INTRODUCTION

Invasive diagnostic and minor surgical procedures outside the traditional operating room have increased in the last decade. So providing analgesia and sedation for procedure suites, imaging facilities, emergency departments and ambulatory surgery centers has also increased ***(Law et al., 2008).***

Upper airway obstruction is common during sedation. Obstruction is caused by loss of muscle tone present in the awaked patient . Loss of wakefulness and depression of airway muscle activity by sedative agents may result in improper respond to asphyxia ***(Hillman et al., 2007).***

Identifying the patient at risk is vital. Previous anesthetic history and investigations of upper airway are helpful. A history of upper airway compromise during sleep (snoring, obstructing apneas) should be sought ***(Hillman et al., 2007).***

Methods used to evaluated sleep apnea and related breathing disorders are now being embloyed for studying the effects of sedation and general anesthesia ***(Litman, 2005).***

Appropriate drug selection for the intended procedure as well as the presence of an individual with the skills needed to rescure a patient from an adverse response is essential ***(Hoffman et al., 2002).***

The airway should be secured before sedation started where doubt exists. Every anesthetist should have in mind a plan for

improper oxygenation or, worse, failed ventilation ***(Hillman et al., 2007).***

Familiarity with emergency airway management procedure algorithms is essential . These guidelines are intended for all venues in which sedation for a procedure might be performed (hospital, surgical center, freestanding imaging facility, dental facility, or private office) ***(Sullivan et al., 2006 & Dionne et al., 2006).***

AIM OF THE WORK

The aim of this review is to focus on upper airway collapse during sedation in relation to different drugs used, with a close reference to patient related factors augmenting the problem as well as preoperative detection of susceptible patients and intraoperative management of such a problem.

ANATOMY OF THE UPPER AIRWAY

Upper airway is a compartment that has two openings: the nose, which leads to the nasopharynx, and the mouth, which leads to the oropharynx.These passages are separated anteriorly by the palate, but joined posteriorly in the pharynx. The upper airway extends from the anterior nares down to the larynx. (Figure 1) ***(Morris, 2004).***

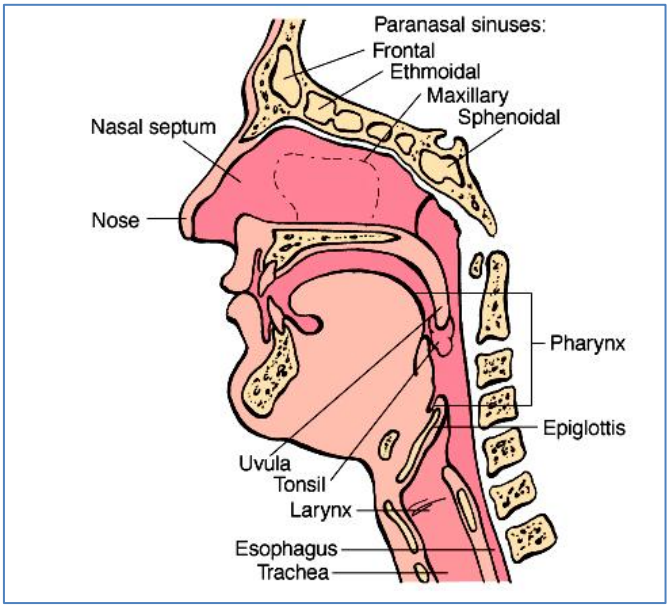

Fig. (1): Major structure of upper airway ***(Morris, 2004).***

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 vestibule is formed by the lips, cheeks, gums and teeth within. An important feature is the opening of the parotid duct on a small papilla opposite the 2nd upper molar tooth. Normally the walls of the vestibule are kept together by the tone of the facial muscles. The mouth cavity is bounded by the alveolar arch of the maxilla and the mandible, and teeth in front, the hard and soft palate above, the anterior two-thirds of tongue and the reflection of its mucosa forward onto the mandible below and the oropharyngeal isthmus behind ***(Morris, 2004).***

Nerve supply: The palatine nerves provide sensory fibers from the trigeminal nerve to the hard and soft palate. The lingual nerve (a branch of the mandibular division of the trigeminal nerve) and glossopharyngeal nerve provide general sensation to the anterior two-third and posterior third of the tongue, respectively ***(Morris, 2004)***.

