

## The Effect of Endotracheal Tube Suctioning Education of Nurses on Decreasing Pain in Premature Neonates

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### Abstract

**Objective:** Endotracheal tube suctioning (ETS) is a painful and invasive procedure. Studies have shown that the performance of nurses in this procedure is weak, so we conducted a study to evaluate the effect of ETS education for nurses on neonates' pain in neonatal intensive care units (NICUs).

**Methods:** In a quasi-experimental study, performance of 25 nurses working in NICU was assessed before and after ETS education by a checklist. In addition pain score of 50 neonates was measured using pain assessment tool (PIPP) one minute before, during and 5 minutes after ETS. The neonates had a gestational age of less than 37 weeks and were intubated (at least for 8 hours and up to 24 hours). A *P* value of less than 0.05 was considered as statistically significant.

**Findings:** Mean scores of nurses' performance were significantly different before and after education ( $P \leq 0.001$ ) by Wilcoxon test. Friedman test revealed that PIPPs before, during and after ETS were significantly different before and after education ( $P \leq 0.05$ ). Mann-Whitney test showed no significant differences between PIPPs before ETS, before and after education ( $P = 0.2$ ), but PIPPs during and after ETS were significantly different ( $P \leq 0.01$ ).

**Conclusion:** ETS causes moderate to severe pain in neonates. Education improved performance of nurses and decreased pain in neonates during and after ETS. Despite education, neonates will experience mild pain during ETS, so other interventions need to be considerate.

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**Key Words:** Premature Infants; Endotracheal; Pain; Nursing Performance Evaluation; Suction; Education

### Introduction

Annually more than 12 million neonates are born prematurely that include 10-12 percent of births worldwide<sup>[1,2]</sup>. Some of these neonates undergo mechanical ventilation including endotracheal tube suctioning (ETS) that is one of the basic steps in caring and maintaining air way<sup>[3,4]</sup>. Even though ETS is performed to maintain upper air way permeability, it is not a safe procedure and may

lead to short and long term detrimental effects<sup>[4]</sup>. ETS is one of the most frequent interventions in nursing and in fact it is the most important responsibility of nurses in intensive care units<sup>[2,5]</sup>. However, studies have shown that performance of nurses in this procedure is weak and in most wards there is no manual based on evidence about ETS to guide nurses' performance<sup>[6]</sup>.

Studies on adults have revealed that ETS caused moderate to severe pain<sup>[7]</sup>. What is painful for

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adults is painful for neonates as well, even if the neonate doesn't show the physiologic and behavioral symptoms<sup>[8,9]</sup>. Today, there is sufficient evidence that pain, especially due to repeated routine painful procedures like ETS is traumatic in neonates, increasing the likelihood of short and long term complications<sup>[10]</sup>. Pain increases demands on cardio-respiratory system and elevates intracranial pressure, theoretically increasing the risk of intraventricular hemorrhage<sup>[8]</sup>. Other studies have shown that there is a relationship between long term repeated pain during neonatal period and changes in pain sensitivity and pain processing later in life<sup>[11]</sup>.

Neonates, especially premature ones, are subjected to diagnostic and therapeutic procedures which are essential for their survival. One of the most routine procedures done in NICU is nasal, pharyngeal and endotracheal tube suctioning. Simons and his colleagues in 2003 showed that 63.6% of the procedures done on neonates are suctioning<sup>[8]</sup> but often no releasing intervention was done for this repeated painful procedure<sup>[12]</sup>.

Lago et al showed that only 25% of NICUs in Italy had policies for acute pain control and 50% for chronic pain and health care providers took measures for pain control only in 14% of ETS procedures<sup>[13]</sup>.

Studies showed that administering analgesic drug before ETS and non-pharmacological intervention after that could not decrease the pain of ETS<sup>[3]</sup>. Therefore, given that the underlying factors, such as nurses' skills in performing procedures, affect the pain<sup>[8]</sup>, we made an attempt to improve the performance of the nurses by evidence based education and assessed the pain in neonates.

## Subjects and Methods

A quasi-experimental study carried out in August 2009 in NICU (level 3) in Zeinab (PBUH) hospital of Shiraz. This ward was equipped with 8 beds with mechanical ventilation, pulse oximetry and central monitoring. The equipment were controlled before the study and all of them were

calibrated and spot free. There was no protocol for pain control in this ward and nothing was done to control the pain of neonates during ETS.

Inclusion criteria for nurses were consent form and working in NICU. First, one of the researchers observed the performance of 25 nurses during ETS with a checklist including 43 items with maximum score of 43 which were developed by literature review and validated by expert panel. Its content validity was confirmed by a team of 7 nursing specialists and its inter-observer reliability was 93%.

