



Comparing the effect of tracheal tube suction using open and closed methods on hemodynamic indexes of COPD patients under mechanical ventilation

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Introduction: Suction is the most important procedure in patients under mechanical ventilation, and could be performed by two open and closed methods. In addition to considering suction principles, selection of an appropriate method for doing this could be helpful in decreasing the complications such as tissue hypoxia, heartbeat alteration, and blood pressure. The aim of this study was to compare the effect of tracheal tube suction using both open and closed methods, on hemodynamic indexes of COPD patients under mechanical ventilation. **Materials and Methods:** The present study is a semi-experimental one, which is performed on a single group. In this study, 48 patients affected by chronic obstructive pulmonary disease that were hospitalized in Intensive Care Unit of Amiralmomenin Ali hospital of Zabol in 2017, were selected based on accessible sample selection criteria. Number of heartbeats, systolic and diastolic blood pressure, and arterial medium pressure were assessed and recorded at three times: before, just after, and 10 minutes after suction using open and closed methods, in the first, third, and fifth days. Tracheal tube suction performed on patients with 120 mmHg of negative pressure and for 10 seconds in each time, in a random manner (via throwing coins) and with 90 minute intervals, using two open and closed methods (each method performed one time). Data were collected and analyzed using SPSS version 22. **Results:** According to Wilcoxon statistical test, number of heartbeats, systolic and diastolic blood pressure, and arterial medium pressure before, just after, and 10 minutes after suction using open and closed methods, in the first, third, and fifth days, showed no statistical significant difference ($p > 0.005$). **Conclusion:** Results of the present study showed that there was no statistical significant difference between two open and closed suction methods, regarding to effect on hemodynamic indexes of patients affected by chronic obstructive pulmonary disease. Comparison of this result with other studies showed a wide variation; so that, several studies indicated that closed suction method is preferred due to maintenance of most of hemodynamic indexes in comparison to open suction method.

INTRODUCTION

One of the most common kind of chronic diseases is Chronic Obstructive Pulmonary Disease (COPD), which is the main cause of health problem and disability in people over 40 years old and elderly people (1). Progress of the disease is often slow and comes along with limitation of airflow in airways (2). The disease includes two chronic bronchitis and asthma (1-3).

The Global Program of Chronic Pulmonary Disease predicts that to 2020, the disease probably will reach to the third place (from its current sixth place) of worldwide common mortality causes (1). In USA, 16

million people are affected by COPD (2), and in Iran, the disease affects approximately 10% of population (3). COPD has a strong effect on the quality of life of the patients, so that their activity will be limited, and performance of some of them will be completely disrupted and they will lose their independency (2). Expenses, which directly or indirectly will be spent for this disease, impose a heavy economical load on person and therapeutic health system (3). When medicines are not responsive in the patients, mechanical ventilation is required (4).

Mechanical ventilation stimulates ciliary cells to increase production of mucosal secretion, and via destruction of cilia of airways can cause defection in their performance and incomplete clearance of secretions of airway (5). Accumulation of secretions in airways could result to their obstruction, and hypoxia, acidosis and consequently, dangerous complications via defect in oxygenation process (6). Nurses have more care for patients under mechanical ventilation system than other

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members of medical team, because of the critical and sensitive nature of Intensive Care Unit of hospital. An example of these patient care programs for nurses that is introduced for preventing and/or decreasing pulmonary secretion accumulation, and triggering ventilation appropriate condition and pulmonary perfusion, is continuous suction to improve discharging airway secretions (5). Tracheal suction is the most frequent and basic procedure that is performed in patients under mechanical ventilation, so that each patients need suctioning 8 to 17 times per day (7).

Though tracheal suction tube keeps airways open, could result to problems in patients such as hypoxia, hypoxemia, heartbeat or blood pressure alteration, dysrhythmia, and Cardiac or respiratory failure (8). In addition to considering suction principles, selection of appropriate methods for doing this could be helpful in decreasing the complications (2). Tracheal suction tube could be performed using two Open (OSS) and Closed (CSS) systems (9). In the open suction system, patient will not be departed from ventilator (8).

