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Arterial blood oxygen saturation and sedation level of the patients hospitalized in ICUs

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ABSTRACT

One of the highly important cares in intensive care units (ICUs) for keeping the airway and improving ventilation and oxygenation is suctioning. This must be done in a way so that, it can have the fewest effects or complications for the patient, in addition to the mentioned advantages. The goal of the present study is comparison of the two standard and routine suctioning methods on vital signs and arterial blood oxygen saturation and sedation level of the patients hospitalized in ICUs. The present quasi-experimental study was conducted in 2012 on 80 patients under mechanical ventilation hospitalized in ICUs of Zahedan City. The patients were selected purposively and were randomly divided into two groups. In the first group, suctioning was done with the standard method recommended by American Association for Respiratory Care (AARC) and in the second group, it was conducted based on routine nursing cares. The data was collected by means of Richmond scale and bedside patient monitoring, before and in the minutes 1, 5, 10, 15 after suctioning. The results showed that suctioning, in the routine method used, leads to more agitation among the patients and this agitation continued until the minute 10 after suctioning and there was a statistically significant difference between the two groups in minutes 1 and 5 ($p=0.000$, $p=0.000$). The vital signs in both groups had increased after suctioning and these changes were more in the second group but in most of the times there was no significant difference between the two groups. Also, the level of arterial blood oxygen saturation after suctioning had increased in both groups but in group 1 these changes were more and in the minutes 5, 10, 15 after suctioning there was a higher significant difference than before suctioning ($p=0.001$ ،$p=0.000$ ،$p=0.000$); yet in the second group no significant difference was observed in any one of the times ($p>0.05$). The results of the present study showed that suctioning in the standard method brings about less agitation for the patients. It brings about fewer changes in vital signs and also leads to the increase of arterial blood oxygen saturation. Thus, it should be contained in the work program of the nurses with adequate training.

Keywords: suctioning, vital signs, arterial blood oxygen saturation

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INTRODUCTION

Respiratory system disorder is the most important challenge in ICUs. Thus, use of the mechanical ventilator and use of the endotracheal tube in these units is unavoidable [1]. In adults, 100 ml mucus is secreted for the airway humidification per day and different factors, by stimulating the airway, can increase the amount of these secretions.

From among the factors that can lead to the increase of the airway secretions, foreign body aspiration, chronic obstructive pulmonary disease, heart surgery and existence of endotracheal tube can be mentioned. These factors can both lead to the increase of the secretions and also lead to inability in discharge of the secretions[2]. Accumulation of secretions in the respiratory tract leads to the obstruction of the airway and by disorder in the process of oxygenation it leads to hypoxemia, acidosis and other dangerous complications for the patients[3]. As patients with endotracheal tube can't discharge the secretions, they therefore need periodic suctioning[4]. Endotracheal tube suctioning is one of the most important and most common measures that is taken in ICU for cleaning the airway, improving oxygenation and preventing from atelectasis and infection[5, 6]. If suctioning is not conducted in a proper and standard way, it brings about complications such as infection, cardiac arrhythmia, decrease of blood oxygen and hypoxemia, increase of carbon dioxide, damage to mucosa, increase of intracranial pressure and even cardiac arrest[7]. Routinely, for every patient hospitalized in ICU, endotracheal tube suctioning is done between 8 and 17 times[8]. In order to minimize the complications of endotracheal tube suctioning observation of the principles of suctioning seems necessary. In addition to observation of these principles, selection of the proper method of endotracheal tube suctioning for reduction of its complications is also helpful[9]. Several studies have been conducted for comparison of different methods of suctioning. In a study that Mazhari et al. conducted for comparison of the two open and closed suctioning methods on the physiological symptoms of the patients hospitalized in ICU, they reported that the changes in the heart rate and arterial blood oxygen saturation were higher in the group with open suctioning than in the group with closed suctioning and these differences were statistically significant but the open or closed suctioning method does not make any changes in the heart Rhythm[9]. Also, in another study, Lee et al. reported that the open suctioning method increases the number of heart rates immediately after endotracheal tube suctioning more than the closed method and the rate of arterial blood oxygen saturation immediately after suctioning in the open method has a significant reduction[10]. In another study, Soltanian et al. engaged in comparison of two open and closed suctioning methods and reported that in the open suctioning method increase of the heart rate occurs more than the closed suctioning method and this increase continues until the minute 10 after suctioning, while in the minute 15 after suctioning it returns to the primary state[7]. In another study, Vahdatnejad et al. compared the two suctioning methods with 100 and 200 mm Hg pressures and reported that the average heart rate and average arterial blood pressure and arterial blood oxygen saturation have been equal in both groups[11].

