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Effect of Upper Respiratory Care Protocol on the Incidence of Ventilator-associated Pneumonia for Critically Ill Patients

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Abstract
Background: *Ventilator-associated pneumonia (VAP) is one of the most frequent ICU-acquired infections and a very challenging infection as it continues to complicate the course of 8% to 28% of patients receiving mechanical ventilation. Upper respiratory care protocol was assumed to prevent aspiration and subsequent VAP.* ***Aim of the Study:*** *This study was conducted to evaluate the effect of upper respiratory care protocol on the incidence of ventilator-associated pneumonia for critically ill patients.* ***Materials and Methods****: A quasi-experimental design was used in this study. Setting the study was conducted at El-fayoum university hospital. The study subjects; A Purposive sample of two groups Group I, consisted of 30 patients received upper respiratory care protocol care protocol (study group) Group II, includes 30 patients received hospital routine care (control group). Tools of the study consist of two tools, the first tool was Patient Assessment sheet, and the second tool was VAP Assessment Tool.* ***Results:*** *It was found that VAP decreased among study group patients (20%) compared with control group patients (83.3%) with a statistically significance difference (X2 =24.093, P=0.000). Also. There were no statistically significant relations between VAP development for both groups and their sociodemographic and health data.* ***Conclusion*** *this study concluded that upper respiratory care protocol effective in reduce aspiration and ventilator associated pneumonia among critically ill patients.* ***Recommendations:*** *Replication of the study using a large probability samples acquired from different geographic areas. Continued research regarding safety and efficacy of upper respiratory care protocol and its effect on hemodynamic parameters.*

Key words: *Critically Ill Patient- upper Respiratory Care Protocol –ventilator associated pneumonia.*

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I. Introduction:

Most of critically ill patients hospitalized in the intensive care unit (ICU) require endotracheal intubation and mechanical ventilation (MV) to maintain airway patency, prevent aspiration, and improve oxygenation **(Şahiner, 2018).** Treatment with MV is used to save the patients' life However, the natural defense mechanism of the body against microorganisms' decreases, mainly due to bypassing the endotracheal tube (ETT) through the epiglottis. Therefore, these patients will be more liable to succumb to VAP **(Charles, et al, 2014).**

Ventilator - associated pneumonia (VAP) is a sub-type of hospital-acquired pneumonia which occurs in people who are on intubation or mechanical ventilation that was not present at the time of admission to hospital or that occurs 48 hours after intubation and mechanical ventilation through an endotracheal or tracheotomy **(Elkolaly , et al , 2019).** The diagnostic clinical Triad for VAP consists of pulmonary infection signs including fever, purulent secretions, and leukocytosis, together with bacteriologic evidence of pulmonary infection, and radiological suggestion of pulmonary infection **(Abdelrazik& Salah, 2017).**

The incidence of VAP in Egypt, a study conducted in surgical intensive care unit (ICU) at Zagazig University Hospitals over a period of 1 year. The study show that incidence of VAP in ICU was 9.94% while the incidence of VAP **(Michael, et al , 2020).** While the incidence of VAP worldwide 10–28% and 9 -27% in the United States. **(Abdelhafez , 2013).** Furthermore, the mortality rate attributable to VAP is 27% and Length of stay in the intensive care unit is increased by 5 to 7 days3 and hospital length of stay 2- to 3- fold in patients with VAP. Also The cost of VAP is estimated to be an additional $40000 per hospital admission per patient with the disease and an estimated $1.2 billion per year (**Augustyn,2019).**

Microaspiration of colonized or infected oropharyngeal is probably the main cause of VAP. Most cases of VAP are caused by microorganisms residing in the adjacent oropharyngeal or upper gastrointestinal tract. Aspiration of oral and /or gastric fluids is recognized to be an essential step in the development of VAP.

Pulmonary aspiration is increased by supine positioning and pooling of secretions above the ET tube cuff. **(Rouze , et al, 2017).**

The current study show the effect of simultaneous administration of three modes of airway care (upper respiratory care) including regulating the cuff pressure in range of 25 cm H2O, elevation of bed head up to 45° and mouth care &oral suctioning resulted on the incidence of VAP. Previous studies have not investigated the simultaneous and cumulative effect of these variables on VAP, but some studies have been conducted on the effect of each of these methods on VAP. This evidence based guidelines for prevention of ventilator associated pneumonia, ultimately improving patient's outcomes. Improved outcomes will shorten patient's ICU length of stay, hospitalization as well as benefit the patient financially with decreased hospital costs.

Aim of the Study:

The study aimed to evaluate the effect of upper respiratory care protocol on the incidence of ventilator-associated pneumonia for critically ill patients.

The aim was fulfilled through:

1-Assessment of the patient respiratory status and risk for infection by using Modified Clinical Pulmonary Infection score (MCPIS).