Nowadays, the most common tracheal suction tube method is the open system (10). In this method, oxygen, humidity, and positive pressure of exhalation end will not be received to the patient during suction, and patients that have unstable condition may become unwell due to hypoxemia (11). Some researchers believe that in closed suction, arterial oxygen pressure has lower decrease in comparison to open system. Moreover, cardiac complications (tachycardia and arrhythmia) are more common in open suction system (12). Dadkhah and colleagues (2012) approved this in their research. Heartbeat alteration in open suction system was more than closed system (13), though in the study of Mohammad pour and colleagues (2013), no significant differences were seen in two open and closed suction system (12).

Regarding importance of suction in COPD patients under mechanical ventilation (5-7), effective role of suction in complications which appears due to it (12), and ambiguity in affection background of two open and closed suction systems on hemodynamic indexes (12, 13), the aim of this study was to compare the effect of tracheal tube suction in both open and closed methods, on hemodynamic indexes of COPD patients.

METHODS

The present study is a semi-experimental one, which is performed on a single group and its statistical population were all COPD patients hospitalized in Intensive Care Unit of Amirmomenin Ali hospital of Zabol in 2017. Based on accessible sample selection criteria, 48 patients, which had consent to participate in our study were selected. Inclusion criteria were: connection to trachea tube and ventilator, ages between 18 to 65 years old, normal sinuous cardiac rhythm before suction, lack of cardiac disease history, ventilation with SIMV mode, lack of symptoms of intra-skull hypertension, and certainly diagnosed to be COPD. Exclusion criteria were: death of patients, performing any critical therapy or required action on the patients during study, alteration in adjustments of ventilator device, any need to repeat the suction in the time intervals between open and closed suction, and removing trachea tube from airways of the patient (6).

For recording data, data collection forms were used that included personal information and hemodynamic parameters such as number of heartbeats, systolic and diastolic blood pressure, and arterial medium pressure that were assessed and recorded via monitor, by researcher.

In the open system, patients were departed from ventilator and secretions discharged by entering Nalton catheter into trachea tube. Patients were reconnected to ventilator after the end of suction.

However, in closed system, patients were not departed from ventilator during suction, and one end of the suction catheter was connected to the ventilator and the tracheal tube, and the other end was connected to the suction tube. After opening catheter valve, Nalton catheter were driven into tracheal tube and secretions were discharged (11).

In all units of study, suction method performed according to FDA approved protocol of respiratory cares group of USA, so that before suction into tracheal tube, patients received oxygen 100% for 2 minutes via ventilator. Then, tracheal tube suction was performed with maximum 120 mmHg of negative pressure and 10 seconds in each time. Tracheal tube suction performed in a random manner (via throwing coins) and with 90 minute intervals, using two open and close methods (each method performed one time with 1.2 of diameter tracheal tube). Afterwards, patients hyper-oxygenated again for 2 minutes with 100% oxygen (6).

Hemodynamic indexes of patients were assessed and recorded before, just after and 10 minutes after bedside monitoring of patients. Third and fifth days later, the process repeated for all patients Data were collected and analyzed using SPSS version 22, and Shapiro-Wilco and Wilcoxon tests. P value >0.05 were considered significant. Ethical considerations were considered in this study.

RESULTS

In this study, totally 48 COPD patients were studied, age range of these patients was 26-52 years old and mean age of them was 45.9 years. Also, 25 patients were male (52.1%) and remained were female.

