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Review Article

EFFECT OF SIMULATION-BASED SUCTION EDUCATION ON THE KNOWLEDGE AND PERFORMANCE OF PEDIATRIC INTENSIVE CARE UNIT NURSES

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Abstract

Introduction: Nursing interventions have a direct effect on the health and clinical improvement of children. Therefore, nurses should be aware of the risks of endotracheal suctioning and receive continuous education in this field. The present study aimed to investigate the effect of simulation-based suction education on knowledge and performance of pediatric intensive care unit nurses.

Methods: In a quasi-experimental study between 2019 and 2020, 33 nurses working in pediatric and neonatal intensive care units were selected as availability samples. First, nurses' performance in suctioning was evaluated by a standard checklist, then, suction education was performed by simulation method. Six months after the education, nurses' performance in standard suctioning was re-evaluated and analyzed by SPSS 22 software.

Results: The mean score of knowledge and performance after the education (43.99 ± 6.03) was significantly different from before the education (5.58 ± 5.3) (P <0.05).

Conclusion: The results showed that nurses' performance in suctioning needs further attention. To improve the clinical performance of nurses, the use of small group education is useful. Therefore, it is suggested that the education courses be delivered to nurses in small group discussions in the form of in-service programs.

Keywords: Suction education, Simulation method, Knowledge and performance, Nurses, Neonates and children

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INTRODUCTION

The ultimate goal of nursing is to provide evidence-based care that can improve quality for patients, families, providers, and the health care system. Many of the established nursing therapies appear to have not been substantiated by solid evidence. One area of concern in nursing is ETT (ETT) suctioning. ETT suctioning is a critical protocol that is mainly used to keep the artificial air ducts open in mechanical ventilation [1]. However, it is not safe and should not be implemented as a routine protocol. Hypoxia, arrhythmia, mild and severe bleeding, increased intracranial pressure, cardiac arrest, and even death are amongst the side effects of this protocol [2]. Approximately half of children admitted to the intensive care unit need mechanical ventilation and endotracheal suctioning to continue their lives. Neonates are subjected to painful interventions throughout the day, with 45% of them being oral or nasal suctioning, which usually does not occur with anesthesia and pain relief [3]. 20% of the painful procedures of the neonatal population are endotracheal suctioning. In nurses' decision to perform ETT suctioning, personal experiences and patient factors play a crucial role [4]. Patients who did not receive anesthesia or sedative drugs before suctioning had a higher pain score [5]. Patients receiving more effective sedatives show less cutaneous electrical activity during suction [6]. In patients with high pulmonary secretion, the use of a larger catheter is recommended, thought it may increase intracranial pressure and pain [7]. Studies have shown that a 2 mm change in suction catheter diameter would increase systolic and diastolic pressure, pain, and heart rate [8]. The mean suction pressure is approximately twice that of the standard, and in only 67% of cases, patients receive pre-oxygenation [9]. Unlike usual suctioning, ETT suctioning lessens the risk of airway injury and pain [4].

Most nurses in intensive care units lack the knowledge and skills needed for ETT suctioning [10]. Studies has shown that nurses suction in ventilated patients more than needed and they have a higher risk of ventilator-associated pneumonia [16]. Therefore, nurses' performance in ETT suctioning needs further attention [11]. Nurses require education in examination of patients and following oxygenation guidelines [12, 10]. According to studies, there is equality between the knowledge of nurses and nursing students in suctioning [13]. In a study by Ghorbanpoor et al., knowledge and performance of intensive care unit nurses in ETT suctioning was good and moderate, respectively [14]. In a study by Hussain et al., there was a positive relationship between prior education and performance of nurses and performance was reported to be moderate. [15]

Purposeful educational programs could have a positive effect on the knowledge and performance of pediatric intensive care units nurses [17, 10]. Simulation-based education has had a positive effect on the knowledge and performance of nursing students in ETT suctioning [18]. Education creates a positive educational atmosphere in performance and simulation labs and motivates nursing students [19]. It also improves the medial students' knowledge and satisfaction [20]. In this regard, this study aimed to investigate the effect of simulation-based suction education on knowledge and performance of pediatric intensive care units nurses.