The Nose

The nose is divided anatomically into the external nose and the nasal cavity.

The External Nose is formed by an upper framework of bone (made up of the nasal bones, the nasal part of the frontal bones and the frontal processes of the maxillae), a series of cartilages in the lower part, and a small zone of fibro-fatty tissue that forms the lateral margin of the nostril (the ala). The cartilage of the nasal septum comprises the central support of this framework.

The Cavity of the Nose is subdivided by the nasal septum into two separate compartments that open to the exterior by the nares and into the nasopharynx by the posterior nasal apertures which is called choanae. Immediately within the nares is a small dilatation, the vestibule, which is lined in its lower part by stiff, straight hairs. Each side of the nose presents a roof, a floor and a medial and lateral wall. The roof first slopes upwards and backwards to form the bridge of the nose (The nasal and frontal bones), then has a horizontal part (the cribriform plate of the ethmoid), and finally a downward-sloping segment (the body of the sphenoid). The floor is concave from side to side and slightly so from before backwards. It is formed by the palatine process of the maxilla and the horizontal plate of palatine bone.The medial wall is the nasal septum, formed by the septal cartilage, the perpendicular plate of the ethmoid and the vomer. The lateral wall has a bony framework made up principally of the nasal aspect of the ethmoidal labyrinth above, the nasal surface of the maxilla below and in front and the perpendicular plate of the palatine bone behind ***(Morris, 2004).***

Upper part of the nasal cavity receives its arterial supply from the anterior and posterior ethmoidal branches of the ophthalmic artery, a branch of the internal carotid artery. The sphenopalatine branch of the maxillary artery is distributed to the lower part of the cavity and links up with the septal branch of the superior labial branch of the facial artery on the antero-inferior part of the septum.

A rich submucous venous plexus drains into the sphenopalatine, facial and ophthalmic veins, and through the latter

links up with the cavernous sinus. Small tributaries also pass through the cribriform plate to veins on the undersurface of the frontal lobe of the brain ***(Ellis et al., 2004).***

Nerve supply: The olfactory nerve supplies the specialized olfactory zone of the nose, which occupies an area of some 2 cm in the upper most parts of the septum and lateral walls of the nasal cavity. The ordinary sensory nerves are derived from the nasociliary branch of the first division of trigeminal nerve and also from the second division or maxillary division ***(Morris, 2004).***

The pharynx

The pharynx is a wide muscular tube that forms the common upper pathway of the respiratory and alimentary tracts. Anteriorly, it is in free communication with the nasal cavity, the mouth and the larynx, which conveniently divide it into three parts, termed the nasopharynx, oropharynx and laryngopharynx, respectively.In extent, it reaches from the skull (the basilar part of the occipital bone) to the origin of the oesophagus at the level of the 6 th cervical vertebra (C6). Posteriorly, it rests against the cervical vertebrae and the prevertebral fascia ***(Morris, 2004).***

The Nasopharynx

The nasopharynx lies behind the nasal cavity and above the soft palate. It communicates with the oropharynx through the pharyngeal isthmus, which becomes closed off during the act of swallowing. On the lateral wall of the nasopharynx, 1 cm behind and

just below the inferior nasal concha, lies the pharyngeal opening of the pharyngotympanic (Eustachian) tube. The underlying cartilage of the tube produces a bulge immediately behind its opening, termed the tubal elevation, and behind this, in turn, is a small depression called the pharyngeal recessa-fossa of Rosenmüller ***(Morris, 2004).***

The nasopharyngeal tonsil ('adenoids') lies on the roof and posterior wall of the nasopharynx. It consists of a collection of lymphoid tissue covered by ciliated epithelium and lies directly against the superior constrictor muscle; it has no well-defined fibrous capsule. The lymphoid tissue begins to atrophy at puberty and has all disappeared by early adult life. **(*Morris, 2004).***

The oropharynx

The mouth cavity leads into the oropharynx through the oropharyngeal isthmus, which is bounded by the palatoglossal arches, the soft palate and the dorsum of the tongue. The oropharynx itself extends in height from the soft palate to the tip of the epiglottis. Its most important features are the tonsils.

