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Original Article

Health Management and Policy Section

Assessment of Critical Care Provider's Application of Preventive Measures for Ventilator-Associated Pneumonia in Intensive Care Units

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ABSTRACT

Background: The implementation of guidelines for the prevention of Ventilator-associated pneumonia has been shown to have a significant effect in reducing the incidence of VAP.

Objective: The aim of the present study was to evaluate the implementation of the preventive strategies for VAP in ICUs of university hospitals of Sari, Iran.

Materials and Methods: This cross-sectional study was carried out in 600 beds/day in the ICUs of university hospitals of Sari from April to June 2012. Sampling was done by availability technique in patients receiving mechanical ventilation in the ICU. The implementation of the preventive measures was assessed by a standard checklist with previously approved validity and reliability.

Results: The percentage of implementing each of the measures was as follows: sterile suction, 88.44%; semi-recumbent position, 76.8%; oral hygiene, 58.45%; using heat and moisture exchanges (HMEs), 58%; controlling cuff pressure, 46.8%; hand hygiene, 32.8%; using anti-coagulants, 26.8% and physiotherapy, 25.5%. Closed suction system, continuous drainage of subglottic secretions and kinetic beds were not used at all.

Conclusion: The overall mean percentage of implementing preventive measures was low and required designing integrated guidelines by considering the conditions of the ICUs in each country, as well as educating and encouraging the staffs to use the recommended guidelines.

Keywords: Guidelines for preventive measures, ICU staff, Nosocomial infection

INTRODUCTION

Ventilator-associated pneumonia is defined as the pneumonia developed 48 to 72 hours after intubation [1]. Ventilator-associated pneumonia (VAP) is the most common nosocomial infection in intensive care units [2]. The incidence of VAP in other countries are 21.87 [3] and 26 [4] per 1,000 ventilator days [5].

In a study in Iran, incidence of ventilator-associated pneumonia in adult patients hospitalized at the intensive care unit was 31.52% [6]. Patients with ventilator-associated pneumonia had longer accommodation in ICU and hospital length of stay (LOS), with higher hospital cost and mortality rate compared with uninfected patients [7]. In a study in trauma Intensive Care Unit, an episode of VAP cost was $57,000 per occurrence [8].

There are several guidelines for preventive measures of VAP in the different parts of the world, such as guidelines represented by Centers for Disease Control (CDC) [9], Guidelines for the Management of Adults with Hospital-acquired, Ventilator-associated, Healthcare-associated Pneumonia [10] and Nurses' Implementation of Guidelines for Ventilator-Associated Pneumonia [11]. There are several proceedings for prevention of VAP such as oral care [12], administration of prophylactic agents for gastric ulcer [13], hand hygiene [14], application of the nurses' protocol-directed weaning procedure [15], using gloves [16], changing the humidifiers weekly or for each patient and changing the suction system for every new patient [17].

A study demonstrated that nurses do not have enough knowledge about VAP guidelines and non-pharmacological preventive measures for VAP and need to be educated based on the current recommendations [18]. There is little data on the level of application of the guidelines and compliance of the nurses in Iran. The implementation of these guidelines will improve the quality of care. Reviewing these regularly is important to pursue evidence-based strategies for the improvement of patient care.

OBJECTIVE

Accordingly, this study was designed to assess the quality of implementing VAP preventive measures in ICUs of teaching hospitals of Sari, Iran.

MATERIALS AND METHODS

The study population of this cross-sectional study included all beds of the ICUs with patients requiring mechanical ventilation in three ICUs of a university hospital in Sari, Iran from April to June 2012. Study subjects included 600 beds/day of ICU. The data were gathered by one researcher using a questionnaire for the demographic and clinical data of the patients, a checklist for the assessment of VAP preventive measures. Patients' demographic and clinical questionnaire included questions about age, gender, diagnosis, admission date, duration of ICU admission, the type of mechanical ventilation, Glasgow coma scale (GCS), feeding method, type of anti-ulcer, anti-coagulant and sedative drugs, gastric residue determined by aspiration of gastric contents using syringe, patients feeding with NGT, limitation in anti-coagulant use, semi-recumbent position and the type of the mouthwash. The checklist was provided by all of researcher based on the most commonly used VAP preventive guidelines all over the world and included oral hygiene and using mouthwash, sterile suction, measurement of the endotracheal cuff's pressure, subglottic drainage, hand hygiene, semi-recumbent position, physiotherapy, administration of anti-coagulant, floating mats, characteristics of the suction system, using humidifiers with antimicrobial filters and performing blood culture, complete blood count (CBC) and chest X-ray (CXR) in case of fever or hypothermia. The validity of the checklist was evaluated by five

