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Evaluation of Procedural Pain in Neonates in Cameroon

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Abstract

Introduction: Acute pain associated with caregiving is a major cause of pain among neonates. Left untreated, it can lead to long-term neurosensory and psychoaffective consequences. In Cameroon, this subject has been scarcely explored, thus constituting an impediment to the management of care-induced pain. Objective: Assess procedural pain in neonates in Yaoundé. Material and Methods: We conducted a cross sectional study with prospective data collection over a period of eight months (October 2022 to May 2023) in three hospitals. We included neonates who were being cared for and were not crying prior to the onset of healthcare, whose parents consented to the study. Assessments were done using the DAN scale, which is specific to care-induced pain. Data was entered and analyzed using SPSS 23.0 software. Results: A total of 161 newborns were included. The hospital prevalence of care-induced pain in neonates was 85%. Neonatal sepsis was the main cause for admission (96.6%). The most common procedures were venous blood sampling (94.4%) and insertion of peripheral venous lines (93.8%). The pain intensity for these procedures was severe (83.9%). The most painful procedure was lumbar tap, followed by venous access procedures. Conclusion: Neonates in hospitals are subjected to many painful procedures. The pain experienced during these procedures is severe. The most nociceptive procedure is a lumbar puncture.

Keywords

Assessment, Procedural Pain, Neonate, Yaoundé, Cameroon

1. Introduction

It is difficult to provide healthcare without causing pain and discomfort. Proce-

dural pain, also known as care-induced pain, is defined as an unpleasant sensory and emotional experience caused by caregivers or treatment in circumstances where its occurrence is foreseeable and can be prevented by appropriate measures [1]. Contrary to the dictum that children do not experience pain, it has been shown that from the first hours of life, neonates are likely to experience acute pain due to obstetric trauma, and untimely maneuvers, but especially during care procedures such as blood sampling or aspiration of any kind [2].

However, pain assessment in the newborn remains a challenge because of the lack of language acquisition at this age. As a result, pain is not expressed in words, but rather through attitudes and behavioral changes that are easily overlooked. The neglect of repeated acute pain episodes develops dynamically, with biochemical and electrophysiological changes that can lead in the short term to hyperalgesia with a reduction in the pain tolerance threshold [3]. Similarly, the fact that pain in the neonatal period occurs in a developing brain with great plasticity has the potential to alter the normal development of somatosensory circuits and pain pathways.

In the long term, this leads to a plethora of neurological disorders, including cognitive impairment, learning disabilities, attention deficit, behavioral problems, and motor disorders [4].

Proper assessment of care-induced pain is the basis for effective screening and appropriate management [5]. It should be carried out using a validated scale, depending on the patient's age and context. Unlike adults and older communicating children, for whom self-assessment is preferred, there can only be a hetero-assessment in neonates [2].

Although tools for assessing acute pain in newborns exist, their use in current practice reveals several shortcomings. These include inappropriate description of pain intensity and inadequate use of analgesics in relation to pain severity [6] [7] [8] [9].

In Cameroon, improvements in neonatology services have led to better care for full-term and premature newborns over the years [10], resulting in a reduction in the neonatal mortality rate [11].

As a result, hospitalizations in neonatology departments are more frequent, and by extension more painful healthcare procedures are carried out. This article looks at the assessment of acute pain experienced by hospitalized neonates during healthcare procedures.

2. Material and Methods

We conducted a cross sectional study with prospective data collection. It took place in the neonatology units of the *Mother and Child Centre of the Chantal Biya's Foundation* (MCC-CFB), the *Yaoundé Gynaeco-obstetric and Pediatric Hospital* (YGOPH), and the *Essos Hospital Center* (EHC). These facilities were chosen because they are leading pediatric teaching hospitals in Cameroon.

The study was observational and lasted for eight months, from October 2022

to May 2023. It targeted all neonates who were hospitalized in the neonatology units of the three selected hospitals. After obtaining parental consent, all hospitalized neonates who were awake and not crying prior to onset of the healthcare procedure were enrolled.

Patients were examined firstly during the care procedure and secondly two minutes after. Pain was assessed and graded using the DAN scale. The DAN scale is a behavioral scale used to score acute pain in term and preterm neonates. This tool evaluates three items: facial expressions, limb movements and vocal expression. Pain is scored from 0 to 10 where 0 represents no pain and 10 the maximum pain.

