INTRODUCTION

Providing anesthetic care to the patient with a difficult airway keenly interests anesthesiologists and is a situation that often provokes much anxiety and trepidation. However, dealing effectively and safely with these patients is a skill that all anesthesiologists should be familiar with and are expected to perform with competency ***(Shawn et al., 2002).***

Difficult airways arise from multiple causes. Access to the oral cavity can be impeded by unfavorable anatomy, such as a small mouth or receding jaw, as well as reduced mouth opening due to radiation therapy, jaw fracture, or previous head and neck surgery. Difficulty in neck extension shows up in the patient who can’t extend due to prior cervical fusion or advanced osteoarthritis. In addition, neck extension is contraindicated in patients with unstable cervical spines due to fractures, rheumatoid arthritis, Down syndrome, etc ***(Berry et al., 1995).***

Although fiberoptic intubation can be done under general anesthesia and may be advantageous in some situations, many believe that the use of regional anesthesia in the setting of a difficult airway is advantageous. Possible advantages include the fact that the patient is able to cooperate with the operator, is able to breathe spontaneously throughout the procedure, and is able to maintain airway patency though conscious control of the airway muscles ***(Shawn et al., 2002)***.

There are several techniques used to provide airway anesthesia for fiber-optic intubation. These techniques include methods of topically anesthetizing the airway by the use of sprays and direct application of local anesthetics to the respiratory mucosa, as well as descriptions of a variety of nerve blocks ***(Sudheer et al., 2003).***

It is important to provide excellent anesthesia of the airway before attempting laryngoscopy or intubation. For topical anesthesia, the right drug must be selected in the right concentration, and sufficient time must be allowed for it to work ***(Bergese et al., 2010).***

Topical anesthetics are available, a viscous solution, a gel, an ointment, or in a spray can. Topicalization is the easiest method for anesthetizing the airway; spray local anesthetic directly onto the airway mucosa. Nebulization of lidocaine 2% to 4% by oral nebulizer for 15 to 30 minutes also can be effective ***(John, 2014)***.

Nerve blocks are often used to provide anesthesia for awake fiberoptic intubation. While these blocks are often more technically difficult to perform and generally carry a higher risk of complications (including bleeding, nerve damage, and intravascular injection) than the above mentioned noninvasive methods, in experienced hands they are useful and provide excellent anesthesia and intubating conditions. Therefore, 3 blocks are used to provide anesthesia to the upper airway: glossopharyngeal (oropharnyx), superior laryngeal (larynx above the cords), and translaryngeal (larynx and trachea below the cords) ***(Shawn et al., 2002)***.

AIM OF THE WORK

The aim of this work is to review the different techniques of regional anesthesia of the airway for awake fiber-optic intubation and to throw the light on its advantages, disadvantages and complications.

CHAPTER (I): NEUROANATOMY OF THE AIRWAY

Introduction

All the airways, from nares to alveoli, are supplied with sensory and motor parasympathetic and sympathetic nerves, with the possible exception of the alveoli which have not been shown to have a motor innervation.

The sensory nerves relate signals mainly from the mucosa, which cause sensation and set up various reflexes. Some sensory nerves may have a role in neurogenic inflammation, which is important in allergic reactions. The motor nerves act mainly on blood vessels and mucus-secreting glands and in the lower airways, also on tracheobronchial smooth muscle ***(Widdicombe, 2009).***

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 [VII]). Sensory fibers for the posterior third come from the glossopharyngeal nerve (IX) (Fig. 1) ***(Brendan et al., 2011).***

