

Original Article

## Knowledge and Practices of Intensive Care Nurses on Mechanical Ventilation

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### Abstract

**Background:** The nursing care and interventions play an important role in preventing the complications associated with mechanical ventilator, used commonly in the intensive care units.

**Aim:** This study was conducted to determine the use of the mechanical ventilator by the intensive care nurses and their knowledge, attitude, and behaviours about the care practices of the mechanically ventilated patients.

**Method:** This descriptive study was conducted with the nurses working in intensive care units of a university hospital. The population consisted of the intensive care nurses (n=200). In the study, the sample selection method was not used and 108 nurses who agreed to participate in the study were included.

**Material:** The data collected with the "Questionnaire" prepared by the researchers based on the literature were assessed using percentage, mean and correlation analyses in SPSS 20.0 program.

**Results:** In the study, 76% of the nurses were females and 30% had the intensive care certificate. 24% answered correctly the criteria of starting the mechanical ventilation and 86% answered the ventilation modes correctly. 60% and 71% could not answer the reasons of the mechanical ventilator's high and low pressures, respectively. It was found that almost all of the nurses (94%) made the endotracheal tube care, 85% controlled the cuff pressure routinely, and 63% made this control by touching with hands. 57% used physiological saline solution before aspiration. 58% defined correctly the anxiety symptoms.

**Conclusion:** It was determined that the nurses, following up the mechanically ventilated patients in the intensive care units, did not have enough knowledge about mechanical ventilation practices.

**Keywords:** Mechanical Ventilation, Nurse, Knowledge, Practice

### Introduction

One-third of the patients admitted to the ICUs in the world need the mechanical ventilation (MV) treatment (Roh et al., 2012; Kaydu, 2013; Clark and Lettieri., 2013). The mechanical ventilation(MV) process is life-saving for the patients with respiratory insufficiency or hypoxemia and it may also lead to life-threatening results in terms of the side effects and complications it may cause (Mahmood et al., 2013). Prolonged mechanical ventilation,

increased mortality, prolonged hospital stay and high cost may be regarded among these complications. (Guilhermino et al., 2018)

The cost of the patient receiving the MV support is between 15-27 billion dollars every year in the developed countries (Panwar, 2016). Ventilation-Associated pneumonia (VAP), one of the most important complications associated with the ventilator, affects the mortality rate in the intensive care unit at the rate of 25% and 50% (Chastre and Fagon., 2002). The number of

VAP observed throughout Turkey in 2017 has been determined as 8667. (Uhesa., summary report of the year 2017).

It is highly important that the intensive care unit team have a good knowledge of the MV practices in preventing the MV-associated complications or in diagnosing the developing complications early.

The roles in initiating, maintaining, and ending MV may vary by countries. For example, while the MV management is performed with the cooperation of the respiration therapists and physicians in North America, intensive care nurses have high autonomy in MV management in North Europe, England, Austria, and some other countries (Rose et al., 2015). In Turkey, the decision of MV and its maintenance is under the responsibility of the physicians and the nurses have an important responsibility in following up the patients and preventing the MV-associated complications. For this reason, the nurses working in ICUs should have a good knowledge about the MV indications, the mechanical ventilation modes and settings, the alarm reasons, and the interventions for their solution. The fact that the nurses know the problems and actions may eliminate the acute respiratory distress, shortness of breath and the increasing respiratory load and prevent the complications. (Eckberlad, 2009; Borkowska, 2015)

In the studies investigating the practices of IC nurses about MV device and care of ventilated patients, it has been concluded that the results are not at the desired level and the nurses need the mechanical ventilation training (Said, 2012; Akin Korhan et al., 2014; Dellaca, and Veneroni, 2017; Al Shameri, 2014). There are a limited number of studies in Turkey assessing the knowledge and attitudes of the nurses on the mechanical ventilation.

**Aim:** This study was conducted to determine the knowledge, attitude, and behaviours of the ICU nurses about the use of MV and care of the mechanically ventilated patients.