The neonates had a gestational age of less than 37 weeks, were intubated (at least for 8 hours and up to 24 hours) and did not get any analgesics. They had normal nervous system and were born from non-addicted mother. The exclusion criteria were suffering from IVH grade 3 and 4, having chest tube and being complicated due to ETS such as hemorrhage and pneumothorax.

Pain was assessed using Premature Infant Pain Profile (PIPP) one minute before, during and 5 minutes after ETS. PIPP is a tool for assessing acute pain in premature and term neonates. It has two physiologic indicators (Heart rate and oxygen saturation), three facial indicators (brow bulge, eye squeeze and nasolabial furrow), and two contextual factors (gestational age and behavioral state). Each indicator scored from 0 to 3. Total scores varied from 18-21 depending on the infant's gestational age. Pain scores  $\leq 6$  indicate minimum pain or no pain, 7-12 indicate mild to moderate pain and scores  $> 2$  indicate moderate to severe pain<sup>[8,9]</sup>. This tool was translated into Persian and back translated to English by a professional translator (content validity). Inter-reliability analysis of PIPP yielded a reliability coefficient of 0.93-0.96. Intra-reliability coefficients analysis was equally high at 0.94-0.98<sup>[15]</sup>.

In a 6 hour workshop, the standard principle of ETS in neonates was instructed using lecture, film, demonstration and back demonstration. One day following the education, the performance of the nurses in ETS was observed and pain score of the neonates was assessed using PIPP. Data were gathered only in the morning for controlling confounding variables such as light, noise, crowding, etc, before and after education.

This study was approved by the research and ethics committee of Shiraz University of Medical

**Table 1:** Demographic characteristics of premature neonates in different groups

variables	Before education Mean (SD)	After education Mean (SD)	P-value
Gestational age (week)	30.84 (1.86)	31.32 (1.7)	0.3
Weight (gram)	1759.6 (388.4)	1791.6 (442.6)	0.8
Intubation period (hour)	14.4 (4.7)	15.92 (5.2)	0.3
Sex (F/M)	13/12	13/12	0.8

Sciences and consent forms were gathered from nursing staff. ETS is a routine procedure in NICU and the researchers did not interfere in it, so obtaining consent form from the parents was not necessary.

The data were analyzed using SPSS, version 16 (SPSS Inc., Shanghai, China). Chi square and t-test were used for controlling confounding variables before and after education.

Wilcoxon test was used for comparison of performance scores of nurses before and after education. Friedman tests were used for comparing pain before, during and after ETS and Mann-Whitney tests were used for comparing pain of neonates before and after education. Statistical significance was defined as  $P < 0.05$ .

showing significant differences with McNemar test ( $P = 0.001$ ).

Demographic variables such as sex, gestational age, and weight, and intubation period of neonates were not significantly different (Table 1).

Result of Friedman nonparametric test showed that PIPP1, PIPP2 and PIPP3 were significantly different before and after education and Wilcoxon test affirmed that the differences were significant between all pairs except PIPP1-PIPP3 after education ( $P = 0.61$ ) (Table 2). Mann-Whitney test showed no significant differences between PIPP1 before and after education ( $P = 0.25$ ) but PIPP2 and PIPP3 were significantly different before and after education ( $P \leq 0.01$ ) (Fig. 1).

## Findings

All the nurses were female with a mean age of  $30.1 \pm 6.8$  years and mean experience of  $6.9 \pm 5.6$  years. 89.3% had bachelor degree in nursing and 10.7% diploma. Wilcoxon test showed statistically significant differences between the mean score of nurses' performance in ETS before ( $20.6 \pm 3.12$ ) and after ( $39.14 \pm 3.06$ ) education ( $P = 0.001$ ). Before education, 4% of the nurses and after that 72% of them assessed the neonatal need for ETS,

## Discussion

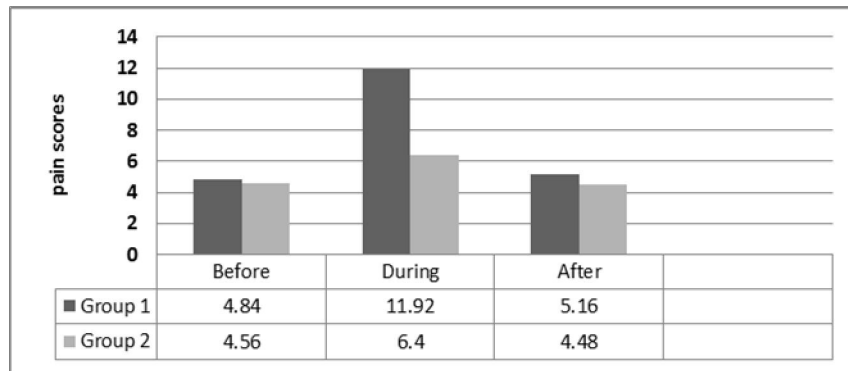
ETS procedure was performed in each neonatal ward differently, even every nurse uses her own methods and the standard instructions were not used<sup>[16]</sup>.