MATERIALS AND METHODS

1. Objective: Despite many studies in the field of comparison of closed and open suctioning methods, no studies have been so far conducted for comparison of the standard recommended method and the routine method used by the nurses for endotracheal tube suctioning; thus, the researcher decided to carry out a study for comparison of the standard suctioning method and the routine method on vital signs and arterial blood oxygen saturation and sedation and agitation level of the patients hospitalized in ICU.

2. Patients and methods:

2.1. Study design: This quasi-experimental study was conducted, after obtaining the ethics code no. 138/91/k from Kerman University of Medical Science, on 80 adult patients hospitalized in ICUs of three hospitals of Zahedan City in 2012. As the patients were not conscious, informed consent was obtained from their First-degree family members.

2.2.

2.3. Intrusion and exclusion criteria: referred to the age range between 18-65 years, constancy of hemodynamic symptoms, lack of reception of inotropic and Chrono tropic drugs for maintenance of blood pressure and heart rate, having a sinus heart rhythm, minimum duration of stay of 48 hours and ventilation with $fio_2$40% in the last 24 hours and positive end-expiratory pressure of 5 cm of water, not having the signs of increased ICP; the exclusion criteria of the study included: clear hemodynamic changes and a sharp drop in the level of arterial blood oxygen saturation and the need for the change of level of fio_2 in the study.

2.4. Sample size and randomization: The sample size was considered as 80 subjects based on the results of a study[7].The formula for calculating sample size. Sampling was done purposively. Subsequently, by means of the table of random numbers they were divided into two groups of forty subjects.

2.5. Data collection tools: It included a pre-designed form in which the demographic characteristics and vital signs and arterial blood oxygen saturation and Richmond agitation sedation scale of the patient, before suctioning and in the minutes 1, 5, 10, 15 after suctioning were recorded.

Richmond agitation sedation scale (RASS) is one of the recommended scales for measurement of the sedation and agitation level in ICU. This scale is a 10-point continuum of -5 to +4 with three levels. In these tools, five negative points, zero point and four positive points have been allocated to the sedation level, normal and calm behavior and the agitation level respectively (table 1). The validity of these tools was previously confirmed by Ely and Sessler [12, 13]. In the study by Ely, reliability of these tools has been reported to be between 79 and 91% by means of Cronbach's alpha coefficient. Tadrisi et al. reported that these tools with the visual analog of 0.76 (r) and inter-group coefficient of concordance of 0.95 have a proper validity and reliability for measurement of sedation of patients in ICU [14].

Table 1: Richmond agitation sedation scale

Description	Definition	Point
The patient is too nervous and aggressive and can be dangerous for the nurse.	Rough and irritable	+4
The patient kills and brings out the tubes and catheters and has an aggressive behavior.	Very agitated	+3
The patient has pointless and repetitive movements. The patient's ventilation is not placed on the synchronizer system.	Agitated	+2
The patient is anxious and restless but does not show offensive or violent movements.	Restless	+1
The patient is completely calm and comfortable.	Awake and calm	0
The patient is not fully conscious but stays awake for more than 10 seconds and can open his/her eyes with a verbal request.	Sleepy	-1
The patient stays awake for a short time (less than 10 seconds) and opens his/her eyes with a verbal request.	Light sedation	-2
The patient has limited movements with a verbal request (but doesn't have eye contact)	Average sedation	-3
The patient has no reactions to sound but moves by physical stimulation.	Deep sedation	-4
The patient shows no reactions to audio or physical stimulation.	Non-consciousness (coma)	-5

