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Evaluation of Pain Response of Expressed Breast Milk Versus Placebo During Intravenous Cannulation in Neonates

V. Krishna Prabhath [1], Nuthan Sai Paruchuri *[1], Hariprasad Dusa [1], Saiprasad Onkareshwar Kavthekar [2], Nivedita Balasaheb Patil [3], Harshwardhan Saiprasad Kavthekar [4], Nupur Balasaheb Patil [5]

[1]Junior Resident, Department of Pediatrics, D.Y. Patil Medical College, D. Y. Patil Education Society (Deemed to be University), Kolhapur (416003), Maharashtra, India.
[2]Professor, Department of Pediatrics, D.Y. Patil Medical College, D. Y. Patil Education Society (Deemed to be University), Kolhapur (416003), Maharashtra, India.
[3]Professor and HOD, Department of Pediatrics, D.Y. Patil Medical College, D. Y. Patil Education Society (Deemed to be University), Kolhapur (416003), Maharashtra, India.
[4]Second Year MBBS Student, Government Medical College Ratnagiri (415612), Maharashtra University of Health Sciences, Nashik, Maharashtra, India.
[5]Third Year MBBS Student, D.Y. Patil Medical College, D. Y. Patil Education Society (Deemed to be University), Kolhapur (416003), Maharashtra, India.

*Corresponding author: Dr. Nuthan Sai Paruchuri; *nuthansaiparuchuri@gmail.com*

Abstract

Objective: To evaluate pain response of expressed breast milk (EBM) versus placebo during intravenous (IV) cannulation in neonates admitted in NICU by neonatal infant pain scale (NIPS). ***Study design:*** Non-blinded randomized control study. ***Place and duration:*** Neonatal Intensive Care Unit of Dr. D.Y. Patil Medical College, Hospital & Research Institute, Kolhapur from 5th December 2022 to 5th May 2024. ***Materials and Methods:*** This study included 257 neonates (128 in EBM and 129 in placebo group) with more than 32weeks of gestational age and who needed IV canulation. The neonates were exposed to EBM and sterile water of 2 ml by sterile syringe starting two minutes prior and during the procedure in EBM and placebo groups respectively. A senior resident put 26G needle IV canula for all neonates in first attempt. NIPS was utilized for the evaluation of the pain and the gross pain score was interpreted as: 0-2 (no pain), 3-4 (moderate pain), greater than 4 (severe pain). This score was calculated during and till 30 seconds after the first prick. ***Results:*** The mean NIPS score in EBM group was significantly less compared to placebo group (2.56 vs 3.81, P<0.0001). The individual variables of NIPS observed significantly lower scores in EBM group as compared to placebo group. The placebo group experienced higher levels of pain as compared to EBM group. ***Conclusion:*** EBM as a non-pharmacological intervention demonstrated superior efficacy in reducing pain responses during IV cannulation in neonates as compared to a placebo.

Keywords: ***Analgesia, Expressed breast milk, Neonate, Procedure.***

Introduction

The neonates undergo several procedures namely venepunctures, lumbar punctures, heel pricks etc every day in the neonatal intensive care unit (NICU), often causing significant pain in neonates [1]. Early life painful stimuli may have long-term effect on brain microstructure and its connectivity, poor cognitive motor and behavioural development, and changes in the neuroendocrine and immune system especially if they are presented repeatedly [2-4]. If some efforts are taken to lessen the procedural pain in neonates, the neonatal care would be more compassionate. So, a great importance is being laid on diminishing pain throughout procedures in newborns.

The use of pharmacological therapies in neonates is limited due to uncertainty about their efficacy and worry about potential side effects [5]. In postnatal wards, many non-pharmacological analgesic techniques have been utilized on healthy-term newborns having venepuncture [6]. It has been demonstrated that giving babies oral sweet solutions like glucose and sucrose significantly lessens their procedural pain [7]. Breast milk, which has 7% lactose, and sweet taste might function physiologically in place of sucrose to relieve pain [8]. The present study was conducted to evaluate pain response of expressed breast milk (EBM) versus placebo during intravenous (IV) cannulation in neonates admitted in NICU by neonatal infant pain scale (NIPS).

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Materials and Methods

This non-blinded randomized control study was carried out in the NICU of Dr. D.Y. Patil Medical College, Hospital & Research Institute, Kolhapur from 5th December 2022 to 5th May 2024 after Institutional Ethics Committee approval (DYPMCK/IEC-41/2022-23). A total 257 neonates satisfying the inclusion and exclusion criteria were included in this study. The sample size was calculated by Slovin's formula (n=N/1+Ne2, N=720 and e=5%) and sample size was 257 neonates.

Inclusion criteria

1. Neonates who needed an IV cannulation.
2. Neonates of more than 32weeks of gestational age.
3. Neonates whose parents give informed and written consent for participation in the study.

Exclusion criteria

1. Neonates with encephalopathy (due to moderate to severe birth asphyxia, intracranial bleed, bacterial meningitis, bilirubin encephalopathy.)
2. Neonates with birth injury, craniofacial anomalies, or syndromic babies.
3. Neonates with maternal opiate abuse or who on analgesics or any condition which alters the response to NIPS.
4. Neonates who are on ventilator or on nasogastric tube feeds.

