Perioperative Management of Patients with Respiratory Problems

An essay submitted for partial fulfillment of master degree in Anesthesiology

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Respiratory problems are one of the most frequently problems in anesthetic practice, contribute significantly to morbidity and mortality in surgical patients.

These problems include obstructive pulmonary diseases as (bronchial asthma and COPD), restrictive pulmonary diseases (acute and chronic), primary pulmonary hypertension, pulmonary pneumonia as (active TB), and pulmonary cancer, also end stage lung transplantation.

A review of normal anatomy and physiology of respiratory system, pathophysiology of obstructive and restrictive pulmonary diseases were discussed with some details in this essay.

Preoperative assessment of the patient's condition was discussed to help in reducing the expected complications and their management that could be achieved by careful history, examination and investigations including pulmonary function tests in details.

Preoperative preparation was important goal, intending to improve the respiratory condition as possible through eradication of infection, cessation of smoking, treatment of bronchospasm and chest physiotherapy.

through the arousal stage could initiate severe bronchospasm and laryngospasm.

Postoperative management was also discussed according each situation regarding recovery duration and satisfactory ventilation. The use of elective postoperative artificial ventilation would be required in some cases.

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Introduction

Introduction and the aim of work

Respiratory problems contribute significantly to morbidity and mortality in surgical patients. Pulmonary complications occur more frequently than cardiac complications. The complication rates for upper abdominal and thoracic surgery are the highest. A better understanding of the risk factors associated with postoperative pulmonary complications is essential to develop strategies for reducing these complications. ***(Khan and Hussain, 2005)***

A good preoperative assessment can be achieved by careful history, examination and investigations including pulmonary function tests in details. Proper preoperative preparation is important goal, intending to improve the respiratory condition as possible through: eradication of infection, cessation of cigarette smoking, treatment of bronchospasm and chest physiotherapy. ***(Delisser and grippi, 2008)***

Postoperative pulmonary complications (PPCs) include hypoxemia, hypoventilation, atelactasis, pneumonia and respiratory failure. All of which can be minimized by good preoperative preparation and with the ability of weighing the benefits derived from the operation against the possibility of subsequent morbidity and mortality, by establishment of a specific anesthetic plan and by careful attendance to the patients in the early postoperative period. ***(Jabber et al, 2005)***

The aim of the work:

This essay aims to highlight the role of the anesthetist in perioperative management of patients with respiratory problems to reduce postoperative morbidity and mortality.

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Anatomy and Physiology of the Respiratory System

A) Anatomy of the respiratory system:

The respiratory system may be divided into the upper respiratory tract and the lower respiratory tract:

- The upper respiratory tract consists of the parts outside the chest cavity: the air passages of the nose, nasal cavities, pharynx, larynx, and upper trachea.

- The lower respiratory tract consists of the parts found within the chest cavity: the lower trachea and the lungs themselves, which include the bronchial tubes and alveoli. ***(Scanlon and Sanders, 2007)***

Anatomy of the Upper Airways: fig. (1)

Upper airways consists of the nose that filters, warmth, and moistens air, the pharynx which is a chamber posterior to oral cavity; lies between nasal cavity and larynx that make connection to surrounding regions, glottis opening into larynx and make a passage of air into larynx, and the larynx which is a cartilaginous organ that houses the vocal cords. ***(Mader, 2004).***

