Journal of Research in Medical and Dental Science
Volume 5, Issue 6, Page No: 89-94

Available Online at: www.jrmds.in
eISSN No. 2347-2367: pISSN No. 2347-2545

Comparison of Changes in Arterial Blood Oxygen Saturation and Occurrence of Cardiac Dysrhythmia in Patients with Head Trauma undergoing Open and Closed Suction

Behrouz Dadkhah[1], Asieh Shabani Faramarzi[2]*, Parviz Amri[3], Mohammad Ali Mohammadi[4]

[1] PhD of nursing, Educational nursing, Department of Nursing, School of Nursing, Ardabil University of Medical Sciences, Ardabil, Iran
[2] Student of master degree of critical care nursing, members of student research committee, Department of Nursing, Ardabil University of Medical Sciences, Ardabil, Iran
[3] Associate Professor, Department of Anesthesiology, School of Medicine, Babol University of Medical Sciences, Mazandaran, Iran
[4] Lecturer, student of PhD, Educational nursing, Department of Nursing, School of Nursing, Ardabil University of Medical Sciences, Ardabil, Iran

DOI: 10.24896/jrmds.20175616

ABSTRACT

Endotracheal suctioning is one of the most important care that done continuously in patient with Brain injuries. Type of suctioning affected on the hemodynamic status of patients, this study was performed with the aim of comparing changes in Arterial Blood Oxygen Saturation and Occurrence of Cardiac Dysrhythmia in head trauma patients with open and closed suction. In this cross-over clinical trial study, 88 patients who under mechanical ventilator were enrolled randomly divided into two groups. Closed and open suctioning each done for each patient and changes on Arterial Blood Oxygen Saturation and Occurrence of Cardiac Dysrhythmia at intervals before, during. Immediately, five, ten and fifteen minutes by using paired t-test, ANOVA with repeated data and Fisher's exact test were performed by software SPSS version 22. 88 patients with ranging from 15 to 45were enrolled. 68% of patients were male. The most cause of head injury was car accident (75%) that the most frequent CT scan findings associated with intraventricular hemorrhage (22%). The occurrence of Cardiac Dysrhythmia and changes on Arterial Blood Oxygen Saturation was more in open method of endotracheal suctioning. There were significant relationships between Arterial Blood Oxygen Saturation and occurrence of Cardiac Dysrhythmia in Multiple time intervals with type of suctioning.($p<0.001$). According to the findings, to reduce Arterial Blood Oxygen Saturation and incidence of Cardiac Dysrhythmia due to endotracheal suctioning, the use of closed suction in the intensive care unit is recommended.

Keywords: Head Trauma, Open Suctioning, Closed Suctioning, Arterial Blood Oxygen Saturation, Cardiac Dysrhythmia

HOW TO CITE THIS ARTICLE: Behrouz Dadkhah, Asieh Shabani Faramarzi, Parviz Amri, Mohammad Ali Mohammadi, Comparison of Changes in Arterial Blood Oxygen Saturation and Occurrence of Cardiac Dysrhythmia in Patients with Head Trauma undergoing Open and Closed Suction, J Res Med Dent Sci, 2017, 5 (6): 89-94, DOI: 10.24896/jrmds.20175616

Corresponding author: Asieh Shabani Faramarzi
e-mail✉asiehshabanifaramarzi@gmail.com
Received: 12/06/2017
Accepted: 11/09/2017

INTRODUCTION

Traumatic accidents always shadow humans [1-4]. They account for the second of mortality in advanced countries and the third in Iran [5]. Traumatic brain injuries with the incidence of 31% account for the majority of all injuries [6,7]. Annually, 100,000 people are hospitalized for head injuries, out of which 40-50% die and 35% experience long-term disabilities [8]. Traumatic brain injury (TBI) is more prevalent among men [1].The first priority in the care of all trauma

patients (GCS≤8) is intubation. Since patients with endotracheal tube cannot clear secretions and it is important to maintain oxygenation in them [9], periodical suction is needed and should be done carefully [10], [11]; otherwise, arterial blood oxygen may reduce [12], leading to cardiac dysfunction and dysrhythmia [10], [13]. As a result, in addition to careful implementation of suctioning procedure, the selection of an appropriate endotracheal suctioning method can be helpful for minimizing these complications [10], [14], and [15]. At present, open suction is common in intensive care units; however, closed suction is sometimes administered. Regarding the attempts made to minimize secondary injuries, mainly caused by open suction, as well as contradictory results of the existing studies regarding the effects of open and closed suction on changes in the percent of arterial blood oxygen saturation (ABOS) and occurrence of cardiac dysrhythmia (CD), we intended to conduct this study.

