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ORIGINAL ARTICLE

The Effect of Nursing Practices on the Near Infrared Spectroscopy Levels of Premature Infants

Hemşirelik Uygulamalarının Prematüre Bebeklerin Near Infrared Spectroscopy Düzeylerine Etkisi

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ABSTRACT

Aim: This study was conducted to determine the effect of nursing care practices on the Near Infrared Spectroscopy (NIRS) levels of premature infants in the neonatal intensive care unit (NICU).
Materials and Method: This is a cross-sectional, analytical study. It was conducted over the in the NICU of a hospital in Eskişehir province. We did not calculate sample size, but included in the study, after the parents had been informed about the research, the entire universe of neonates in the NICU who matched the inclusion criteria during the period March 1 - April 26, 2019. The study was completed with 40 neonates. Data collection was performed with a "Descriptive Data Form," and a "Procedures Performed Chart." The data were evaluated with the IBM SPSS 24 package program.
Results: A significant difference was discovered between the nursing care practices included in the study and the neonates' Near Infrared Spectroscopy (NIRS) values, oxygen saturation (SpO2), and peak heart rates (PHR) ($p<0.01$).
Conclusion and Recommendations: At the end of the study, we concluded that the nursing care practices conducted with premature infants had an adverse impact on cerebral oxygenation. We suggest that nursing practices carried out with premature infants be executed with sensitivity and care; no unnecessary practice should be implemented, and lengthy collective care practices should be divided into convenient increments so that the neonates are allowed to rest in-between.

Keywords: Nursing care, NIRS, Premature, Neonate, Neonatal intensive care unit

ÖZ

Amaç: Bu çalışma yenidoğan yoğun bakım ünitesi (YYBÜ)'nde yatan prematüre bebeklerde yapılan hemşirelik bakım uygulamalarının bebeklerin Near Infrared Spectroscopy (NIRS) düzeylerine etkisini belirlemek amacıyla yapılmıştır.
Materyal ve Metod: Kesitsel analitik bir çalışmadır. Araştırma, Eskişehir'de bir hastanenin YYBÜ'de gerçekleştirilmiştir. Çalışmamızda örneklem hesabına gidilmemiş olup 1 Mart- 26 Nisan 2019 tarihleri arasında NICU'da yatan, çalışma seçim kriterlerine uyan ve ebeveynlerinden bilgilendirme sonrası onam alınan tüm yenidoğanlar dahil edilmiştir. Çalışma 40 yenidoğan ile tamamlanmıştır. Veri toplamak amacıyla "Tanımlayıcı Bilgi Formu", ve "Yapılan İşlemler Çizelgesi" kullanılmıştır. Çalışmada elde edilen veriler IBM SPSS 24 paket programı ile değerlendirilmiştir.
Bulgular: Çalışma kapsamına alınan hemşirelik bakım uygulamaları ile yenidoğanların Near Infrared Spectroscopy (NIRS) değerleri, oksijen saturasyonları (SpO2) ve kalp tepe atım (KTA) değerleri arasında önemli fark olduğu saptanmıştır ($p<0.01$).
Sonuç ve Öneriler: Çalışma sonucunda prematüre bebeklere yapılan hemşirelik bakım uygulamalarının bebeklerin serebral oksijenlenmesini olumsuz etkilediği belirlenmiştir. Önerimiz; prematüre bebeklere yapılan hemşirelik uygulamalarında hassas davranılması, bu uygulamaların gerekli olmadıkça bebeğe yapılmaması, uzun sürecek toplu bakım uygulamalarının farklı zamanlara bölünmesi ve bebeklerin dinlenmesine izin verilmesidir.

Anahtar Kelimeler: Hemşirelik bakımı, NIRS, Prematüre, Yyenidoğan, Yenidoğan yoğun bakım ünitesi

Introduction

Because premature infants are born before they can complete their developmental process, they need to be cared for in the NICU for a long period of time. The NICU environment generally necessitates additional procedures in the care of the infant (1-3). Although these procedures are all executed for the baby's benefit, many of them are a source of stress and pain for premature infants (3-5). Some pain-related effects on the baby that are ignored or not treated can be short-term or long-term. For example, the body can respond to untreated pain by increased secretion of stress hormones that may be associated with heightened morbidity and mortality in the short term. The long-term effects of pain can include a change in the perception of pain, chronic pain syndromes, sleep disturbances, feeding problems, and somatic symptoms. It is reported that attention deficit disorders, learning disorders and behavioral problems in a child's later life may be associated with repeated sensations of pain experienced by the premature infant (6).