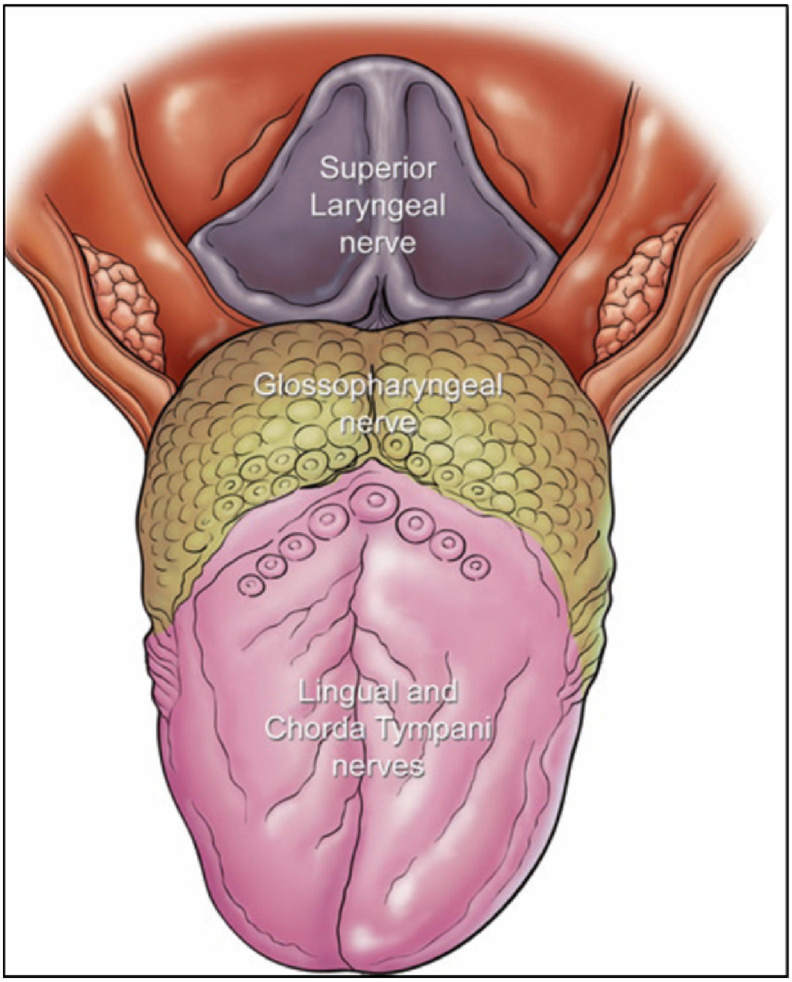

Fig. (1): Sensory innervation of the tongue

(Brendan et al., 2011)

The major motor nerve supply of the tongue is from the hypoglossal nerve (XII) (fig. 2) 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 ***(Brendan et al., 2011).***

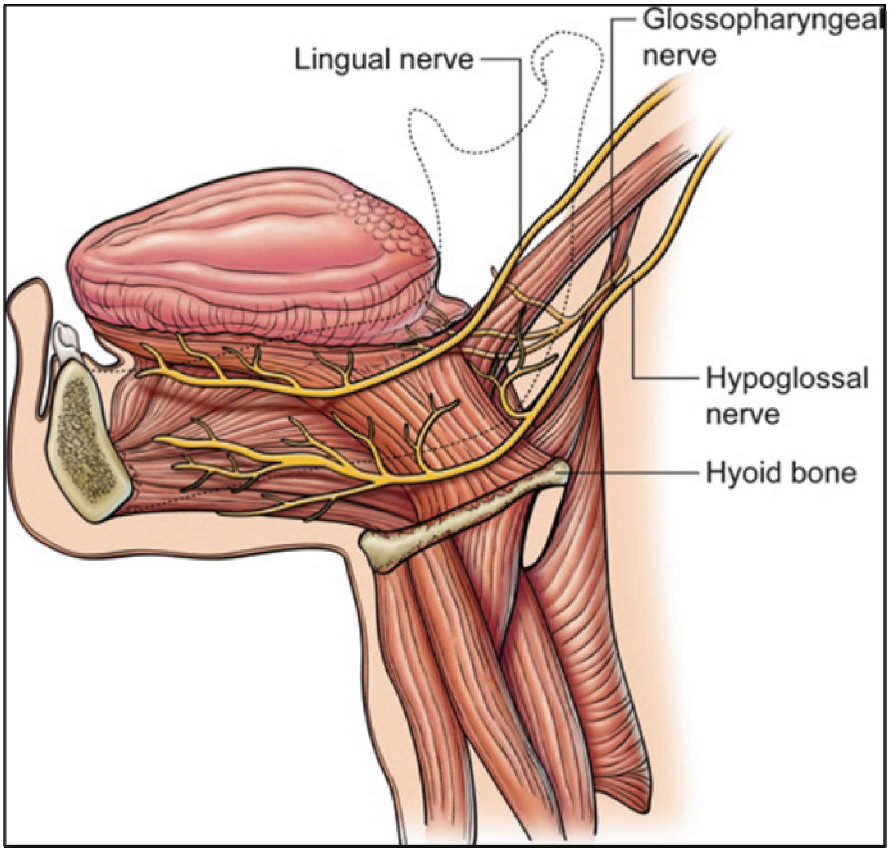

Fig. (2): Motor innervation of the tongue
(Brendan et al., 2011)

