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Effect of Open versus Closed Endotracheal Suctioning System on Vital Signs among Mechanically Ventilated Patients in ICU.

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Abstract:
Background:-*Endotracheal suction is a recurrent and essential procedure in patients with mechanical ventilation. Suction airway leads to mucosal stimulation and mucus production. Cardiovascular disorder and sever hypoxia are significant complications of suction. Therefore, selecting the least dangerous way of endotracheal tube suction can reduce severe complications.*
Aim of the study: *this study aimed to determine the effects of open versus closed endotracheal suctioning system on vital signs among mechanical ventilated patients in ICU.*
Materials and methods: *Quasi experimental design was used in this study. This study was conducted in anesthetic ICU at Tanta Emergency Hospital. Forty patients on mechanical ventilation attending from the previous setting were included in the study.*
Tools of the study: *one tool was divided into three parts used in this study, data were obtained firstly by using a socio-demographic data form of patients, the second is the clinical patient's data and the third part is an assessment tool for vital signs and O_2 saturation in three consecutive times.*
Results: *Regarding the mean scores of vital signs among the studied sample before and after suctioning ,it was observed that there was a significant differences in the closed suction method in relation to respiratory rate before, after two and five minutes of suctioning. The difference was not significant in relation to O2 saturation, heart rate and blood pressure.*
Conclusion and recommendations: *Open and closed suction were effective methods on heart rate and arterial blood oxygen saturation stability, where the closed suction method causes less changes in patient's vital signs than open one.*
Keywords: *Closed suction; open suction; mechanical ventilation.*

I. Introduction

Advanced technology creates an extensive change in treatment and care of critically ill patients by using new methods of treatment and skilled nursing staff.(1) Mechanical ventilation is supportive therapeutic modality used to assist patients who are unable to maintain adequate oxygenation and Carbon dioxide elimination.(2,3) Endotracheal suctioning (ES) is a procedure performed to remove secretion from the patient's airway which aspirated through a suction catheter placed proximal to the secretions inserted through the mouth or nose, tracheal stoma, a tracheostomy tube, or an endotracheal tube.(4,5) It is essential and frequently procedure for patients requiring mechanical ventilation, which regularly clean and suction the artificial airway to maintain ventilation, provide optimal oxygenation, avoid accumulation of secretions which lead to tube occlusion, increased work of breathing, decreased atelectasis, and pulmonary infections.(6,7) The statistical records in Tanta Main University Hospital reported that about 920 patients admitted to anesthetic care unit from 2014-2015, about 75% of these patients on mechanical ventilation and more than 80% of them need suction. Today, about 7.8% of patients require post-surgery care in ICU.(5) Since the main problem of these patients is the respiratory system, thus endotracheal intubation and mechanical ventilation are increasing in these units.(8-10) Establishing these artificial air ways leads to increase mucus stimulation and production.

Although endotracheal tube suction is a device to remove secretions and keep the airways open, it causes many complications, some of the early complications of suctioning are; changes in heart rate, blood pressure, breathing and oxygen saturation percentage and other complications as disturbances hypoxemia (due to interruption of the mechanical ventilation and subsequently the decay of intrathoracic pressure), microbial contamination of airway and environment and development of ventilator-associated pneumonia (VAP).(11-13) Hypoxia resulted from suction puts pressure on cardiovascular system and lead to tachycardia, dysrhythmias, increase blood pressure, increase breathing pressure and eventually cyanosis and dizziness. Therefore, assessing vital signs during endotracheal tube suctioning is necessary for controlling and preventing more serious complications.(14-16)

