MECHANICAL VENTILATION IN PEDIATRICS

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of
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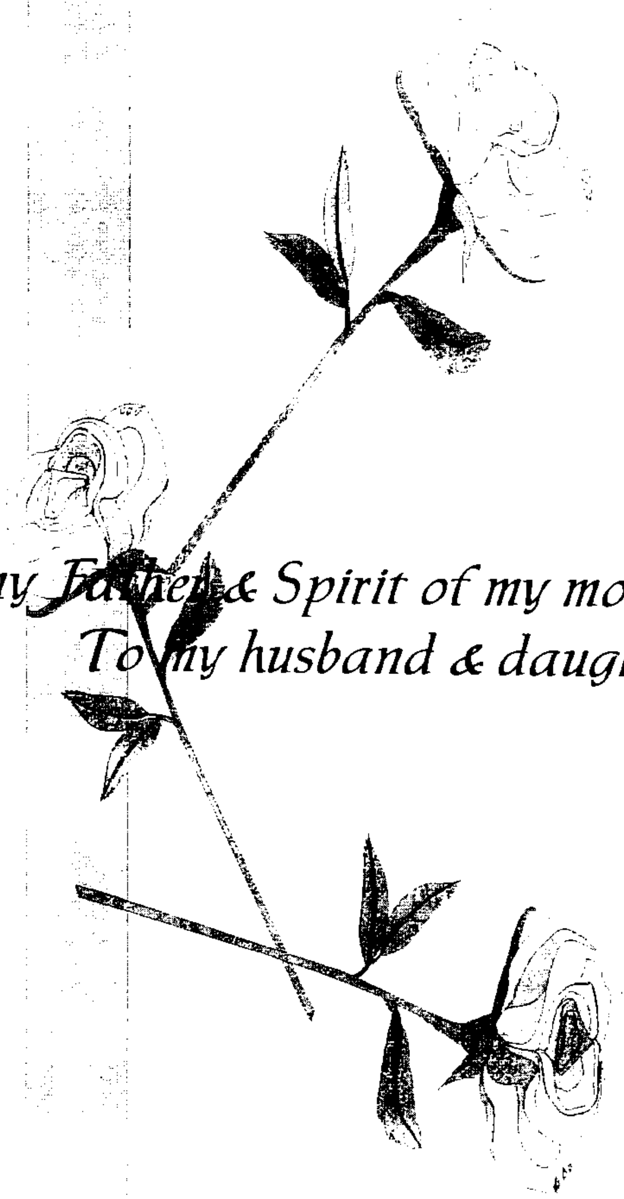

To my Father & Spirit of my mother
To my husband & daughters

Acknowledgment

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Introduction:

Intensive care unit (ICU) utilization requires a list of unique ICU therapies and a method of assessing severity of illness. Unique therapies are those that are best delivered in the ICU such as mechanical ventilation (M.V.) ***(Pollack, 1995).***

Improvements in pediatric intensive care have produced a growing population of children dependent on mechanical ventilation for survival. Long term mechanical ventilation has become a realistic alternative to death from progressive respiratory failure for many children with chronic respiratory illness ***(Pilmer, 1994).***

Mechanical ventilation is a process by which a positive force is generated in the airway to inflate the lungs with humidified, oxygenated air. Mechanical ventilation is necessary for patients who are unable to provide enough force for their own respirations such as, patients with compromised lungs or chest wall or apneic or nearly apneic patients. Such abnormalities may result in acute respiratory failure in which the patient is unable to maintain adequate ventilation and oxygenation and which results in hypoxemia or hypoxemia with hypercapnea. Mechanical ventilation is necessary when conservative means can not rectify the clinical picture of acute respiratory failure ***(Johanson et al., 1988).***

The physical characteristics of mechanical ventilators are important to the clinician because they establish the framework within which most mechanical ventilatory support is provided. Physiological parameters, e.g., minute ventilation, alveolar gas exchange, distribution of pulmonary blood flow, venous return and cardiac output, oxygen consumption and work of breathing can all be affected by the physical characteristics and available modes of the ventilator. Most ventilators in common use today have similar operational characteristics ***(Spearman and Sanders, 1990).***

