

Mechanical Ventilation Of The Morbidly Obese Adult Patients

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Introduction And Background

The Mechanical ventilation method for patients who are unable to breathe on their own has been in practice since 1929. This mechanical respirator, or “iron lung,” was a metallic cylinder in which the patient was inserted and connected to a vacuum pump that pushed air or oxygen into the patient’s lungs (Slutsky, 2015). The loss of pressure in the lungs changed the geometry of the lungs, allowing air to flow through them. This type of iron constantly monitors the air pressure in the patient’s lungs, and it allows the patient to exhale air when the pressure reaches its maximum.



(Fig.1, Paul Alexander, the last patient to receive iron lung)

The mechanical ventilation technique was initially used for polio patients, and both positive and negative pressure-building techniques were used to pump air into the lungs. These ventilators were also used in 1945 in World War II to facilitate breathing in jet fighter pilots flying at higher altitudes. The use of this technique in polio-stricken patients was reduced when the vaccination of poliovirus became common, and nowadays, it is used to facilitate patients in the ICU.

Discussion

Obesity is the prevailing cause of many problems. There are surgeries and intervention programs that have tried to reduce the obesity rate, but their results were not so fruitful. Obesity also brings certain other problems with it that cause many long and short-term consequences in patients. The significant issues originating from prolonged obesity are diabetes, high blood pressure, and loss of stamina. However, a severely big concern also exists in case obese patients are admitted to Intensive Care Units, and there is a need for a mechanical respirator to facilitate breathing.



(Fig.2 Outcomes of Morbidly Obese Patients Receiving Invasive Mechanical Ventilation)

The percentage of morbid patients admitted to the hospital between the years 2004 and 2008, as shown in this graph, depicts that the rate has increased substantially for obese patients in these four years (Fig.2). The percentage of morbid patients has not increased substantially, but the stats show

an increased rate of patients who need ventilation (Cheney., 2014). This fact has created a concern to modify the ventilation process for obese patients as they have been observed having trouble with the normal methods.

Mechanical Ventilation For Obese Patients

The complete or partial collapse of the lung, accompanied by increased weight on the thoracic wall, as well as increased weight in case of patient movement, creates additional problems in breathing. These conditions worsen after the patient is induced with anesthesia as the patient loses consciousness and the risk of any abnormality increases. The increased prevalence of heart diseases and blood pressure among obese patients leads to comorbidity, which makes it more difficult to manage their treatment in the ICU. Having a 30 to 70% percent chance of sleep apnea among obese patients creates more respiratory complications that are a must to be taken care of (Jong, Chanques, and Jaber, 2017).



(Fig. 3 Invasive Mechanical Ventilation)

The mechanical ventilation process uses an artificial pump that assists breathing in patients who cannot breathe on their own. The process is carried out by a respiratory physician or nurse who uses the invasive or non-invasive technique of mechanical breathing. The non-invasive technique uses a respirator that is fixed on the patient's mouth, while the invasive technique uses a tube, accompanied by an inflatable balloon, to insert into the patient's trachea. The tube is attached to a pump that pumps oxygen directly into the lungs at regular intervals. The purpose of an additional balloon in the technique is to position the tube inside the trachea safely. The ventilation can be both positive, i.e., pushing the air into the lungs, or negative, i.e., sucking air into the lungs. The technology has now developed to be effective for use in morbidly obese patients.

Indications And Contraindications Of Mechanical Ventilation

Indications

- To release any obstruction in the air passage.
- To decrease the patient's stress in breathing (whether it is due to any obstruction or increased oxygen demand in the body).
- To increase the volume of air in the lungs, opposing the elastic recoil of the lungs and chest.
- To regulate the breathing process and enable a continuous supply of oxygen in the body.

Contraindications

- Respiratory arrest.
- Internal bleeding in the trachea or lungs.
- Cardiac instability, instability to shock or heart attack
- Increased obstruction of the airway, increased coughing, or mental sensorium.
- Head or neck tumors obstructing the airway cause allergic reactions or swelling of the trachea and lower neck (Bancalari et al., 2015)

Strategies Currently In Place

Various studies aim to facilitate breathing in obese patients. These methods of mechanical ventilation keep the breathing process regulated. With the increased level of inflammation in obese patients, leptin levels increase, which increases airway obstruction (Jong, Chances, and Jaber., 2017). The increased level of adiponectin also triggers a macrophage response, which increases airway obstruction. Due to all these reasons, mechanical respiration in obese patients is both necessary and sensitive.



(Fig.4 Mechanical ventilation in obese patients)

The first research uses recruitment maneuvers to facilitate breathing. By modifying adequate lung pressure, end-expiratory pressure, tidal volume, and a fraction of inspired oxygen, the combined effect of all these modifications is used to facilitate breathing. The ratios and constants are carefully calculated by considering body weight, inspiratory capacity, and maximum lung capacity (Fig.4). The use of recruitment maneuvers with end-expiratory pressure works better than the use of only end-expiratory pressure and careful regulation of tidal pressures by considering body weight would demonstrate benefits of this system (Jones, Gittens, and Manuel., 2018).

It was also observed that with an increasing rate of obesity, high tidal volume is required. A study that used the increased tidal pressure technique in class III obesity patients found it more beneficial to keep the pressure within the limit of the maximum endurable pressure of the lungs (Kalra et al., 2017). The process used low trans-pulmonary pressure, which was observed to give additional protection to morbidly obese patients.

The invasive mechanical ventilation techniques are the volume-controlled methods of oxygen injection in the lungs. A very large oxygen volume can cause internal injury to the lungs, and a very low oxygen volume may not complete the body's oxygen intake. One study uses the method of lower volume and increased rate of oxygen intake in obese patients to be an effective mechanical respiration strategy. The low oxygen volume with improved oxygenation rate and respiratory compliance was found helpful in facilitating obese patients in ICU (Maia et al., 2017).

Outcomes

With the improvement in methods of ventilation for obese patients, the rate of mortality in patients due to insufficient respiration is expected to decrease in the coming years. The improved method of facilitated respiration, low volume, and high supply of oxygen are also expected to decrease this rate substantially if their adaptation in a hospital environment is increased. There is a need for more advanced methods of ventilation in the invasive type of mechanical respiration as it involves more risks, and it is sometimes inevitable when patients reach a limit, their lungs are completely incapable of inhaling lungs. The process is slow and critical as it involves certain variables that are to be evaluated by careful calculations. Therefore, more advanced tools are needed to measure metrics like lung pressure, the rate of oxygen intake, expiratory capacity, and maximum lung capacity of the patients. However, once this method is made common and available in healthcare organizations worldwide, the rate of mortality in obese morbid patients will surely reduce.

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