There are two methods for endotracheal tube suction (ETT), open and closed method. The most common method used for ETT suctioning in patients is the open technique.[17, 18] The standard of open method to remove secretions of patients' airway is performed by separating the patient from ventilator and crossing the sterilized suction catheter through the endotracheal tube. Closed suction technique is done by connecting an instrument to the ventilator which allows suction catheter enters into endotracheal tube through a one-way valve without removing the patient from the ventilator.[19-21] Continuation of mechanical ventilation during suctioning would keep positive end-expiratory pressure (PEEP) with minimal changes in fraction of inspired oxygen (FIO_2).[22, 23] Although the closed suction method is costs, it has advantages as reduce respiratory pollution and pulmonary infections. Another potential advantage is its easy application, which only needs one nurse.[24] In closed suction method, nurse would not be infected by patient's endotracheal tube secretions and suction catheter can be used frequently. Following principles and choosing a suitable method of (ETT) suctioning is necessary to minimize the complications of (ETT) suction.[25] The open suction system has some advantages such as a lower incidence of pneumonia, less physiological changes during the procedure, less bacterial contamination and lower costs.[26] Until now, there are no concrete evidences of one system being better than the other. Therefore the study was performed to illustrate which of these methods have less effect on vital signs stability.[27] The ventilated patients are not able to cough effectively and excrete secretions due to larynx closure and decrease in intra thoracic pressure; therefore, suction is very important method for cleaning and removing the airway secretions if performed correctly and according to standard of care, it will lead to decrease the complications such as cardiac arrhythmias, infection, decrease of blood oxygen, damage to the mucus layer, increase in carbon dioxide pressure, intracranial pressure rising, atelectasis or even death. In addition, suction itself causes stimulation of mucus and evacuation of oxygen from airways.[28]

At the present time, the most common method used for ETT suctioning in patients is the open technique that requires patients' disconnection from ventilator and results in pressure drop of airways and lung volume loss.[29] However, in closed method, the patient's suctioning can be done by connecting an interface to the ventilator simultaneous with supplying oxygen. Therefore, due to positive pressure during the suction, the hemodynamic disturbances could be prevented.[30] The present study was performed to evaluate and compare the effect of two methods of suctioning on vital signs among mechanical ventilated patients.

Significance of the study:

The majority of intensive care units at Tanta Main University Hospital used the open suction method and rarely used the closed one, so the researcher emphasis in this study to compare the effect of two methods on vital signs stability and recommended for its used.

Aim of the study:

This study aimed to determine the effects of open versus closed endotracheal suctioning system on vital signs among mechanically ventilated patients in ICU.

II. Material and Methods

Design:

A quasi-experimental study was utilized in the study.

Research hypothesis:

The closed endotracheal suctioning method may have a positive effect on vital signs among mechanical ventilated patients than the open suctioning method.

Setting:

The study was conducted in anesthetic intensive care unit at Tanta Emergency Hospital.

Subjects:

Convenient sample of 40 mechanically ventilated patients in anesthetic intensive care unit at Tanta Emergency Hospital.

Inclusion criteria:

-Both sexes

- Patients' age from 18 to 65 years

-Patients having an ETT and being connected to ventilator with stable hemodynamic parameters (blood pressure, mean arterial pressure, and heart rate).

-The mode of ventilator is SIMV.

-PEEP = 5 cm H_2O, and FI O_2 = 50%.

Tools of data collection:

Data of the study was collected through utilizing the following tool:

Tool (I): Mechanically ventilated patient assessment tool:
Structured schedule was developed by the researcher to collect the data after reviewing related literatures which consisted of three parts:
Part (1): Socio-demographic characteristics which include patients' name, age and sex.
Part (2): Clinical patients' data which include: type of suction, diagnosis, date of hospital admission.
Part (3):Vital signs assessment sheet: which consisted of measurement of vital signs including blood pressure, mean arterial blood pressure, heart rate, respiratory rate and rhythm, arterial blood oxygen saturation percentage for each method of suction (open &close) which measured three times before, 2 and 5 minutes after suctioning.
Content validity*:*
The tool was handed to 5 experts from medical surgical and critical care nursing departments to assess its clarity, validity and applicability which based on their recommendations and the necessary modifications were done.
Content reliability:
The reliability of the tool was 0.78 by using Cronbach's Alpha test and it was done by the researcher.
Methods for data collection

1. An official permission was obtained from the responsible authorities at Tanta Emergency Hospital. This was intended to explain the purpose of the study to facilitate the data collection and to use the closed suction catheters, whereas the open suction catheter is the mostly common used method in the anesthetic ICU.
2. Privacy and confidentiality was maintained.
3. Tool of the study was developed by the researcher after review of relevant literature.
4. A pilot study was carried out on 4 patients to test the feasibility and applicability of the developed tool, accordingly, needed modification was done. The pilot study was excluded from the study sample.
5. A Socio-demographic characteristic was administered for each patient and measurement of patients' vital signs where checked and recorded using monitors before, 2 and 5 minutes after suctioning.