Pain suffered by the premature neonate due to applications in the NICU may impact cerebral

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blood flow autoregulation. This is why premature infants are at great risk of cerebral damage (4). It is therefore important that care practices are handled with sensitivity, that the duration and frequency of applications are carefully determined, and that an evaluation is made of the pain felt by the neonate during an application. This is a task that falls upon the shoulders of all healthcare professionals, particularly nurses providing long-term care.

There are many measures today used to assess the pain levels of neonates according to physiological and/or behavioral indicators. At the same time, however, measuring the degree of pain felt by an infant or small child continues to be problematic. There is a possibility that instruments for this purpose cannot make a sufficient assessment of pain, especially in early term neonates (6). Determining the pain level of a critically ill infant is even more complex. When heavy sedation and neuromuscular blocking agents are administered, observing hints as to the degree of pain an infant feels is generally precarious (7).

Working with a functional biomarker will lead to clinical accuracy, contribute to making a diagnosis, and perhaps even improve the effectiveness of a patient's treatment. Many approaches have been taken to arrive at an efficient pain biomarker. NIRS is a portable and easy-to-use technology that is noninvasive and allows the measurement of cortical hemodynamics (8,9). This method provides a means of monitoring the effect of nursing care on the cerebral blood flow of newborns, making it possible to better plan the duration and frequency of care services. In our scan of the literature, however, we came across no study that had investigated the impact of nursing care practices on NIRS levels. This study was conducted to determine the effect of nursing care practices on the NIRS levels of premature infants in the neonatal intensive care unit (NICU).

Materials And Method

Aim and Form of the Study: The aim of our study was to identify the effect of nursing care practices in the NICU on the NIRS levels of premature neonates. This is a cross-sectional, analytical study.

Research Questions:

1. Can nursing care practices carried out on premature infants affect their NIRS levels?

Site and Time of the Research: It was conducted over the in the NICU of a hospital in Eskişehir province during the period March 1 - April 26, 2019.

Research Population and Sample: We did not calculate sample size, but included in the study, after the parents had been informed about the research, the entire universe of neonates in the NICU who matched the inclusion criteria during the period March 1 - April 26, 2019. A total of 47 premature infants were being treated at the unit in this period. However, three neonates were excluded from the study due to the need for intubation as a result of a deterioration in their general condition, and an additional two due to a preliminary diagnosis of intracranial hemorrhage. Another two infants were also excluded because the NIRS device was being used on other infants and they had no access to it before the end of their 37th gestational week. The study was ultimately completed with 40 premature neonates. At the end of the study, the power analysis on the data for 40 infants was performed with the G*Power 3.1 program, which indicated an alpha of 0.05 and a power of 98%.

Study Inclusion Criteria

- Neonates younger than a gestational age of 37 weeks

- Those monitored in an open or closed incubator

Study Exclusion Criteria

- Intubated neonates connected to a mechanical ventilator

- Infants of a gestational age of 37 weeks or more

- Infants under sedation

-Infants with neurological illness (e.g., hypoxic ischemic encephalopathy, hydrocdphalus)

Data Collection Instruments Used in the Study: Data collection was performed with a "Descriptive Data Form," a "Procedures Performed Chart," an NIRS device, NIRS probe and a patient monitor.

One of the researchers created the Descriptive Data Form in line with the literature (10-12). This form contains seventeen closed-end questions on the infant's characteristics. The general condition of the patient was filled out on the form as good, fair or poor according to the observation made by the nurse in the routine procedure.

One of the researchers prepared the "Procedures Performed Chart" used in the study. This form was used to record SpO2, PHR and NIRS values prior to and during each nursing care practice performed on the infant

during the day. The duration of the procedure is the time that elapses between the moment the care was applied to the infant and the time it was completed. Since the following processes were applied to each infant and were frequently repeated, they were included in the study: removing adhesive bandages, diaper changes, cannula insertion, positioning, aspiration, change of clothing, OG/NG tube insertion, blood drawing and other general care practices. A total of 120 adhesive bandage removals, 240 diaper changes, 80 cannula insertions, 342 positionings, 74 aspiration procedures, 84 changes of clothing, 296 OG/NG tube insertions, 83 blood/blood gas drawings, 86 general care procedures, an overall 1405 nursing care practices were monitored. The general care procedures included change of clothing, changing the sheets, diaper changes, changing probe location and other similar procedures carried out at one time.