The Nose

Sensory Innervation

The sensory nerves of the nose are supplied via the ophthalmic and maxillary divisions of the trigeminal nerves. The nasociliary branch of the ophthalmic division gives rise to the anterior and posterior ethmoidal nerves that supply the upper and anterior areas of the lateral walls and septum of the nose. The maxillary division supplies the posterior and inferior areas ***(Widdicombe, 2009).***

Sensations mediated by the nerves include touch, pain, cold, itch and even pain can be caused by irritants such as ammonia, sulphur dioxide, histamine .***(Baraniuk and Kim, 2007).***

Apnoea, bradycardia, laryngeal closure and bronchoconstriction or dilation normally elicited from the skin outside the nose ***(Sheahan et al., 2005).***

Intranasal reflex responses include rhinorrhea and nasal vasodilation with sinus congestion and airflow limitation. A stimulus located to one side of the nose produces a response on the opposite side, a crossover effect ***(Baraniuk and Kim, 2007).***

Arterial vessels carry blood to arteriovenous anastomoses (AVAs), which regulate blood flow into venous sinusoids, and a superficial plexus of periglandular and subepithelial fenestrated capillaries. Sensory, parasympathetic and sympathetic neurons innervate the vessels and glands, while sensory neurons also innervate the epithelium. Sensory nerves release acetylcholine .Motor nerves release noradrenaline and neuropeptide Y (NPY) ***(Widdicombe, 2009).***

Motor Innervation:

1. Parasympathetic

The origin of the parasympathetic supply to the nasal mucosa (including the nasopharynx and the nasal sinuses) is in the facial nuclei of the brainstem and the superior salivatory nuclei. The emerging fibres run in the superficial petrosal and the vidian nerves and synapse in the sphenopalatine ganglia ***(Baroody, 1999).***

Postganglionic fibres reach the nasal mucosa via the posterior nasal nerves, and innervate arteries, arteriovenous anastomoses (AVAs), veins and mucous glands ***(Widdicombe, 2009).***

The parasympathetic innervation, when activated, releases glandular secretions arise both from submucosal glands and from the lateral and anterior nasal glands. The response can be mimicked by Ach (Acetyl choline) and blocked by atropine ***(Widdicombe, 2009).***

2. Sympathetic

The sympathetic innervation of the nose has preganglionic fibres arising from the thoracolumbar region of the spinal cord, passing into the vagosympathetic trunks in the neck, and relaying in the superior cervical ganglia ***(Baroody, 1999).***

Postganglionic fibres run in the deep petrosal nerves, which join the greater petrosal nerves to form the vidian nerves. Thus, the vidian nerves contain both sympathetic and parasympathetic motor fibres. Some sympathetic fibres also reach the nose via the carotid plexuses through branches of the trigeminal nerves ***(Widdicombe, 2009).***

The sympathetic motor fibres supply primarily the nasal vasculature. The predominant action of the nerves is to cause vasoconstriction, including emptying of the venous sinuses, which increases the patency of the nasal airway by decongestion ***(Widdicombe, 2009).***

The Pharynx

Several sensory modalities are conveyed by the glossopharyngeal nerve. It provides the posterior third of the tongue, the fauces and tonsillae, epiglottis and all parts of the pharynx with visceral sensory fibers, and the posterior third of the tongue and soft palate with special visceral sensation (taste). It also carries secretomotor fibers to mucous glands in the areas supplied. Importantly, a visceral branch innervates the carotid sinus. Sympathetic fibers are derived from the carotid plexus and the cervical sympathetic trunk. Efferent motor fibers innervate the stylopharyngeus muscle and join the pharyngeal plexus ***(Shawn et al., 2002).***