2.6. Methods and indications for suctioning: All patients received airway humidification by means of the same humidifier with the same heat. Suctioning of all the patients was done by means of central suction. Indication needed suctioning in both groups including the increase of airway pressure and start of p peak alarm of the ventilator, auscultation of the coarse crackles sound on trachea, coughs and seeing of the secretions inside the patient's endotracheal tube. In the first group, suctioning was done with the standard method based on the approved protocol of AARC, in such a way that before doing endotracheal suctioning, the patient was hyper oxygenation, for 1 minute with 100% oxygen, with the ventilator. Then, the suctioning procedure started. catheter whose external diameter was less than half of the internal diameter of the patient's endotracheal tube was lowered with sterile gloves, based on the size of the patient's endotracheal tube, to such an extent that it was lowered for fewer than 2 cm . from the patient's endotracheal tube and then the suction device was turned on and by means of the finger tube, the suction pressure was controlled between 120 and 150 mm Hg and for 15 to 30 seconds suctioning was done periodically and then Catheter was excluded and the patient was connected to the ventilator[15].; and in the second group, suctioning was done in the routine method. In the routine method, Latex gloves were used for suctioning and selection of catheter didn't follow a special principle and green Catheter was often used for suctioning, or any other catheter that was available and can enter the endotracheal tube. Before suctioning, hyper-ventilation of the patient with 100% oxygen was not always done. Sometimes, when the suction device was turned off, Catheter entered the endotracheal tube or simultaneous with the turning on of the suction device, Catheter entered the endotracheal tube and suctioning started. Usually an indefinite amount of normal saline solution would be poured into the endotracheal tube through an extension tube attached to a normal saline solution which was prepared for this task, and in some cases also suctioning was done without normal saline. Suctioning didn't have a specific time and would be stopped based on the nurse's diagnosis that no secretion is remaining. Catheter would be inserted into the airway to the end and no control was done on the increase of pressure. It was observed that the pressure of the suction device increased even to 400 mm Hg in some cases. In both groups, before suctioning and the minutes 1, 5, 10, 15 after suctioning, vital signs and arterial blood oxygen saturation and Richmond agitation sedation scale were measured and recorded.

2.7. Data analysis: The data was analyzed in SPSS18 Software with the independent t-test for comparison of the average inter-group scores at different times and analysis of variance of repeated measures ANOVA test for study of the impact of time on the obtained scores and ($p>0.05$) was considered as significant.

2.8. Ethical considerations: Approval of the project in Kerman University of Medical Sciences and reception of the ethics code no. 138/91/k and going through the official process of coordination with the relevant hospitals and

obtaining informed consent from the first-degree family members and assuring them regarding the confidentiality of the data.

2.9. Limitations: Limitation of this study was lack of a study in the field of investigation of performance of suctioning by ICU nurses.

RESULTS

From a total of 80 patients, 64 subjects were male and 16 subjects were female. The average age of the patients was 32.5 with the standard deviation of 10/6 years. No statistically significant difference was observed between the two groups in terms of age and gender with the independent t-test (p=0.264 ،p=0.220).

Based on the results of independent t-test, Richmond average score before suctioning was the same in the patients of both groups and there was no statistically significant difference between them (p=1); yet in the times of 1 and 5 minutes after suctioning, a significant difference was observed between the Richmond average scores of the patients in both groups, in such a way that the average scores showed that suctioning had led to the increase of Richmond score in the patients of group two in comparison with the patients of group one (p=0.000 ،p=0.000). Richmond score in the minutes 10 and 15 after suctioning was the same in the patients of both groups and there was no statistically significant difference between them (p=0.186 ،p=0.32).

Study of the changes of time with the repeated measures ANOVA test showed that the average score of Richmond in group one, after suctioning in all the times (1, 5, 10 and 15 minutes) had increased after suctioning in comparison with before suctioning , but this difference was significant only in the minutes 1 and 5 (p=0.000 ، p=0.01). Average score of Richmond in group 2 like group one, after suctioning in all the times (1, 5, 10, and 15 minutes) had increased in comparison with before suctioning. This difference was significant in the minutes 1, 5 and 10 (p=0.000 ، p=0.000 ،p=0.006).

The independent t-test showed that the average systolic blood pressure before suctioning was the same in both groups and that there was no statistically significant difference between them (p=0.73). Also, in none of the times of 1, 5, 10, 15 minutes, a significant difference was observed between the two groups in terms of the average systolic blood pressure (p>0.05).

Study of the changes of time in the patients of each group with repeated measures ANOVA test showed that the average systolic blood pressure in group one, after suctioning in the times (1, 5, 10 minutes) had increased after that compared with before, yet this difference was significant in none of the minutes (p>0.05). In the minute 15 after suctioning, systolic blood pressure showed a reduction compared with before and this difference was not statistically significant (p>0.05). Based on the results of this test, average systolic blood pressure in group 2 after suctioning in all the times (1, 5, 10 and 15 minutes) had increased compared with before. This difference was significant in the minutes 1, 5 and 10 (p=0.000 ،p=0.000 ،p=0.000).

By means of independent t-test no statistically significant difference was observed in the average diastolic pressure of the two groups before suctioning (p=0.80). Although the average diastolic blood pressure in all the minutes after suctioning in group two was more than the patients in group 1, this difference was statistically significant only in the minute 15 (p=0.04).

