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The Effect of Endotracheal Suction Intervention on Oxygen Saturation Level in Preterm Infants

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ABSTRACT

The endotracheal tube suctioning is one of the most commonly performed nursing procedures which preterm infants under mechanical ventilation require to remove endotracheal tube secretions. **Aim of the study** isto assess the effect of endotracheal suction intervention on oxygen saturation level in preterm infants. **Settings** this study was carried out at Neonatal Intensive Care Units of Benha University Hospital, Benha Teaching Hospital and Specialized Pediatric Hospital at Benha city. **Sample of the study was** a convenient sample composed of seventy nurses and seventy preterm infants undergoing mechanical ventilation at the previously mentioned settings. **Tools of data** collection included two tools, (1) A structured interviewing questionnaire schedule about characteristics of preterm infants, personal data of nurses and nurses' knowledge, (2) Assessment schedule for monitoring oxygen saturation level of preterm infants and observational checklist for endotracheal suctioning procedure. **The main results of this study** revealed that, oxygen saturation level decreased after 5 minutes from endotracheal tube suctioning procedure and there was a positive correlation between nursing practice of endotracheal suctioning procedure and oxygen saturation. **Conclusion of the study** revealed that endotracheal tube suctioning decreases oxygen saturation level of preterm infants. **The main recommendation** is making periodical educational training programs for nurses working at NICU about oxygen saturation and importance of monitoring it during endotracheal tube suctioning procedure.

Key words: Endotracheal tube suction - oxygen saturation - mechanical ventilation - preterm infants.

Introduction

Preterm infants are defined as infants born alive before 37 weeks of gestation. There are sub-categories of preterm birth, based on gestational age; extremely preterm (<28 weeks), very preterm (28 to <32 weeks) and moderate to late preterm (32 to <37 weeks). Common causes of preterm birth include; multiple pregnancies, infections and chronic conditions, such as; diabetes and high blood pressure **(World Health Organization, 2015).**

In Egypt, preterm birth is estimated as 136,900 neonates and 8,100 neonates die from preterm birth complications **(The Global Action Report in Preterm Birth, 2012)**

Many preterm infants with signs of early respiratory distress disease need invasive mechanical ventilation (MV) which require endotracheal intubation.The presence of an endotracheal tube causes soft-tissue irritation and increased secretions. Intubation can lead to thickening of secretions and these thick secretions add to the risks of

endotracheal-tube blockage, lobar collapse, and compromised gas exchange**(El-Sayedetal., 2010).**

Methodsfor endotracheal tube suctioning include; open suctioning system in which the preterm infant's disconnected from the ventilator and the suction performed through insertionof sterilized suctioncatheter through endotracheal tube. The other method is closed suctioning system which performed by positioning a catheter between the endotracheal tube and the Y piece of the ventilator circuit without disconnection of the infant from the ventilator **(pour et al., 2015).**

Endotracheal tube suctioning (ETS) is one of the most commonly performed nursing procedures that infants need**.** So,it should be performed with high quality of practice and by experienced nurses.Because if not performed by a correct and standard method, it will lead to many complications such as; cardiac arrhythmias, infection, decreasing in blood oxygen, damage to the mucus layer, atelectasis or even death**(Brannagan, 2015).**

Moreover, the nurse should monitor oxygen saturation through pulse oximetrybefore, during and after performing suction. As oxygen saturation reflects the quantity of hemoglobin in the blood that is saturated with oxygen. Also respiratory rate and pattern, sputum characteristic and ventilator parameters should be observed. And she should maintain hemodynamic stability by increasing I.V. fluids or administer a drug**(Emirates Nursing Association, 2014).**

Significant of the study:

Preterm birth is one of the most common causes of newborn deaths, as every year an estimated 15 million neonates are born preterm in the world, and this number is rising. Over one million neonates die annually from preterm birth complications **(World Health Organization, 2015).**

One of these complications is respiratory problems which require mechanical ventilation with endotracheal tube intubation, and a part of its intensive care in preterm infants is endotracheal suctioning (ETS), which is one of the most commonly performed nursing procedures that infants need **(Cignacco et al., 2008)** In Egypt, preterm birth is estimated as 136,900 babies and 8,100 neonates die from preterm birth complications **(The Global Action Report in Preterm Birth, 2010).**

Aim of The Study

This study aimed to assess the effect of endotracheal suction intervention on oxygen saturation level in preterm infants.

Research Questions:

-Does endotracheal tube suctioning affect on oxygen saturation level in preterm infants?

-Do nurses, practice related to endotracheal tube suctioning affect on oxygen saturation level in preterm infant's blood?