The glossopharyngeal nerve emerges at the jugular foramen and curves forward between the jugular vein and internal carotid artery. It then descends in front of the later vessel and beneath the styloid process and its attached muscles to the inferior border of the stylopharyngeal muscle, which it follows a variable distance before curving medially and entering the pharyngeal muscles at the level of the middle constrictor. The motor innervation of the pharynx receives extensive efferent input from the vagus nerve, which sends multiple branches to the pharyngeal plexus through its pharyngeal branch. It arises from the inferior ganglion located below the jugular foramen carrying fibers from the accessory nerve ***(Shawn et al., 2002).***

The Larynx

The origin and contributions from the accessory nerve are similar in the case of the superior laryngeal nerve (fig. 3). The superior laryngeal nerve slants forward to the cornu major of the hyoid bone before dividing into an internal and external branch. The former enters through a foramen in the thyrohyoid membrane and provides visceral sensory and secretomotor innervation to the larynx above the true cords, whereas the later descends along the outside of the thyrohyoid membrane beneath the sternothyroid muscle to the cricothyroid muscle, which it supplies with motor fibers ***(Shawn et al., 2002).***

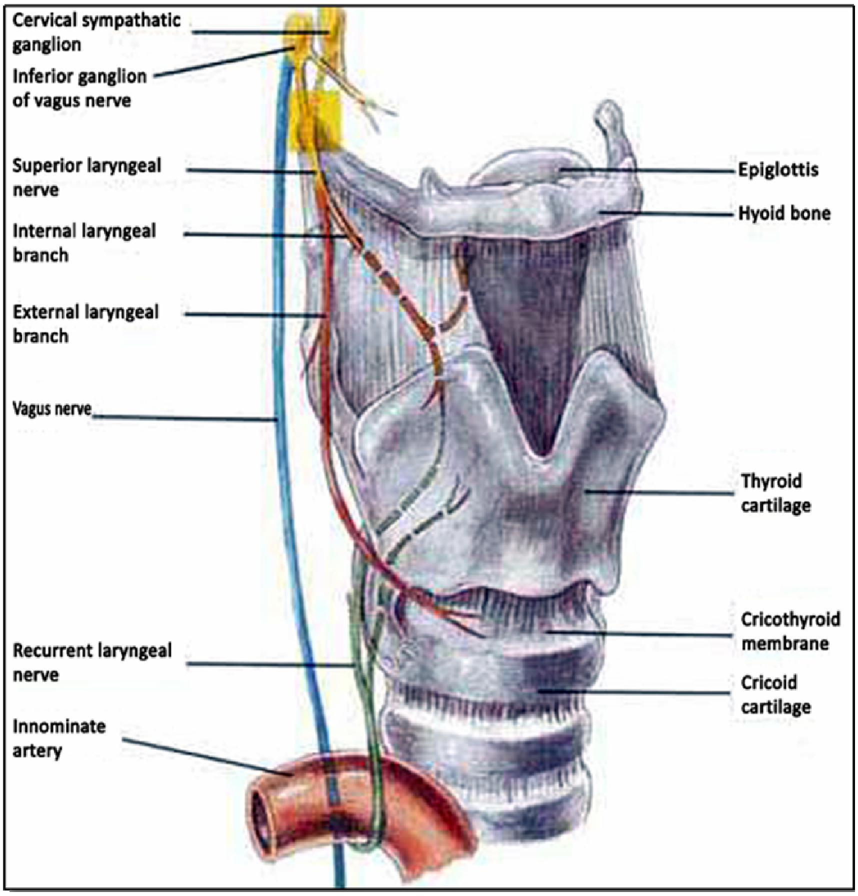

Fig. (3): The vagus nerve and its branches in the larynx
(Atlas of Regional Anethesia, 1999)

In the neck the vagus nerve descends in the carotid sheath to the thoracic inlet, at first lying behind and between the internal jugular vein and internal carotid artery, and then between the former and the common carotid artery ***(Shawn et al., 2002).***

During its intrathoracic course, it gives off the recurrent laryngeal nerve, which curves around the aortic arch lateral to the ligamentum arteriosum on the left and around the subclavian artery on the right. The recurrent laryngeal nerve then ascends in a groove formed by the trachea and esophagus to the larynx, while providing both structures with fibers for visceral sensation, motor and secretomotor innervation, and sympathetic branches, which join the nerve after originating from the cervical sympathetic chain ***(Shawn et al., 2002).***