MATERIALS AND METHODS

Study design

This quasi-experimental study was performed on pediatric and neonatal intensive care units nurses working in Hazrat Ali Asghar Hospital from 2019 to 2020. 33 nurses were selected and entered into the study as availability samples based on inclusion criteria.

Inclusion and exclusion criteria

Inclusion criteria included nursing in pediatric and neonatal intensive care units and exclusion criteria was unwillingness to participate in the study and absence in educational sessions.

Work process

After obtaining the necessary authorization and receiving a code of ethics, nurses were asked to individually refer to the education room. Before the educational intervention, the performance of the nurses were evaluated by a researcher-made checklist. Then two one-hour session was held for nurses to discuss the physiology of breathing, the importance of proper suctioning, standard principles of suctioning, and the effect of suctioning on the health of ventilator-dependent neonates. During the practical education, they were then asked to perform the suction on the moulage and provide the necessary explanation. According to the checklist, their knowledge in all sections was score 0 or 1. After the instructor performed suctioning on the moulage, nurses were asked to do the same procedure and then scored again. After 6 months, the process was repeated. Similarly, after education, performance and knowledge of nurses by the bedside of the patients was re-evaluated in different shifts. Education was also performed by simulation method.

Data analysis

After collecting data, SPSS software version 22 was used to compare knowledge and performance in the study groups. For descriptive purposes, central, descriptive, and dispersion indices were used. For analytical purposes, independent t-test was used. Significance level was considered 0.05.

RESULTS

The mean age of the nurses was 38.18 years, the majority of them (93.9%) were female, and 93.9% had a bachelor's degree. 78.7% of them was employed and the average work experience was 13.24 years.

Table 1: Frequency distribution of nurses' personal specifications

Personal specifications		Frequency	Percentage
Age	30-39	16	48.5
	40-49	17	51.5
	Total	33	100
	SD±M	38.18±4.88	
Sex	Female	31	93.9
	Male	2	6.1
	Total	35	100
Education	B.A.	31	93.9
	M.A.	2	6.1
	Total	35	100
Employment	Permanent	26	78.7
	Probation	2	6.1
	Contractual	5	15.2
	Total	35	100
Work experience	<10 years	6	18.2
	10-15 years	15	45.5
	≥15 years	12	36.4
	Total	35	100

Table 2 shows the frequency distribution of knowledge and performance of nurses working in pediatric intensive care units during the first 6 months of the year. Table 3 shows that the mean score of knowledge and performance was statistically significant at least once ($p < 0.001$). Also, Bonferroni pairwise comparison showed that the mean score of knowledge and performance was significantly higher and lower than before ($p = 0.04$) and after the intervention ($p < 0.001$), respectively. Results also showed that the mean score of knowledge and performance after the education was significantly higher than before the education ($p < 0.001$).

Table 2: Frequency distribution of knowledge and performance of pediatric intensive care unit nurses in the first 6 months of 2019

No.	Knowledge and performance	Before intervention				After intervention				6 months after intervention			
		Yes		No		Yes		No		Yes		No	
		Frequency	Percentage	Frequency	Percentage	Frequency	Percentage	Frequency	Percentage	Frequency	Percentage	Frequency	Percentage
1	Specifies suction applications	33	100	0	0	33	100	0	0	33	100	0	0
2	Explains the reasons for the procedure, if parents are present	3	9.1	30	90.9	32	97	1	3	3	9.1	30	90.9
3	Disinfect hands with alcohol-based antiseptic or water and soap	28	84.8	5	15.2	33	100	0	0	27	81.8	6	18.2
4	Provides ambo bag and oxygen connections	8	24.2	25	75.8	32	97	1	3	20	60.6	13	39.4
5	Controls the correct operation of suction and connections	15	45.5	18	54.5	33	100	0	0	20	60.6	13	39.4
6	Examines the patient for cardiovascular and respiratory status through the monitor	9	27.3	24	72.7	33	100	0	0	0	0	33	100
7	Puts child/neonate in folded position	0	0	33	100	22	66.7	11	33.3	0	0	33	100
8	Uses disposable sterile catheters	33	100	0	0	33	100	0	0	33	100	0	0
9	Connects the catheter with the appropriate size	33	100	0	0	33	100	0	0	33	100	0	0
10	Turns on the suction and determines its negative pressure while it is blocked	14	42.4	19	57.6	33	100	0	0	4	12.1	29	87.9
11	Determines the depth of catheter insertion, including the size of the ETT	23	69.7	10	30.3	33	100	0	0	19	57.6	14	42.4
12	Prepares normal saline sterile 0.25 to 0.5 cc	0	0	33	100	33	100	0	0	1	3	32	97
13	Performs Pre-oxygenation with fio2 10% above normal level	1	3	32	97	31	93.9	2	6.1	1	3	32	97