An X-brand NIRS sensor was used in the study to measure the neonates' NIRS levels. The NIRS system makes it possible to monitor in real time regional oxygen saturation in the brain or in the areas of body tissue under the sensor (rSO2) in adults, children, infants and neonates. The NIRS device and its probe was connected to each neonate in the study for 12 hours during the day and 12 hours during the night, a total monitoring time of 24 hours.

An X-brand NIRS sensor was used in the study to measure the neonates' SpO2 and PHR values.

Data Collection: Prior to the data collection, the parents (mother or father) of the neonates matching the study criteria were informed about the study and those who agreed to participate in the research provided their written consent. The data collection form was filled out on the basis of the information contained in the patient's medical file and according to the information provided by the parents. One of the researchers measured and recorded the neonates' current anthropometric data. The NIRS probe was secured on the patient's forehead, allowing the device to indicate the neonate's cerebral NIRS value. The NIRS probe was left on the baby for 12 hours in the day and 12 hours in the night. The 12-hour daytime and 12-hour nighttime periods were scheduled according to the researcher's shift duty times to accommodate the collection of the data. The researcher recorded the neonate's NIRS, PHR and SpO2 levels before and during each nursing application. The parameter measurement on the NIRS device was adjusted to every second. At each application, the lowest NIRS value was recorded on the Procedures Performed Chart.

Data Analysis

The statistical analyses were performed using the SPSS 24 program (IBM Corp. Released 2012. Armonk, NY: IBM Corporation). Frequency tables and descriptive statistics were used in the interpretation of the findings. Data showing normal distribution were compared with the Independent Samples-t test in order to analyze the measurements of two independent groups (t-table values). The ANOVA test was used in the comparison of three or more independent groups (F-table values). The Tukey test was employed for two-way comparisons of variables that displayed significant differences, taking into consideration the homogeneity of the variance. In the case of data displaying normal distribution, the comparison of two dependent groups was analyzed using Paired Sample-t test statistics (t-table values). In the case of data not displaying normal distribution, the comparison of two independent groups was carried out with the Mann-Whitney U test (Z-table values); Kruskall-Wallis H test statistics were employed in the comparison of three or more independent groups (χ2-table values). Two-way comparisons in the case of variables displaying significant differences were carried out with the Bonferroni Correction. In the case of data not displaying normal distribution, the comparison of two dependent groups was analyzed using Wilcoxon test statistics (Z-table values). Significance for the study was accepted as $p<0.05$.

Ethical Considerations in the Study

Prior to the start of the study, ethics committee approval was received from T.C. Karatay University Clinical Studies Ethics Committee (approval dated 05.04.2018, numbered 41901235-050.99) (Appendix-7) and permission was also obtained from the hospital administration where the study was to be conducted (Appendix-8). Only the infants of parents who had given their informed consent were included in the study.

Strengths and Weaknesses of the Study

Weaknesses

-Because of the high cost of the NIRS probe and the limited TL15,000 received as support for the project, the study could be completed with only 40 neonates.

-Because there were not enough NIRS devices, two neonates were left out of the study.

Strengths

-No study was found in our search in the Turkish and international literature that reported on the effect of nursing care practices on the cerebral oxygenation of premature neonates. Our study is therefore a pioneer in this respect.

Results

This study was conducted to determine the effect of nursing care practices on the comfort and NIRS levels of premature infants in the neonatal intensive care unit (NICU). It was completed with 40 neonates. Descriptive data on the neonates can be seen in Table 1.

Table 1. Descriptive Characteristics of the Neonates (n=40)

	n	%
Gestational weeks		
<28 weeks	12	30.0
Weeks 28-32	12	30.0
32+1-37 weeks	16	40.0
Mode of Delivery		
Normal spontaneous vaginal delivery	7	17.5
Cesarean section	33	82.5
Gender		
Female	21	52.5
Male	19	47.5
Mode of feeding		
Oral	5	12.5
Enteral	19	47.5
Parenteral	4	10.0
Parenteral+Enteral	12	30.0
General condition		
Poor	7	17.5
Fair	32	80.0
Good	1	2.5
O2 status		
Nasal CPAP	17	42.5
Free O2 inside incubator	7	17.5
O2 through hood	4	10.0
O2 at close range	7	17.5
No O2	5	12.5
Type of incubator		
Open	15	37.5
Closed	25	62.5
Postnatal age		
1-20 days	32	80.0
21-40 days	8	20.0
Type of feeding		
Breast milk	18	45.0
Breast milk+formula	12	30.0
Formula	9	22.5
Other	1	2.5