professionals and the content index was estimated to be 0.043 with p=0.532 using Kendall's statistics. The reliability of the check list was assessed by evaluating 5 nurses' performance on 15 patients independently while they were unaware of each other's scores and the correlation coefficient was found to be 0.87 according to Kuder-Richardson Formula. The patients' clinical records and the nurses' reports were used to complete the questionnaire (disease progress, lab results, physicians' orders and consultations). Checklists were completed by one researcher and recording the nurses' first actions and performance for each bed and continued until complete 600 ICU beds/day. For days when the researcher could not be present in hospital; checklists were filled using nursing report. The data were analyzed using SPSS 16. Descriptive statistics was reported as mean± standard deviation and percentages.

RESULTS

Study findings showed that the majority of the patients were men (68.2%). The age group with the highest prevalence was 21-35 years (29%) followed by 66-80 years (28.5%). Mean, median and mode for age was 52.82±21.28, 57 and 76 years, respectively. The most prevalent diagnoses of the ICU admitted patients were multiple trauma (32.6%), head trauma (23.2%) and cancers (22.7%). A total of 61% of the patients were connected to the mechanical ventilator through orotracheal tube and the other 39% had tracheostomy. The mean duration of ICU admission was determined 20.16 days with mode and median of 5 and 11 days, respectively. According to the records, using nasogastric tube (NGT) was the most common method of feeding (65.8%). Of the total patients, 97.3% were receiving anti-ulcer drugs with ranitidine tab being the most commonly used (48.5%) followed by proton pump inhibitors (PPIs) (25.5%) and sucralfate (18.7%). Seventy three percentage of the patients received no anti-coagulant agent [Table/Fig-1].

Implementation of the preventive measures by ICU nursing staff is summarized in [Table/Fig-2]. Overall, the mean implementation of the guidelines was 48.89%. This percentage was determined 59.37% after exclusion of the three methods including closed suction system, drainage of subglottic secretions and kinetic beds which are not available in most of the developing countries with limited resources.

DISCUSSION

In our study, the most common method for patient feeding was using NGT. According to CDC guidelines, OGT is the best and the most effective method in reducing VAP risk [19], a method which unfortunately was rarely used in our study. A high percentage of the patients in our study received anti-ulcer agents with Ranitidine being the most common drug. According to the studies, Sucralfate (which does not reduce the gastric pH in most patients) results in lower risk of VAP [20]. The use of Sucralfate has been reported to be associated with lower incidence of GI bleedings and VAP. Other agents such as H2 blockers, PPIs or anti-acids might have similar effects; however, since these agents destroy the normal gastric flora, it is recommended that their use should be limited to the patients with high susceptibility for GI bleeding. A study has reported no significant difference between using Ranitidine and Sucralfate regarding VAP incidence, the duration of ICU admission and mortality rate and even reported Ranitidine to be more effective in preventing GI bleeding [21]. A review article has recommended that the prophylactic administration of the anti-ulcer drugs should be considered only after careful evaluation of the positive and negative effects of the drug and the patient's clinical condition [22]. Meanwhile, many studies recommend using different types of anti-ulcer agents [21,23-25]. Our results also show a high percentage of implementation of this preventive measure in the ICUs.