Endotracheal tube suctioning was done once using a closed technique and another time by open technique of the same patient and the interval between the two methods was 90 minutes in order to let the heart rate pattern and the percentage of arterial blood oxygen saturation be back fully to its initial condition after the first suction [(12)]. All patients were hyper oxygenated and the patients' vital signs were measured before, 2 and 5 minutes after the procedures for each type of suction. The heart rate, rhythm, respiratory rate and rhythm, blood pressure (systole and diastole) and the percentage of arterial blood oxygen saturation were measured as recorded by a monitor beside the patient's bed. The data collection was held three times/week for 2 patients /day for about 2months. Each time lasted about three and half hours. The study was conducted on patients who were hospitalized in the anesthetic intensive care units at Tanta Emergency Hospital. Subjects were connected to SIMV mode of ventilator. At every turn of (ETT) suction, the suction was done 1-3times and endotracheal tube suction time was 5 to 10seconds for both methods [(12)]. The patient was excluded from the study if he needed repetitive suctioning or if he needed suctioning with less than 90min intervals or any change in his medication state or his device position within the intervals of the two suctions.

III. Result

Table (1): Distribution of the studied sample according to socio-demographic data (n=40):

Characteristics		N	%
Age	< 20 years	1	2.5
	20-29 years	11	27.5
	40-49 years	1	2.5
	>= 50 years	27	67.5
Sex	Male	26	65.0
	Female	14	35.0
Diagnosis	Cardiovascular disorder	1	2.5
	Respiratory disorder	13	32.5
	Neurological disorder	20	50.0
	GIT disorder	4	10.0
	Renal disorder	2	5.0

Table (1) shows: Distribution of the studied sample according to socio-demographic data, it was observed that about two third of the study sample (65%) were males, more than two third of the study sample (67.5%) were aged more than fifty years old and half of them (50%) were diagnosed as neurological disorder. While small percentages (2.5%) were diagnosed as cardiovascular disorder.

Table (2): Mean scores of vital signs among the studied sample before and after suction (n=40).

vital signs	Open suction				Closed suction			
			Range Mean ± SD	F P			Range Mean ± SD	F P
	Before	After 2 min	After 5 min		Before	After 2 min	After 5 min	
Systolic BP	73-182 21.348±134.85	114-165 15.183±137.80	103-158 15.630±131.75	**1.180** **0.311**	82-164 21.888±135.65	98-160 17.482±131.75	91-180 23.82±133.10	**0.348** **0.707**
Diastolic BP	25-119 24.535±71.35	39-112 21.104±73.05	39-112 21.082±73.40	**0.097** **0.908**	22-84 15.810±65.30	22-90 14.651±62.90	46-80 10.99±66.50	**0.689** **0.504**
Respiratory rate	13-36 6.479±22.65	16-35 5.889±24.30	15-35 6.436±24.90	**1.380** **0.256**	10-29 5.458±18.40	14-27 3.70±20.45	10-35 5.882±21.15	**3.140** **0.047***
O_2 saturation	64-100 8.078±95.35	71-100 7.285±95.40	71-100 8.384±94.65	**0.112** **0.894**	95-100 1.853±97.95	80-100 5.878±96.90	90-100 2.968±98.25	**1.289** **0.280**
Heart rate	64-140 23.073±96.05	68-152 24.862±96.50	64-157 24.762±99.05	**0.178** **0.837**	16-153 27.140±85.50	16-154 27.88±81.80	19-145 27.498±82.45	**0.206** **0.814**

* Significant for P<0.05.

Table (2) shows the mean scores of vital signs among the studied sample before and after suctioning. It was observed that there are significant differences between the three period of closed suction in relation to respiratory rate P= (0.047)

Table (3): Comparison between open and closed suction methods in relation to vital signs among the studied sample throughout period of the study (n=40).

vital signs	Range Mean ± SD					
	After 2 min		T P	After 5 min		T P
	Open suction	Closed suction		Open suction	Closed suction	
Systolic BP	114-165 15.183±137.80	98-160 17.482±131.75	**1.653** **0.102**	103-158 15.630±131.75	91-180 23.820±133.10	**1.300** **0.765**
Diastolic BP	39-112 21.104±73.05	22-90 14.651±62.90	**2.499** **0.015***	39-112 21.082±73.40	46-80 10.990±66.50	**1.836** **0.070**
Respiratory rate	16-35 5.889±24.30	14-27 3.700±20.45	**3.501** **0.001***	15-35 6.436±24.90	10-35 5.882±21.15	**2.720** **0.008*** *
O_2 saturation	71-100 7.285±95.40	80-100 5.878±96.90	**1.013** **0.314**	71-100 8.384±94.65	90-100 2.968±98.25	**2.560** **0.012*** *
Heart rate	68-152 24.862±96.50	16-154 27.880±81.80	**2.489** **0.015***	64-157 24.762±99.05	45-191 27.498±82.45	**2.837** **0.006*** *