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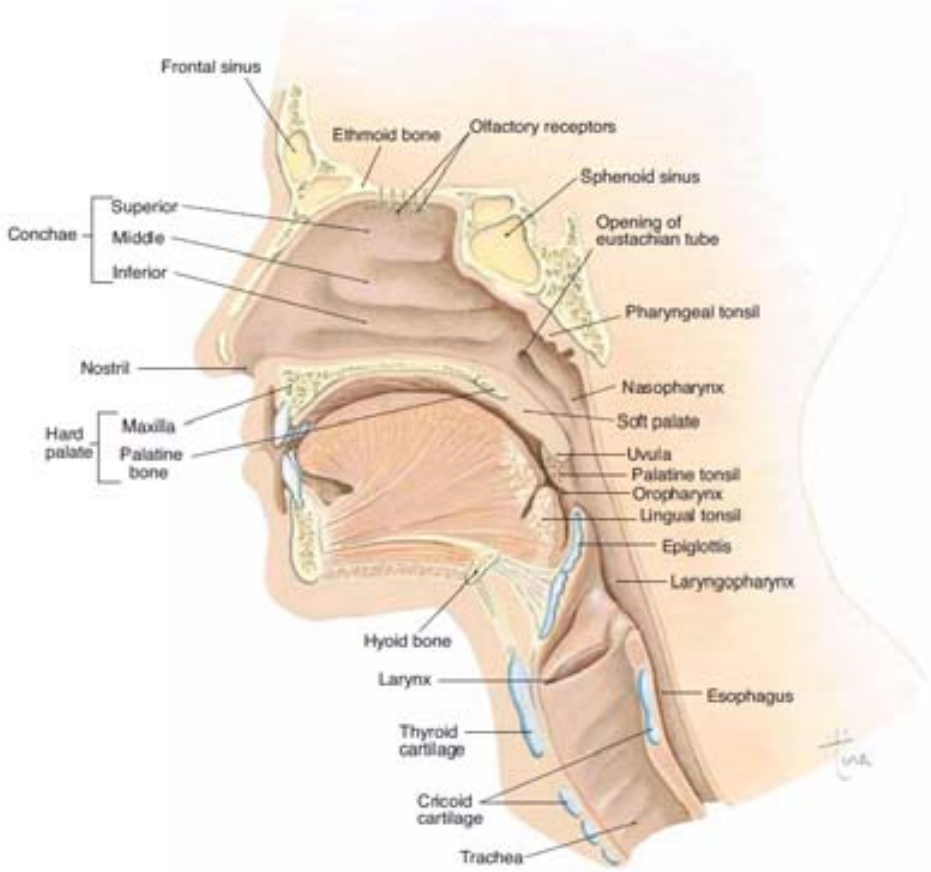

Fig. (1): *Midsagittal section of the head and neck showing the structures of the upper respiratory tract.* ***(Scanlon and Sanders, 2007)***

It has three main functions:

- Regulation of expiratory airflow (expiratory braking), this is important for coughing and control of end expiratory lung volume.

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- Protection of the lower airways, vocal cord closure prevents aspiration of foreign materials or objects ***(Scanlon and Sanders , 2007)***
- Vocalization.

The Conducting Airways (the tracheo-bronchial tree):

The tracheobronchial tree is the structure from the trachea, bronchi, and bronchioles that forms the airways that supply air to the lungs. Fig. (2) ***(Stock, 2006)***