Measures	Options	Absolute frequency	Relative frequency
Feeding method	NGT	395	65.8%
	OGT	119	19.8%
	PEG*	73	12.2%
	PO	12	2.2%
Anti-ulcer agent	No drug	16	2.7%
	Ranitidine	291	48.5%
	PPI**	153	25.5%
	sucralfate	112	18.7%
	PPI+ sucralfate	28	4.7%
Anti-coagulant agent	No drug	438	73%
	Subcutaneous heparin	98	16.3%
	Enoxaparin	36	6%
	Heparin infusion	25	4.2%
	Intermittent heparin	3	0.5%

[Table/Fig-1]: absolute and relative frequencies of feeding methods and the type of anti-coagulant and anti-ulcer drugs used in the ICUs
*Percutaneous Endoscopic Gastrostomy
**Including omeprazole and pantoprazole

Preventive measures	Implementation (%)
Gastric aspiration before gavage	52.3
Using anti-acid	97
Oral hygiene	58.45
Sterile suction	88.44
Controlling the cuff's pressure	46.8
Suctioning the secretions before deflating the cuff	55.3
Hand hygiene	32.8
Changing the position	92.5
Semi-recumbent position	76.8
Physiotherapy	25.5
Using anti-coagulant	26.8
Floating mats	98.3
Closed suction system	0
Drainage of subglottic secretions	0
Humidifiers or HME*	58
Kinetic bed	0
Mean percentage of implementation	48.89
Mean percentage of implementation after excluding kinetic beds, closed suction system and drainage of subglottic secretions	59.37

[Table/Fig-2]: Percentage of implementation of VAP preventive measures
* Heat and Moisture E

Most of the patients in this study did not receive any anti-coagulant medication and among those who received medication, subcutaneous Heparin or Enoxaparin were the most common choices. Most of those who did not receive any anti-coagulant were not found to have a clear contraindication, and in few cases, the risk of bleeding and recent surgery was the reasons for not starting anticoagulant therapy. Meanwhile, using anticoagulant for the prevention of DVT has been strongly recommended [24,25]. Almost half of the patients in our study had a sedative in their medication order (42.8%) and in the majority of cases, it was discontinued once a day. This preventive measure was implemented only in 11% of the cases in a similar study [26].

We found that the ventilator circuits in our ICUs were routinely changed every 7-14 days; however, newer researches emphasize on changing them for each new patient or at least when there is overt contamination [27,28]. In a study in Spain in 2005, it was found that mechanical ventilator circuits were changed every 72 h in 75% of the ICUs [26]. In Canada, in only 10% of the cases the ventilator circuits were changed for every new patient or when there was overt contamination [27]. Consistently, in our study, also, the interval for changing the ventilator circuits is shorter than that recommended in

the guidelines and thus requires further staff education. Chlorhexidine mouthwash was present at bedside of 79% of the patients. It was mostly used at morning visits as a part of the nurses' routine practices. As mentioned before, IHI recommends comprehensive oral decontamination using chlorhexidine mouthwash twice a day as a preventive measure for VAP [29], and several studies have suggested it as the standard measure for oral hygiene [24,30,31]. In addition, it is recommended that intubated patients need teeth brushing twice a day and maintenance of the natural humidity of their mouth since it helps to preserve the normal bacterial flora of oral cavity and pharynx which prevents the colonization of pathogenic bacteria [32]. In the present study, toothbrush was only used in morning shifts despite the guidelines on applying it twice a day [33]. In our study, oral hygiene was considered as using anti-bacterial mouth wash, tooth brush, and general oral care. We found that 95.3% of the patients had a general mouth care including observation of the oral cavity, moisturizing the tongue and suctioning oral secretions. Anti-bacterial mouthwash was used in 41.65% of the patients and toothbrush was used in 38.4% of the cases. Implementation of oral care protocol was reported 50% in the United States [19] and 83.3% in India [21].

In the present study, the mean implementation of oral hygiene guidelines was 58.45% which is same to the United States; although it seems that by providing the required items including the toothbrush and the mouthwash, which are currently charged by the patient's family, as well as staff education, might increase the implementation of this measure. Frequency of physiotherapy sessions was low (25%) with most cases implemented in the morning shifts and by physiotherapist. In addition, most nurses did not perform positioning and percussion during suction. In a study in Italy, only 76.2% of the nurses believed respiratory physiotherapy to be effective in reducing the risk of VAP [34]. In another study in Brazil, an average of 37.5% of the patients received respiratory physiotherapy [35] which is rather similar to our results. One possible reason for low implementation of this item might be the lack of nursing staff in the ICUs. According to our results, the implementation of hand hygiene guidelines including hand washing before and after contacting the patients and wearing gloves when there is the possibility of contact with the patient's body fluids was low. Relative frequency of hand washing before and after contact with each patient and using gloves was 7.16%, 28.25% and 63%, respectively with the overall implementation of 32.8%. The main reasons for this low compliance were the unavailability of the facilities and alcohol-based waterless antiseptic agents and limited space in the ICUs. In the studies in which implementation was reported by the nurses themselves, compliance was reported as high as 80% [19,34]. Sterile suction was applied in 88.44% of the cases which is lower in comparison with the Brazilian study (99%) [35]. Sterile suctioning in the present study included using sterile catheter, syringe and normal saline. In more than half of the cases in our study (53.2%), cuff pressure was not checked regularly. In consistent with our results, a study reported that despite the adequate knowledge of the nurses about the appropriate tracheal tube cuff pressure and its significant impact, only in 53% of the cases they actually measured the cuff pressure every 8 hours and most of them were done by palpating the cuff balloon [31]. This value was reported 57% in another study [26].