Table (3) illustrates Comparison between open and closed suctioning methods in relation to vital signs among the studied sample throughout period of the study. It was observed that after two minutes there was a significant difference between the two methods of suctioning in relation to diastolic blood pressure, respiratory, and heart rate. P= (0.015, 0.001, 0.015) respectively. While after five minutes the significance difference was in respiratory, heart rate and O_2 saturation= (0.008, 0.012, 0.006) respectively.

Table (4): Distribution of studied group of open and closed suction methods according to heart rhythm

Items	Open suction						Closed suction					
	Before		After 2 min		After 5 min		Before		After 2 min		After 5 min	
	N	%	N	%	N	%	N	%	N	%	N	%
Regular	32	80	32	80	32	80	36	90	36	90	36	90
Irregular	8	20	8	20	8	20	4	10	4	10	4	10
χ^2, P	**0.00 , 1.00**						**0.00 , 1.00**					

Table (4) demonstrates distribution of studied group of open and closed suction methods according to their heart rhythm. It was observed that there was no difference between the study groups regarding regularity of heart rhythm but the regular percentage was higher (90%) in closed suction group compare with opened suction group (80%), while the irregular percentage was higher in open group (20%) compare with the closed group (10%).

Figure (1): Comparison between open and closed suction methods according to heart rhythm throughout period of the study (n=40).

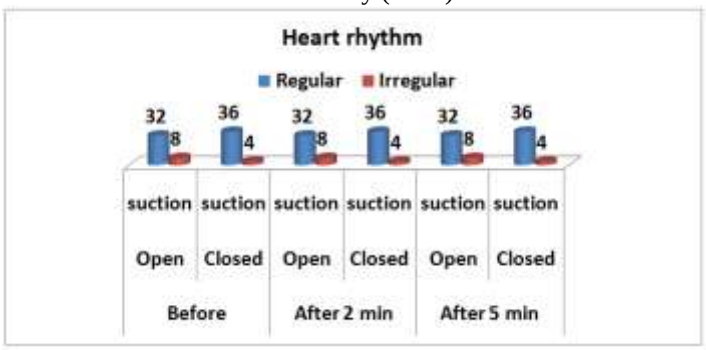

Figure (1): Shows the comparison between open and closed suction methods according to heart rhythm throughout period of the study. It was observed that the heart rhythm was mainly regular in the two methods of suction throughout the period of the study.

Table (5): Correlation between socio-demographic data and mean vital signs scores in open suction method.