### **Material**

This descriptive study was conducted with the nurses working in the ICU of a university hospital between 20.02.2018 and 10.03.2018. The data of the study were collected with a

questionnaire having 45 questions prepared upon a literature review.

### **Method**

The population of the study consisted of the nurses working in the level 2. and 3. intensive care units of a university hospital (n=200) and the sampling method was not used. The study was conducted with 108 nurses who accepted to participate in the study after the ethics committee approval (ethics committee number: 2018/6-24) was received. The data obtained from the study was assessed by performing the percentage, mean, correlation analyses with SPSS 20.

### **Results**

The average age of the nurses participating in the study (n=108) was 31.43 (min=22 ±max =49) and 73% were female. 30% had intensive care certificates. 65% of the participants stated that their units had the operating manual of mechanical ventilator.

When the knowledge of the IC nurses on the technical data and terms of MV was examined (Table 1), 24% of the nurses answered correctly the question on the Pao<sub>2</sub> and the respiration type, which are critical value in the MV initiation; 86% answered correctly the question on the modes used in the ventilation process, and 68% answered correctly the question on meaning and function of the term PEEP. While 60% of them did not answer correctly the question on the causes of the MV's high-pressure alarm and 71% did not answer correctly the question on the MV's low-pressure alarm.

When examining the practices of the nurses working in the ICU on the care of the patients receiving the MV support (Table 2), it was found that almost all of them performed the ETT care (94%), 85% of them controlled the cuff pressure and 63% did this control by touching with hand. 57% of the nurses stated that they used the physiological saline solution before aspiration. It was determined that 69% used chlorhexidine in the oral care. In the study, it was determined that 47% of the participants got training on VAP (Table 2)

No significant correlation was found between the intensive care certificate, getting mechanical ventilator training and mechanical ventilator and its practices. (P> 0.05).

**Table 1 Technical data of the mechanical ventilator**

Technical data of the device	n = 108 % Yes	n = 108 % no
Training on mechanical ventilator	44	56
Knowing the critical Pao2 amount in the mechanical ventilation decision	24	76
Knowing the critical respiratory rate in the initiation of mechanical ventilation	27	73
Knowing the critical PH in the mechanical ventilation initiation	34	66
Knowing the critical respiration type in the mechanical ventilation initiation	24	76
Knowing the ventilation modes	86	14
Knowing the explanation of the term FIO2	75	25
Knowing the PEEP term and its function	68	32
Knowing the term of tidal volume and its function	64	36
Knowing the causes of high pressure alarm	40	60
Knowing the causes of low pressure alarm	29	71

**Table 2 The practices on the care of the mechanically ventilated patients**

Care Practices	n = 108 % yes	n = 108 % no
Endotracheal tube maintenance frequency	94 (at least once a day)	6 (Other)
Checking the endotracheal tube level	94	6
Control type of the cuff pressure	85	15
Cuff pressure control type	Manual = 63 With injector= 18 With cuff measuring instrument = 5 Other = 15	
Knowing the endotracheal tube complications	50	50
Giving physiological saline solution to the endotracheal tube before aspiration.	57	43
Ventilating patient with 100% oxygen before aspiration	78	22
Eye care type (Answered more than once)	Closing with tape = 76 Using tears = 50 Wiping eye from the inner canthus out = 81	
Frequency of Oral Care:	Six times a day = 43	Other = 57
The solutions used in the oral care (Answered more than once)	Sodiumbicarbonate = 69 Chlorhexidine = 69 I don't know = 31	
Following the anxiety of the patient receiving the ventilation support	72	28
Recognizing the anxiety findings of the patient receiving the ventilation support	58	42

The methods of relieving the anxiety of the patient receiving the ventilation support (Multiple options may be marked)	Relaxing the patient by talking to him/her= 82 Ensuring that the patient expresses himself / herself with by writing = 67 Getting the patient in touch with their relatives = 58
Informing the relatives of the ventilated patient	35 65
Getting the training for ventilator-induced pneumonia	47 53
Taking the ventilator-induced pneumonia precautions	79 21

### Discussion

It is highly important to know the technical specifications of the MV device and recognize and correct early the practices that may cause complications for maintaining and terminating the time elapsed in mechanical ventilation in a healthy way.

