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A report of separation from mechanical ventilation in a patient with Chronic Obstructive Pulmonary Disease (COPD)

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Abstract

Introduction: Chronic Obstructive Pulmonary Disease (COPD) is a chronic disorder with many systematic complications and one of the most important reasons for patients to require mechanical ventilation, admission in intensive care unit and prolonged mechanical ventilation. Although the first attempt in separation of mechanical ventilation is failed in half of chronic obstructive pulmonary disease (COPD) patients, but delaying in the weaning process in these patients also cause ventilator dependence. P_aCO_2 = 35- 60 mm/Hg is one of the most important indexes for predicting a successful extubation.

Case report: A 49-year-old man and known case of COPD who was supported by mechanical ventilation following to bronchopneumonia and severe respiratory infection. After 9 days, followed by gradual reduction of ventilatory support, the patient was placed on Spontaneous Mode with 15 cm/H2o pressure support. Due to satisfactory consciousness and stable hemodynamic status, in spite of high P_aCO_2 (P_aCO_2> 115) , weaning was done on the 11th day of hospitalization. Patient was discharged from ICU with satisfactory breathing and clinical status one week after the extubation.

Conclusion: Regarding the results of this report, it could be stated that because of the compatibility generated in COPD patients in the endurance of the high levels of P_aCO_2, in case satisfactory consciousness and stable hemodynamic condition of patients, the option of successful weaning could be considered. Additionally, it is suggested that clinician experience and his clinical judgment in addition to predictor indexes for successful weaning be utilized.

Keywords: Chronic Obstructive Pulmonary Disease (COPD), Mechanical ventilation, Separation, Weaning.

Introduction

Chronic Obstructive Pulmonary Disease (COPD) is a chronic disorder with many systematic complications that its incidence and prevalence are on the rise (1). Although we cannot specify COPD epidemiology in critical patients precisely, we can claim that COPD is one of the most important reasons for patients to require mechanical ventilation (2), admission in intensive care unit and prolonged mechanical ventilation (3). This disease also causes considerable mortality and morbidity during long-term acute hospital care (1).

Detrimental effects of prolonged mechanical ventilation such as increased mortality risk (4) and ventilatory dependence has caused timely and appropriate weaning from mechanical ventilation to become a basic target for health providers (5). Results indicate that COPD is an important predictive parameter for prolonged mechanical ventilation and weaning failure (6).

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Substantially the first attempt for weaning has been unsuccessful in more than 50 percent of COPD patients accompanying 27% mortality rate (7).

Although there are several criteria for removal of ventilatory support in COPD patients, none of them can predict solitarily patient's ability to endure spontaneous breathing (8). Previous studies have shown the difficulty to identify parameters predicting the outcome of COPD patients treated by invasive mechanical ventilation (2).

Among the existent predictive parameters, patients' ability to interact with the environment (9), normal levels of pressure arterial carbon dioxide (P_aCO_2=35-45 mm/Hg) and maximum inspiratory pressure (MIP) are reliable in more than 90% instances (10). Since the increase in P_aCO_2 may be a marker for decrease in alveolar ventilation and inadequate strength of respiratory muscles, P_aCO_2= 62/75- 86/25 mm/Hg can be a marker for weaning failure and P_aCO_2= 35- 60 mm/Hg an indicator for weaning success. Results of the studies show that an increase in P_aCO_2 (hypercapnia) in the end of spontaneous breathing and before weaning may create prolonged weaning process, increased need for re-intubation (11) and decreased survival after isolation (12).

In this paper, effects of patient's satisfactory level of consciousness, his stable hemodynamic condition, and clinical judgment of health providers in a successful separation from mechanical ventilation in a COPD patient, despite having high levels of P_aCO_2 (115< P_aCO_2) will be discussed.

Case report

The patient was a thin 49-year-old man and known case of COPD by the reason of exposure to mustard gas during the Iran-Iraq war, who was supported by mechanical ventilation following to bronchopneumonia and severe respiratory infection.

Lung and mediastinal CT scan report showed an increase in Bronchoalveolar marking related to pneumonia, reduction of right lung volume associated with presence of large emphysematous bull in the upper lobe of this lung, shifting of the left lung toward mediastinum and deviation of the heart and mediastinum to the right side. The result of the first ABG (Arterial Blood Gases), in the beginning of the hospitalization showed in table 1.

Initial settings of ventilator was as follows and subsequent changes in ventilator settings applied on the basis of measurements of ABG:

Mode: ACV- Fio2: 100% - RR: 16 – TV: 500 – PEEP: 5 cmH_2o

The result of ABG of the patient after respiratory acidosis correction was as follows:

PH= 7/47– P_aCO_2 = 63 – Pao_2= 194 – HCO_3= 45/9

After 9 days, followed by gradual reduction of ventilatory support (gradual reduction of respiratory rate of mechanical ventilator), the patient was placed on Spontaneous Mode with 15 cm/H2o pressure support. At this time ABG showed reduction of blood PH and severe hypercapnia (table 1).