The sociodemographic and clinical data of each subject was recorded in an anonymous data collection form. The collected data were analyzed using SPSS 23.0 software. The one-factor ANOVA test was used to analyze the variance of pain intensity according to the type of procedure (statistical significance was set at 0.05). The significance of the difference in mean DAN scores according to the type of procedure was confirmed using the TUKEY test.

3. Results

3.1. Hospital Prevalence of Neonatal Procedural Pain

During the study period, 137 of the 161 neonates evaluated had experienced pain during care. The hospital prevalence of care-induced pain was 85%.

3.2. Sociodemographic Characteristics

The median age of the neonates was 5 days, with a range of 1 to 49 days. Males accounted for the majority of cases (60.9%), with a sex ratio of 1.56 (Table 1).

3.3. Perinatal Features of Neonates

3.3.1. Mode of Delivery and Adjusted Gestational Age

Most of the new-borns, 67.1%, were born pervaginallly.

The median adjusted gestational age at birth was 37 weeks, with a range of 26 to 38 weeks (Table 2).

Table 1. Population distribution based on sociodemographic characteristics.

Variables	Categories	Counts (N = 161)	Percentages (%)
Age range (Days)			
	< 7	106	65.8
	8 - 14	23	14.3
	15 - 21	10	6.2
	22 - 28	17	10.6
	29 - 45	5	3.1
Gender			
	Male	98	60.9
	Female	63	39.1

Table 2. Population distribution based on mode of delivery and adjusted gestational age.

Variables	Categories	Counts (N = 161)	Percentages (%)
Mode of delivery			
	Pervaginal	108	67.1
	Cesarean section	53	39.9
Adjusted gestational age			
	<28	3	1.9
	[28 - 32]	9	5.6
	[32 - 35]	21	13
	[35 - 37]	12	7.5
	≥37	116	72

3.3.2. Neonatal Anthropometric Measurements

The measurements were taken on the day care was provided. The mean birth weight was 2694.1 ± 1023 grams, ranging from 600 to 5000 grams. The mean height was 47.5 ± 5.5 cm, ranging from 32 to 58 cm. Of the patients, 55.4% were eutrophic, 33.5% were hypotrophic, and 10.6% were macrosomic (Table 3).

3.4. Diagnosis on Admission

Neonatal sepsis was the main diagnosis on admission (96.9%) (Table 4).

3.5. Care Procedures Performed

At the time of the survey, the two main procedures performed were blood sampling (94.4%) and the insertion of peripheral venous lines (93.8%). These procedures were performed once a day in 90.7% of cases (see Table 5).

3.6. Evaluation of Neonatal Care-Induced Pain

3.6.1. Evaluation of Global Care-Induced Pain

Procedural pain experiences were dominated by the insertion of peripheral venous lines, which accounted for 62.1% of cases. Before care, pain was present in 8.7% of patients and was of mild intensity. During the procedure, pain was observed in all subjects in the sample and was severe in 83.9% of cases. Two minutes after the procedure, pain was present in 26.1% of neonates and was of mild intensity. The mean duration of pain was 64.1 ± 26.1 seconds, ranging from 15 to 124 seconds depending on the type of procedure (Table 6).

3.6.2. Evaluation of Care-Induced Pain According to Procedure

Median DAN scores varied according to the type of procedure (Table 7). They were highest for lumbar punctures (DAN = 10). They were 9 for peripheral venous access line and blood sampling. The lowest median (DAN = 8) was for intravenous injections.

Table 3. Population distribution based on neonatal anthropometric measurements.

Variables	Categories	Counts (N = 161)	Percentages (%)
Weight (g)			
	[500 - 1000]	10	6.2
	[1000 - 1500]	18	11.2
	[1500 - 2000]	16	9.9
	[2000 - 2500]	15	9.3
	[2500 - 4000]	85	52.8
	≥4000	17	10.6
Height (cm)			
	<35	8	5
	[35 - 45]	27	16.8
	[45 - 55]	23	76.4
	≥55	3	1.9
Fetal growth			
	Eutrophic	90	55.9
	Hypotrophic	54	33.5
	Macrosomic	17	10.6

Table 4. Diagnosis on admission.

Variables	Counts (N = 161)	Percentages (%)
Diagnosis on admission		
Neonatal sepsis	156	96.9
Prematurity	50	31.1
Neonatal jaundice	41	25.5
Neonatal asphyxia	16	9.9
Growth retardation	6	3.7
Congenital heart disease	4	2.5
Chromosomal abnormalities	2	1.2
Surgical conditions	1	0.6

Table 5. Healthcare procedures performed.

