Adaptive Support Control Volume (ASV) and Early weaning of Ventilator in Intensive Care Unit

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ABSTRACT

Aim: To demonstrate the role of choosing the mode of ventilator in the patient's outcome and therefore early weaning from ventilators.

Method: After obtaining the acceptance of our ethical committee this study was done.
One hundred and twenty six patients were randomly taken in this study, in two groups; sixty four patients in group (A) using the synchronized intermittent mandatory volume (SIMV), and the other sixty two patients (B) group using an adaptive control volume (ASV) as another mode.

Result: We found that patients who were on adaptive support volume (ASV) group (B) had faster process of weaning and early extubation, and showed better arterial blood gases with easier management, which lead to early discharge from the ICU.

Conclusion: Training to use the new mechanical ventilators modes like adaptive support ventilation (ASV) is advisable, in some patients to wean and extubate early in comparison with the (SIMV) mode with best arterial blood gases and early discharging from the intensive care unit.

Key words: Mode, Weaning, Mechanical Ventilators. SIMV, ASV

Introduction

This study was conducted in a our busy intensive care unit (ICU) of King Hussein medical city in the period between November 2012 to September 2014, which includes forty nine beds;, all our beds are occupied most of the time. Each one is fully equipped with standard international tools and monitors.

Most of the admitted patients are in need to be on ventilator for different etiologies, and they are ventilated, by using the traditional mode already included in standard ventilators, and watching the results of arterial blood gases for each one in provision of early starting of weaning and then extubation.

A new mode (which is called intelligent mode) included in new ventilators, was optionally started to be used in some patients. Results were analyzed to prove the benefit of this new mode, adaptive support ventilation (ASV) for early weaning from ventilator.

Most seriously ill lung patients were selected to be on ASV mode. We start weaning of the patient since intubated by using this mode, because the work of breathing (WOB) is minimal and the loop is closed; the time of ventilation was observed to be shorter than in the other previously used mode (SIMV). It has become a recommended way to early extubate and then discharge of the patients from the intensive care unit; it also a safe way of weaning (1) which decreases the hospitalization of patients with less use of resources, cost, morbidity and mortality (2-6).

Adaptive support ventilation (ASV) was introduced internationally in 1994 as an intelligent mode of ventilation which contains the measurement of respiratory mechanics and algorithm of closed loop pressure control for maintaining the proper minute volume.

Patients and Method

After the approval of the ethics committee of royal medical services was obtained, one hundred and twenty six patients were taken randomly in this study; they were taken in two groups A and B. as shown in Table 1 below.

An ordinary intubation was done for all critically ill patients by using Popofol or Ketamine in sleeping dose upon the patient's blood pressure and suxamethonium chloride in intubating dose. They were randomly assigned to be in one of our two studied groups (A or B) then connected to ventilator and putting the setting reasonable for each one upon his/her condition. Sedation was given to both groups which consisted of two to three milligrams of morphine sulphate as initial dose then two to three milligrams hourly infused, and increased or decreased as needed, for example giving either two or three milligrams when suctioning the endotracheal tube or inserting an intravenous line mainly in central veins. Vasopressors or anti -hypertensive drugs were prescribed as required for each case.

Group (A) the synchronized intermittent mandatory volume SIMV was selected. The setting installed is dependent on the patients' arterial blood gases, and body weight;, seven to ten milliliter per each kilogram body weight tidal volume (TV), fractional inspired oxygen (FIO2), positive end expiratory pressure (PEEP) and respiratory rate (RR) were chosen for each case respecting the saturation of oxygen (SPO2), metabolic state and PCO2. All these ventilator settings were fine tuned after obtaining the results of each arterial blood gas (ABGs) which were taken as routine, thirty minutes after first intubation or after attaching the patients to ventilator. If the patient admitted was already intubated, then ABGs were reviewed twice daily, early morning and afternoon, or upon any modification of the patient's condition all through the day.