MATERIALS AND METHODS

This cross-sectional double-blinded clinical trial with 80% power and 5% error rate was conducted as a part of a thesis study on 88 patients with traumatic brain injuries with the Glass cow Coma Scale (GCS) of 4-8 [3], undergoing mechanical ventilation in the surgical intensive care unit (SICU) of Shahid Beheshti Medical-Educational Hospital, affiliated to Babol University of Medical Sciences. The subjects were selected using convenience sampling technique, after obtaining the clinical trial registration code (IRCT2015092624213N1) and approval of the Ethical Committee of Ardabil University of Medical Science (IR.ARMUS.1394.21). In this study, endotracheal tube was placed for all patients [4] and patients without history of underlying diseases (such as chronic obstructive pulmonary disease and increased intracranial pressure), patients intubated over the past 72 hours, and patients with normal vital signs were included. On the other hand, patients in need of frequent suction were excluded. In this study, a two-part questionnaire was used. The first part included demographic information (age, gender, causes of head injury, GCS, CT-scan results, and radiology test results) and the second part included information concerning the percent of ABOS [16] and incidence of cardiac dysrhythmia. The observed variations in relevant variables of carefully monitored patients were recorded in a certain form. The selection of the type of suction was done using computer generated random numbers. After the selection of patients, standard suction protocol was used [17]; in addition, both open and closed suction procedures were administered to all patients. During the suction, the patient's head was positioned at 30° with the flexed neck [18] to prevent intracranial pressure increase [6]. To eliminate the remaining effect [7], 90-minute interval was considered between each two suctions [19]. In the open suction, the patient is released from the incubator and the secretions are removed through inserting a suction catheter (diameter 1.5 mm) [20] into the endotracheal tube with the maximum negative pressure of 20-30 Kappa [21]. After the end of the suction procedure, the patient is connected to the ventilator again. In the closed suction system, there is no need for releasing the incubator; rather, ventilation is done by positioning the suction catheter between the endotracheal tube and the ventilator circuit. The closed suction catheter can be replaced every 72 hours [22]. Before the suction, all patients were connected to the ventilator and hyper oxygenated with 100% oxygen for two minutes. Then, the percent of ABOS and the incidence of CD were measured before, during, and 5, 10, and 15 minutes after the suction. Immediately after the end of the suction, pre oxygenation with 100% oxygen was done for 2-3 minutes, and each method lasted for 5-10 seconds (17), (20).The obtained data was then analyzed with descriptive analysis techniques, ANOVA, chi-square test, and paired t-test in SPSS version 22.

RESULTS

In this study, 88 patients with the mean age of 29±9 years (ranging from 15 to 45) were included, out of which 60 patients (30%) were men and 28 patients (31%) were women. Car accident was the major cause of head injuries (75%). Radiology and CT-scan test results in patients with the conscious level between 4 and 8 were investigated in a one year study (2015-2016). Stress fractures were observed in 22% of patients with head injuries. The greatest frequency (22%) of CT-scan test results (Table 1) was for intraventricular hemorrhage. The open and closed suction methods were used in both groups (n=44) to investigate the variations in the percent of ABOS and occurrence of cardiac dysrhythmia in