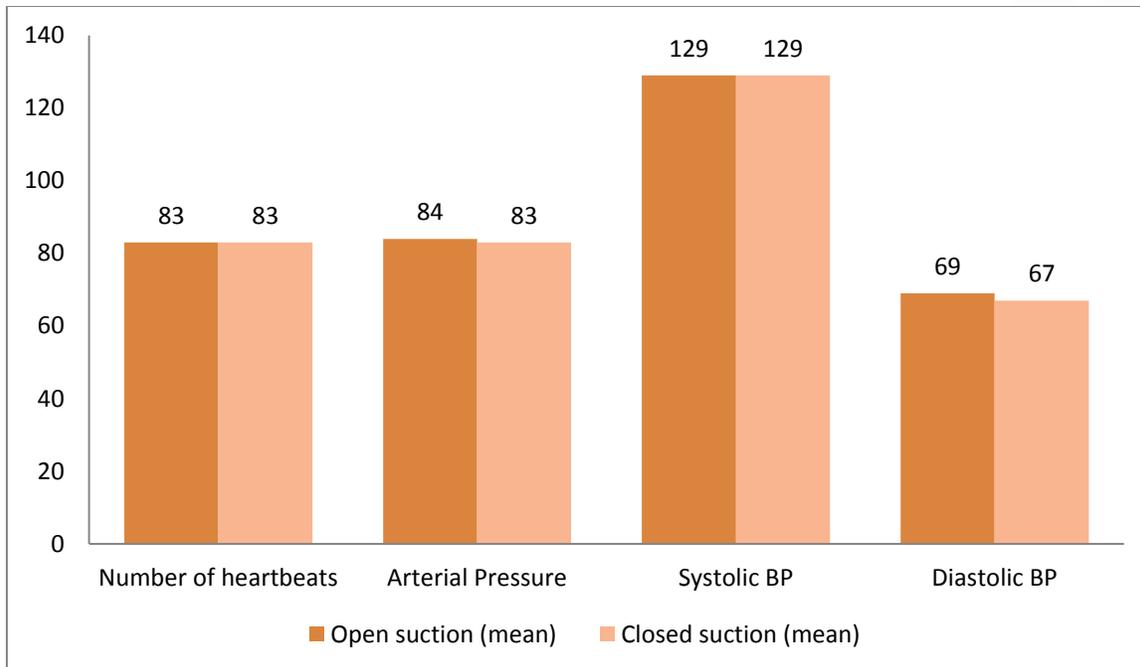
Wilcoxon test showed that there was no statistical significant difference in systolic blood pressure, heartbeat rate, and mean arterial pressure between two open and close suction methods. However, this rate was different in diastolic blood pressure, and there was no significant difference in blood pressure mean between open and closed methods. Although, this clinical difference was insignificant and could be ignored (Table 1). Also, the mean difference and deviation between quartiles of hemodynamic indexes, before, just after, and 10 minutes after open and close suction, in the first, third, and fifth days showed no significant difference.

DISCUSSION

Results of the present study showed that hemodynamic indexes of COPD patients included number of heartbeats, systolic and diastolic blood pressure, and arterial medium pressure recorded at three measurement times (before, just after, and 10 minutes after suction) using open and closed methods, in the first, third, and fifth days had not statistical significant difference. It could be concluded that probably both closed and open suction systems are similar regarding to hemodynamic indexes, and there is no preference between them. Researchers found various results in the different data websites, so that some of the studies completely approved our results. Mohammad pour and colleague (2013) in their study named "comparison of the effect of tracheal tube suction using two open and closed systems on hemodynamic indexes of patients after coronary bypass surgery under mechanical ventilation", showed that mean of number of heartbeats and medium arterial pressure in two groups of patients with open and closed suction have no significant differences. Also, no alteration was seen regarding to heart beat pattern or cardiac rhythm in two groups and they concluded that none of suction methods is not preferred (12). Results of this study (despite differences in the method), studied population and study environment were inconsistent with ours.

Table 1 Comparison of mean and Deviation between quartiles of hemodynamic parameters, in two open and closed suction methods

Variables	Open suction method		Closed suction method		z	Wilcoxon's test results
	Mean	Deviation between quartiles	Mean	Deviation between quartiles		
Number of heartbeats	83/83	14/87	83/77	12/33	-1/323	0/186
Medium arterial pressure	84/88	9/17	83/72	8/86	-0/762	0/446
Systolic blood pressure	129/33	13/69	129/83	14/58	-0/031	0/975
Diastolic blood pressure	69/77	14/78	67/83	9/72	-2/725	0/006