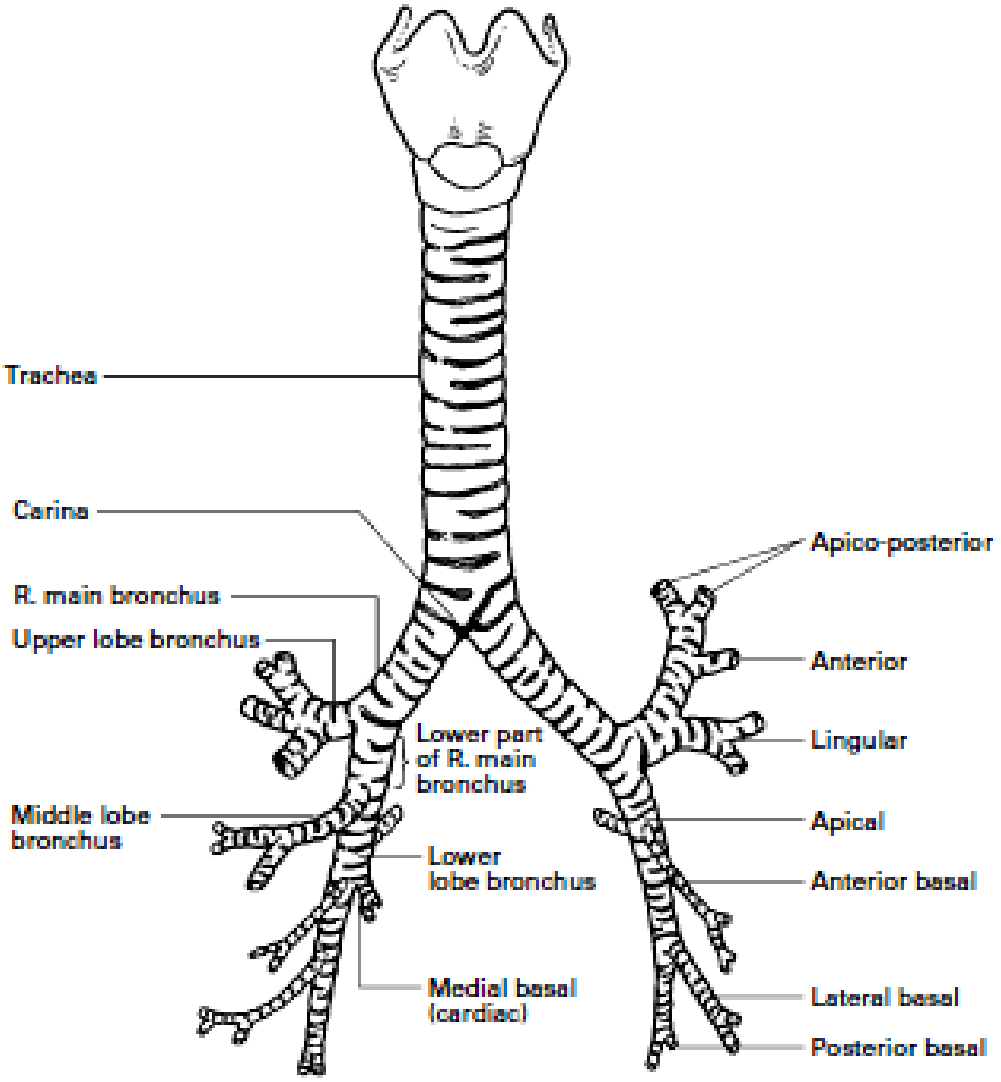

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Fig.(2): *The tracheo-bronchial tree.* ***(Ellis et al, 2004 A)***

Anatomy of the lower airways:

It consists of the lower trachea and the lung parenchyma, the lower trachea is composed of the right and left main-stem bronchi, the diameter of the right bronchus is generally greater than that of the left. In the adult the right bronchus leaves the trachea at ~25° from the vertical tracheal axis, whereas the angle of the left bronchus is ~45° (Fig. 2).Thus inadvertent endobronchial intubation or aspiration of foreign material is more likely to occur in the right lung than the left. ***(Stock, 2006)***

The right main bronchus is ~2.5 cm long before its initial branching into lobar bronchi. However, in 10% of adults, the right upper lobe bronchus departs from the right main-stem bronchus 2.5 cm from the carina. Furthermore in ~2-3% of adults, the right upper lobe bronchus opens into the trachea, above the carina (Fig. 2). So patients with these anomalies require special consideration when placing double-lumen tracheal tubes. ***(Stock, 2006)***

The left main bronchus is ~5 cm long prior before its initial branching point to the left upper lobe and lingual, and then continues on as the left lower lobe bronchus. (Fig. 2) ***(Stock, 2006)***

The lung parenchyma is subdivided into three airway categories based on functional lung anatomy, the *conductive* airways provide basic gas transport but no gas exchange, the next

group, which has smaller diameters, is the *transitional* airways, they are conduits for gas movement, and additionally perform limited gas diffusion and exchange, finally, the smallest *respiratory* airways primary function is gas exchange. Table (1) ***(Stock, 2006)***

Functional lower airway divisions:

Table (1): *Functional lower airway divisions.* ***(Stock, 2006)***

Type	Function	Structure
Conductive	Bulk gas movement	Trachea to terminal bronchioles
Transitional	Bulk gas movement & Limited gas exchange	Respiratory bronchioles & Alveolar ducts
Respiratory	Gas exchange	Alveoli & Alveolar sacs