	Mean±Standard Deviation	**Median (Min-Max)**
APGAR Min.1	6.18±18.82	6.0 (2.0-10.0)
APGAR Min.5	8.45±1.20	8.0 (6.0-10.0)
Weight (g)	1558.25±685.75	1285.0 (485.0-3120.0)
Length (cm)	39.29±5.72	41.0 (25.0-51.0)

Table 2 shows a comparison of NIRS, SPO2 and PHR levels before and during the procedure, by procedure. A statistically significant difference was observed in the interventions to the infant in terms of NIRS, SPO2 and PHR measurements before and during the procedures (p<0.001).

Table 2. Comparison of NIRS, SPO_2 and PHR Measurements Before and During Procedures, by Procedure

Procedure Executed	**Before Procedure**		During Procedure			p
	x□ ± sd	Median [IQR]	x□ ± sd	Median [IQR]		
Removal of adhesive bandage						
NIRS	72.48±12.85	74.0 [7.8]	66.12±7.53	65.0 [10.8]	Z=-4.664	<0.001
SPO2	95.33±1.91	95.0 [2.0]	91.40±4.63	92.5 [4.8]	Z=-4.539	<0.001
PHR	146.13±11.69	148.0 [18.8]	161.70±12.86	164.0 [22.5]	Z=-5.290	<0.001
Diaper change						
NIRS	71.08±15.54	75.0 [6.0]	65.35±10.61	68.0 [10.5]	Z=-4.827	<0.001
SPO2	93.33±13.22	95.0 [3.0]	90.30±13.13	93.0 [4.8]	Z=-4.539	<0.001
PHR	148.95±8.99	152.0 [14.8]	162.08±10.65	164.0 [18.0]	Z=-5.333	<0.001
Cannula insertion						
NIRS	71.83±12.42	73.0 [6.0]	67.78±7.09	69.0 [6.8]	Z=-5.220	<0.001
SPO2	95.55±1.92	95.0 [2.8]	91.95±3.16	92.0 [4.0]	Z=-4.981	<0.001
PHR	146.78±8.87	148.5 [15.8]	159.95±12.09	162.5 [22.5]	Z=-4.816	<0.001
Positioning						
NIRS	74.10±5.50	73.0 [7.5]	67.50±7.49	68.0 [7.5]	t=7.717	<0.001
SPO2	95.45±1.99	95.0 [1.8]	91.52±5.14	92.5 [4.8]	Z=-4.507	<0.001
PHR	146.25±10.10	145.0 [18.8]	160.60±12.26	164.0 [18.0]	t=-6.179	<0.001
Aspiration						
NIRS	74.75±5.97	74.0 [4.8]	64.40±9.37	65.5 [12.8]	Z=-5.434	<0.001
SPO2	95.08±1.44	95.0 [2.0]	90.63±4.97	92.0 [3.8]	Z=-4.891	<0.001
PHR	146.60±9.76	149.0 [15.0]	162.15±11.33	164.0 [14.8]	Z=-5.210	<0.001
Change of clothing						
NIRS	74.75±6.27	75.0 [7.5]	68.93±8.97	68.5 [11.5]	t=5.163	<0.001
SPO2	95.35±2.43	95.0 [1.8]	92.00±4.34	93.0 [3.0]	Z=-4.314	<0.001
PHR	147.83±7.73	148.0 [10.5]	159.25±13.83	161.0 [17.8]	Z=-4.330	<0.001
OG/NG insertion						
NIRS	74.55±5.03	74.5 [4.8]	67.35±7.74	66.0 [7.5]	t=6.390	<0.001

SPO2	95.93±1.56	96.0 [2.0]	91.83±3.97	92.5 [4.0]	Z=-5.398	<0.001
PHR	146.23±11.17	150.0 [18.5]	161.63±13.22	164.0 [18.3]	Z=-5.319	<0.001
Drawing blood/blood gases						
NIRS	74.70±5.40	75.0 [7.0]	66.60±7.72	66.0 [7.0]	t=7.601	<0.001
SPO2	95.08±2.58	95.0 [2.8]	91.15±3.94	92.0 [4.8]	Z=-4.865	<0.001
PHR	148.55±8.16	148.5 [9.0]	165.78±9.91	167.5 [11.0]	Z=-5.445	<0.001

*The "Paired Sample-t test (t-table value) was used in the comparison of two dependent variables with normal distribution; the "Wilcoxon" test (Z-table value) for the comparison of two independent variables without normal distribution.