14	Continues pre-oxygenation for 30 to 60 minutes	1	3	32	97	31	93.9	2	6.1	1	3	32	97
15	In case of open suctioning, separates the child/neonate from the ventilator	0	0	33	100	33	100	0	0	1	3	32	97
16	When open suctioning is performed, the child/neonate will be separated from the ventilator	33	100	0	0	33	100	0	0	33	100	0	0
17	Bring the suction catheter to the pre-set value	30	90.9	3	9.1	33	100	0	0	24	72.7	9	27.3
18	When the catheter is ejected, applies the negative suction pressure	33	100	0	0	33	100	0	0	33	100	0	0
19	Allows suction time of up to 15 seconds	0	0	33	100	33	100	0	0	1	3	32	97
20	After each suction, re-ventilates the patient to reach the normal oxygen level	25	75.8	8	24.2	33	100	0	0	21	63.6	12	36.4
21	Repeat the procedure 2 to 3 times at most	33	100	0	0	33	100	0	0	32	97	1	3
22	If something goes wrong, stops suctioning	33	100	0	0	33	100	0	0	29	87.9	4	12.1
23	After completion of suction, performs post-oxygenation for 1 minute	0	0	33	100	33	100	0	0	1	3	32	97
24	After completion of suctioning, restricts post-oxygenation by 10% above normal level	0	0	33	100	33	100	0	0	0	0	33	100
25	Based on the acceptable level of oxygen saturation for every neonate, reverts the oxygen to normal level before	0	0	33	100	33	100	0	0	0	0	33	100

	suctioning												
26	After suctioning, examines respiratory status, heart rate and oxygen saturation	0	0	33	100	32	97	1	3	0	0	33	100
27	When finished, washes hands with an antiseptic or soap.	29	87.9	4	12.1	33	100	0	0	31	93.9	2	6.1
28	Performs a proper recording of the secretion's characteristics	4	12.1	29	87.9	33	100	0	0	4	12.1	29	87.9
29	Patient tolerance of the procedure and any sudden changes in the patient's condition	0	0	33	100	15	45.5	18	54.5	0	0	33	100
	SD±M	12.75±1.75				27.9±`1.12				12.27±1.71			

Table 3: Frequency distribution of knowledge and performance of pediatric intensive care unit nurses in the second 6 months of 2019

No.	Knowledge and performance	Before intervention				After intervention				6 months after intervention			
		Yes		No		Yes		No		Yes		No	
		Frequency	Percentage	Frequency	Percentage	Frequency	Percentage	Frequency	Percentage	Frequency	Percentage	Frequency	Percentage
1	Specifies suction applications	33	100	0	0	33	100	0	0	33	100	0	0
2	Explains the reasons for the procedure, if parents are present	3	9.1	30	90.9	33	100	0	0	3	9.1	30	90.9
3	Disinfect hands with alcohol-based antiseptic or water and soap	31	93.9	2	6.1	33	100	0	0	28	84.8	5	15.2
4	Provides ambo bag and oxygen connections	16	48.5	17	51.5	32	97	1	3	24	72.7	9	27.3
5	Controls the correct operation of suction and connections	17	51.5	16	48.5	33	100	0	0	26	78.8	7	21.2
6	Examines the patient for cardiovascular and respiratory	9	27.3	24	72.7	33	100	0	0	0	0	33	100