In the study, the nurses could not explain the meaning and the functions of the terms PEEP (32%) and FIO<sub>2</sub> (25%). It was more clear that the heart functions were affected negatively in the patients for whom PEEP was applied in MV (Corredor and Jaggar, 2013). In case that a non-concurrence develops between the intrinsic (auto) PEEP, developing in the patient, and the adjusted PEEP value, the respiratory load of the patient increases and there may be a non-concurrence between the ventilation and the patient. (Pepe and Marini, 1982). The PEEP settings is a procedure performed under the control of a physician but the control, follow, and record of whether the PEEP is performed with the right settings are performed by the nurses.

Although it is known that exposure to high O<sub>2</sub> concentrations is less harmful than hypoxemia, as it will cause oxygen toxications, it is important to decrease the frequency of inhaled oxygen (FIO<sub>2</sub>) and prevent it to exceed 0.65 under any circumstances (Ciledag and Kaya 2009). Not knowing the definition and the functions of the PEEP and FIO<sub>2</sub> will cause the complications associated to them to develop more frequently and to be recognized late.

In the units where the study was performed, 36% of the nurses could not explain correctly the tidal volume.

The fact that the patient becomes agitated due to high and low tidal volume practices, his/her hypoxemia becomes evident, he/she has hypotension and symptoms of cardiovascular collapse, and crepitation is observed in the neck should raise volutrauma suspicion and it should be reported to the responsible physician by the nurses who follow up the patient. (Hsu and Sun, 2014; Ucgun, 2008). In order to prevent volutrauma-associated complications, the nurses should follow the tidal volume getting into the patient, recognize the symptoms caused by the high or low tidal volume and intervene immediately.

When the nurses were asked about the criteria of starting mechanical ventilation, 24% of them answered correctly the critical value of Pao<sub>2</sub> to initiate MV, 34% answered correctly the pH value, and 24% answered correctly the critical respiration rate and type. The fact that the respiratory acidosis deteriorates, the pH falls below 7.20, the PaO<sub>2</sub> cannot be increased over 40 mmHg, that the mental symptoms deteriorate, the secretions cannot be excreted, and cardiovascular stability cannot be provided are the most important symptoms in the decision of the patient for the mechanical ventilation support (Urden et al., 2017; Ucgun 2013). If these symptoms are recognized and intervened early, the hypoxia-associated complications and the mortality rates will decrease. The present study also revealed that the nurses were insufficient at recognizing the emergencies that require the MV support.

Most of the nurses (94%) stated that they performed ETT care, 81% stated that they changed the place of the ETT in order to prevent the pressure sores that will occur in the mouth at

least once a day and 94% stated that they controlled the tube level. The nursing care of the mechanically ventilated patient should be planned and maintained according to the patient needs (Moreira, 2017). In the care of the patients, whom the endotracheal intubation are applied, providing and maintaining the right position and hygiene are important. The fact that the tube progresses and enters into the tracheobronchial tree may cause the vocal cords and epiglottis to get damaged (Ozde, 2011; Smith and Pietrantonio, 2016; Stauffer et al., 1981). At which cm the endotracheal tubes are determined should be noted down and whether or not the tube is at the same level should be controlled at each care (LaMar, 2012; Brown, 2015; BPG 02: Endotracheal Tube Care., 2015; Mechanical Ventilation for the Adult., 2017). It can be asserted that the nurses act in accordance with the literature in the ETT care and follow up.

It was found that 85% of the nurses stated that they controlled routinely the cuff pressure during the ETT care and 63% stated that they did this control by touching with hand. The fact that the cuff pressure was very low and the secretions leak from the tube circumference into the lower respiratory tracts or (Colak et al., 2010) or it is higher than the capillary perfusion pressure (25-35 mmHg) may cause complications (Jaber et al., 2010). It is stated in the literature that aneroid manometer should be used for adjusting and monitorization of the cuff pressure of ETT (Jordan et al., 2012). The aneroid devices should be extended in the intensive care units for cuff measurement.