different time intervals. Findings of this study showed that the most prevalent type of cardiac dysrhythmia during and immediately after open suction was sinus tachycardia; whereas, only two cases with ventricular para systole and sinus tachycardia was observed in the closed suction. These findings indicated a significant relationship between cardiac dysrhythmia and suction type (p<0.001). There were one case with ventricular Para systole and eight cases with sinus tachycardia within the first five minutes after open suction; whereas, only one case with ventricular par asystole was observed in the closed suction, indicating a significant relationship between the two methods in term of the occurrence of ventricular par asystole (p=0.006). In addition, one case with ventricular par asystole was observed within the first 10 minutes after the closed suction; whereas, seven cases with sinus tachycardia and one case with ventricular par asystole were observed in the open suction, indicating a significant relationship these time intervals (p=0.012). In addition, no cardiac dysrhythmia was observed 15 minutes after closed suction; whereas, two cases with sinus tachycardia were observed 15 minutes after open suction, indicating a significant relationship between the open suction method and the occurrence of cardiac dysrhythmia (p<0.001). Table 2 presents the occurrence of cardiac dysrhythmia in aforementioned time points for both the open and closed suction methods. The greatest change in the percent of ABOS was occurred 10 minutes after the open suction (95±4) and closed suction methods (97±3). The minimal change in the percent of ABOS in open suction was observed during the suction and five minutes after it relative to pre-suction (86±4 and 91±3 versus 92±3); whereas, the minimal change in the percent of ABOS in the closed suction method was observed during the suction relative to pre-suction (92±3 versus 93±3). Table 3 shows the mean changes in the percent of ABOS in several time intervals based on the type of suction. Changes in the percent of ABOS are presented in Table 1.

Table 1: Frequency of CT-scan finding in head trauma patients

CT-scan findings	Frequency(percent)
subarachnoid hemorrhage	17 cases (19%)
Intraventricular hemorrhage	20 cases (22%)
epidural hemorrhage	16 cases (18%)
subdural hemorrhage	19 cases (21%)
contusion	16 cases (18%)

Table 2: Occurrence of Cardiac Dysrhythmia in times after closed and opening endotracheal suctioning

Time	During suction	immediately after suctioning	Five minutes after suctioning	Ten minutes after suctioning	Fifteen minutes after suctioning
Open suctioning	28 %63/1	25 %56	9 %20	8 %17	2 %4
Closed suctioning	4 %8	4 %8	1 %2	1 %2	0
p-value*	p<0.001	p<0.001	P=0.006	p<0.001	p<0.001

** Exact Fisher's test*

Table 3: Mean arterial blood oxygen saturation changes in multiple time intervals based on the type of suction (mean±SD)

Time	T_B	T_D	T_I	$T_{5\ minute}$	$T_{10\ minute}$	$T_{15\ minute}$	P*
SPo_2							
Open suctioning	92±3	86±4	88±9	91±3	92±4	95±4	<0/001
Closed suctioning	93±3	92±3	93±3	94±3	95±3	97±3	<0/001
P**		<0/001	>0/05	<0/001	<0/001	<0/001	

T_B :Time before suctioning; T_D: time during suctioning; T_I: time immediately after suctioning; $T_{5\ minute}$: five minutes after suctioning; $T_{10\ minute}$: ten minutes after suctioning; $T_{15\ minute}$: fifteen minutes after suctioning; P: Repeated Measured Analyze*