Variables	Counts (N = 161)	Percentages (%)
Procedures performed		
Blood sampling	152	94.4
Peripheral venous access	151	93.8
Intramuscular injections	43	26.7
Lumbar punctures	19	11.8
Nasogastric tubing	14	8.7
Central venous access	3	1.9
Daily frequency of procedures		
1	146	90.7
2	12	7.5
3	1	0.6

Table 6. Assessment of procedural pain.

Variables	Counts (N = 161)	Percentages (%)
Procedures performed		
Peripheral venous access	100	62.1
Blood sampling	33	20.5
Injection	25	15.5
Lumbar puncture	3	1.9
DAN score before care		
Absence of pain (0)	147	91.3
Mild pain (1 - 3)	14	8.7
DAN score during care		
Moderate pain (4 - 7)	2	16.1
Severe pain (8 - 10)	135	83.9
DAN score after care		
Absence of pain (0)	102	63.3
Mild pain (1 - 3)	42	26.1
Moderate pain (4 - 7)	17	10.6

Table 7. DAN score during the procedure according to the different types of care.

Performed procedure	Means ± SD	Median [IQR]
Peripheral venous access (N = 100)	8.96 ± 1.19	9 [8 - 10]
Blood sampling (N = 33)	8.76 ± 1.52	9 [8 - 9]
Intravenous injection (N = 25)	7.88 ± 1.01	8 [7 - 8]
Lumbar puncture (N = 3)	9.33 ± 1.16	10 [8 - /]

3.6.3. Correlation between Pain Intensity and Type of Procedure

1) One-factor ANOVA test

The one-factor ANOVA test showed that the DAN score varied significantly according to the type of procedure performed ($p = 0.002$). The procedure with the highest pain was lumbar puncture (Table 8).

2) Association between pain and type of procedure

During the procedures, the difference in mean DAN scores was significant between peripheral venous line placement and injections ($p = 0.001$). Similar results were observed between blood sampling and injections ($p = 0.041$). Venous access procedures were therefore more painful than intramuscular injections (Table 9).

3.6.4. Correlation between Duration of Pain and Type of Procedure

1) One-factor ANOVA test

The One-factor ANOVA test showed that there was a significant difference between the mean pain durations associated with each type of procedure ($p < 0.001$) (Table 10).

Table 8. One-factor ANOVA test.

	Variables	Means	p value
Dan scale	Peripheral venous access (N = 100)	8.96	0.002
	Blood sampling (N = 33)	8.76	
	Injection (N = 25)	7.88	
	Lumbar puncture (N = 3)	9.33	

Table 9. Tukey test comparing pain during different procedures.

		Mean differences	p values
Peripheral venous access	Lumbar puncture	−0.373	0.956
	Blood sampling	0.202	0.848
	Injection	1.080	0.001
Lumbar puncture	Peripheral venous access	0.373	0.956
	Blood sampling	0.576	0.868
	Injection	1.453	0.224
Blood sampling	Peripheral venous access	−0.202	0.848
	Lumbar puncture	−0.576	0.868
	Injection	0.878	0.041
Injection	Peripheral venous access	−1.080	0.001
	Lumbar puncture	−1.453	0.224
	Blood sampling	−0.878	0.041

Table 10. One-ANOVA test.

	Variables	Means	p value
Duration of pain	Peripheral venous access (N = 100)	67.57	<0.001
	Blood sampling (N = 33)	71.52	
	Injection (N = 25)	41	
	Lumbar puncture (N = 3)	58.33	

Table 11. Tukey test comparing pain durations during different procedures.

		Mean differences	p values
Peripheral venous access	Lumbar puncture	9.237	0.916
	Blood sampling	−3.945	0.851
	Injection	26.570	<0.001
Lumbar puncture	Peripheral venous access	−9.237	0.916
	Blood sampling	−13.182	0.806
	Injection	17.333	0.649
Blood sampling	Peripheral venous access	3.945	0.851
	Lumbar puncture	13.182	0.806
	Injection	30.515	<0.001
Injection	Peripheral venous access	−26.570	<0.001
	Lumbar puncture	−17.333	0.649
	Blood sampling	−30.515	<0.001

2) Association between duration of pain crisis and type of procedure

The mean duration of acute pain episodes was significantly greater between peripheral venous access and injections ($p < 0.001$). Similar results were observed between blood sampling and injections ($p < 0.001$) (**Table 11**).

