Effect of hyperoxygenation for one minute on ABGs during endotracheal suctioning in ICU in Zanjan Vali-e-Asr hospital 2011

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Abstract: Background and objective: Endotracheal suctioning is an inevitable procedure in patient under mechanical ventilation. The most important complication of this procedure is hypoxemia. The aim of this study is effect of hyperoxygenation on hypoxemia during endotracheal suctioning. Method: This study is a clinical trial on 30 patients under mechanical ventilation in ICU of Vali-e-Asr hospital in Zanjan that samples are selected based on study criteria. Results: Finding show that hyperoxygenation during endotracheal suctioning is necessary. Based on results of this study recommended this procedure and further study for distinct during of time of hyperoxygenation.
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Introduction

Using artificial airways such as intra-tracheal tube is inevitable in patients that undergo mechanical ventilation with positive pressure due to different causes. By placing the tube within the trachea and the patient's inability to cough and removal of pulmonary secretions, which may be added as a considerable amount due to the disease process, performing the pulmonary secretions removal technique with suction help would be needed. Endotracheal tube suctioning is a stressful and uncomfortable process for the patients; however, it is essential for clearing the tracheobronchial tree from the pulmonary secretions. Suctioning has several side effects on different body systems, including:

1. Respiratory system (Lung volume reduction, hypoxia, alveolar collapse and trachea infection and trauma)
2. Circulation system (Bradycardia and hypotension)
3. Nervous system (Increased intracranial pressure and decreased cerebral blood flow)

Despite observing such complications, there is little evidence and conducted research on incidence and prevalence of these side effects and performing preventive measures in this regard (American Association of Respiratory Care, 2009, AARC).

There are several different systems for tracheal suctioning, including: open suctioning system, semi-open suctioning system and closed suctioning system.

In open endotracheal suctioning system, which is now used in Hazrat-e-Valiasr Hospital, the tracheal tube is removed at the place of Y piece from the ventilator and the suction catheter will be entered into the endotracheal tube. In this method, disconnecting the patient from the ventilator causes the reduced airways pressure equal to the atmospheric pressure. In the second method, which is called the semi-closed method, without disconnecting the patient from the ventilator, the suction catheter removes the patient's respiratory secretions through a lateral hole created by the help of an adaptor at the junction site of ventilator to the endotracheal tube. In this method, pressure reduction, and thus, the reduced volume of the lungs will be avoided partially. But in the final approach, which is called as the closed method, the suction catheter is continuously placed between the endotracheal tube and the Y piece, and without disconnecting the patient from the ventilator, the secretions are suctioned (Al-Megren, 2005).

One of the important complications of endotracheal suctioning that other side effects may be due to the same problem includes the hypoxia induced by disconnecting the patient from the ventilator and applying negative pressure to remove the secretions. To reduce the hypoxia, methods such as hyperinflation and hyperventilation are used. On of the measures done to reduce the hypoxia induced by endotracheal suctioning in mechanically ventilated patients is hyper-oxygenation before and after suctioning of secretions. In this method, before and after endotracheal suctioning, the patient is given pure oxygen (100% oxygen). Hyper-oxygenation may be performed through equipments that are usually mounted on the ventilator or manually after disconnecting the patient from the ventilator (Demir, 2004).

Using high percentage of oxygen during endotracheal tube suctioning is not without risk for the patients. It has been proven that high percentage

of oxygen for even a short time can cause absorptive atelectasis in normal subjects. In patients with lung problems treated by high percentage oxygenation, the caused atelectasis and subsequent lung volume reduction will worsen the patient's condition. Thus, unnecessary use of pure oxygen for patients is dangerous. Control of oxygen saturation of arterial blood (O_2sat) before and after endotracheal tube suctioning is necessary, and if the oxygen saturation rate of arterial blood reduces, treating the patients with high percentage oxygen considering its complications will be essential.

Most ventilators have the opportunity to provide 100% oxygen at a predetermined time that will cause minimum hemodynamic side effects for the patient (Thompson, 2000).

By reviewing the researches conducted on hyper-oxygenation, arterial blood oxygen saturation and other parameters included in the study of arterial blood gases, it was found that no specified and constant time has been recommended for performing hyper-oxygenation before and after endotracheal tube suctioning. Thus, in order to determine the effect of hyper-oxygenation period time before and after endotracheal tube suctioning and compare the influence of different period times on the arterial blood oxygenation rate, and ultimately help in determining the appropriate time for hyper-oxygenation, the researcher intends to examine the effect of different period times of 100% oxygen administration on the parameters included in the study of arterial blood gases in a clinical trial in this study.

Materials and Methods

The current study is a clinical trial that was performed aimed at study of hyper-oxygenation period time influence on the study parameters of arterial blood gases (ABGs) in patients under mechanical ventilation in ICU ward of Hazrat-e-Valiasr hospital. The study samples were 30 patients, which were calculated using the Cochran's sample size formula. The samples had the following characteristics: age over 18 years old, being mechanically ventilated for more than 48 hours, having mild to moderate respiratory failure, lack of hyperthermia, hematocrit rate greater than 25, sustained hemodynamic status and 7.5-8 endotracheal tube.