*P** :paired T-Test*

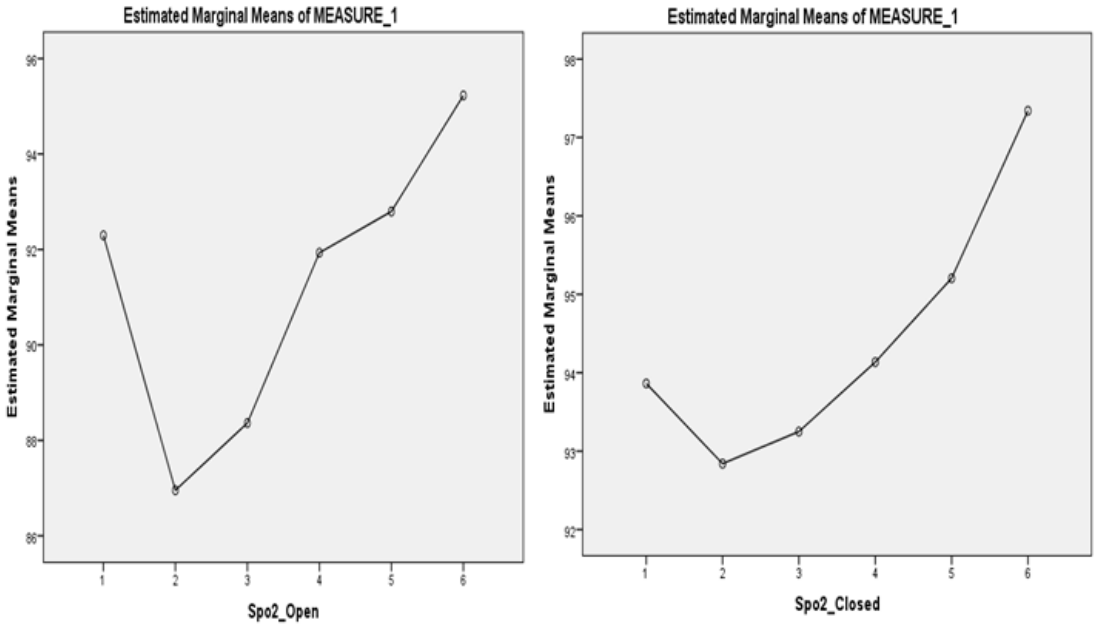

Figure 1: Changes in Arterial Blood Oxygen Saturation with the type of Endotracheal suctioning

According to this table, these changes in closed suction are regular, but are not in the open suction. In the open suction, the percent of ABOS before suction was larger than in 10-minute after suction, but started to increase afterwards; whereas, since there was no need to disconnect ventilator in the closed suction method, the percent of ABOS was lower than the pre-suction percentage of ABOS only during the suction, and started to increase five minutes after the suction.

DISCUSSION AND CONCLUSION

This study was conducted aiming to compare changes in the percent of ABOS and occurrence of cardiac dysrhythmia among 88 ICU patients with traumatic head injuries, undergoing both open and closed suction. Results showed greater incidence of cardiac dysrhythmia in open suction method than in closed suction. This finding is consistent with the finding of Seyyed Mazhari et al.'s study, entitled "effect of open and closed suction on heartbeat rhythm of patients hospitalized in ICU" [23]. In this study, there was a significant difference between post-suction time intervals in terms of the occurrence of cardiac dysrhythmia. Seyyed Mazhari et al. reported that the type of suction did not change cardiac rhythm, which is inconsistent with the finding of the present and previous studies. However, this inconsistency was due to the difference in research subjects (patients with traumatic brain injuries in the present study versus all patients hospitalized in ICU in Mazhari's study).

Alipour et al. [24] in a study, entitled "comparison of effect of open and closed suctions on hemodynamic condition of ICU patients," reported that there was no significant between-methods difference in terms of cardiac dysrhythmia frequency. This finding was consistent with the findings of Iron et al. [21] and inconsistent with those of the present study, which may be due to the difference in research samples. Previous studies included all ICU patients; whereas, this study was conducted only on ICU patients with traumatic head injuries. According to the results, there was a greater increase in the percent of ABOS in closed suction than in open suction; however, the between-methods difference was not significant for all time intervals, except for immediately after the suction. Lee et al. [25] concluded that the percent of ABOS decreases immediately after open suction, which is consistent with the findings of the present study. The mean difference in the percent of ABOS between immediately after and during suction was greater in the open suction method than closed suction method, which is consistent with the finding of Afshari et al. [26] A significant relationship was observed between the percent of ABOS and the suction type in each time interval.

This finding is consistent with the findings of SeyyedMazhari et al. [23] and Ozden et al. [27]. Zolfaghari et al. [10] reported that the percent of ABOS in the first five minutes after open suction decreased, which is consistent with the finding of the present study.

In conclusion, changes in the percent of ABOS and occurrence of cardiac dysrhythmia, as life threatening factors for patients with traumatic head injury, were lesser in patients undergoing closed suction than open suction. Although closed suction is a more costly method than open suction, it is recommended to be used to decrease and moderate aforementioned ICU complications.

Acknowledgments
The researchers thank and appreciate the vice counselor of research of Medical Sciences University of Ardabil and Babol and treatment management of the Social security organization of babol and the staff of the SICU.