4. Discussion

4.1. Hospital Prevalence

We found a hospital prevalence of acute care-induced pain of 85%. This value can be explained by the large number of painful procedures that neonates undergo during hospitalization. These results are similar to those of Carbajal *et al*. in France in 2008, who found a 79.7% prevalence of painful procedures during hospitalization in a neonatal unit [12]. Similarly, a Congolese series reported in 2019 that one of the main causes of neonatal pain was care-induced pain, with a hospital prevalence of 73.6% [13]. However, this prevalence varies from one study to another, depending on whether there are pre-existing protocols for the management of acute neonatal care-induced pain.

4.2. Sociodemographic Profile

The sample consisted of 161 neonates undergoing painful procedures daily. The median age was 5 days, ranging from 1 to 49 days. Age was recorded on the day of care and according to the length of hospital stay.

Males were more represented, accounting for 60.9% of cases, with a sex ratio of 1.56. However, the impact of sex on pain response has not been proven [14].

Full-term births were more represented than preterm births, 72% and 28% respectively. These data corroborate those from the 2018 National Demographic Health Survey, which found that full-term newborns accounted for around 88% of live births [10].

The weight was measured on the day of the procedure and was 2694.1 ± 1023.0 grams, ranging from 600 and 5000 grams. This result is supported by the fact that most of the newborns admitted to the hospital were full-term.

4.3. Diagnosis

Neonatal sepsis was the main cause for admission (96.9%). Neonatal sepsis is the most common cause of hospital admissions in neonatology, particularly in Cameroon, as shown by the results of a study by KedyKoum *et al*. in a referral hospital in Douala in 2015 [11].

4.4. Healthcare Procedure Performed

Blood sampling and peripheral venous line insertion were the two most painful procedures performed, at 94.4% and 93.8% respectively. Most procedures were performed once a day (90.7%). These results differ from those of other European cohorts, which showed that the most painful procedures in neonates were gastric fluid sampling, pharyngeal suctioning, and skin punctures (venous and capillary

sampling) [5] [15]. These differences could be explained by the severity of the diagnosis. The advanced technical facilities available in developed countries allow them to admit newborns with severe clinical conditions, and the management of these infants involves a large amount of care, ranging from resuscitation measures to various diagnostic tests.

4.5. Evaluation of Care-Induced Pain

The procedures that caused pain in neonates were, in descending order, peripheral venous line insertion, venous sampling, intramuscular injections, and lumbar puncture. There was virtually no pain before the procedure (91.3%). During the procedure, pain was observed in all cases and was severe in 83.9% of cases. Two minutes after the procedure, 36.7% of patients had pain, including 26.1% with mild pain.

The procedure with the highest pain threshold was lumbar puncture, followed by venous access procedures. In the case of lumbar puncture, the severity of pain is explained anatomically and physiologically by the proximity of the puncture site to the nerve roots emerging from the spinal cord in the subarachnoid space. As a result, when the needle reaches these very sensitive areas during the puncture, the pain is severe.

Venous access procedures are not painful per se, but in our context the use of large caliber needles, which are unsuitable for neonates, raises the pain threshold. On the other hand, the repetition of the nociceptive gesture in the search for a vein biases the assessment of pain. These results are concordant with those of a Moroccan series from 2011, which found that the severity of the same procedures was 71% during the procedure and 22% after the procedure [16].

The average duration of acute pain episodes was significantly longer for peripheral venous line insertion than for injections. Similar results were observed between blood sampling and injections. These findings may be explained by the way the procedure is performed. When a peripheral venous line is inserted, the difficulty in gaining access to the vein due to age-inappropriate equipment leads to many repeated punctures, thereby increasing the duration of the pain episode. The same explanation applies to blood sampling, the duration of which depended on the quantity of blood required for the examination.

5. Conclusion

Painful procedures are very common during neonatal hospitalization. The most common nociceptive healthcare procedures were peripheral venous line insertion, blood sampling, injections, and lumbar puncture. The intensity of acute care-induced pain was predominantly severe. The most painful procedure was lumbar puncture. Venous access procedures caused severe pain and lasted longer. The recurrence of neonatal procedural pain in our context suggests the need to harmonize pain management protocols for neonates.

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Meguieze C.A. designed the research protocol. Bidias R. collected and analyzed the data obtained. Nseme E.E. and Koki N.P.O. corrected the research project and supervised the work. All authors participated in writing the research article.

Conflicts of Interest

The authors declare no conflicts of interest regarding the publication of this paper.

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