2- Developing upper respiratory care protocol based on literature review.

3- Implementing upper respiratory care protocol for the study group.

4-Evaluating the efficacy of the implemented upper respiratory care protocol on the incidence of ventilator-associated pneumonia for critically ill patients by using modified pulmonary infection score.

Research Hypothesis:

At the end of the study the incidence of ventilator associated pneumonia for critically ill patients who received upper respiratory care protocol less than those patients who don't receive the protocol as measured by modified pulmonary clinical infection scale.

Subjects and Methods:

The study was portrayed under the four main designs as follows:

1. Technical design.
2. Operational design.
3. Administrative design.
4. Statistical design.

1)The technical design:

-It includes research design, setting, subject and tools for data collection.

A) Research design:

A Quasi-experimental research design was used in this study.

B) Setting:

This study was carried out at the intensive care unit (ICU) at El-Fayoum university hospital.

C) Subjects:

A Purposive sample of 60 adult patients who met the inclusion criteria and agree to participate in the study, and then they were divided alternatively into two equal groups (study and control group, 30 patients in each).

- **Inclusion and Exclusion criteria:**

The inclusion criteria of the current study include Adult Patients from both gender >20years old, Intubated patients

And New admission <48 hours from admission. While the exclusion criteria include Chest infectious patients, Immune compromised patients and Patients have VAP.

D) Tools for data Collection:

Data were collected using the following two tools:

Tool (I) : Patient Assessment sheet:

This tool was developed by the researcher based on review of relevant recent literatures, Elpasiony et al, (2017) & Hafez, et al,(2017) and it includes patient' age, gender, the level of education, marital status, occupation smoking, Causes of ICU admission, past medical history, allergic history, Level of consciousness and Current medication.

Tool (II) VAP Assessment tool: Modified Clinical Pulmonary Infection Score (MCPIS):

It was adopted from Bakhtiari, et al (2018) and it was used to assess the clinical diagnosis of VAP. This is a standard scale including five parameters of (body temperature, pulmonary secretion, White blood cells, Oxygenation, and a chest X-ray).

Scoring system:

Each parameter scored from 0 to 2 except oxygenation, where zero indicates normal result and 2 indicate abnormal result. While in oxygenation parameter zero indicate presence of acute respiratory distress syndrome (ARDS) and 2 indicate absence of ARDS. The score varied from 0-10 .Obtaining scores over 5 in this scale reveals involvement in VAP. The score ≤ 5 indicate absence of VAP.

Field Work:

1- An official permission for conducting the study was obtained from the director of El fayoum university hospital and head of ICU department.

2- Development of tool I &II after reviewing recent relevant literatures.

3- Data collection started and completed within 9 months from February (2019) until the end of October (2019).

4- Data collection was done 5 day/weak by the researcher, two times per day at the morning and afternoon shifts.

5- At first day demographic and health data of all patient "age, gender, smoking, causes of ICU admission, past medical history, level of consciousness and medication" were collected using (tool I), data collected from the medical records**.**

6- VAP was examined using (tool II) at the first day on admission and the subjects with VAP were excluded.

7- The researcher performed a scheduled upper respiratory care for the study group, this care carry out every day in the morning shift and afternoon shift and continues for five days.

- Which includes simultaneous application of:

- Mouth suctioning &oral care .Patients in the study group received mouth suction followed by standardize oral care protocol; oral care with chlorhexidine antiseptic solution (used Hexitol as alternative) (twice a day at 8:00 AM and 8:00 PM) and every day continues for five successive days.
- Measuring and regulating the cuff pressure of tracheal tube in the range of 25 cm H2O.Measuring cuff pressure by using sphygmomanometer as shown in figure 1 to preserve in the range of (18-20 mmHg) because cuff manometer that used to measure cuff pressure of endotracheal tube is not available. Every day and continues for five day(Twice a day at 8:00 AM and 8:00 PM).
- Patient position, checking the bed head elevation at 45° by use of a bevel (twice a day at 8:00 PM).every day and continues for five day.

8- The subjects in the control group underwent upper respiratory routine care by ICU nurses.

Finally for all studied patient (study and control groups);

9- VAP was examined using MCPIS at third and fifth days using (tool II) to determine the effect of the implemented upper respiratory care protocol on the study groups.

Ethical Considerations:

Ethical approval was obtained from the scientific ethical committee of Helwan University. In addition, written informed consent was obtained from each participant prior to data collection. The participants assured that anonymity and confidentiality would be guaranteed and the right to withdraw from the study at any time. Ethics, values, culture and beliefs were respected

Statistical Design:

The collected data were organized, categorized, tabulated, and statistically analyzed using the statistical package for social science (SPSS) version (20). Data were presented in tables and graphs. The statistical analysis included; percentage (%), the arithmetic mean ($\overline{X}$), standard deviation (SD), chi-square (X^2), and Pearson correlation (r).