The palatine tonsils are the collections of lymphoid tissue that lie on each side in the triangle formed by the palatoglossal and palatopharyngeal arches (the pillars of the fauces), connected across the base by the dorsum of the tongue.The free surface of each palatine tonsil presents about 12–20 tonsillar pits, and its upper part bears the intratonsillar cleft. The deep surface of the palatine tonsil may send processes of lymphoid tissue into the dorsum of the tongue, into the soft palate and into the faucal pillars.

The palatine tonsil is bounded on this deep aspect by a dense fibrous capsule of thickened pharyngeal aponeurosis, which is separated by a film of lax connective tissue from the underlying superior constrictor muscle **(*Morris, 2004).***

The laryngopharynx

The third part of the pharynx extends from the tip of the epiglottis to the lower border of the cricoid at the level of C6. Its anterior aspect faces first the laryngeal inlet, bounded by the aryepiglottic folds, then below this, the posterior aspects of the arytenoids, and finally the cricoid cartilage.The larynx bulges back into the centre of the laryngopharynx leaving a recess on either side termed the pyriform fossa. The internal branch of the superior laryngeal nerve passes in the submucosa of the pyriform fossa **(*Morris, 2004).***

Muscles of the pharynx are the superior, middle and inferior constrictors (which have been aptly likened to three flower-pots fitted into each other), the Stylopharyngeus, Salpingopharyngeus, and Palatopharyngeus.

Actions: When deglutition is about to be performed, the pharynx is drawn upward and dilated in different directions, to receive the food propelled into it from the mouth ***(Adant et al., 1998*)**.

Blood supply of the pharynx: The arterial supply of the pharynx includes the ascending pharyngeal artery, the ascending palatine branch of the facial artery, the descending palatine and

pharyngeal branches of the maxillary artery, and the muscular branches of the superior thyroid artery.The veins of the pharynx drain into the pterygoid plexus and the internal jugular vein**. (*Adant et al., 1998*)**.

Nerve supply of the pharynx: Most of the muscles of the pharynx are innervated by the pharyngeal plexus. This plexus is formed by the pharyngeal branches of the glossopharyngeal, vagus, cranial portion of accessory nerves and superior cervical sympathetic ganglion. So there is a threefold sensory nerve supply: the glossopharyngeal nerve via the pharyngeal plexus, the posterior palatine branch of the maxillary nerve and twigs from the lingual branch of the mandibular nerve ***(Adant et al., 1998).***

The Larynx

The larynx (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 ***(Danoy et al, 1991).***

In relation to surface anatomy of the larynx, the levels of laryngeal cartilages are:

- C3 (level of body of hyoid and its greater cornu)
- C3-4 junction (level of upper border of thyroid cartilage and bifurcation of common carotid artery)
- C6 (level of cricoid cartilage) ***(Lawrence Bannister and Roger Parker* 2005).**

