Original Article

Noninvasive Mechanical Ventilation Related Some Complications: Patients Treating Intensive Care Unit

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Abstract

Background: Noninvasive mechanical ventilation (NIMV) is a method of delivering positive-pressure respiratory support through a mask without using an endotracheal tube. Although NIMV is safe and tolerable for many patients, some complications related to the mask, airflow, and pressure can be seen.
Objective: This descriptive study aimed to determine the complications seen in patients undergoing NIMV.
Methods: Forty patients who met the inclusion criteria were included in the study. The data were collected using the Personal Identification Form and the NIMV-related Complication Form. The patients were evaluated every day at the same time for 7 days, and the data were recorded in the form by researcher.
Results: No significant changes were observed in the complications such as nasal dryness, dry mouth, eye irritation, sinus pain, pressure ulcer, barotrauma, hypotension, and hypertension within 7 days (P >0.05). However, a statistically significant decrease was seen in the complications such as ear pain, gastric distention, pneumonia, claustrophobia, noise, treatment nonconformity, agitation, sleep problem, and mask discomfort (P <0.05).
Conclusions: Nurses should be aware of NIMV-related complications, prevent complications and make necessary nursing interventions.

Key words: Complication, Noninvasive Mechanical Ventilation, Nursing

Introduction

Noninvasive mechanical ventilation (NIMV) is defined as alveolar ventilation via a mask without invasion of the tracheostomy or endotracheal tube. It is performed when hypoxemia and/or hypercapnia cannot be controlled by medical therapy in patients with respiratory failure (Duran, 2010).

Some complications such as mask discomfort, pressure ulcer, claustrophobia, noise, nasal or mouth instability–congestion, eye irritation, sinus pain, ear pain, gastric distension, barotrauma, aspiration pneumonia, hypotension, hypertension, and treatment incompatibility can be seen in patients undergoing NIMV (Rocha & Carneiro 2008; SchOnhofer et al. 2010; Carron, Freu & Ori, 2010; Cabrini et al. 2014; Sanchez et al. 2014; Morley, 2016; Scala, 2016; Conde, et al. 2017; Torreda et al. 2017).

Nurses focus more on invasive mechanical ventilation than on NIMV application, which is the first-step respiratory support. Limited data are available reflecting the quality of patient experience and comfort with the use of NIMV (Saxena & Mani, 2014).

Ferrer et al. (2003) reported NIMV-related complications such as pressure ulcer, conjunctivitis, and gastric distension in patients (Ferrer et al. 2003). Carron et al. (2013) conducted a revision study with patients who underwent

NIMV and reported that 5% of patients had pneumonia, 5%–20% had claustrophobia, 30%–50% had mask discomfort, 2%–50% had nasal lesions, and 50%–100% of the patients had noise complaints (Carron et al. 2013). Durmus (2014) compared complications of the patients who underwent NIMV and reported that 50% of the patients had skin, 45% had eye, 60% had nasal, and 40% had sleep disorders (Durmus, 2014).

An evaluation of the available information on the subject indicated that the detection of complications seen in patients undergoing NIMV might be helpful in determining the solutions to patients' problems, providing the necessary care for the patient-oriented problems, improving patients' comfort, and thus increasing their quality of life. The aim of this study was to determine the complications seen in patients undergoing NIMV.

Methods

Design and Participants

The study population consisted of all patients who underwent NIMV in the intensive care unit (ICU) of an university hospital for pulmonary diseases. The study included 40 patients who met the sample selection criteria, agreed to participate in the study, and were followed up for 7 days. The patients were monitored by the investigator to maintain the data standard and reliability.

Data Collection

The data were collected by the investigator using the "Personal Identification Form" and the "NIMV-related Complication Form" after the patients who met the inclusion criteria were informed about the aim of the study and their approval was taken. A written approval (Approval number 31.12.2014-115) was obtained from the ethics committee of the Ege University Nursing Faculty, and a written consent was obtained from the research institution and each patient to conduct the study.

