cricothyroid ligament. In acute airway obstruction, the cricothyroid membrane may be penetrated with a needle, knife, or tube and connected to an oxygen source. This procedure is called

“Cricothyrotomy” and is usually the first surgical procedure performed to relieve asphyxiation (*Jones and Cohle, 1993*).

Downward pressure on the cricoid cartilage is required to prevent passive regurgitation of gastric contents during induction of anesthesia in non fasting patients and emergency situations. This is known as **“Sellick’s maneuver”**.