Subjects And Method

Design

A descriptive design was utilized in the current study.

Settings

This study was carried out at Neonatal Intensive Care Units of BenhaUniversity Hospital, Benha Teaching Hospital and Specialized Pediatric Hospital.

Sample

Data of the present study were gathered through 6 months period, from the above

mentioned settings, the sample was a convenient sample and consisted of:-

1- The nurses were (70) working at the Neonatal Intensive Care Units in the previously mentioned settings regardless of their characteristics.

2- The preterm infants were (70) with certain criteria.

Inclusion criteria:

The preterm infants (<37 weeks) were:-

- On mechanical ventilator or continuous positive airway pressure (CPAP).
- Having normal body temperature and hemoglobin level.
- Free from any congenital malformation.

Tools of data collection

Two tools were used for data collection:

1- A structured interviewing questionnaire schedule:

That was designed by the researcher after reviewing related literatures. It was written in Arabic language. It composed of closed ended questions and consists of three parts as the following:-

Part I - Characteristics of preterm infants: It includes data about characteristics of preterm infant as; current diagnosis, gender, gestational age, current age, type of delivery, weight on admission ,current weight and duration of staying on mechanical ventilation.

Part II-Personal data of nurses: It includes characteristic of nurses as; age, academic qualification, and years of experiences.

Part III-Nurses' knowledge about mechanical ventilation, endotracheal suction and its effect on oxygen saturation level in preterm infants.

Scoring System of Nurses' Knowledge:

Scoring system for knowledge of the studied nurses was designed as follows:-

- Knowledge contents include (29) questions divided into 5 groups of questions.

- The studied nurses' answers were compared with a model key answer, where scored as; complete answer had score (2), incomplete answer had score (1), and don't know or incorrect answer had score (0).

- The levelof nurses' knowledge was categorized as the following:

Inadequate level (< 75%).

Adequate level (≥75 %).

2- Assessment schedule which composed of two parts:

Part I- Monitoring oxygen saturation level of preterm infants: It was adopted from **Elsayed et al., (2010).** It assessed oxygen saturation level and heart rate of preterm infant before (baseline), during and every minute after endoracheal suctioning and for five minutes after the suction.

Part II-Observational checklist for endotracheal suctioning procedure: It was adopted from **(Wilkinson & Leuven, 2007).** It was used to assess nursing practice during endotracheal suctioning intervention.

Scoring System of Nurses' Practice in endotracheal suctioning:-

Scoring system for practice of the studied nurses was calculated as the following:

- The nurses' practice was classified as; not done had score (0), incompetent had score (1) and competent had score (2).

- According to the nurses' actual practice, their level of practice was categorized as the following:

- Incompetent (< 80%).

- Competent (≥ 80%).

II- Operational design:-

1) Preparatory phase:

A review of current and past local and international related literatures to get acquainted with the needed knowledge for preparing tool and conducting the study.

Ethical consideration:-

Each study subject had the freedom to be involved in the study or to withdraw at any time, data was explained to the nurses and informed consent was obtained from nurses at previously mentioned settings for participation in the study before data collection ensuring complete privacy and total confidentially.

Pilot study:-

A pilot study was carried out on 10% of predetermined sample which accounted as seven preterm infants and seven nurses providing care for these infants to test the validity, reliability, applicability and time consumed to filling the study tools. The necessary modifications were done in the form of addition of some questions in nurses' knowledge about endotracheal tube suction and its effect on oxygen saturation level in preterm infants and also changing duration of observing oxygen saturation level from every 30 seconds to 1minute because there was no differentiation in oxygen saturation level every 30seconds as every 1minute.

Field of work:-

The current study was carried out from the first of January, 2015 to the end of June, 2015. The researchers were available at each study setting by rotation, two days per week during morning and afternoon shifts. Each preterm infant involved in the study was observed by the researcher and data were collected from the medical record. Oxygen saturation level was observed using pulse oximtery before, during, after 1, 2, 3,4and 5 minutes from endotracheal tube suction. The researcher gave the studied nurses the questionnaire to fill it and each nurse was observed separately to assess her practice by using observational checklist during their actual practice.

Written permission

An official permission for data collection was obtained from administrators of previously mentioned settings to carry out the study after submitting a letter from the researcher and clear explanation was given about the nature, importance and expected outcomes of the study.

Data analysis

The collected data were organized, categorized and analyzed, using frequencies, percentage, mean scores, standard deviation and chi-square. Data were presented in the form of tables and figures by using SPSS version20.

Results

Table (1): Distribution of studied nurses in relation to their personal data.