Study of the changes in different times with the repeated measures ANOVA test showed that diastolic blood pressure average in group one, after suctioning in all the times, had a decreasing trend compared with before; yet this difference was significant only in the minute 15 (p=0.03). Based on the results of this test, diastolic blood pressure average in group two after suctioning in all the times (1, 5, 10 and 15 minutes) had increased compared with before. This difference was significant in the minutes 5 and 10 (p=0.006، p=0.01)

In the average heart rate of the patients of the two groups before suctioning with the independent t-test, no statistically significant difference was observed (p=0.34). The average number of heart rate of patients in group two in all the minutes after suctioning was more than group one. This difference was statistically significant in the minutes 1, 5 and 10 (p=0.001 ،p=0.000 ،p=0.002).

Study of the changes in different times in every group with repeated measures ANOVA test showed that the average number of heart rates in group 1 after suctioning in the minutes 1 and 5 was significantly more compared with before (p=0.000 ،p=0.009). Based on the results of this test, the average number of heart rates in group two after suctioning in all the times (1, 5, 10 and 15 minutes) was significantly more compared with before (p=0.000 ، p=0.000 ،p=0.000 ،p=0.004).

The average oxygen saturation before suctioning in the patients of both groups with the independent t-test did not have a statistically significant difference (p=0.24). Average oxygen saturation of the patients in group one in all the minutes was more than the patients of group two but this difference was statistically significant only in the minute 5 (p=0.04).

Study of the changes in different times in the patients of each group with repeated measures ANOVA test showed that the average oxygen saturation in group one, after suctioning in the minutes 5, 10 and 15, was significantly more than before (p=0.001 ،p=0.000 ،p=0.000). Based on the results of this test, average of oxygen saturation in group two after suctioning in the minutes 10 and 15 had slightly increased but this increase was not statistically significant compared with before (p>0.05) (diagrams 1 and 2).

Diagram 1: changes of arterial blood oxygen saturation in standard suction group

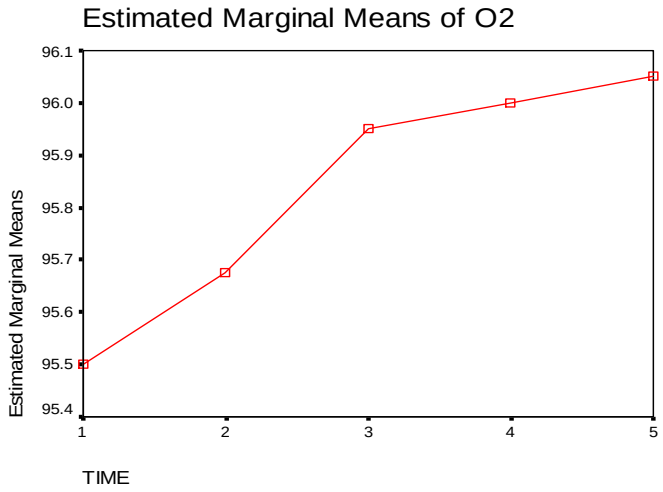
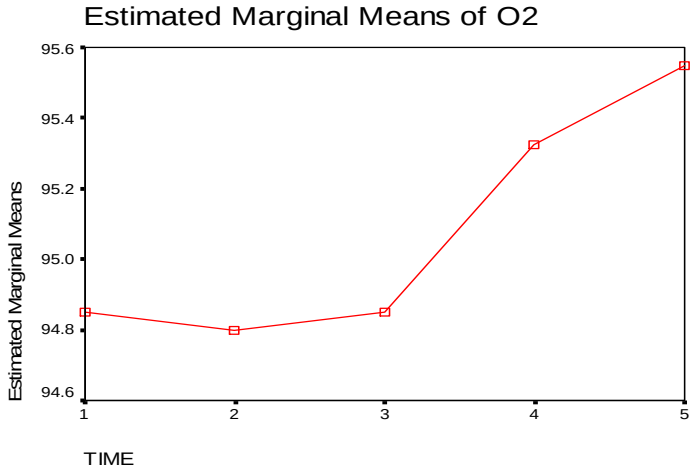


Diagram2: changes of the level of arterial blood oxygen saturation in the routine suction group