	status through the monitor												
7	Puts child/neonate in folded position	0	0	33	100	29	87.9	4	12.1	0	0	33	100
8	Uses disposable sterile catheters	33	100	0	0	33	100	0	0	33	100	0	0
9	Connects the catheter with the appropriate size	33	100	0	0	33	100	0	0	33	100	0	0
10	Turns on the suction and determines its negative pressure while it is blocked	19	57.6	14	42.4	33	100	0	0	7	21.2	26	78.8
11	Determines the depth of catheter insertion, including the size of the ETT	27	81.7	6	18.2	33	100	0	0	19	57.6	14	42.4
12	Prepares normal saline sterile 0.25 to 0.5 cc	0	0	33	100	33	100	0	0	1	3	32	97
13	Performs Pre-oxygenation with fio2 10% above normal level	1	3	32	97	33	100	0	0	1	3	32	97
14	Continues pre-oxygenation for 30 to 60 minutes	1	3	32	97	33	100	0	0	1	3	32	97
15	In case of open suctioning, separates the child/neonate from the ventilator	0	0	33	100	33	100	0	0	1	3	32	97
16	When open suctioning is performed, the child/neonate will be separated from the ventilator	33	100	0	0	33	100	0	0	33	100	0	0
17	Bring the suction catheter to the pre-set value	33	100	0	0	33	100	0	0	33	100	0	0
18	When the	33	100	0	0	33	100	0	0	33	100	0	0

	catheter is ejected, applies the negative suction pressure												
19	Allows suction time of up to 15 seconds	0	0	33	100	33	100	0	0	1	3	32	97
20	After each suction, re-ventilates the patient to reach the normal oxygen level	28	84.8	5	15.2	33	100	0	0	22	66.7	11	33.3
21	Repeat the procedure 2 to 3 times at most	33	100	0	0	33	100	0	0	33	100	0	0
22	If something goes wrong, stops suctioning	33	100	0	0	33	100	0	0	31	93.9	2	6.1
23	After completion of suction, performs post-oxygenation for 1 minute	0	0	33	100	33	100	0	0	1	3	32	97
24	After completion of suctioning, restricts post-oxygenation by 10% above normal level	0	0	33	100	33	100	0	0	0	0	33	100
25	Based on the acceptable level of oxygen saturation for every neonate, reverts the oxygen to normal level before suctioning	0	0	33	100	33	100	0	0	0	0	33	100
26	After suctioning, examines respiratory status, heart rate and oxygen saturation	0	0	33	100	33	100	0	0	0	0	33	100
27	When finished, washes hands	31	93.9	2	6.1	33	100	0	0	33	100	0	0

	with an antiseptic or soap.												
28	Performs a proper recording of the secretions characteristics	11	33.3	22	66.7	33	100	0	0	14	24.2	19	57.6
29	Patient tolerance of the procedure and any sudden changes in the patient's condition	0	0	33	100	25	8.75	8	24.2	0	0	33	100
	SD±M	13.87±1.57				28.6±0.74				13.45±1.52			

Table 4: Frequency distribution and numerical indicators of knowledge and performance of nurses

Knowledge and performance	Before intervention		After intervention		6 months after intervention	
	Frequency	Percentage	Frequency	Percentage	Frequency	Percentage
<50	28	84.8	0	0	31	93.9
50-75	5	15.2	0	0	2	6.1
>75	0	0	33	100	0	0
Total	33	100	33	100	33	100
SD±M	43.99±6.03		96.23±3.89		42.31±5.92	

The frequency of knowledge and performance of pediatric intensive care units nurses in the second 6 months of 2019 could be seen in Table 4. The result of the statistical test in Table 5 showed that the mean score of knowledge and performance was statistically significant at least once ($p < 0.001$) and the Bonferroni pairwise comparison showed that mean score of knowledge and performance was significantly higher and lower than before ($p = 0.013$) and after the intervention ($p < 0.001$), respectively. Results also showed that the mean score of knowledge and performance after the education was significantly higher than before the education ($p < 0.001$).