Passing under the lower border of the inferior constrictor of the pharynx, it enters the larynx. It supplies all muscles of the larynx except the cricothyroid and conveys visceral sensation to the cords and infraglottic regions. It is the motor nerve of all intrinsic muscles of the larynx, except the cricothyroid muscle, which is supplied by the external branch of the superior laryngeal nerve. The vagus nerve then continues on its course through the thorax and supplies sensory input to the tracheal mucosa ***(Shawn et al., 2002).***

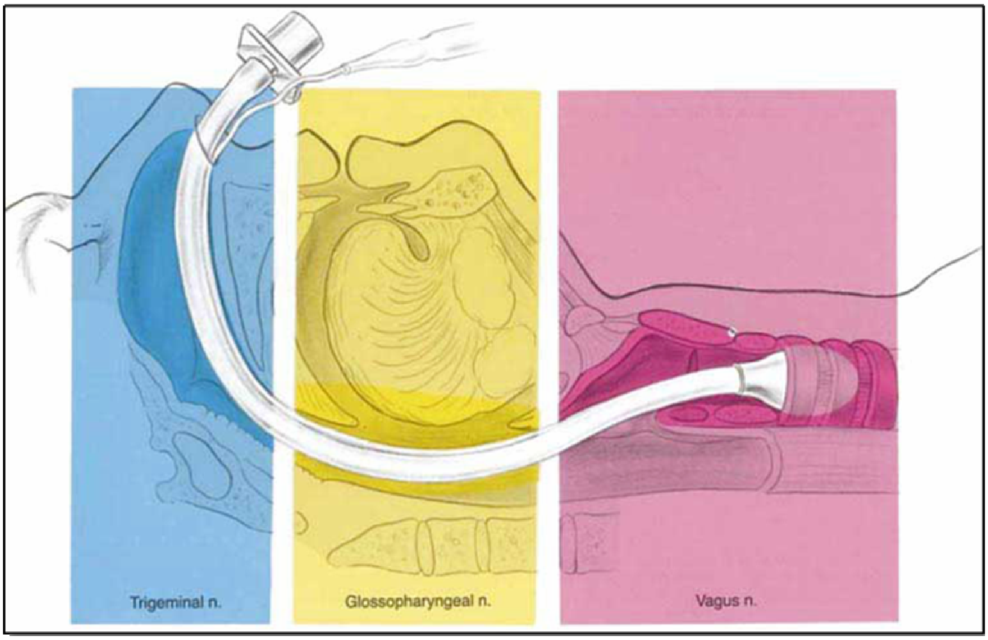

Fig. (4): The innervation of the upper airway
(Atlas of Regional Anesthesia, 1999)

The Tracheobronchial Tree and Lungs

Unlike the nose, on the motor side, its vasculature differs in that there are no muscular-walled venous sinuses, and both the bronchial and the pulmonary vasculatures have different aspects of control ***(Widdicombe, 2009).***

The sinus walls lack smooth muscle although nervously mediated congestion can be shown. There is no reason to believe that their congestion has an appreciable effect on airflow resistance. The main difference between the innervations of the nose and the TB tree is that the latter contains abundant airway contractile smooth muscle, with distinctive reflex and motor controls ***(Widdicombe, 2009).***

A. Sensory Innervation

The Tracheobronchial tree and lungs contain many different neural sensors; they can be broadly divided into two groups: those with myelinated (A) nerve fibres and those with nonmyelinated (C) fibres. The former comprise slowly adapting pulmonary stretch receptors (SARs), rapidly adapting receptors (RARs), Aδ-nociceptors and 'cough receptors'. The C-fibre receptors can be subdivided into pulmonary and bronchial, according to their site, and recently a subdivision has been made based on membrane properties ***(Schelegle, 2003).***

They are all stimulated by lung inflations, but some also respond to deflation; their discharge is regular. They were subdivided into types I and II. The former are found mainly in the trachea and larger bronchi and their frequency of discharge plateaus at about 10 cm H_2O inflation pressure; the latter are mainly intrapulmonary, have higher volume thresholds, only reach maximum discharge frequency at high inflation pressures and often also respond to deflation of the lungs ***(Schelegle, 2003; Yu, 2005).***

The main reflex from the slowly adapting pulmonary stretch receptors (SARs) is the Hering–Breuer inflation reflex, the inhibition of inspiration and the initiation of expiration produced by lung inflation and conducted by the vagus nerves ***(Schelegle and Green, 2001).***