Vital signs		Age	Sex		Diagnosis				
			Male	Female	Cardiov--ascular disorder	Respiratory Disorder	Neurological Disorder	GIT disorder	Renal Disorder
		R P	R P	R P	R P	R P	R P	R P	R P
Systolic BP	Before	0.225 0.163	0.096 0.570	0.091 0.577	0.153 0.346	0.009 0.955	0.087 0.594	0.130 0.423	0.249 0.122
	After 2 min	0.060 0.715	0.116 0.459	0.118 0.467	0.097 0.550	0.097 0.550	0.078 0.632	0.246 0.126	0.299 0.061
	After 5 min	0.170 0.295	0.109 0.556	0.009 0.956	0.014 0.932	0.185 0.252	0.104 0.522	0.087 0.594	0.269 0.093
Diastolic BP	Before	0.143 0.379	0.109 0.503	0.109 0.503	0.125 0.442	0.009 0.955	0.078 0.632	0.130 0.424	0.109 0.501
	After 2 min	-0.360* 0.022*	0.055 0.738	0.055 0.738	0.125 0.442	0.065 0.691	0.152 0.349	0.210 0.194	0.169 0.296
	After 5 min	-0.316* 0.047*	0.041 0.802	0.041 0.802	0.125 0.442	0.116 0.477	0.148 0.363	0.130 0.423	0.179 0.268
Respiratory rate	Before	0.095 0.560	0.101 0.537	0.101 0.537	0.014 0.932	0.075 0.648	0.109 0.503	0.029 0.859	0.140 0.388
	After 2 min	0.167 0.304	0.064 0.694	0.064 0.694	0.112 0.492	0.000 1.000	0.092 0.573	0.226 0.161	0.180 0.265
	After 5 min	0.202 0.211	0.041 0.799	0.041 0.799	0.197 0.223	0.042 0.796	0.127 0.433	0.300 0.060	0.171 0.290
O_2 saturation	Before	0.033 0.842	0.267 0.096	-0.267 0.096	0.211 0.191	0.070 0.666	0.066 0.686	0.212 0.188	0.141 0.385
	After 2 min	0.164 0.311	0.166 0.340	0.186 0.250	0.043 0.794	0.019 0.907	0.040 0.806	0.030 0.856	0.122 0.452
	After 5 min	0.059 0.719	0.310* 0.045*	-0.333* 0.036*	0.000 1.000	0.118 0.469	0.106 0.515	0.074 0.652	0.091 0.576
Heart rate	Before	0.162 0.318	0.027 0.867	0.047 0.807	0.209 0.197	0.144 0.377	0.082 0.613	0.080 0.625	0.159 0.326
	After 2 min	0.278 0.083	0.056 0.693	0.086 0.596	0.181 0.264	0.172 0.290	0.195 0.227	0.080 0.625	0.159 0.326
	After 5 min	0.248 0.122	0.036 0.823	0.036 0.823	0.139 0.392	0.065 0.691	0.178 0.272	0.217 0.178	0.130 0.426
Regular heart rhythm	Before	0.079 0.627	0.026 0.872	0.026 0.872	-0.320* 0.044*	0.080 0.623	0.000 1.000	0.042 0.799	0.115 0.481
	After 2 min	0.079 0.627	0.026 0.872	0.026 0.872	-0.320* 0.044*	0.080 0.623	0.000 1.000	0.042 0.799	0.115 0.481
	After 5 min	0.079 0.627	0.026 0.872	0.026 0.872	-0.320* 0.044*	0.080 0.623	0.000 1.000	0.042 0.799	0.115 0.481
Irregular heart rhythm	Before	0.079 0.627	0.044 0.647	0.026 0.872	0.320* 0.044*	0.080 0.623	0.000 1.000	0.042 0.799	0.115 0.481
	After 2 min	0.079 0.627	0.026 0.872	0.024 0.879	0.320* 0.044*	0.080 0.623	0.000 1.000	0.042 0.799	0.115 0.481
	After 5 min	0.079 0.627	0.036 0.772	0.026 0.872	0.320* 0.044*	0.080 0.623	0.000 1.000	0.042 0.799	0.115 0.481

Table (5) Shows correlation between socio-demographic data and mean scores of vital signs in open suction method. It was observed that regarding patient's age there was significant negative correlation between age and diastolic blood pressure two and five minutes after suctioning. In addition, there was significant negative correlation between sex and O_2 saturation five minutes after suctioning. In relation to the diagnosis there was a significance positive correlation between cardiovascular disorder and irregular heart rhythm in every time of measurement while there was significant negative correlation between cardiovascular disorder and regular heart rhythm in every time of measurement . Since P value =0.044 in each other.

Table (6): Correlation between socio-demographic data and mean scores vital signs in closed suction method.