REFERENCES

1. Saxena S, Sharan P, GARRIDO M, Saraceno B. World Health Organization's mental health atlas 2005: implications for policy development. World psychiatry. 2006;5(3):179.
2. Sharma B. Development of pre-hospital trauma-care system—an overview. Injury. 2005;36(5):579-87.
3. Krug EG, Sharma GK, Lozano R. The global burden of injuries. American journal of public health. 2000;90(4):523.
4. af Wåhlberg A. Driver behaviour and accident research methodology: unresolved problems: Ashgate Publishing, Ltd.; 2012.
5. K M, al e. Trauma Nursing: Philadelphia: WB Saunders company; 2002.
6. Rangraz jedi F, Farzandipour M. Epidemiology of trauma in patients admitted to NAGHAVI hospital in Kashan city Kashan university of medical science journal. 2001;6(2):88-93.
7. Soleimani H, Iranfar S. Investigating the causes of trauma patients admitted to the surgical ward of Taleghani hospital in Kermanshah. Journal of kermanshah university of medical sciences 2001;4(1):65-70.
8. Merri A, Stiecy K. In: Esmaeilzadeh Noghabie F, editor. book of critical care of Tellan 3. Tehran: Hakim Hidjie; 2012. p. 161-78.
9. Davaei M, Soroush A, Tahmasbie MN. Emergency surgery, urology, orthopedics and practical skills: Noordanesh publisher; 2009.
10. Zolfaghari M, Nikbakht Nasrabadi A, Karimi Rozveh A, Haghani H. Effect of Open and Closed System Endotracheal Suctioning on Vital Signs of ICU Patients. Journal of Faculty of Nursing and Midwifery, Tehran University of Medical Sciences ,HAYAT. 2008;14(1):13-20.
11. Rafiei MR, Hojjat M, Ebrahimi A, Sadeghi A. The effect of three methods of oral administration, endotracheal and intravenous N-acetylcysteine on respiratory parameters in patients with stroke and undergoing mechanical ventilation admitted in the intensive care unit. Journal of Esfahan Medical School. 2013;26.
12. Etemadifar s, Nemati S, Aslani Y, Mehr-Alian HA. effect of intratracheal suctioning on hemodynamic parameters and arterial oxygen. Iran Journal of Nursing. 2008;21(54):31-9.
13. Nazmiyeh H, Mirjalali MR, Emami Maibodi R. comparison the eefect of open and closed endotracheal suctioning on cardiovascular and ventilation parameters for patients undergoing medical ventilation. Journal of Rafsanjan medical school. 2010;9(2):97-106.
14. Akgül S, Akyolcu N. Effects of normal saline on endotracheal suctioning. Journal of Clinical Nursing. 2002;11(6):826-30.
15. Stackhouse RA, Infosino A. Airway management. Stoelting RK, Miller RD Basics of Anesthesia 5th ed Philadelphia, PA: Churchill Livingstone. 2007:231-2.
16. McQuillan KA, Makic MBF, Whalen E. Trauma nursing: From resuscitation through rehabilitation: Elsevier Health Sciences; 2008.
17. Asgari M. Intensive nursing care in ICU, CCU and dialysis wards. ed, editor. Tehran: Boshra2004.
18. Miller RD, Pardo M. Basics of anesthesia: Elsevier Health Sciences; 2011.
19. Crisp L, Taylor C. Fundamentals of nursing. Philadelphia: Mosby2005.
20. Mofrad MN, Shiri H. Intensive Care in ICU. Tehran: Noor-Danesh pub; 2013.
21. Jongerden IP, Kesecioglu J, Speelberg B, Buiting AG, Leverstein-van Hall MA, Bonten MJ. Changes in heart rate, mean arterial pressure, and oxygen saturation after open and closed endotracheal suctioning: a

prospective observational study. Journal of critical care. 2012;27(6):647-54.
22. Chulay M. AACN essential of critical care nursing. edition t, editor: tehran: jameeh negar,Salemi; 2010.
23. Seyyed Mazhari M, Pishgou'ei AH, Zareian A, Habibi H. Effect of open and closed endotracheal suction systems on heart rhythm and artery blood oxygen level in intensive care patients. journal of critical care nursing. 2010;2(4):133-37.
24. Alipour N, Toulabi T, Manouchehrian N, Anbari K, Rahimi Bashar F. A comarison the effect of open and closed endotracheal suctioning on hemodynamic status of patients in the ICU. Journal of evidence care. 2015;3(9).
25. Lee ES, Kim SH, Kim JS. Effects of a closed endotracheal suction system on oxygen saturation, ventilator-associated pneumonia, and nursing efficacy. Journal of Korean Academy of Nursing. 2004;34(7):1315-25.
26. Afshari A, Safari M, Oshvandi K, Soltanian AR. The effect of the open and closed system suctions on cardiopulmonary parameters: time and costs in patients under mechanical ventilation. Nursing and midwifery studies. 2014;3(2).
27. Ozen D, Gorgulu RF. Effects of open and close suction systems on the haemadynamic parameters in cardiac surgery patients. British Association of critical care nurses. 2014.