Weaning from Mechanical Ventilation

Thesis

Submitted for partial fulfillment of master degree in critical care medicine

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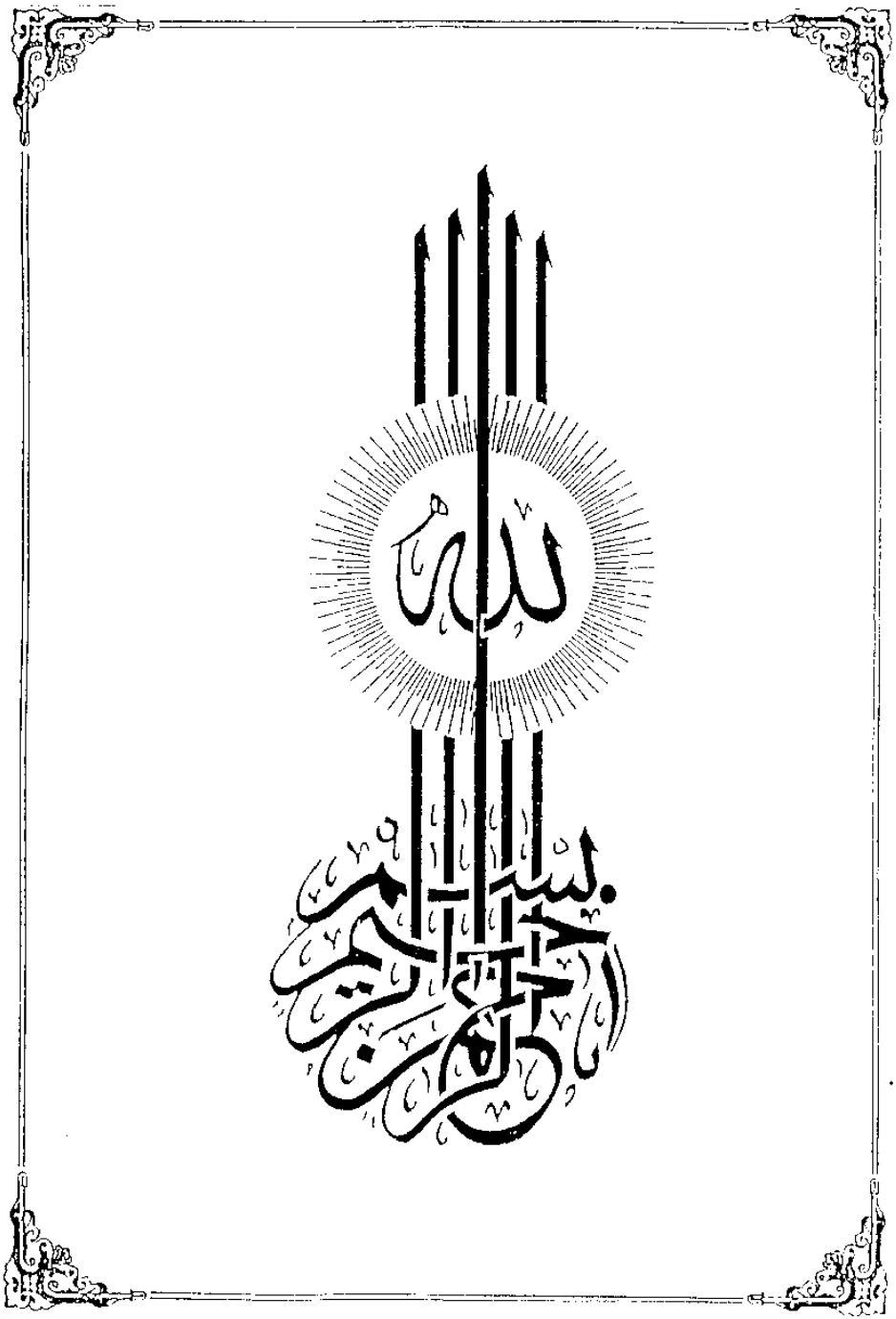

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Dedication

To prof. DR. : *M.H. Shaker*
who is very kind and helpful for me too much. He is actually the Sir of ICU.

To Prof, Dr: *Nahed. S. omar*
who is very helpful and supportive to me.

To prof. DR: *M. Abd-El Khalek Mohamed.*

Who is so kind, patience and The greatest thanks to him for what he did for me
He represents a great Value for me

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Introduction

I- Introduction to Ventilatory Support

Mechanical ventilatory support is one of the major supports modalities used in critical care. It is used as essential element in cardio-pulmonary resuscitation (C.P.R.). It can be used as life saving during acute and chronic illness, when respiratory drive is depressed or when patients lack neuromuscular ability to breath. Artificial mechanical ventilation was introduced as early as (1555) by Versalis, who forced gases into the trachea of an open - chested dog (***Huston et al., 1976***). One of the most unique attempts to mechanical ventilation was reported in (1961 by Johns Hunter). Who utilized double bellow system assembled, so that one bellow would pump ambient air into and other bellow aspirate "bad air" out of lung, by mid nineteenth century much attention was given to so called negative pressure ventilation.