After the intubation tube is placed and stabilized, the main task of the nurses is to maintain the patency of the intubation tube (Ozde, 2011). In the study, it was determined that 57% of the nurses used *sf* to eliminate the occlusion. Various studies have been conducted on the effectiveness of *sf* that is given into the airway in order to soften the secretions before the aspiration and ensure them to be aspirated easily and it has been stated that *sf* decreases the oxygenation, increases the arterial blood pressure and intracranial pressure and increases the risk of nosocomial pneumonia when it is given to the lungs instead of softening the secretions (Kalender and Tosun, 2015; AARC clinical practice guideline 2010; Demers et al., 1973; Halm et al., 2008). The fact that even though the use of *sf* before aspiration is not recommended, most of the nurses used *sf* will

increase the complications due to the use of *sf* (Pedersen et al., 2009; AARC clinical practice guideline 2010).

It was found that 60% of the nurses could not answer correctly the high-pressure alarm reasons. Flexion in the connections of the ventilator, leaning of the tube to the tracheobronchial tree, the position of the patient, biting of the tube or clogging of the tube may be regarded as the reasons for the high-pressure alarms. It was determined in the present study that 71% of the nurses did not know the first reasons coming to mind in the low-pressure alarm. If MV gives a low-pressure alarm, the connections should be controlled and the required interventions should be performed if there is any leakage. It should be controlled whether there is a malfunction in the ventilator or not and; if any, the technical service should be informed. If this problem results from the tiredness of the patient, the ventilator mode should be changed in accordance with the physician's request. The cuff pressure should be controlled; if it is low, it should be blown up; if there is any leakage, the tube should be changed. The fact that the alarms cannot be recognized early and the precautions are not taken may cause some serious negative problems like losing the patient.

It was stated 71% of the nurses stated that the MV operating manual was not in the unit. The operating manual is a booklet including the basic information for using things properly and consciously. The most important function of the operating booklet is to provide the user to behave correctly while using a product (Ziya., 2017). Each mechanical ventilator should have an operating manual just beside and this operating manual should be read and understood by the users.

It was determined that 43% of the nurses stated that they performed oral care once every four hours and 69% of them stated that they used chlorhexidine in this care. Continuously open staying of the mouth due to ETT, identification materials used in identification of the tube, and failure of oral feeding of the patient cause deterioration in tissue integrity of the mouth and its surrounding (Ozveren, 2010; Berry et al., 2006; Beraldo C & Andrade D 2008). The oral care is important in the protection of the oral health and prevention of ventilator-associated pneumonia (VAP). In the literature, it has been emphasized in the VAP prevention procedure

that the oral care of the patients in the mechanical ventilation control should be given once every 2-4 hours (Yava and Koyuncu, 2006; McNeill, 2005). El-Rabbany stated that the oral care performed with chlorhexidine was effective in preventing VAP (El Rabbany,2015). In order to prevent or minimise the oral problems that may develop in the mechanically ventilated patients, a regular oral care should be provided with a standard protocol in the clinics.

The mechanically ventilated patients have problems in communication as well as the limitations in the physical movements. The intubated patients are under stress as their lives depend on a device and they are in an unfamiliar environment. In the study, it was found that 58% of the nurses followed the anxiety symptoms developing in the patient, most of them (82%) relieved the patients by talking when the anxiety was developed, and 58% of them got the patient in touch with his/her relatives. The patients, who were informed enough, saw his/her relatives and the nurses continuously communicated with act more well-adjusted compared to other patients. This decreased the period to stay intubated and in the intensive care unit ( Cornock et al., 1998; Arslanian et al. 2003; Hemslew et al. 2001; Thomas 2003). In a study conducted with the patients hospitalized in ICU, depression and anxiety have been determined in 72% and 42% of the patients, respectively (Alaca et al., 2011). In the light of these data, it is required that the nurses not only focus on the physical needs and specify the interventions for meeting the psychological needs of the patients hospitalized in ICU.