A comparison of the infants' NIRS levels according to the duration of the procedure is presented in Table 3. A statistically significant difference was found in terms of the NIRS scores according to the duration of the procedure of cannula insertion (χ2=7,304; p=0,026). To detect which group was responsible for this significant difference, Bonferroni's correction was used in the comparison of the two groups, and it was seen that the difference stemmed from that between those procedures that took 30 seconds or less and those that took 61 seconds or more. The NIRS scores in those cannula insertion procedures taking 30 seconds or less were statistically and significantly higher than in the procedures that took 61 seconds or more. A statistically significant difference was found in terms of the NIRS scores according to the duration of the procedure of general care (χ2=6,026; p=0,049). To detect which group was responsible for this significant difference, Bonferroni's correction was used in the comparison of two groups, and it was seen that the difference stemmed from that between those procedures that took 30 seconds or less and those that took 61 seconds or more. The NIRS scores in those general care procedures taking 30 seconds or less were statistically and significantly higher than in the procedures that took 61 seconds or more.

Discussion

A comparison was made of the NIRS values of the premature infants before and during the procedures. It was found that in all of the care procedures, NIRS values were lower during the procedure compared to before (p<0.01) (Table 2).

We also compared the physiological indicators of pain, PHR and SpO2, measured before and during the procedures. The infants' PHR was higher during the procedures compared to before, but it was seen that SpO2 values were significantly lower (p<0.01) (Table 2). This result is important in that it suggests that care procedures cause pain and stress in the newborn, adversely affecting cerebral oxygenation, tissue perfusion and heart rate.

Monitoring NIRS values is a useful method of evaluating pain (13-15). In the scan of the literature for this study, we did not come across any article on the effect of nursing care practices on the NIRS levels of neonates. On the other hand, there were article (16-18) that reported, similar to our finding, that pain-inducing procedures decreased the tidal volume capacity and the SpO2 level of the neonate and increased the peak heart rate. In a study exploring a supraspinal pain modulation model, Bartocci et al. found that the response of premature infants to a stimulus was a rise in PHR, a decrease in NIRS levels, and reduced SpO2 (13). In a study by Axelin et al. the authors demonstrated that an aspiration procedure performed on premature infants of 24-33 gestational weeks led to pain, an increase in PHR, and a decrease in SpO2 levels (19). Olsson et al. showed in their study that the NIRS levels of infants experiencing skin-to-skin contact during venous blood drawing were less affected by the procedure compared to the controls (14). In another study, the authors found that newborns responded to a painful stimulus (heel-prick blood sampling) with changes in brain activity that could be associated with the premature infant pain profile (PIPP) score (6). In a study by Ranger et al. reporting on the removal of a chest tube after pediatric heart surgery, the researchers asserted that cerebral hemodynamic readings were important in determining the level of pain, particularly in sedated patients (7).

In the present study, we found that premature infants were negatively affected in terms of cerebral oxygenation, tissue perfusion and peak heart rate levels, even in painless care procedures. It has been established that sensitivity to pain in premature infants is greater than in term infants (20), and that the greater the degree of prematurity, the more the baby will be affected by pain (21). Premature neonates have an extreme sensitivity to pain (22). This condition is called "allodynia," meaning the perception of any stimulus as pain, even though the stimulus may not normally elicit pain (23). In the light of this finding, it is important that, even in procedures such as diaper changing or positioning, the baby is approached with sensitivity and that nonpharmacological techniques are utilized. It is important that painful procedures such as the insertion of a cannula, blood drawing should be handled only when necessary and by experienced

Table 3. Comparison of the Neonates' NIRS scores according to the Duration of the Procedure