Personal Identification Form

The Personal Identification Form was a form containing information about gender, age, height, weight, occupation, diagnosis of disease, chronic diseases, and smoking history (Callaghan & Trapp, 1999; Weng, 2008; Roberts et al. 2008; Keenan et al. 2011).

NIMV-related Complication Form

The form containing NIMV-related complications included nasal or mouth dryness, eye irritation, sinus/ear pain, gastric distension, pressure ulcer, pneumonia, barotrauma, hypotension, hypertension, claustrophobia, noise, sleeping problem, and mask discomfort (Mehta & Hill, 2001; Woodrow, 2003; Gay, 2009; Donoghue, 2009; Carron et al. 2013; Yamaguti et al. 2014). The patients were evaluated by the same researcher every day at the same time for 7 days, and the data were recorded in the form. Also, some complications such as sinus pain, pneumonia, barotrauma and treatment incompatibility and agitation were assessed by intensive care doctor. Their assessment consequences were recorded in the NIVM related complication form by researcher.

Data Analysis

Statistical Package for Social Science for Windows package program version 16.0 (SPSS, IL, USA) was used for analyzing the data. Personal identification information of patients was given in percentage values. The chi-square method was used to evaluate the distribution of the independent variables. Independent variables were compared using parametric or nonparametric analyses.

Reults

Most of the patients included in the study were males (60%), and the mean age was 73.4 ± 1.25 years. Table 1 shows the sociodemographic characteristics of the patients.

Table 2 shows the complications seen in NIMV-related patients on days 1, 4, and 7. The symptoms most commonly experienced by the patients (75% and above) on each of the 3 days were mask discomfort, treatment mismatch, pressure ulcer, and mouth dryness. Symptoms seen with a decreasing rate in the follow-up of the patients were claustrophobia, noise sensation, and agitation. Gastric distension and pressure ulcer formation in the nasal region were increasingly common complications during the follow-up days (Table 2).

Table 1: Patient's characteristics

Descriptive characteristics		
	Number (*n*)	Percentage (%)
Gender		
Female	16	40
Male	24	60
Age group	$X = 73.4 \pm 7.93$	
Below 60	3	7.5
Between 61 and 75	18	45
76 and above	19	47.5
Occupation		
Labor	7	17.5
Retired	15	37.5
Housewife	16	40
Farmer	5	5
Education status		
Illiterate	2	5
Literate	8	20
Primary school	21	52.5
Middle school	4	10
High school	4	10
University	1	2.5
Addiction level		
Moderately addict	2	50
Advanced addict	20	50
Hospitalization time (day)	10.7 ± 3.06	
Smoking		
Yes	21	52.5
No	19	47.5
BMI		
Normal	10	25
Overweight	23	57.5
Obese (first stage)	6	15
Obese (second stage)	1	2.5
Morbidly obese	0	0
Total	40	100

Table 2: Distribution of the complications on first, fourth, and seventh days

	First day				Fourth day				Seventh day			
	Yes		No		Yes		No		Yes		No	
Complication	**n**	**%**	**n**	**%**	**n**	**%**	**n**	**%**	**n**	**%**	**n**	**%**
Nasal dryness	29	72.5	11	27.5	29	72.5	11	27.5	28	70	12	30
Mouth dryness	35	87.5	5	12.5	34	85	6	15	34	85	6	15
Eye irritation	26	65	14	35	28	70	12	30	27	67.5	13	32.5
Sinus pain	17	42.5	23	57.5	22	55	18	45	23	57.5	17	42.5
Earache	12	30	28	70	20	50	20	50	20	50	20	50
Gastric distension	23	57.5	17	42.5	37	92.5	3	7.5	36	90	4	10
Pressure ulcer	35	87.5	5	12.5	40	100	0	0	40	100	0	0
Pneumonia	16	40	24	60	28	70	12	30	32	80	8	20
Barotrauma	1	2.5	39	97.5	1	2,5	39	97.5	1	2.5	39	97.5
Hypotension	10	25	30	75	12	30	28	70	11	27.5	29	72.5
Hypertension	12	30	28	70	10	25	30	75	9	22.5	31	77.5
Claustrophobia	30	75	10	25	15	37.5	25	62.5	13	32.5	27	67.5
Noise sensation	32	80	8	20	19	47.5	21	52.5	18	45	22	55
Treatment mismatch	36	90	4	10	23	57.5	17	42.5	20	50	20	50
Agitation	36	90	4	10	21	52.5	19	47.5	18	45	22	55
Sleep disorder	36	90	4	10	28	70	12	30	24	60	16	40
Mask discomfort	39	97.5	1	2.5	33	82.5	7	17.5	33	82.5	7	17.5