The desire to improve the patient's tolerance of M.V. led to the development of assisted or patient-triggered ventilation. Ventilatory support should be tailored to each patient's pathophysiology rather than employing a single technique for all patients with ventilatory failure ***(Brathwaite and Borg, 1990).***

Thus ventilatory support ranges from controlled mechanical ventilation (no opportunity for the patient to breath spontaneously) to total spontaneous ventilation with continuous positive airway pressure (CPAP) for support of oxygenation and the elastic work of breathing. Partial ventilatory support bridges the gap for patients who are able to provide some ventilation but who can not entirely support their own alveolar ventilation. The decision-making process regarding the quality and quantity of ventilatory support is further complicated by our increasing knowledge of the effect of M.V. on other organ systems ***(Dupuis, 1992).***

Ventilators have traditionally been classified according to the cycling method. However, modern ventilators have microprocessors which allow them to function in many different modes with enomerous versatility, it is classified as: volume cycled, pressure flow, and time cycled ***(Marik, 1996).***

Valuable work has been done to evaluate systematically the optimal method of weaning the infant from ventilatory support. As the need for ventilatory support decreases, the infant begins to breath spontaneously and vice versa ***(Hakanson, 1988).***

Aim of the essay:

The aim of this research is to summarize the up-to date knowledge about ventilators, their types, indications, modes of application and benefits of mechanical ventilation in pediatrics. The method and time of weaning from ventilatory support will be also discussed.

Applied Respiratory Physiology

Air gets in, air gets out, oxygen is taken up, carbon dioxide is eliminated; this is the essence of breathing, spontaneous or otherwise.

Tidal breathing is the basic mechanism of spontaneous breathing and conventional ventilators.

During spontaneous inspiration, a pressure gradient is created between the proximal air-way and the pleural space (transpulmonary pressure $P_{(tp)}$) as a result of diaphragmatic and inspiratory intercostal muscle contraction. This transpulmonary pressure results in inspiratory gas flow into the lungs ***(Allen, et al., 1987).***

There are other muscles that are used for inspiration but usually only when increased breathing is needed. These are the external intercostal muscles that lift the ribs to expand the chest and other accessory muscles during more strenuous breathing that lift the sternum and elevate the first two ribs. Flaring of the nose is also seen in strenuous breathing ***(Slonim and Hamilton, 1987).***

Expiration is generally passive, so that with relaxation after inspiration the air leaves the chest because of return of the lungs and chest to the resting position. In the active phase of expiration the internal intercostal muscles are used to decrease the chest diameter, and in addition, the abdominal muscles contract, pushing the diaphragm upwards ***(Eitzman, 1993).***

Lung Volumes and Capacities: Spirometry

Air within the lungs can be measured with an instrument called "Spirometer". Total air is divided into subdivisions called volumes. Measurement of lung volumes is useful because many pathophysiologic states alter the lung volumes (Table 1-1).

Tidal Volume (V_T):

The volume of gas moved into and out of the lung in a single normal inspiration or expiration. It averages 500 ml, or 5 to 8 ml/kg. It represents the volume reaching the alveoli, about 350 ml, plus the volume in the conducting airways, known as the anatomic dead space, which is about 150 ml, or 2 ml/kg ***(Demling and Knox, 1993)***.

Inspiratory Reserve Volume (IRV):

The volume of air that can be inspired at the end of a normal tidal inspiration. It is appropriately titled "reserve volume". The IRV is called on when increased tidal breathing is necessary, as in exercise.

Expiratory Reserve Volume (ERV):

The maximal volume of gas that can be exhaled after a normal exhalation.

Residual Volume:

The volume of gas remaining in the lungs after a maximal expiration. This volume cannot be measured with spirometry. It is obtained indirectly by using the helium dilution test, nitrogen washout method, or body