Due to satisfactory consciousness and stable hemodynamic status, the patient was permitted to stay on spontaneous breathing mode in spite of high P_aCO_2. The amount of intaken oxygen was decreased regarding the high amounts of arterial partial pressure of oxygen (PaO_2>100), and the patient was monitored constantly in respect of the status of consciousness and analysis of hemodynamic condition. Regarding the stable clinical status and

relative recovery of the patient, the separation from the mechanical ventilator was done on the 11th day of hospitalization and the supplementary oxygen was started by T piece. The ABG of the patient after one hour of being placed on the T piece, while intaking 6 Lit/min oxygen, was:

PH= 7/36– P_aCO_2= 88 – HCO_3= 49/7- PaO_2= 98

24 hours after separation, the tracheal tube was extracted. Table 1 illustrates the result of ABG sample of the patient after extubation while intaking the supplementary oxygen via face mask with 6 liters density per minute. The clinical status of the patient shows relative recovery through time, and accordingly the patient was discharged from ICU with satisfactory breathing and clinical status one week after the extubation of the tracheal tube.

Table 1: The analysis of the results of the experiments on arterial blood gas (ABG) in different stages of the study

Time of experiment	Duration from the start of hospitalization	Result of ABG			
		HCO_3	P_aO_2	P_aCO_2	PH
In the beginning of hospitalization	Start of hospitalization	16	48	> 110	7.18
After the breathing acidosis correction	After 12 hours	45.9	194	63	7.47
After the start of the spontaneous breathing	After 9 days Time:				
	10:20 Am	18	102	> 115	7.19
	11:22 Am	19	57	> 115	7.19
	13:42 Pm	19	109	> 115	7.19
	14:24 Pm	18	102	> 115	7.18
One hour after the weaning (breathing through the T piece)	After 11 days	49.7	98	88	7.36
After extubation	After 12 days	47.5	83	86	7.35

Discussion

The analysis of the studies shows that the selected time for separation of the highly ill patients from the mechanical ventilation system are mostly not appropriate and this challenging item is done either too early or too late (13).

In different studies have considered various parameters such as Minute volume (MV), Maximum inspiratory pressure (MIP) and Rapid shallow breathing index (RSBI) for predicting of appropriate time for endurance spontaneous breathing exercises by patient. Also parameters as diaphragmatic fatigue, increase in the tracheal resistance, pulmonary infiltration, hypoxia, malnutrition and recurrent infections can predict extubation outcome (14).

Some studies have reported P_aCO2 as the most important element in success of weaning procedure. Li in a study has shown that there is a direct and significant relation between the amount of P_aCO2 and failure in separation from the mechanical ventilation system (10). Also, Lamia stated that high amount of P_aCO2 (hypercapnea) could aggravate patients' status after the separation, and increased their need to re-intubation (11). Nevertheless, some like Castro have not affirmed the relation between the amounts of P_aCO2 and the result of the separation from the mechanical ventilation (15).

For the reported patient, the amount of P_aCO2 before the reduction of ventilatory support was 63 mm/Hg and after placing on the Spontaneous Mode has been increased noticeably beyond 115. Nonetheless, after the reduction of the intaken oxygen the level of P_aCO2 has been decreased; though a severe acidosis was observed in blood so that the amount of P_aCO2 was higher than 115 and the PH was reported less than 7.20 in each time of the 3 times successive checking of ABG in 3 hours (Table 1). But due to satisfactory consciousness and stable hemodynamic status, the patient was permitted to stay on spontaneous breathing mode in spite of high P_aCO_2. The reason would be found in the generated compatibility in COPD patients with high levels of P_aCO_2.

Some studies, such as Vidotto (9) and Tate (16), the satisfactory consciousness of the patient during the separation considered as an important element for the success of the weaning procedure. These results have confirmed the employed parameters in this article. For the reported patient, a disturbance in the consciousness and hemodynamic status was expected as results of the generation of severe acidosis. The amount of P_ao_2 more than 100 could also cause the obstruction of the breathing centers in this COPD patient. But the patient's consciousness was not disturbed and his hemodynamic status remained unchanged, and this status allowed the health providers to separate the patient successfully. Perhaps, the existence of constant levels of hypoxia and acidosis in COPD patients caused the compatibility and the increase of the endurance of hypoxia and severe acidosis.

Another category of studies have shown that the application of the experience of the physician or the in-charge nurse could have appropriate result (17). In the reported patient, also, the clinical judgment of the in-charge nurse according to the previous and the current circumstances of the patient led to successful separation of the COPD patient from the ventilator.

Conclusion

Regarding the results of this report, it could be stated that because of the compatibility generated in COPD patients in the endurance of the high levels of P_aCO_2, in case satisfactory consciousness and stable hemodynamic condition of patients, the option of successful weaning could be considered. Additionally, it is suggested that clinician experience and his clinical judgment in addition to predictor indexes for successful weaning be utilized. Also according to the results of this report, it could be assumed that in the separation procedure of COPD patients from the mechanical ventilation, instead of leaning on the number, constant analysis of the hemodynamic and consciousness status of the patients alongside the predicting parameters of the success of separation could be advantageous.

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