Discussion

This novel study observed the incidence of NIMV-related complications for 7 days in Western Turkey. The first objective of the study was to monitor the complications of patients receiving NIMV treatment in the ICU. At the same time, the primary aim of this study was not to develop a questionnaire form to assess these complications. For this reason, the validity and reliability of this questionnaire form was not tested.

Some complications developed in patients who underwent NIMV, which affected the treatment process. A previous study determined that 25%–30% of the patients could not adapt to the treatment due to the reduction in comfort level because of mask discomfort (Holanda et al. 2009). Kramer et al. showed that NIMV failed in 18% of patients because of mask discomfort (Gregoretti, 2002; Yamaguti et al. 2014). Nurses are involved in monitoring and detecting these complications earlier, which are treated with NIMV but have reduced the treatment compliance. Nurses also initiate necessary interventions. In the present study, no significant changes were seen in the complications such as nasal dryness, dry mouth, eye irritation, sinus pain, pressure ulcer, barotrauma, hypotension, and hypertension within 7 days ($P > 0.05$). However, a statistically significant decrease was seen in the complications such as earache, gastric distention, pneumonia, claustrophobia, noise, treatment nonconformity, agitation, sleep problem, and mask discomfort ($P < 0.05$).

It was determined that the occurrence rate of complications such as earache and gastric distention increased by the fourth day. However, the occurrence rate of complications such as claustrophobia, noise sensation, treatment mismatch, agitation, sleep disorder, and mask discomfort reduced on the fourth day.

The present study found that the agitation of the patients decreased significantly on the follow-up days. The patients with shortness of breath were often agitated and anxious as a result of hypoxia. This agitation usually alleviated after the patients were adequately ventilated (Preston, 2006). In parallel with the literature, it was seen that the agitation of patients during NIMV decreased. In addition, nurses informing patients about the NIMV need and providing psychological support, including the description of the equipment used such as a ventilator, might provide patients a more relaxed breathing (Preston, 2006). Similar to previous studies, a study conducted by Durmus showed that sleep problems and complaints of mask discomfort decreased after 2 days. However, complications such as gastric distension and pressure ulcer increased (Durmus, 2014).

Gastric distension has been reported in 50% of patients undergoing NIMV, which affects the quality of life of the patients and creates pressure in the lungs to reduce airway obstruction. Nasogastric tube insertion and NIMV should be performed especially after eating to reduce the incidence of the aforementioned complication (Parsons, Sole & Byers, 2000; Woodrow, 2003; Preston, 2006; Carron, Freu & Ori, 2010).

A previous study demonstrated that the mask discomfort of the patients decreased significantly (97.5% and 82.5%) on the follow-up days. However, the rate of masked discomfort was found to be higher (70%) in the present study compared with the study by Silva et al. (Silva et al. 2013). Schneider et al. found that 72.5% of the patients had mask discomfort (Schneider et al. 2006). When positive-pressure support was given, the expiration was resisted by the same pressure. This made the breathing process difficult and created a discomfort sensation (Woodrow, 2003). Mask discomfort could be alleviated by reducing the tension of the fixed mask bands, so that they were no air leaks, and using different mask sizes suitable for the patient (Hill, 2004; Preston, 2006; Gay, 2009; McBrien, Reilly & Wynne, 2009). Low-dose analgesics/sedatives can be used with caution to reduce patient anxiety and improve comfort (Saxena & Mani, 2014). In the present study, the number of patients with claustrophobia decreased significantly compared with other follow-up days (75% vs 32.5%) also, the rate of symptom onset was lower (Silva et al. 2013). The ventilator settings need to be adjusted to provide the lowest inspiratory pressure required to prevent or reduce claustrophobia and improve patient comfort. The use of sedation may help prevent claustrophobia (Mitka, 2009; Carron, Freu & Ori, 2010).