All Group B patients were attached to ventilators by using ASV mode, which consists of three parameters only: ideal patient's body weight, percentage of theoretical value of minute ventilation desired based on nomogram of Radforf (7), and maximal inspiratory pressure tolerated after first four to five breaths taken from ventilator. The ventilator determines the compliance and resistance of the patient's airways and delivers a pressure controlled ventilation then optimizing inspiratory pressure and respiratory rate using the formula of Otis (8) which determines the respiratory rate with least work of breathing as a function of the expiratory time constant. As the patients start to take the breath by their own effort which is detected for each breath, the ventilator switches to inspiratory pressure support (IPS). This level of support is always adapted to patient's respiratory rate and tidal volume to achieve the preset minute ventilation using a comfortable breath pattern.

Harmful patterns like rapid shallow breathing, high dead space ventilation, breath holding and excessive large breath are all prevented by adjustments of inspiratory pressure and respiratory rate which means that the machine is continuously changing.

In both groups A and B the weaning protocol of our ICU was applied, and the end results of each group were analyzed by the attending intensivest to see in which of the selected ventilator modes (ASV versus SIMV) the early weaning and extubation occurred.

Results

The main interesting finding in this study was duration of weaning is shorter in group B in comparison with group A as showed above 5 to14 hours, intubation time also was shorter, and then the stay length in ICU, and other parameters like respiratory rate which was found to be little bit lower in the ASV

Table 1: Differences between patients and their numbers in each group

No. of Patients in each group	Group (A) 64	Group(B) 62
Age	55 ±3 years	56±2
Sex (M/F)	33/31	32/30
Height(cm)	165±8	170±5
Weight	67±5	69±4
ICU stay length(days)	6±2	5±1

Table 2: The difference in all parameters in both groups

Group	SIMV (A)	ASV (B)
Duration in hours	14 h	5 h
Breath per minute RR	12/ min	14/min
Tidal volume TV(ml)	500ml/br.	525/br.
Paco2	44mmhg	40mmhg
Heart Rate (HR)	85/min.	83/min.
Mean arterial pressure (MAP)	88 mmhg	87 mmhg
Sedation Morphine total dose (mg)	6mg /h	2mg/h

mode, tidal volume was found somewhat higher in the ASV group in comparison with the SIMV, which reflects less $PaCo_2$ in the ASV.

Also vital signs were taken into consideration; the difference in both groups was watched, heart rate (HR) and mean arterial pressure (MAP) were shown to be minimally different in response to different concepts of ventilation during the weaning. Finally the total amount of sedative drugs, Morphine, was used in significant smaller doses in the ASV group (B), compared to the SIMV group (A); all these findings are shown in Table 2.

Discussion

This study shows that using different ventilator modes results in different variable outcomes in the weaning process, such as time of ventilation and then extubation which may differ from one mode to another. In this study we compared the most popular mode of ventilation used in the ICUs in our region, SIMV, with the new mode called (intelligent mode) ASV which was used in our ICU included in the new ventilator machine.

The great finding was observed in the group that used the ASV mode in whom the trachea was extubated earlier, with at least 6-24 hours than in the other group.

In ASV group (group B) this mode provides a ventilation in pressure support (pressure control ventilation) and automatic change from pressure control ventilation to inspiratory pressure support. This also leads to fast spontaneous ventilation; the patient-machine interaction was improved in comparison with the SIMV mode, and this leads to early weaning from the ventilator.

The ASV mode was possible in almost all types patients, including the moderate respiratory failure (PaO22/FIO2 ratio between 150-300mmhg) with appropriate inspiratory pressure.

The smooth weaning and extubation in ASV mode decreased the requirement of serial ABGs with its reducing the use of resources, nursing effort, and finally the total cost, and simplifying of the weaning trials.

The effect of different modes on ventilator and their safety and efficacy on patient outcomes is difficult to assess. (9,15)

Conclusion

Training to use the new mechanical ventilator modes like adaptive support ventilation (ASV) is advisable in some patients in order to be able to wean and extubate early in comparison with the (SIMV) mode with better arterial blood gases; therefore providing early discharge from the intensive care unit and less burden financially and human resources.

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