Proce-dure Execut-ed	30 sec. or ↓ (1)		31-60 sec. (2)		61 sec. or ↑ (3)		Statis-tics	p
	x□ ± sd	Median [IQR]	x□ ± sd	Median [IQR]	x□ ± sd	Median [IQR]		
Remov-ing the adhesi-ve bandage	65.69±7.71	66.0 [8.8]	68.88±8.90	69.5 [15.3]	64.33±4.08	64.0 [6.0]	F=0.737	0.486
Diaper change	64.26±13.60	68.0 [7.0]	66.83±8.51	70.0 [14.0]	65.66±5.12	66.0 [9.5]	χ2 =0.835	0.659
Cannula insertion	70.95±5.74	70.0 [6.3]	64.25±9.33	65.5 [18.3]	64.83±5.39	62.5 [10.3]	χ2 =7.304	**0.026** [1-3]
Posi-tioning	66.92±7.22	68.0 [5.0]	67.63±3.78	67.0 [6.5]	69.13±11.06	67.0 [20.3]	χ2 =0.014	0.993
Aspira-tion	63.89±9.08	65.0 [13.0]	68.14±13.18	66.0 [19.0]	62.33±4.50	63.5 [7.3]	F=0.735	0.486
Change of cloth-ing	71.55±8.93	72.0 [8.0]	66.00±5.60	67.0 [6.0]	66.67±11.34	63.0 [19.5]	F=1.799	0.180
OG/NG inser-tion	69.00±7.67	66.5 [11.5]	65.10±9.33	65.5 [16.5]	64.50±2.74	64.0 [4.3]	F=1.401	0.259
Draw-ing blood	66.58±8.78	66.0 [9.0]	69.83±6.88	69.5 [11.0]	65.33±6.62	66.0 [6.0]	F=0.718	0.494
Gener-al care	67.21±8.97	68.0 [8.0]	66.87±8.19	66.5 [13.3]	65.48±7.02	65.0 [8.0]	χ2 =6.026	**0.049** [1-3]

*Statistics yielded by the "ANOVA" test (F-table values) were used in the comparison of three or more independent variables showing normal distribution; those of the "Kruskal-Wallis H" test (χ2-table value) for comparing three or more independent variables not exhibiting normal distribution.

persons, together will pain-reducing applications.

The longer the duration of nursing care in newborns, the infant's hemodynamics may suffer longer imbalances, with the result that the physiological response will stray from the normal. In particular, infants will respond to situations that induce long-lasting pain as if responding to acute pain (24). Based on this information, we compared the durations of the nursing care applied to the neonates to the infants' NIRS levels in this study (Table 3). Our results showed that in terms of the duration of procedures, there was a significant correlation between NIRS levels and cannula insertion and general care. The study revealed that NIRS levels fall as the duration of the cannula insertion and general care procedures are prolonged, pointing to reduced cerebral oxygenation. We observed that the difference between a procedure of a duration of 30 seconds or less and a duration of 61 seconds or more was particularly significant. We did not encounter any study in the literature reporting on this. The basic principle of premature infant care is "touch less, observe more." In light of this, the importance must be stressed of having an experienced healthcare professional handle cannula insertion and perform the procedure in the shortest time so that the infant is subjected to a minimum of harm. We found in our study that a prolongation of the general nursing care procedures performed in the same session negatively affected the NIRS values of the premature infants. Trying to perform many procedures within the same time period can prolong the duration of the intervention, causing the baby pain and stress and a possible imbalance in cerebral oxygenation. For this reason, general care procedures should be broken up in increments, leaving the baby time to rest, this way ensuring that cerebral oxygenation is less affected.

Conclusion And Recommendations

We found in our study that nursing care procedures performed on premature infants caused NIRS and SpO2 levels to fall and PHR to rise. Our results showed that a prolonged duration of cannula insertion and general care practices caused NIRS levels to decrease in premature infants while also adversely affecting cerebral oxygenation. Nursing care practices are applications that must be performed in the NICU. It should not be forgotten however that even painless nursing practices may have a negative outcome in premature newborns.

Our suggestions are that nursing practices carried out with premature infants should be carried out with sensitivity and care, that no unnecessary practice is implemented, and that lengthy collective care practices be divided into convenient increments so that the neonates are allowed to rest in-between, and that invasive procedures such as cannula insertion are handled by experienced professionals in as short a time as possible.

Most Important Information Obtained As A Result Of This Study

- A significant difference was discovered between the nursing care practices included in the study and the neonates' Near Infrared Spectroscopy (NIRS) values, oxygen saturation (SpO2), and peak heart rates (PHR).

- A statistically significant difference was observed in the interventions to the infant in terms of NIRS, SPO2 and PHR measurements before and during the procedures.

- The study revealed that NIRS levels fall as the duration

of the cannula insertion and general care procedures are prolonged, pointing to reduced cerebral oxygenation. The difference between a procedure of a duration of 30 seconds or less and a duration of 61 seconds or more was particularly significant.

Authors' Contributions

Study conception and design: EA, AA; data collection: EA; analysis and interpreparation: AA; draft manuscript preparation: EA, AA. All authors reviewed the result and approved the final version of the manuscript.

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