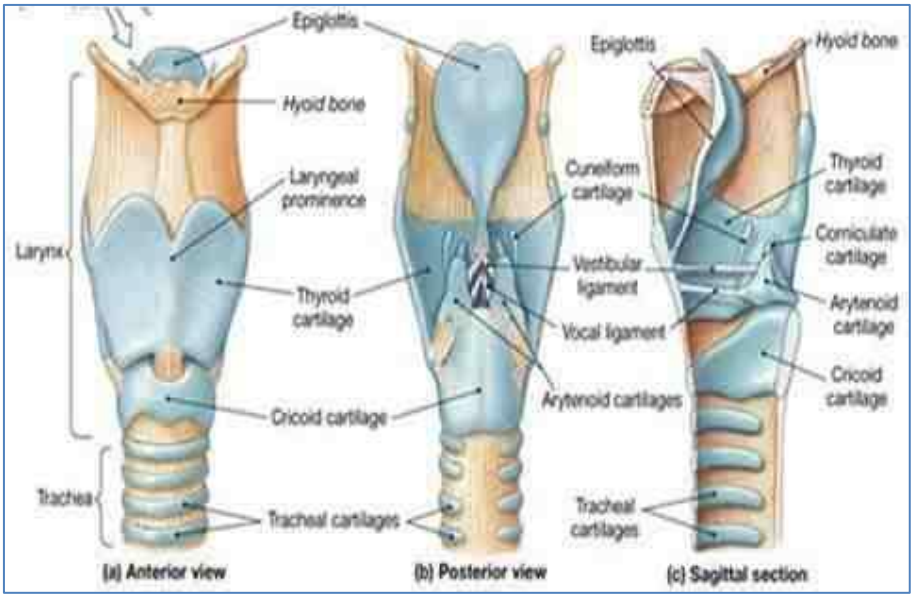

Fig. (2): The cartilages of the larynx

***(Lawrence Bannister and Roger Parker* 2005).**

The Cartilages of the Larynx

They are nine in number, three single and three paired, as follows; Thyroid, Cricoid, Epiglottis, Two Corniculate, Two Cuneiform and Two Arytenoids. (Figure 3).

The thyroid cartilage is shield-like and consists of two laminae that meet in the midline inferiorly, leaving the thyroid notch between them above. This junction is well marked in the male, forming the laryngeal prominence or Adam's apple, but in the female it is not obvious ***(Danoy et al., 1991).***

The cricoid cartilage is in the shape of a signet ring; the 'signet' lies posteriorly as a quadrilateral lamina joined in front by a

thin arch. The side of the lamina bears two articular facets, one for the inferior horn of the thyroid cartilage and the other, near its upper extremity, for the arytenoid cartilage ***(Danoy et al., 1991).***

The arytenoid cartilages are three-sided pyramids that present one on either side of the supero-lateral aspect of the lamina of the cricoid. Each has a lateral muscular process, into which are inserted the posterior and lateral cricoarytenoid muscles, and an anterior vocal process, which is the posterior attachment of the vocal ligament ***(Lawrence Bannister and Roger Parker 2005).***

The epiglottis is likened to a leaf. It is attached at its lower tapering end to the back of the thyroid cartilage by means of the thyro-epiglottic ligament. Its superior extremity projects upwards and backwards behind the hyoid and the base of the tongue, and overhangs the inlet of the larynx. The posterior aspect of the epiglottis is free and bears a bulge, termed the *tubercle*, in its lower part. The upper part of the anterior aspect of the epiglottis is also free. The lower part of the anterior surface of the epiglottis is attached to the back of the hyoid bone by the hyo-epiglottic ligament ***(Morris, 2004).***

Membranes and ligaments of the larynx

Ligaments of the larynx are extrinsic, i.e., those connecting the thyroid cartilage and epiglottis with the hyoid bone, and the cricoid cartilage with the trachea; and intrinsic, those which connect the several cartilages of the larynx to each other **(*Danoy et al., 1991).***

***Extrinsic Ligaments**:*

1 The *thyrohyoid membrane*, which stretches between the upper border of the thyroid cartilage and the hyoid. This membrane is strengthened anteriorly by condensed fibrous tissue, termed the median thyrohyoid ligament, and its posterior margin is also thickened to form the lateral thyrohyoid ligament.

2 The *cricotracheal ligament*, which links the cricoid to the first ring of the trachea.

3 The *cricothyroid ligament* lies between the thyroid cartilage and the cricoid. It is an easily identified gap in the anterior surface of the laryngeal skeleton through which intratracheal injections may be administered. It is also the recommended site for emergency laryngotomy in cases of laryngeal obstruction.