In 1928 Drinker and Shaw introduced first IRON LUNG to enjoy wide spread use, similar iron lung was built by J. E. Emerson in 1931. Emerson tank ventilators incorporated many improvements over existing models.

Iron lungs showed extensive service during Los Angeles polio-myelities epidemics in 1948 to 1949 (***Bower et al., 1950***) and continued to be used even to day.

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Modern positive pressure mechanical ventilators was introduced by Engstrom during polio epidemics in Denmark in 1952, Sweden 1953 and contributed significantly to a reduction in the mortality. It was adapted subsequently to provide ventilation during anesthesia and for postoperative ventilatory support (***B. Jock et al., 1956***).

Numerous mechanical ventilators have been developed and became more specialized and complicated. In recent years, the most recent advance of ventilators is introduction of microprocessor technology into modern ventilators.

Microprocessor ventilators are equipped typically with sensors that monitor breath by breath flow, pressure, volume and derived mechanical respiratory parameters. Their ability to sense and transduce accurately combined with computer technology makes the interaction between patient and ventilators are more sophisticated than even before (**Sluisky A.S. et al., 1993**) and (***Tobin et al., 1994***).

Review

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Functional anatomy of respiratory system

Respiratory tract passages

This is divided into two parts an air conducting part and respiratory part.

I- Air conducting part:

This includes nose, pharynx, trachea and two main bronchi, small bronchi, till terminal bronchioles. The branching of the bronchus is similar to that of the tree, so, it is sometimes called bronchial tree. No gas exchange occur in this part i.e. dead space, it's function is to conduct air to and from respiratory part (***Spearman, 1982***).

II-The respiratory part:

This part forms the main bulk of the lung and is concerned with gas exchange between air and blood brought to the lung in pulmonary artery (***Marini, 1990***). It consists of respiratory bronchioles, alveolar duct and alveolar sacs, each alveolar sac contains about 17 alveoli (***Kelly 1990***). Between the trachea and alveolar sacs, the airway divides 23 times. The first 16 generations form the conducting zone and are made up of bronchial branches till terminal bronchioles. The

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remaining 7 generations form the transitional and respiratory zone and are made up of respiratory bronchioles, alveolar sac and alveoli.

These multiple bronchial divisions greatly increase the total cross sectional area of the airway. The circumference of 16^{th} generations of air passages is about 2000 times circumference of the trachea. This results in reduction of velocity of airflow in small air ways to a very low value (***Kelly, 1990***).

The lung is formed of lobes, each lobe is formed of multiple lobules. Each lung lobule receives one terminal bronchiole and is formed of small acini. The terminal bronchiole branches into many respiratory bronchioles one for each acinus. The latter constitutes the functional unit of the lung which is formed of one respiratory bronchioles, its alveolar duct, air sac and alveoli (***Pitty, 1993***).

There are about 200-600 million alveoli in both lungs which have a total surface area of about 70 square meter, the alveoli are surrounded by pulmonary capillaries and thickness of membrane that separates the alveolar air from the blood in this capillaries (gas-blood barrier) is about 0.2-0.6 micron which allows easy diffusion of respiratory gases (***Pierce, 1995***).

The characteristic component of alveolar and capillary membranes are critical to maintain an effective surface for gas delivery and exchange.

Because the alveolar epithelial cells have tight junctions and are quiet impermeable to particles, the alveolus is kept dry. Gas exchange occurs remarkably efficiently at the alveolo-capillary membrane (***Sexton, 1990***).

Blood passes through the capillaries in approximately ½ second at rest. However, it is estimated that gas exchange is completed when the blood has traversed only one fourth of capillary distance. This efficiency provides for gas exchange a reserve during disease process or during exercise. In ARDS as a result of direct or indirect injuries to endothelium or epithelial cells, there will be an increased gap formation between the endothelial cell layer, retraction of cells along, disruption and even loss of endothelial cell layer. If the gap becomes > 60 angstrom wide, particles of sufficient size can leak resulting in an oncotic drowning of fluid into interstitum and finally pulmonary edema (***Marini, 1993***).

The alveoli:

Adjacent alveoli are connected by pores and they are lined by two main types of epithelial cells, type I cells are flat and primarily lining cells while, Type II cells granular pneumocytes are thicker and contain numerous inclusion bodies and they secret a lipoprotien substance called surfactant which reduces surface tension within alveoli, prevents collapse of the lung

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