Vital signs		Age	Sex		Diagnosis				
			Male	Female	Cardiov--ascular disorder	Respiratory disorder	Neurological Disorder	GIT disorder	Renal Disorder
		R P	R P	R P	R P	R P	R P	R P	R P
Systolic BP	Before	0.239 0.137	0.019 0.923	0.014 0.933	0.042 0.798	0.376* 0.017	-0.352* 0.026*	0.022 0.894	0.060 0.714
	After 2 min	0.197 0.222	0.146 0.357	0.156 0.337	0.042 0.797	0.084 0.606	0.105 0.519	0.153 0.345	0.241 0.134
	After 5 min	0.184 0.256	0.197 0.394	0.137 0.400	0.070 0.669	0.084 0.606	0.148 0.362	0.094 0.563	0.240 0.136
Diastolic BP	Before	0.150 0.355	0.191 0.237	0.187 0.257	0.125 0.441	0.329* 0.038*	0.269 0.093	0.043 0.790	0.120 0.462
	After 2 min	0.109 0.504	0.155 0.340	0.115 0.349	0.209 0.196	0.088 0.589	0.026 0.873	0.014 0.929	0.000 1.000
	After 5 min	0.076 0.640	0.151 0.354	0.150 0.349	0.139 0.391	0.070 0.669	0.030 0.852	0.058 0.722	0.040 0.807
Respiratory rate	Before	0.165 0.309	0.364* 0.015*	-0.386* 0.014*	0.126 0.437	0.229 0.154	0.075 0.648	0.037 0.823	0.181 0.263
	After 2 min	0.029 0.861	0.310 0.065	-0.326* 0.045*	0.112 0.493	0.260 0.105	0.170 0.295	0.167 0.303	-0.320* 0.044*
	After 5 min	0.032 0.845	0.492** 0.001*	-0.482** 0.002*	0.014 0.932	0.210 0.193	0.236 0.142	0.277 0.083	0.281 0.079
O_2 saturation	Before	-0.372* 0.018*	0.153 0.366	0.142 0.384	0.187 0.247	-0.437** 0.005*	0.356* 0.024*	0.068 0.679	0.083 0.612
	After 2 min	0.194 0.231	0.138 0.396	0.138 0.396	0.174 0.282	0.295 0.064	0.191 0.239	0.129 0.429	0.250 0.120
	After 5 min	0.208 0.198	0.063 0.698	0.063 0.698	0.149 0.359	0.238 0.139	0.177 0.275	0.155 0.339	0.213 0.186
Heart rate	Before	0.173 0.286	0.014 0.933	0.014 0.933	0.126 0.440	0.232 0.149	0.196 0.226	0.029 0.859	0.080 0.624
	After 2 min	0.183 0.259	0.191 0.237	0.191 0.237	0.125 0.441	-0.334* 0.035*	0.209 0.196	0.080 0.625	0.040 0.807
	After 5 min	0.195 0.228	0.068 0.675	0.068 0.675	0.153 0.346	0.213 0.186	0.130 0.423	0.138 0.397	0.140 0.390
Regular heart rhythm	Before	0.043 0.846	0.99 0.530	097 0.533	0.044 0.834	0.053 0.744	0.167 0.304	0.111 0.495	0.076 0.639
	After 2 min	0.053 0.746	0.108 0.517	0.120 0.510	0.036 0.941	0.053 0.744	0.167 0.304	0.111 0.495	0.076 0.639
	After 5 min	0.057 0.741	0.105 0.520	093 0.480	0.067 0.542	0.043 0.844	0.167 0.304	0.111 0.495	0.076 0.639
Irregular heart rhythm	Before	0.053 0.746	0.94 0.528	0.105 0.520	0.052 0.746	0.053 0.744	0.167 0.304	0.111 0.495	0.076 0.639
	After 2 min	0.049 0.748	0.112 0.510	0.115 0.512	0.053 0.744	0.056 0.741	0.167 0.304	0.111 0.495	0.076 0.639
	After 5 min	0.053 0.746	0.101 0.524	0.105 0.520	0.073 0.344	0.053 0.744	0.167 0.304	0.111 0.495	0.076 0.639

*** Correlation is significant at the 0.05 level.**

**** Correlation is significant at the 0.01 level.**

Table (6) shows correlation between socio-demographic data and mean scores of vital signs in closed suction method. It was observed that there was significant negative correlation between age and O2 saturation before suction. Regarding sex there was significant negative correlation between female patients and respiratory rate in every time of measurement while in male the difference was significant positive correlation between male sex and respiration before and 5 minutes after suctioning. Regarding diagnosis there was significant negative correlation between respiratory disorder and O_2 saturation before suctioning and heart rate after two minutes after suctioning, and there was a significant positive correlation between respiratory disorder and systolic and diastolic blood pressure before suctioning P= 0.017 and 0.038 respectively. Regarding neurological disorders there was significant negative correlation between neurological disorders and systolic blood pressure and significant positive correlation between neurological disorders O_2 saturation before suctioning. In relation to renal disorder there was significant negative correlation between respiratory rate and renal disorder after two minutes of closed suction. Since P=0.044 and R= -0.320.