Song et al. detected abdominal distension, pressure ulcer, and pneumothorax in 58%, 24.7%, and

12.3% of the patients who underwent NIMV, respectively (Song et al. 2015). In another study, the pressure ulcer rate was 7%–100%; this rate was 87%–100% in the present study (Carron, Freu & Ori, 2010). Ozbudak et al. (2016) found that the duration of pressure ulcer formation was delayed in patients who used the protective material on the nasal bridge compared with those who did not use (Ozbudak & Yesilbalkan, 2016). The deterioration of skin integrity is related to tight bands, increased inspiratory pressure, long-term NIMV, and use of an oronasal mask (Woodrow, 2003; Gay, 2009; Carron et al. 2013; Hess, 2013). Pressure ulcers can be prevented by using the nasal bridge, different protective materials, and masks of a size appropriate for the anatomic structure of the patient's face (Mehta & Hill, 2001; Woodrow, 2003; Hill, 2004; Preston, 2006; Weng, 2008; Carron, Freu & Ori, 2010; Hess, 2013). Ozbudak et al. reported that the time required for developing NIMV-related pressure ulcer in patients using transparent film for the protective material was statistically significantly longer than the time required for developing pressure ulcer in patients receiving routine care. Protective covers do not prevent the formation of pressure ulcers. However, they reduce friction and laceration and the effect of pressure (Ozbudak & Yesilbalkan, 2016). The present study showed noise complication in 50%–100% of the cases, which was consistent with the available literature. The nasal and mouth dryness was observed in 20%–50% of the cases. The incidence of gastric distension was generally reported to be 5%–50; however, it was higher in the present study (42%–90%). Barotrauma is an extremely rare complication seen in a few patients in the present study (Carron, Freu & Ori, 2010).

During the follow-up study, the rate of eye dryness in the patients changed between 65% and 70%. The eye irritation could be avoided by adjusting the tightness of the mask bands and using eye drops (Mehta & Hill, 2001; Donoghue, 2009). For eye irritation, it is possible to adjust the tension of the mask bands around the eye to prevent air escape and reduce irritation caused by eye drops (Parsons, Sole & Byers, 2000; Mitka, 2009).

In the present study, 85%–87.5% of the patients were found to have mouth dryness on the follow-up days. Nasal saline or gel may be used to prevent or eliminate the nose and mouth dryness. Also, oral care can be given every 2–3 h so as not to disturb the treatment. The use of medical treatments (inhaled corticosteroids, decongestants, or oral histamine–decongestant inhaler combinations) is recommended for nasal obstruction (Parsons, Sole & Byers, 2000; Hill, 2004; McBrien, Reilly & Wynne, 2009; Carron, Freu & Ori, 2010; Sanchez et al. 2014). The use of heated humidifiers has also been recommended in the literature. However, it was not recommended in the latest care guidelines due to issues related to patients' inspiratory–expiratory cycle (McBrien, Reilly & Wynne, 2009).

Conclusions

Nurses are involved in the care and management of patients undergoing NIMV. They provide direct care and support to patients for 24 h (Duran, 2010; Sorensan et al. 2013). They should be aware of NIMV-related complications, prevent these complications, and make necessary nursing interventions to increase both the comfort of the patient and the efficacy of the treatment and also to ensure the success of the treatment.

Moreover, training programs should be arranged to increase the awareness of nurses, conduct studies with larger patient groups, and use previous study results as a data source for future studies.

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