**Figure 1** Hemodynamic parameters in open and closed suction groups

Results of some studies were an approximate approval for our results. Ali pour and colleagues (2013) in their study named “comparison of the effect of closed and open suction methods on hemodynamic status of patients hospitalized in ICU” indicated that diastolic blood pressure, medium arterial pressure, and number of heart beats at the times just after open suction, 2 minutes later, and 5 minutes later, had higher increase in comparison to closed system. However, no statistical significant difference were seen in systolic blood pressure, during different times after suction (11). Afshari and colleagues (2014) compared the effect of two open and closed suction methods on hemodynamic indexes and showed that during five times measurement of indexes, only number of heartbeats had statistical significant difference between two groups; however, regarding systolic and diastolic blood pressure and medium arterial pressure had no statistical significant difference between two groups (6). As it can be seen, the results of Ali pour only is in consistent with our results regarding to lack of any alteration in systolic blood pressure in response to suction type. The study of Afshari also was in consistent with our results regarding to lack of any alteration in systolic and diastolic blood pressure, and medium arterial pressure in response to suction type. Most probably the differences in used methods, studied population, and research environment were almost effective in obtaining these different results.

However, results of many studies are in contrast with our results. Seyed Mazhari in his study on ICU hospitalized patients showed that there is a significant difference between two studied groups (treated with open or closed suction system), regarding number of heartbeats in different times that suction is performed; so that, closed suction makes less alterations in hemodynamic status of the patients regarding number of heartbeats (10). Dadkhah and colleagues (2017), in their study named “effect of open and closed suction systems on vital signs of patients with head trauma hospitalized in ICU” showed that number of heartbeats in open suction method was more than closed method and they resulted that closed suction has more certainty and is recommended for ICU sections (13). Afshari and colleagues (2013) studied the effect of two open and closed suction methods on cardiac dysrhythmia in patients under mechanical ventilation, and concluded that number of heartbeats after open and closed suction methods is significantly different between two groups; so, as closed suction triggers less bad effects on cardiac system of the patients, patients under mechanical ventilation with a cardiac disease background, could receive closed suction method instead of open suction (6). Ozden and colleagues (2014) also in their results entitled “effect of open and closed suction on hemodynamic indexes of patients which had surgery” showed that open suction could have negative effect on number of heartbeats and arterial blood pressure.

However, during closed suction method, no significant alteration was seen in the rate of these indexes. They concluded that closed suction system is a safer method in comparison to open suction system, for patients that had cardiac surgery (14). Valizadeh and colleagues (2013), in their study named “comparison of the effect of intra tracheal suction with two open and closed methods on persistence of physiologic indexes of immature infants under mechanical ventilation condition” also concluded that significant statistical differences were seen between two groups, regarding medium arterial blood pressure index. Moreover, the time that is required for heartbeat and medium arterial blood pressure to return to the basic range, in closed suction method was less than open method. They concluded that physiologic persistence in the closed suction is better (15). Almegi and colleagues (2016) also compared the effect of open suction method with closed suction method and analyzed the vital signs of patients under mechanical ventilation which were hospitalized in ICU. Their results showed that both closed and open suction methods were effective on number of heartbeats; however, closed suction resulted to less alteration in vital signs in comparison to open suction (16). As it could be seen, results of Seyed Mazhari, Dadkhah, Afshari, Azdon, Valizadeh, and Almegi were in contrast with ours; they indicated that closed suction method results to less alterations in hemodynamic indexes in comparison to open suction method. They also concluded that because of more persistency of these indexes in closed suction method, its use will be safer than open suction method and is preferred. Probably, difference in studied society and environment, as well as study method, have been effective in these contrast results. It should be noticed that the present study is different from the mentioned studies, as it is performed on COPD patients. Moreover, the present study is used a single group and patients are not divided to two open and closed suction groups.

A limitation of this study is lack of COPD patients, which had inclusion criteria; this limited our possibility for dividing patients to two open and closed suction groups. So it is recommended to repeat the present study on a bigger sample size and in a two group's method.

CONCLUSION

Results of the present study showed that there is no statistical significant difference between two open and closed suction methods at different times after suction, regarding their effects on hemodynamic indexes of COPD patients. Comparison of these results to other studies in this field was different; so that, several studies preferred to use closed suction method to have a more persistent hemodynamic indexes. These different results could be due to poor sample size that recommended that conducting more studies with higher sample size.

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Open suction, closed suction, Patients with chronic obstructive pulmonary disease, Hemodynamic indexes.

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