Table 5: Frequency distribution and numerical indicators of knowledge and performance of nurses

Knowledge and performance	Before education		After education		6 months after education	
	Frequency	Percentage	Frequency	Percentage	Frequency	Percentage
<50	21	63.6	0	0	24	72.7
50-75	12	36.4	0	0	9	27.3
>75	0	0	33	100	0	0
Total	33	100	33	100	33	100
SD±M	47.85±5.43		98.64±2.57		46.39±5.25	

DISCUSSION

A nurse monitors the patient's response to ventilation and makes intervention to maintain oxygen supply and ventilation, ensuring that the patient's complex needs are met. Therefore, in order to provide more comprehensive patient care through mechanical ventilation and to reduce the incidence of common complications of tracheal suctioning, it is important for the nurse to have evidence-based knowledge of the various methods of tracheal suctioning [21].

In the present study, the mean score of knowledge and performance was statistically significant at least once, and the result showed that the mean score immediately after education was significantly higher than before the education. Day et al. also showed in a similar study that after education, ETT suction performance improved. However, a similar study showed that the performance of ICU nurses was not consistent with educational recommendations, and there was a significant difference between knowledge and educational guidelines as well as knowledge and performance [23].

In the present study, the mean score of knowledge and performance in the second half of the year was statistically significant at least once after the intervention. The results also showed that the mean score immediately after education was significantly higher than before the education. Similar studies have also shown that there is a significant difference between what suctioning guidelines are and what is actually being followed [30].

Our results showed that there was a significant positive relationship between the knowledge and performance after the intervention. The results were consistent with the results of Shammari et al. [24]. However, the results of study by NS et al. showed that most ICU nurses provided correct answers to questions regarding symptoms of eye infection, physical examination of eye and pupil response. It was also found that there was no significant relationship between the total score of nurses' knowledge and their performance on eye care [25]. In other studies, 36% of nurses stated the vagus nerve stimulation during ETT suctioning, 42% of them confirmed that paroxysmal cough was due to carina stimulation, and 74% of them reported that sodium bicarbonate induction through the ETT causes damage to lung tissue. In this regard, the present study showed that 58% of nurses stopped suctioning when it increased intracranial pressure and hypertension, 56% of nurses stated that before suctioning oxygenation increased, 46% of nurses did not recommend injecting normal saline through ETT suctioning to prevent hypoxia, 32% of nurses suggested that they should not abort suction when arrhythmia, and 18% of them reported that normal saline could cause palpitations and shortness of breath. [30].

The results of the study by Frota et al. showed a lack of knowledge in the nursing team of some medical centres. Also, given the inadequate knowledge leads people to do the wrong thing, the lack of knowledge in suctioning can cause complications such as hypoxemia, infection, and hemodynamic instability, thus endanger patient safety. On the other hand, informing patients in advance on the methods to be used and encouraging patients to participate not only is ethical and humane, but also serves as an important strategy for reducing stress and improving suction results. These results could be used in planning strategies such as continuous education and preventive measures to improve the knowledge of the specialists and increasing the quality of care [26].

Overall, the present study showed that knowledge and performance of nurses were improved by education. Due to the importance of ETT suctioning, the need for education has also been emphasized in other studies [27]. In a study by Fallahinia et al., it was reported that performance of nurses in suctioning needs further attention and to improve the clinical performance of nurses, small group education could be useful [11]. In addition, knowledge and performance of intensive care units nurses should be increased through a safe and effective method [28].

CONCLUSION

Although the ETT suctioning protocol may be necessary for mechanical ventilation, it could also have risks and side effects for the patient. Therefore, to provide more comprehensive care using mechanical ventilation and to reduce the common complications of ETT suctioning, nurses must have the necessary knowledge about the different methods of ETT suctioning. The results also showed that performance of nurses in suctioning needs further attention and education. Since education in small groups could be useful to improve the clinical performance of nurses, it is therefore recommended to provide theoretical and practical education in the form of in-service programs for nurses.

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