Data collection tool was a recording data sheet, which is composed of two parts. In the first section, the demographic characteristics of the samples were collected and were recorded based on Demir, F. research factors including, sex, age, diagnosis, the airway type and the ventilation type. In the second section, the data were related to the measurement of arterial blood gases parameters, including PaO_2, $PaCo_2$, PH and O_2sat that was performed using the arterial blood gases study device by Techno media 630 IE model.

The content validity method has been used to determine the validity of the method of data collection (by 11 faculty members). The simultaneous observing technique was also used to determine the reliability. The reliability of the arterial blood gases analysis system was evaluated based on the manufacturer's instructions.

The researchers selected the samples and performed the sampling according to their skills in ICU section and with the assistance of a qualified physician (for verification and identification of research samples and interpretation of data in ABGs). After taking the initial ABGs sample and its recording, in the case of endotracheal tube secretions and the need for its suctioning, the suctioning of the endotracheal tube secretions was performed by doing hyper-oxygenation with 100% oxygen for one minute before and after the suctioning.

The ABGs results were interpreted and compared by the physician partner. Then, the data was entered into the SPSS software. The statistical analysis was performed by two descriptive and inferential methods (hypothesis testing, comparison of two dependent samples).

The study exclusion criteria included the use of muscular paralyzing drugs and bronchodilator and changes in ventilator settings during performing the research. Written consent was taken from the conscious patients prior to performing the research, and in unconscious patients, the written consent was obtained from their relatives. Sampling was performed from the femoral artery.

Results

To achieve the research objectives, data was collected and examined using descriptive and inferential statistics as follows. First, to describe the studied variables, the means of arterial blood gases study parameters (PaO_2, $PaCo_2$, PH and O_2sat) were measured before doing the suctioning of tracheal tube secretions and after hyper-oxygenation for one minute and were recorded in Table 1.

Table 1: The means of study parameters of arterial blood gases of initial ABGs and ABGs after one - minute hyper-oxygenation and the tracheal tube suctioning

Variables / ABGs turn	O_2sat	PaO_2	$PaCo_2$	PH
$ABGs_0$*	92.73	90.28	38.88	7.37
$ABGs_1$*	95.56	89.94	45.91	7.27

$ABGs_0$ *: ABGs before endotracheal tube suctioning
$ABGs_1$ *: ABGs 30 seconds after performing hyper-oxygenation for one minute.

After recording the means, means comparison was performed that the following results were obtained:

About the O_2sat parameters, with P=0.015, $PaCo_2$ with P=0.00 and PH with P0.006, there was a significant difference between the two samples. But in case of PaO_2 parameter with P=0.92, no significant difference was observed between the two means.

Discussion

Regarding the measurement of study parameters of arterial blood gases immediately before performing tracheal tube suctioning, the means of parameters were measured. The results show that the research samples have no acute respiratory problems or there are no drastic changes in the values of PaO_2, $PaCo_2$, PH and O_2sat.

In this regard, hyper-oxygenation for one minute and the endotracheal tube suctioning of the patient were performed, and the ABGs were performed 30 seconds after suctioning.

By examining each of the studied variables and comparing the means of variables, it was seen that the difference between variables is significant. Then, the result of this study shows that using hyper-oxygenation during tracheal tube suctioning not only prevents the hypoxia induced by tracheal tube suctioning, but also leads to improvement of the initial situation of the patient O_2sat. Prior to this, researchers such as Xu-Yang-Ping (2004) has found the effect of endotracheal suctioning on the patient O_2sat, and in a research conducted by Wang et al., they recommended hyper-oxygenation in order to prevent hypoxia induced by suctioning the endotracheal tube secretions (Wang 2005).

In a research conducted by Abbas Ebadi in Baqyiatallah Jamaran Hospital, he studied the effects of hyper-oxygenation, hyper-inflation and hyper-ventilation on hypoxia induced by suctioning and concluded that the hyper-oxygenation not only prevents the hypoxia, but also it certainly is preferable to the other methods (Ebadi, 2009).

Searching of the literature, we found that although the researcher have found the importance of hyper-oxygenation in reduction or prevention of hypoxia-induced following endotracheal tube suctioning and will recommend it, but they have not determined a specific time period for it. For example, Fernandez used a period time of two minutes for hyper-oxygenation in his study (Fernandez, 2004), and Demir selected the time of one minute to perform this procedure.

The time period of hyper-oxygenation has not been also specified in Ebadi's research. It should be noted that by review of conducted studies with an emphasis on performed hyper-oxygenation before and after endotracheal tube suctioning, the definitive effect of hyper-oxygenation on study parameters of arterial blood gases, particularly PH and $PaCo_2$ has not been already determined, and no source was found to measure the effect of hyper-oxygenation on PH and $PaCo_2$.

Final result

In patients undergoing mechanical ventilation, performing hyper-oxygenation for one minute during tracheal tube secretions suctioning leads to improvement of hypoxia and prevention of the hypoxia caused by this procedure. Although performing hyper-oxygenation increases O_2sat, but it will not change the amount of PaO_2 significantly, and despite of hyper-oxygenation, performing tracheal tube suctioning of secretions will lead to increased $PaCo_2$ and reduced PH.

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