In the present study, semi-recumbent position or elevation of the head of the bed at an angle of ≥30 degrees from horizontal was implemented in 76.83% of the patients. Meanwhile, implementation of this preventive measure in the studies of United States and Brazil was reported 50%, and it was found to be 58.3% in 72 ICUs of France and 30 ICUs of Canada [36]. A study in Spain reported 93% compliance for this item [26]. Another study from the US reported 83% compliance to this preventive measure [37]. It seems that difference between implementation rates for this item between ICUs all over the world is partly attributed to the difference in patients' clinical conditions. Moreover, in the present study, this measure was mostly implemented in patients who needed less procedures and lower transfer outside the ICU. In our study, closed suction system, drainage of subglottic secretions and kinetic beds as well as humidifiers was not used in any of the ICUs and HMEs were only used in 58% of the patients. In a study in Canada, HME humidifier was used in 80% and closed suction was used in 88% of the patients [27]. Drainage of subglottic secretions was reported 21% in a study from the US [37] and 45.2% in a study from Brazil [35]. Closed suction system and humidifiers were also used in 74.6% and 92.9% of the cases, respectively. These preventive techniques are not used in Iran mostly due to the lack of financial resources, necessary equipment and high humidity of the area. Different frequencies of using these techniques from hospitals all over the world may also indicate the disagreement between the experts on the actual preventive role of them. Increased or decreased body temperature is one of the clinical criteria for the diagnosis of VAP. There is no comprehensive, consensus method for the diagnosis of VAP; however, it is recommended to perform CBC, CXR and culture after the detection of fever or hypothermia in order to early diagnose it [38]. In our study, 3% of the patients developed hypothermia (body temperature<35.5) and 10% developed fever (body temperature>38), of whom very few received all the mentioned diagnostic tests within the first 24 h.

In the present study, the mean implementation of the guidelines was 48.89% with accounting kinetic beds, closed suction system and drainage of subglottic secretions and it was estimated 59.37% after excluding these three measures which are not available even in some developed countries. In either case, this level of compliance is low. Although compliance to the guidelines is widely different worldwide and reports from different studies are very distinct for some items, which might also be due to difference in data gathering methods (observation, interview, etc…) and the definition of the standards. Therefore, further assessments in several studies are recommended.

In a study titled "Why do physicians not follow evidence-based guidelines for preventing VAP?", a questionnaire containing 33 pharmacologic and non-pharmacologic preventive practices was administered to 110 opinion leaders on VAP from 22 countries, asking them which of the measures were implemented in their ICUs and if a measure was not used, they were asked to identify the reason for non adherence. The study showed that the overall non adherence rate was 37.0%. Pharmacologic guidelines had the highest implementation rate. The most common reasons for non-compliance were disagreement with the guidelines, unavailability of the resources and high costs. Given the difference between the compliance rates of the doctors and nurses to the preventive guidelines, it seems that the staffs of ICU in our study share the same opinion. Therefore, appropriate education programs may improve the compliance by changing their points of view.

CONCLUSION

Nursing staff play an important role in applying non-drug-based preventive measures directly related to the care they provide. Enrollment in continuing medical education periods, training activities and evidence-based protocols aimed at ICU nurses, improving the care quality and narrowing the gap between scientific knowledge and actual performance. The training program improved ICU nurses' theoretical knowledge and adherence to VAP preventive measures.

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