In this study before education, nurses' performance in ETS was poor and theoretical and practical education improved the performance. These findings are consistent with those of Ansari et al. They showed that the performance of nurses were poor in ETS and in addition to theoretical

**Table 2:** Comparisons of pain scores in different times of endotracheal tube suctioning

Stage	PIPP1 Mean (SD)	PIPP2 Mean (SD)	PIPP3 Mean (SD)	P. value	P. value (Wilcoxon test)
Before education	4.84(0.94)	11.92(1.77)	5.16(0.98)	<0.001	PIPP1- PIPP2 <0.001 PIPP2- PIPP3 <0.001 PIPP1- PIPP3 <0.001
After education	4.56(0.82)	6.4(0.70)	4.48(0.71)	<0.001	PIPP1- PIPP2 <0.001 PIPP2- PIPP3 <0.001 PIPP1- PIPP3 0.6

PIPP: Premature Infant Pain Profile



**Fig. 1:** Comparison of pain score before and after education

education, practical education, administrative and prevocational support are also required to improve the performance and decrease ETS complications<sup>[6]</sup>.

Painful procedures in NICU may be inevitable, so it is necessary that nurses balance the painful, but medically necessary care and employ painful procedures based on neonatal needs<sup>[9]</sup>. An outstanding result of this study is that before education, a small number of nurses (4%) assessed neonatal need for ETS while after the education the majority of nurses (72%) did this assessment. It can be inferred that education can improve nursing performance and prevent pain due to unnecessary painful procedures. Wood in her study showed that assessing patients' need for ETS reduced the number of procedures and decreased its complications<sup>[17]</sup>.

This study showed that pain scores were different before, during and after ETS before education. Neonates had no pain before ETS or they had minimum pain, but they experienced moderate to severe pain during and mild pain after ETS. Arroyo-Novoa and colleagues (2007) showed that in 169 hospitals of Canada, Australia, England and USA, the severity of pain just before, after and ten minutes after ETS were different and pain severity just after ETS was more. In addition 64% of patients reported moderate to severe pain related to ETS<sup>[7]</sup>.

In our study after education, neonates experienced pain during ETS but this pain was mild, in addition pain severity after ETS was similar to that before ETS. These results revealed that education had effect on reducing pain severity during and after ETS. Various interventions have been performed for relieving pain in ETS.

Saarenmaa et al (2001) in a clinical trial administered ketamine for relieving pain of ETS in the neonatal intensive care unit but the result showed that ketamine could not relieve pain and it had even no effect on the heart rate and blood pressure changes due to ETS procedure<sup>[18]</sup>. Also, Cignacco et al (2008) used morphine before and multisensorial stimulation after ETS procedure but none of them had an effect on the pain of ETS, concluding that due to concerns about potential complications of narcotics especially in premature neonates, non-pharmacological interventions should be considered and performed<sup>[3]</sup>.

According to the results of this research and other studies, various interventions and preferably a combination of different strategies are recommended to stimulate various senses and relieve pain<sup>[19]</sup>. Our data support the assumption that education on principals of ETS could relieve pain in neonates during and after this procedure. The finding that education could decrease complications is consistent with the results of Mohamadi et al (1391) indicating that education could control the changes in the heart rate and oxygen saturation due to ETS and decrease its complications<sup>[20]</sup>.

Therefore, it can be concluded that education on ETS principles could decrease pain in premature neonates. It is recommended that such education become a part of in-service education programs in NICU, and manuals and policies must be prepared in these wards. The main limitations of the present study were lack of a suitable control group and a sample size that did not permit the meaningful evaluation of the large number of variables that can influence pain score. Not

assessed long term effect of education on nurses' performance was another limitation.

## Conclusion

ETS caused moderate to severe pain in premature neonates but performing a standard procedure based on neonatal need and improving nursing performance could decrease this pain. Despite these interventions, neonates will still experience mild pain. There is a need for more research to illuminate optimal pain management and strategies to relieve pain in neonates. Further studies can compare two groups of neonates with administration of analgesics and other groups with skillful nurses in suctioning practices.

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**Conflict of Interest:** None

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