Items	No (n=70)	%
Age in years		
20 < 25	22	31.4
25< 30	24	34.3
≥ 30	24	34.3
x̄±SD	23.78±.098	
Academic qualifications		
Secondary nursing education	36	51.4
Nursing technician institute	25	35.7
Bachelor of nursing	9	12.9
Years of experience		
< 3	18	25.7
3 < 6	4	5.7
6 < 9	8	11.4
≥ 9	40	57.1
x̄±SD	6.89±1.06	

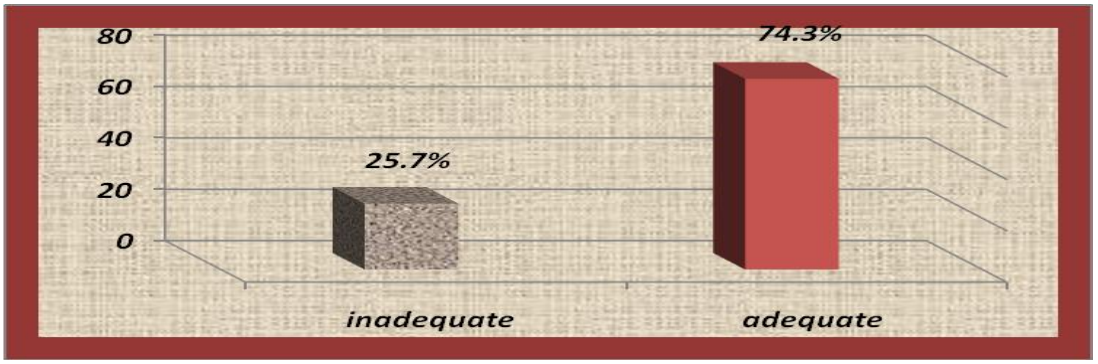
As illustrated in table (1), the nurses'ages were between 20≥ 30yearswith Mean ±SD (23.78±.098) years. Regarding years of experience more than half of the studied nurses (57.1) had an experience more than 9 years. While nearly half of them (51.4%) had secondary nursing education.

Table (2): Distribution of the studied preterm infants regarding their characteristics.

Items	No(n=70)	%
Gestational age		
24 < 28	5	7.1
28 < 32	18	25.7
32 ≤ 36	47	67.1
x̄ ±SD	30.35±1.07	
Current age in days		
1-	13	18.6
5-	22	31.4
10-	17	24.3
15≤20	18	25.7
x̄ ±SD	8.97±2.03	
Gender		
Male	30	42.8
Female	40	57.1
Type of delivery		
Normal	25	35.7
Cesarean	45	64.3

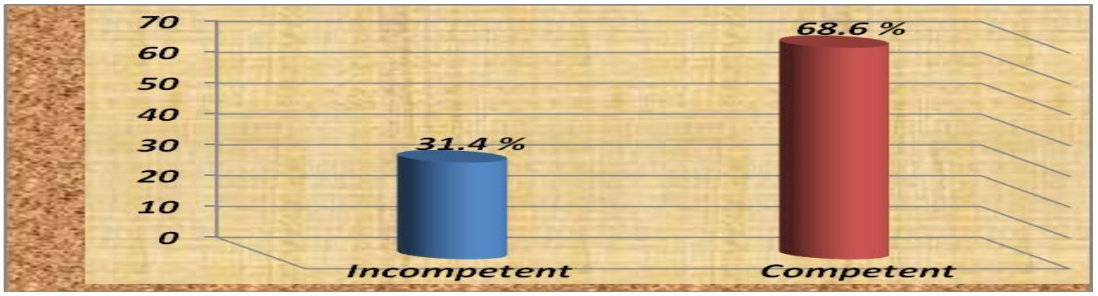
As illustrated in table (2), the mean gestational age of preterm infants was30.35±1.07 weeks. Regarding gender of preterm infants, more than half of the studied preterm infants (57.1%) were females. Regarding type of delivery, about two thirds of the studied preterm infants (64.3%) were delivered by cesarean section.

Figure (1): Percentage distribution of the studied nurses regarding their total knowledge scores.



As shown in figure (1), there was nearly three quarters of the studied nurses (74.3%) had adequate level of knowledge about mechanical ventilation, endotracheal suction and its effect on oxygen saturation level in preterm infants.

Figure (2): Percentage distribution of the studied nurses regarding their total practice scores about endotracheal tube suctioning.



As shown in figure (2), there was more than two thirds of the studied nurses (68.6%) had competent practice in performing endotracheal tube suctioning.

Table (3): Relation between mean scores of the studied preterm infants' oxygen saturation readings at the base line and different times of assessment.