II. Results:

A) Characteristics of studied patients:

A total 60 patients were enrolled in the study (30 for each study and control group) with mean age $\bar{X} \pm$ SD (52.40 ± 14.40) for control group. also it was noted that 60% of the control and study group were male, as regarding to an educational level it was found that 66.7% of the control and study groups were illiterate, while 3.3% of the control group were higher education, Furthermore, it was found that there was no significant difference between study and control group as regarding their demographic data. As regarding health related data found that only (40 %) in the control group and (26.6 %) in the study group were smokers. As regarding level of consciousness, it was found that (66.7%) of study group and (60%) of control group had severe impairment of conscious level, while (6.67%) of study group and (16.6%) of control group had mild impairment of consciousness as illustrated in tables (1, 2).

Table (1): Percentage distribution of demographic data for both study and control groups. (N=60).

Items	Control N=30		Study "N=30"		chi-square	
	N	%	N	%	X^2	P value
Age:						
• 20 - <40 yrs	6	20.0	4	13.3	0.863	0.650
• 40 - < 60 yrs	15	**50.0**	14	46.7		
• ≥ 60 yrs	9	30.0	12	40.0		
Mean (SD)	**52.40 (14.40)**		55.77 (13.96)			
Sex:						
• Male	18	**60**.0	18	**60**.0	0.000	1.000
• Female	12	40.0	12	40.0		
Education :						
• Illiterate	20	**66.7**	20	**66.7**	2.400 FE	0.301
• Diploma	9	30.0	6	20.0		
• Higher-education	1	**3.3**	4	13.3		

Statistically insignificant at p>0.05

Table (2): Percentage distribution of Health related data for both study and control groups. (N=60).

Health related data	Control N=30		Study N=30		X^2	P value
	N	%	N	%		
Smoking :						
•Yes	12	**40**.0	8	**26.67**	1.200	0.273
• No	18	60.0	22	73.33		
Cause of ICU Admission:						
•Respiratory problem	9	30.0	11	**36.67**	2.613 FE	0.928
•Renal problem	4	13.33	2	6.67		
•Neurological	10	**33.33**	10	**33.33**		
•Cardiac Problem	2	6.67	1	3.33		
•GIT problem	2	6.67	1	3.33		
•Trauma	2	6.67	4	13.33		
•Others	1	3.33	1	3.33		
Level of consciousness:						
• Mild impairment	5	**16.67**	2	**6.67**	1.421 FE	0.550
• Moderate impairment	7	23.33	8	26.67		
• Sever impairment	18	**60.00**	20	**66.67**		

Statistically insignificant at p>0.05

B) The impact of upper respiratory care protocol on the development of Ventilator Associated Pneumonia:

At the last day of the study (20%) of study group and (83.3%) of control group developed VAP. Also, there was a statistical significant difference between the two groups at the third and fifth day of the study (X2 =24.093, P=0.000) as illustrated in table (3).

Table (3): Modified Clinical Pulmonary Infection Scores in the last day of study among Studied Subjects

Vap	Group				X^2	P value
	Control		Study			
	N	%	N	%		
Last day of study(fifth day):						
Free	5	(16.7)	24	(80.0)	24.093	0.000**[FE]
Infected	25	(83.3)	6	(20.0)		

(n=60).

** Highly statistical significant at p<0.01

C) Relation between Socio-demographic Characteristics& Health Data and Vap occurrence among infected Studied Subjects (n=60) :

There were no statistical significant difference between age, gender, smoking and causes of ICU admission with VAP for studied patients as illustrated in table (4 , 5) .

Table (4): Relation between Socio-demographic Characteristics and Vap occurrence among infected Studied Subjects (n=60).

Selected demographic data	VAP development				X2 (P value)
	Control		Study		
	No	%	No	%	
Age:					
• 20 - <40 yrs	5	**20.0**	0	0.0	2.870 FE (0.258)
• 40 - < 60 yrs	13	52.0	2	33.3	
• ≥ 60 yrs	7	28.0	4	**66.7**	
Gender:					
•Male	15	**60.0**	4	66.7	0.347 FE
•Female	10	40.0	2	**33.3**	(1.000)

(*) Statistically significant at p<0.05

Table (5): Relation between Health Data and Vap occurrence among infected Studied Subjects (n=60).