DISCUSSION

The results of this study showed that suctioning leads to the increase of restlessness and agitation in patients and this increase until the minute 10 is more in the second group than in the first group, which is in line with the results of the study by Abbaszadeh et al. In their study that had compared the two methods of pain relief, after suctioning, they witnessed the increase of restlessness or agitation and pain in both groups[16]. In their study, the patients in both groups had received the same suctioning method but in this study the suctioning methods were different but in any way suctioning leads to the increase of restlessness or agitation and several factors such as depth, time and pressure of suctioning can be among the important and effective factors in establishing restlessness or agitation and as in the first group more control was applied on these factors, there was also less increase in the agitation level compared with the second group. Also, in the study by Sole et al., it was shown that suctioning leads to the increase of pain and agitation or restlessness in the patients[17]. In line with the results of the present study, in the study by Rahu et al. suctioning in the patients led to the increase of pain and agitation or restlessness and there was a statically significant difference compared with before suctioning[18]. In terms of vital signs also, suctioning led to some changes, systolic blood pressure in group 1 after standard suctioning in all times had a slight increase but this difference was not statistically significant; yet in the second group this increase was high and in all the times there was a statistically significant difference compared with before. In the field of diastolic pressure in group 1 we had witnessed the reduction of diastolic pressure in all the times compared with before suctioning, while in the second group where routine suctioning had been done, in all the times we had witnessed the increase of diastolic blood pressure compared with before suctioning. In the study by Abbaszadeh et al. in both groups they had witnessed the increase of systolic and diastolic pressures after suctioning, which is not fully consistent with the results of this study, since in group one we had witnessed the reduction of diastolic pressure although the type of suction received in this study was different in this group[16]. In the study by Nazmiyeh et al. that had compared the two open and close suctioning methods, they witnessed the increase of systolic pressure and this increase continued in both groups until the minute 10 and then the reversed process also witnessed the increase of diastolic pressure only in the minute 1 after suctioning, while in the other times they had witnessed the reduction of diastolic pressure compared with before suctioning in both groups, and this reduction was higher in the open suctioning method. We also witnessed the reduction of diastolic pressure in group one, which is compatible with their results, although in our study both groups had been suctioned in the open suctioning method[19]. In the field of the heart rate also suctioning in both groups had increased the heart rate while in group one after the minute 5 the rate had returned to its base state while in group two this increase of the heart rate had continued until the minute 15 and hadn't neared the base level and the difference was significant in all stages compared with before suctioning, and this difference can be related to the depth and time or the suction pressure and also use of normal saline in the second group. In the study by Iranmanesh et al. they had witnessed an increase in the heart rate in both suctioning groups with and without normal saline and this increase was higher in the normal saline group, which is in line with the results of this study[20]. Arterial blood oxygen saturation of the patients after suctioning increased in both groups but this increase was done with more delay in the second group and started from the minute 10 after suctioning and didn't have a significant difference compared with before, while in group 1 in all the times the difference was significant. In the study by Sole et al. that conducted endotracheal tube suction with the standard method and the indications of this study, they witnessed an increase in arterial blood oxygen pressure after suctioning, which is compatible with the results of this study[17]. In the study by Iranmanesh et al. they had witnessed the negative changes of oxygen saturation in the suction group with normal saline. In this study, we did not witness the reduction of arterial blood oxygen saturation but in the second group increase of oxygen saturation was conducted with more delay[20]. In the study by Sanagoo et al. that compared the three suctioning methods with normal saline and N-Acetyl cysteine (NAC) and without them, they reported that in all three groups, the level of arterial blood oxygen saturation had decreased in the minutes 2 and 5 after suctioning while the level of heart rate and blood pressure had increased in these minutes compared with before, which is not compatible with the results of this study. In none of the groups, we had witnessed the reduction of arterial blood oxygen saturation. Only in the routine suctioning group, the increase occurred with a slight delay and regarding the pulse and blood pressure in this study we also witnessed the increase of both compared with before suctioning [2]. It is suggested to educate nurses about these issue because the educatioalists belived that training and teaching lead in learning but the sustainability and depth is different in various teaching methods. [21] one of purposes of the education and training is providing the condition for growth and expansion of the talents and capabilities and one of this method is workshop 22].

CONCLUSION

Suctioning with the standard method has led to fewer changes in vital signs and creates less agitation or restlessness in the patients. Also, increase of arterial blood oxygen saturation happens at a time earlier than the routine method. Thus, use of this method should be contained in the work program of the nurses with adequate education. Also, based on the effects or complications resulting from the usual routine method and the short duration of this study, it is recommended that a long-term study be conducted for analysis of the relationship between the type of suctioning and creation of ventilator-associated pneumonia.

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The authors' Share of Work:
Ali Akbar Keykha: data collection and compilation of the paper
Hasan Askari: data collection and assistance in compilation of the paper

Abbas Abbaszadeh: advising in development of research, statistical analysis and final confirmation of the paper
Azizollah Arbabisarjou: Editing and revising this paper carefully

Hasan Enayati: participation in implementation of research and supervision over data collection
Bibi Mahdieh Khodadadi Hosseini: participation in implementation of research

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