1. Transitional Airways: (Fig. 3)

The respiratory bronchiole, which follows the terminal bronchiole is the first site in the tracheobronchial tree where gas exchange occurs. In adults, two or three generations of respiratory bronchioles lead to alveolar ducts, of which there are four to five generations, each with multiple openings into alveolar sacs. The final divisions of alveolar ducts terminate in alveolar sacs that open into alveolar clusters. ***(Stock, 2006)***

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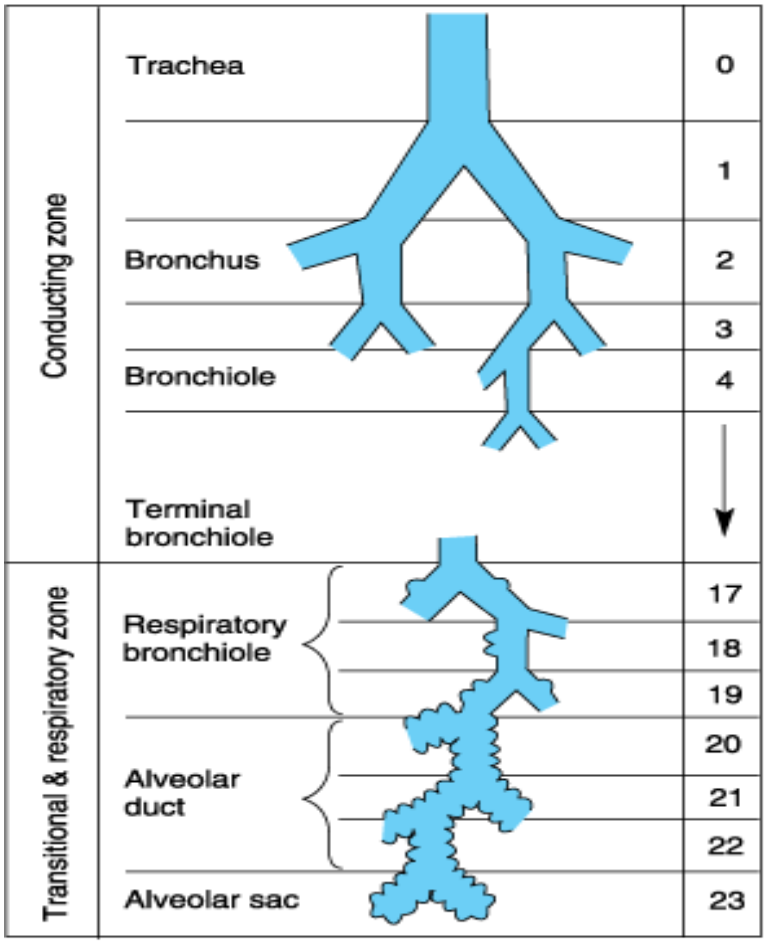

Fig. (3): *Diagrammatic representation of the human airway, generations from 1 up to 16 constitute the conducting zone. Generations from 17 up to 23 constitute the respiratory zone.* ***(Levitzky, 2007 A)***

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2. The respiratory areas of the lung:

- **Acinus:**

The acinus is a structural unit of the lung distal to a terminal bronchiole that contains alveolar ducts and alveoli. It is the largest unit in which all airways participate in gas exchange and is approximately 6 -10 mm in diameter. Between these structures the epithelium comprises ciliated cubical cells and Clara cells. ***(Chilvers et al., 2003)***

- **The Alveolar-Capillary Unit:**

The alveolar-capillary unit is formed of the alveolar surface and the capillary endothelium:

a- The Alveolar Surface: (Fig. 4)

The alveolar surface is mainly composed of a single thin layer of squamous epithelial cells. The type I alveolar cells, interspersed among these are the larger cuboidal type II alveolar cells, which produce the fluid layer that lines the alveoli. ***(Levitzky, 2007 A)***

Type I cells cover 90% to 95% of the alveolar surface, because the average type I cell has a much larger surface area than the average type II cell does. ***(Levitzky, 2007 A)***

A third cell type, the free-ranging phagocytic alveolar macrophage, is found in varying numbers in the extracellular lining of the alveolar surface. These cells patrol the alveolar surface and phagocytize inspired particles such as bacteria. (Fig. 4) ***(Levitzky, 2007 A)***