Oxygen saturation reading					Paired t test	P value
Baseline (before E.T.T suction) Mean ± SD	Time of assessment	x̄	±	SD		
95.90±3.95	During suctioning	88.80	±	5.48	15.41	<0.001**
	After 1min.	93.54	±	4.00	4.93	<0.001**
	After 2 min	94.21	±	3.93	3.58	<0.001**
	After 3 min	94.30	±	4.11	3.59	<0.001**
	After 4 min	94.42	±	3.70	3.22	<0.05*
	After 5 min	94.92	±	4.77	1.97	>0.05

As shown in table (3), there was a statistical significant difference(P <0.001) between oxygen saturation level before and after endotracheal tube suctioning except after 5 minutes from it.

Table (4): Correlation between the studied nurses' total practice scores and oxygen saturation level of the studied preterm infants at different times of assessment.

Blood oxygen Saturation	Base line (before E.T.T suction)		During suctioning		After 1min.		After 2 min		After 3 min		After 4 min		After 5 min	
	R	P value	r	P value	r	P value	r	P value	r	P value	r	P value	R	P value
Total practice score	-.029	.813	-.123	.310	.062	.610	.189	.116	.065	.594	.139	.252	.094	.438

As shown in table (4),there was a positive correlation between nurses' practice related to endotracheal tube suctioning and oxygen saturation level in preterm infants after endotracheal tube suctioning.

Discussion

Annually an estimated 15 million are born prematurely that include 10-12 percent of births worldwide. Some of these neonates undergo mechanical ventilation including endotracheal tube suctioning ***(Hadian&Sabet, 2013).***

Preterm infants, who undergo mechanical ventilation, also require endotracheal intubation and repeated suctioning to remove excessive secretions and to reduce the potential for an obstructed airway***(Cone et al., 2013).***

Oxygen saturation should be monitored during endotracheal suctioning as the preterm infant wasn't attached to the ventilator. Preterm infants who born before 28 weeks' gestation with a target oxygen saturation of 85 to 89% had a significantly higher rate of death than those with a target of 91 to 95%. So, the nurse should avoid targeting ofoxygen saturation less than 90% among such infants ***(The BOOST II United***

Kingdom, Australia, and New Zealand Collaborative Groups, 2013).

Regarding personal data of the studied nurses, the results of the present study revealed that, more than two thirds of the studied nurses were between 20≥ 30years. This finding of stud disagreed with **Mohammed, (2012)** in a study about"Quality of nursing care for neonates undergoing mechanical ventilation at Benha City" who found that, less than half of the studied nurses were between 20 ≤ 25 years.

Concerningacademic qualifications of the studied nurses, the present study viewed that, more than half of them had secondary nursing education.This may be due to the fact that nursing secondary school provides the community with large number of graduate diploma nurses than other agencies such as faculties of nursing and technical nursing institutes. These findings were supported by the finding of **Ahmed, (2014)** in a study entiteled "Quality of nursing care provided for neonates with tracheoesophageal fistula" who reported that, more than half of nurses had secondary school nursing but according to **Loutfy,(2014)** in a study about"Quality of nursing care provided for preterm infants suffering from respiratory distress syndrome", the majority of studied nurses had bachelor degreein nursing.

The present study revealed that, more than half of studied nurses had ≥9years of experiences which may explain that nurses who provide care for ventilated neonates in BenhaHospitals were highly experienced nurses, this result in accordance with **Abd-ElAziz, (2010)** in a studyentitled "Quality of nursing care for neonates with respiratory distress syndrome" who demonstrated that, the highest percentage of the studied nurses had ≥ 9 years experiences in NICU.

Concerning the characteristics of preterm infants, the present study reflected that, more than two thirds of preterm infants had a gestational age between 32 ≤ 36 weeks which may indicate to the preterm infants with this gestational age at high risk to be ventilated.This finding is supported by **Mohammed, (2012)**in a study about"Quality of nursing care for neonates undergoing mechanical ventilation at BenhaCity"who stated that, less than two thirds of neonates were between 32 ≤ 36 weeks.

Concerning gender of the studied preterm infants, the current study demonstrated that, more than half of them were female. This finding disagreed with **Abd-ElAziz, (2010)** in a studyentitled "Quality of nursing care for neonates with respiratory distress syndrome"who reported that, more than half of studied neonates were males, and this difference may be due to difference in times of the study.