IV. Discussion

Tracheal suction is a rather frequent and essential procedure in patients under mechanical ventilation. There are reports that each patient undergoes suction from 8 to 17 times a day. [1,2] During procedure the tracheal secretion is removed to assure adequate oxygen supply and to avoid obstruction of the tube lumen, resulting in increased respiratory work, atelectasis and pulmonary infections. However, there are also adverse effects such as alteration of the heart rate, hypoxemia and ventilator associated pneumonia (VAP). [3] Furthermore, it must be remembered that; this is an uncomfortable and invasive procedure.[4] The study results revealed that about two thirds of the study sample were male, more than two third of the study sample were aged more than fifty years old and half of them were diagnosed as neurological disorder. This result agree with a study carried out by **Al-Shareef and Alyoubi 2014**; who found that neurological diagnoses were the second common diagnosis after kidney diseases , the age in ICU was common between 36 and 65 years and the incidence of admission was higher among male in ICU.[15]Also In multivariable logistic regression analysis in a study carried out by **Kim et al., 2012**; sex appeared to be the most important risk factor for unfavorable outcome, there was difference between females and males while the incidence was higher among male in ICU.[16]

Regarding the mean scores of vital signs among the studied sample before and after open and closed suction. It was observed that there was a significant difference in the closed suction group in relation to respiratory rate before, two, and five minutes after suctioning. The difference was not significant in relation to O_2 saturation, heart rate, and blood pressure. While in a study carried out by **Taheri et al., 2012** [26] there was a significant difference between mean respiratory rate and arterial blood oxygen saturation before, during and after the closed and open suctioning. The percentage of arterial blood oxygen saturation had a significant reduction in open method compared to closed method during suctioning and immediately after it. Respiratory rate three minutes after suctioning showed a significant reduction in both steps in open compared to closed method. The O_2 saturation was improved in both studies groups but the difference was not statistically significant these results agree with **Paula1et al., 2010** [18] who found that there was no statistically significant difference observed when closed and open suctioning were compared in both groups. There was a statistically significant improvement in post-procedure of oxygen saturation in both groups.

In relation to the comparison between open and closed suction methods in relation to vital signs among the studied sample throughout period of the study; it was observed that there was a significant difference between the study groups in relation to diastolic blood pressure, respiratory rate, and heart rate two minutes after suctioning. While after five minutes the significance was in respiratory rate,O_2 saturation and heart rate**.** Also in a study carried out by **Afshari et al., 2014**[19] who emphasized that no significant differences were observed between the two suctioning methods in terms of mean systolic blood pressure, diastolic blood pressure, and mean arterial pressure in the five consecutive measurements. However, significant changes were observed in heart rate and percentage of arterial oxygen saturation. The finding of this study also agree with **Zolfagharietal., 2008**[22] who emphasized that systolic and diastolic blood pressures, and heart rate showed higher increase 2 and 5 minutes after the open compared to closed method (P<0.001). Arterial blood oxygen saturation percentage reduced in the open method more than in the closed one 2 and 5 minutes after the procedure (P<0.001). No significant difference was seen between the patients and respiratory rate in the two methods (P>0.05).

Regarding distribution of studied group of open and closed suction methods related to heart rhythm, it was observed that there is no difference between the study groups regarding regularity of heart rhythm but the regular percentage was higher in closed suction group compared with opened suction group while the irregular percentage was higher in open group compared with the closed group, this results agreed with **Mazhari et al.,2010** [(20)] who mentioned that the suction with close method has less effect on the pattern of heart rate and arterial blood oxygen saturation compared to suction with open method and induce less disorder in patients' hemodynamic symptoms, so open and closed suction methods are effective on heart rate and arterial blood oxygen saturation and it is suspected that closed suction method makes less changes in patient hemodynamic status. Also, **Khamis et al., 2011[(21)]**stated; the results revealed that the closed suction system was more effective in maintaining the oxygen saturation, capillary refill and has less negative impact on the occurrence of cardiac arrhythmia as cardiopulmonary parameters. Other physiological parameters were also better maintained with closed than open suction system. So that 85 % of intensive care units of the hospitals in the United States of America use closed suction that is due to the decreasing hemodynamic and physiologic disorders. Closed endotracheal suction system results in lower disturbances in the vital signs than the open system. Therefore, for better results, the closed endotracheal suctioning is recommended.

V. Conclusion and recommendation:

Suction with close method has less negative effect on the pattern of heart rate and arterial blood oxygen saturation compared to suction with open method and induce less disorder in patients' vital signs .Closed tracheal suctioning maintains better vital sign stability in intubated patient. So the researcher recommended using of the closed suction method at all ICUs at Tanta Emergency Hospital and further studies are needed in a large groups.

Limitation of the study:

The number of sample was limited in the study because the closed suctioning method was rarely used in the Tanta Emergency Hospital ICUs and it was the first time used the close suction catheter in the anesthetic care unit for trial, so the researcher implemented the study at this time.

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