4 The *hyo-epiglottic ligament*, which connects the epiglottis to the back of the body of the hyoid**. *(Morris, 2004).***

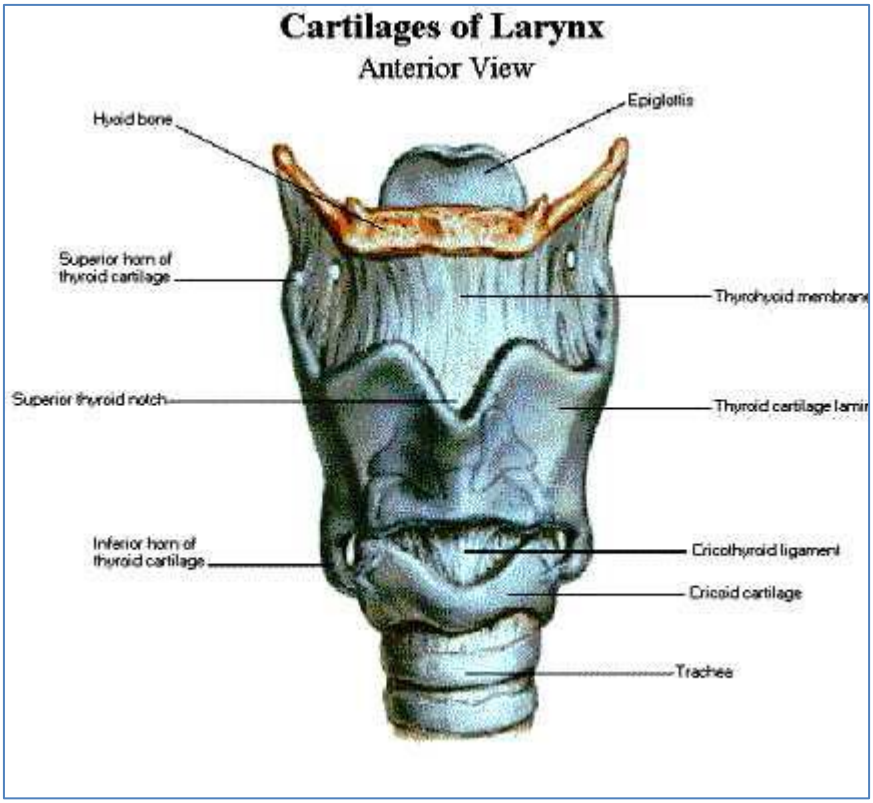

Fig. (3): The Cartilages of the Larynx. ***(Danoy et al., 1991).***

The Vocal Folds are concerned in the production of sound, and enclose two strong bands, named the **vocal ligaments**. Each ligament consists of a band of yellow elastic tissue, attached in front to the angle of the thyroid cartilage, and behind to the vocal process of the arytenoid. Its lower border is continuous with the thin lateral part of the conus elasticus. Its upper border forms the lower boundary of the ventricle of the larynx. Laterally, the Vocalis muscle lies parallel with it. It is covered medially by mucous membrane, which is extremely thin and closely adherent to its surface **(*Danoy et al., 1991).***

Muscles of the Larynx

The muscles of the larynx are extrinsic (passing between the larynx and parts around) and intrinsic (confined entirely to the larynx) **(*Danoy et al., 1991).***

The extrinsic muscles of the larynx are the sternothyroid, thyrohyoid and the inferior constrictor of the pharynx. In addition, a few fibres of stylopharyngeus and palatopharyngeus reach forward to the posterior border of the thyroid cartilage (***Danoy et al., 1991).***

1 The *sternothyroid muscle* stretches from the posterior aspect of the manubrium to the oblique line on the lateral surface of the thyroid lamina. It depresses the larynx.

2 The *thyrohyoid muscle* passes upwards from the oblique line of the thyroid lamina to the inferior border of the greater horn of the hyoid. It elevates the larynx.

3 The *inferior constrictor* arises from the oblique line of the thyroid lamina, from a tendinous arch over the cricothyroid muscle and from the side of the pharynx. This muscle acts solely as a constrictor of the pharynx.

Other muscles play an important part in movements of the larynx indirectly, via its close attachment, by ligaments and muscle, with the hyoid bone. These muscles help to elevate and depress the larynx; the indirect elevators are the mylohyoid, stylohyoid and geniohyoid, and the indirect depressors are the sternohyoid and omohyoid ***(Morris, 2004).***