Concerning the type of delivery, the use of mechanical ventilation for neonates more increased with cesarean section, the present study reflected that, nearly two thirds of the studied neonates were delivered by cesarean section (C.S). This finding is in the same line with **Kunswa, (2010)**in a study about "**Needs,problems and nursing care of newborn infants"& Mohammed, (2012**) in a study about"Quality of nursing care for neonates undergoing mechanical ventilation at BenhaCity"who found that, more than half of neonates delivered by cesarean section.

Regarding nurses' total knowledge scores about mechanical ventilation, endotracheal suction and its effect on oxygen saturation. The present study revealed that, nearly three quarters of the studied nurses had adequate level of knowledge. In contrast, **Mohammed, (2012)** in a study about"Quality of nursing care for neonates undergoing mechanical ventilation at BenhaCity"found that, the minority of the studied nurses had good level.

Regarding nurses' total practice of endotracheal tube suctioning, the present study viewed that, more than two thirds of studied nurses had competent level of

practice. This finding supported by ***Loutfy,(2014)***in a study about"Quality of nursing care provided for preterm infants suffering from respiratory distress syndrome" who found that, the majority of studied nurses had an average level of practice of endotracheal tube suctioning with some clear mistakes.

Regarding assessment of mean scores of oxygen saturation level of preterm infants before endotracheal suctioning and at different times of assessment, the present study illustrated that, there was statistically significant decrease in oxygen saturation during and 1, 2,3and4 minutes after endotracheal tube suction. While there was no statistically significant decrease in oxygen saturation at5minutes after endotracheal tube suctioning. This finding was in accordance with ***El-Sayed, (2010)*** in a studyabout "Relationship between nursing procedures and oxygen saturation level of preterm infants with respiratory distress syndrome"**,** who stated that, there was a statistically significant decrease in oxygen saturation was present in 80% of infants during open endotracheal suctioning.

In contrast ***Ceccon et al.,(2010)*** in a studyabout "Randomized comparative analysis between two tracheal suction systems in neonates", showed that, oxygen saturation level was decreased during open suctioning procedure but this fall was not statistically significant.

Concerning to the findings of the present study, oxygen saturation level was decreased at 5 minutes after endotracheal tube suctioning from baseline. This finding was supported by ***Taheri et al., (2012)***entitled "The effect of open and closed endotracheal tube suctioning system on respiratory parameters of infants undergoing mechanical ventilation", who stated that,arterial blood oxygen saturation reduced after suctioning the secretions. This finding may be due to separation of preterm infant from ventilator during open endotracheal suctioning which cause reduction in preterm infant's oxygenation and lung volume. Another explanation was due to deterioration of preterm infant's condition which can cause decrease in oxygen saturation level.

In contrast to***El-Sayed, (2010)***in a studyabout "Relationship between nursing procedures and oxygen saturation level of preterm infants with respiratory distress syndrome"who demonstrated that,after performing of endotracheal suctioning, there was an increase in oxygen saturation up to 5 minutes. This may be due to removal of secretions thatpartially obstructed the endotracheal tube, but it may be interpreted by the fact that hyper oxygenation before and after ETT suctioning may have a positive effect in increasing oxygen saturation.

Regarding correlation between total nurses' practice scores and oxygen saturation level of preterm infant at different times of assessment, the present study viewed that, there wasno statistically significant difference between them with negative correlation before and during endotracheal tube suctioning, and positive correlation at 1, 2, 3,4and 5 minutes after endotracheal tube suctioning. This result of the current study may indicate that during endotracheal tube suctioning, the preterm infants were disconnected from the ventilator that cause decreasing in oxygen saturation this finding was supported by ***Ceccon et al.,(2010)*** in a studyabout "Randomized comparative analysis between two tracheal suction systems in neonates", showed that, oxygen saturation level was decreased during open suctioning procedure.

While after endotracheal tube suctioning, preterm infants were connected to the ventilator that result in increasing of oxygen saturation, this finding was in accordance with ***El-Sayed, (2010)***in a study about "Relationship between nursing procedures and oxygen saturation level of

preterm infants with respiratory distress syndrome"who demonstrated that, after performing of endotracheal suctioning , there was an increase in oxygen saturation up to 5 minutes.. So, the nurses' practice affect on oxygen saturation level of the preterm infant.

Conclusion:

Based on the current study findings, it was concluded that:

Oxygen saturation level was decreased after 5 minutes from endotracheal tube suctioning and there was a positive correlation between nursing practice related to endotracheal tube suctioning and oxygen saturation level in preterm infants.

Recommendations:

Periodical educational training programs for nurses working at NICU about oxygen saturation and importanceof monitoring it during endotrachealtubesuctioning procedure is mandatory to maintain efficient practice about care of the infant under mechanical ventilation.

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