Health related data	VAP occurrence				X^2 (P value)
	Control		Study		
	No	%	No	%	
Smoking:					
•Yes	10	40.0	3	**50.0**	0.317 [FE]
•No	15	60.0	3	50.0	(0.676)
Cause of ICU Admission:					
Respiratory problem	7	28.0	3	50.0	2.721 [FE]
Renal problem	3	12.0	0	0.0	(0.850)
Neurological problem	10	**40.0**	2	33.3	
Cardiac Problem	1	4.0	0	0.0	
GIT problem	2	8.0	0	0.0	
Trauma	2	8.0	1	16.7	
Others	0	0.0	0	0.0	

(*) Statistically significant at p<0.05

III. Discussion:

The current study is a Quasi-experimental study aimed to evaluate the effect of upper respiratory care protocol which include simultaneous application of (Mouth suction, oral care with chlorhexidine, measuring and regulating the cuff pressure of tracheal tube in the range of 25 cm H2O and Patient positioning) on the incidence of ventilator-associated pneumonia for critically ill patients.

Regarding Demographic data for both study and control groups, The current study showed that more than two third of studied patient in both group had age more than forty years old. , as co-morbidity increase with age and increase the risk of ICU admission. This finding also contradict with **yaghoubina et al (2017)** in a study titled "Impact of care program on ventilator associated pneumonia incidence: a clinical trial" who revealed that the majority of patient were middle age as the most common cause of hospitalization was trauma. Related to gender, the present study results showed that, two third of the study and control group were males; this could due to the natural of ICU admission as emergency and increase accident among male more than female patient. This finding is consistent with **Elkolaly , et al., (2019)** in a study titled "Incidence of ventilator-associated pneumonia: Egyptian study " who reported that two third of the sample were male

Concerning smoking, the present study showed that more than two third of studied patient in both group were non smoker. This could due to the nature of ICU were general and emergency and patient who were smoker expected to admit to chest ICU more than this ICU. this result in the same line with **Abbasinia, et al (2016)**in a study titled" The Effect of a Designed Respiratory Care Program on the Incidence of Ventilator-Associated Pneumonia" who revealed that Two third of the sample were non smoker.

Regarding distribution of studied groups according to Total Modified Clinical Pulmonary Infection Scores(Vap development), The finding of the current study revealed that all patient were not developed vap at the first day of the study as this was one of the important criteria for patients to be enrolled in this study, after application of upper respiratory care protocol, at the last day of the study there was highly statistically significance difference between study and control group patients regarding development of VAP as one fifth of the study group had developed VAP compared to near more than two thirds of control group.

These findings were coinciding with **Yaghoubinia et al. (2017)** in a study titled "Impact of care program on ventilator associated pneumonia incidence: a clinical trial who find that none of the patients in the study group developed VAP after execution of the program, while more than half of the group was developed. Also this finding in the same line with **Mohammed& Sabir (2017)** in a study titled "Effects of Chlorhexidine Solution Formula on Oral Health Status and Occurrence of Ventilator -Associated Pneumonia among Intubated Intensive Care Unit Patients" who revealed that one fifth of patients in the study group was diagnosed of VAP compared with two third of patients in the control group, with highly statistically significant difference between them.

The finding of the current study showed that there were no statistical significant difference between VAP and age. This finding contradicted with **Bedawy, et al.(2015)** in a study titled "Evaluation of risk factor of ventilator associated pneumonia on outcome of acute exacerbation of chronic obstructive pulmonary disease" who revealed that the mean age was lower in VAP patients and most of them were in middle age.

Regarding smoking, the finding of the current study revealed that there was no statistically significant difference between VAP and smoking; this may be due to small number of smoker patients who involved in the study. This finding inconsistent with **Saravu et al. (2013)** in a study titled " determinants of ventilator associated pneumonia and its impact on prognosis: A tertiary care experience" who revealed that patients who developed VAP had cigarette smoking more than patient who not developed VAP.

In the end, it is important to know that upper respiratory care is cost effective interventions to prevent aspiration and ventilator associated pneumonia. Also, it improve patient outcome and easy to perform by ICU nurses. Upper respiratory care protocol contain (oral care with chlorhexidine, mouth suction, patient positioning and preservation cuff pressure of endotracheal tube at 18-22mmhg.

IV. Conclusion:

Ventilator Associated pneumonia decreased among study group patients after implementing upper respiratory care protocol, than control group patients. There was a statistical significant difference between study and control group at the third and fifth day of the study regarding Vap development after implementing upper respiratory care protocol. There was no statistically significant difference between vap development for study and control groups regarding their age, gender &smoking. There was no statistically difference between VAP development and intake of sedation for study and control groups.

V. Recommendations:

- Upper respiratory care protocol should be done twice daily.
- Endotracheal tube cuff pressure should be checked twice daily to prevent inflation problems and aspiration by using cuff manometer or sphygmomanometer.

- Replication of the study using a large probability samples acquired from different geographic areas.
- Periodic monitoring of nurses for implementation of prevention guidelines.
- Oral care should be done with chlorhexidine as it effective in prevent bacterial colonization.

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