In the present study, 70% of the nurses stated that they did not meet with the patient relatives. In the literature, it has been determined that the families, who have patients in ICU, also have some individual needs like being informed, being together with the patient, helping to patient, getting support and express their feelings (Unver 2003; Hughes et al., 2004; Eroglu et al., 2001; Obringer, 2012). It has been emphasized that meeting these needs is under the primary responsibility of the ICU health team (Ozgursoy and Akyol, 2008). The fact that most of the nurses did not meet with the patient relatives indicated that they did not have a holistic approach for the patients.

Protecting the ocular surfaces of the IC patients is a non-negligible and important issue and the

ocular care is a basic and required element of the nursing practices. The deterioration of the patient's consciousness level, and the sedation, and the muscle relaxants, that are needed for the mechanical ventilation treatment and the ventilator support increase the sensitivity of the ocular surface against some diseases. The blink reflex, tear film and anomalies in the eyelid may cause complications like corneal epithelial disorders, microbial keratitis, conjunctival chemosis (oedema) and dry eye in IC patients (Kocacal and Eser, 2008). In the study, it was determined that 81% of the nurses cleaned eyes from the inner canthus to the outer canthus, 76% closed the eyelid with plaster, and 50% used teardrop.

In the study by Ebadi et al., it was found that the nurses preferred the evidence-based practices for the eye care. (Ebadi et al., 2017). In the eye care practices, the practices made to protect the eye moisture were found inadequate.

In the study, it was determined that 47% of the nurses had training in preventing VAP and 79% took precautions regarding VAP. The ventilation-associated pneumonia (VAP), one of the complications of the mechanical ventilation, is also a risk factor for the morbidity and mortality along with increasing the hospitalization duration and the costs. The VAP rate may be decreased by applying the patient care practices that will decrease the risk factors in the patients with high VAP risk and early diagnosing (Altintas, 2015). One of the reasons behind why VAP is observed in the intensive care is the lack of knowledge of the health personnel about the infections (Naharci, 2006; Osti et al.,2017; Kalil,2016). It is pleasing that most of the nurses, included in the study, took VAP precautions, although half of them received the training. However, it is required that all the team receive the training and the precautions are taken completely, in order to prevent VAP.

The MV management is a complex and dynamic situation that requires advanced knowledge and skills. Making the right decision in time provides the patient the best service and reduces the risks (Blackwood et al., 2013; Duff, 2010). In the study, no significant correlation was found between receiving the MV training, and the mechanical ventilation practices and the care practices of the patients in MV. However, the continuing training on MV provides a safe care to be serviced in the intensive care units by

developing the knowledge and the skills in the MV management. (Al-majid et al., 2012; Cooper, 2009; Farnell and Dawson, 2006). In the present study, the fact that the training did not make any difference made us think that the quality of the training should be reviewed.

The roles of the nurses in the MV management require high autonomy. Before starting to work in the intensive care unit, the nurses, like all the team members should be provided the orientation training. The nurses, who become successful at the end of this training, should start working in the intensive care units. The nurses who can manage the mechanical ventilation process well will provide a more qualified patient care. (Gulhermino et al., 2018)

### Limitations of the study

The roles of the nurses in the mechanical ventilation practices vary according to the intensive care units, regions, even the countries that the nurses work in. The changing roles affect the required mechanical ventilation knowledge and practices.

### Implications and Recommendations for Practice

The incomplete practices and the misconducts in the mechanical ventilation in the intensive care units cause mechanical ventilation associated complications. And these complications cause toprolong hospitalization durations in the intensive care units, increase in the mortality and to increase the costs (Fialkow et al., 2016). The fact that the nurses working in the intensive care units perform evidence-based nursing care during the mechanical ventilation and practices will decrease the MV complications.

### Conclusions

In the study, the nurses received MV and intensive care training, which did not make any difference in the practices. The quality of the trainings provided on the intensive care and mechanical ventilation practices should be improved and it should be provided for all the intensive care nurses.

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