The enrolled neonates were allocated into two groups, the even numbers into EBM group while odd numbers into placebo group. Baseline heart rate, respiratory rate, Spo2 and state of wakefulness was recorded before the procedure. To avoid confounding, babies were not fed for at least 30 minutes prior to the intervention. In the EBM group neonates were exposed to EBM starting two minutes before and during the procedure. After explaining the mother about the purpose and details of the study, asked her to express breast milk into a sterile container. In the placebo group, neonates were exposed to sterile water starting 2 minutes before and during the procedure. Both the test solutions with the quantity of 2 ml, was placed on the anterior part of the tongue by a sterile syringe and care was taken that neonates should not suck the tip of syringe. No other stimulus was provided to the baby during the procedure like touch, sound, suction, or changing diaper, etc. If the baby vomits or regurge the test solution immediately, it was reintroduced again. A senior resident, who was trained in IV cannulation was identified for the procedure and only 26G needle IV canula was used for cannulation in all neonates. Response to the first prick and not the subsequent pricks during IV cannulation was recorded. NIPS was utilized for the evaluation of the pain during the procedure [9]. For all the neonates, the gross pain score was interpreted as: 0-2 (no pain), 3-4 (moderate pain), greater than 4 (severe pain). This score was calculated during and till 30 seconds after the first prick for intravenous cannulation. Observations were recorded and analysed by a single investigator and the score was entered in a pre-designed master chart.

Statistical analysis: Data analysis was done by SPSS version 23 software. Data were expressed in numbers and percentages. The results were compared using an unpaired 't' test. P value < 0.05 was taken as significant.

Results

A total of 257 neonates (128 in EBM group while 129 in placebo group) were enrolled in our study. In EBM group there were 61.72% (79) males and 38.28% (49) females while in placebo group 57.36% (74) males and 42.64% (55) females. There was no statistically substantial variance in gender distribution between two groups (p=0.5592). The mean gestational age in EBM and placebo group was 36.69 ± 2.87 weeks and 36.72 ± 2.81 weeks respectively (P=0.9917).

The mean NIPS score in EBM group was significantly less compared to placebo group (2.56 vs 3.81, P<0.0001). Also, the individual variables of NIPS observed statistically significantly lower scores in EBM group as compared to placebo group. The distribution NIPS variables sore is shown in Table 1.

The distribution of NIPS severity in EBM and placebo group is shown in Table 2. There was statistically substantial variance in NIPS scores between the two groups, suggesting that placebo group experienced higher levels of pain as compared to EBM group.

Table 1: Distribution of Neonatal Infantile pain score (NIPS) variables in EBM and placebo groups.

Sr No	NIPS	Variables (Score)	EBM Group		Placebo group		P value
			N	%	N	%	
1	Facial Expression	Relaxed	85	66.41%	53	41.09%	0.00007
		Grimace	43	33.59%	76	58.91%	
2	Cry	No Cry (0)	68	53.13	52	40.31	0.00305
		Whimper (1)	16	12.50	07	05.43	
		Vigorous (2)	44	34.38	70	54.26	
3	Breathing Pattern	Relaxed (0)	110	85.94%	99	76.74%	0.0835
		Change in breathing (1)	18	14.06%	30	23.26%	
4	Arms Position	Relaxed (0)	102	79.69	74	57.36	0.00020
		Fixed Extended (1)	26	20.31	55	42.64	
5	Legs Distribution	Relaxed (0)	117	91.41	105	81.4	0.03095
		Fixed Extended (1)	11	08.59	24	18.60	
6	State of arousal	Sleeping/Awake (1)	108	84.38	91	70.54	0.01231
		Fussy (2)	20	15.63	38	29.4	
7	Heart Rate	Normal (0)	91	71.09	75	58.14	0.04127
		Altered (1)	37	28.91	54	41.86	
8	Oxygen Saturation	Normal (0)	90	70.31	74	57.36	0.00389
		Altered (2)	38	29.69	55	42.64	

Table 2: Distribution of Neonatal Infantile Pain scale (NIPS) severity in EBM and placebo groups.

NIPS Score	EBM Group		Placebo Group		P value
	Frequency(n)	Percentage (%)	Frequency(n)	Percentage (%)	
No Pain (0-2)	70	54.56%	22	17.05%	
Moderate (3-4)	35	27.34%	61	47.29%	
Severe (≥5)	23	17.97%	46	35.66%	
Total	128	100.00%	129	100.00%	<0.00001

Discussion

A simple breastfeeding efficiently decreases crying time and various validated pain scores in neonates, however, expressed breast milk given by syringe might show different efficacy. Hence this study was carried out with the aim of to evaluate efficacy of EBM by comparing to placebo in alleviating pain responses by using NIPS score during IV cannulation among 257 newborns admitted in the NICU. The outcomes of the study indicate substantial changes in pain responses between the two groups. Moreover, neonates administered EBM during intravenous cannulation exhibited lower NIPS scores, while 54.69% and 17.05% neonates from EBM and placebo groups respectively had no pain indicating reduced pain severity with EBM as compared to those receiving placebo.

Facial expression and crying patterns are widely recognized as reliable indicators of pain in neonates. The placebo group showed a higher incidence of grimacing, vigorous crying, and altered limb positions as compared to EBM group, reflecting more pronounced pain responses in the absence of EBM administration. The EBM administration might have a soothing effect, which reduced the behavioural manifestations of pain and better pain management and comfort during intravenous cannulation. The study also assessed heart rate and oxygen saturation which are the physiological parameters. While both groups exhibited altered rates, EBM group demonstrated better maintenance of normal heart rates and oxygen saturation levels as compared to placebo which suggested that EBM administration may contribute to stabilizing cardiovascular and respiratory functions during painful procedures.

This study finding suggests that breast milk might have analgesic effects and the reasons could be firstly due to the presence of tryptophan, a precursor to melatonin, a precursor to beta-endorphin which is present in breast milk, can significantly reduce pain in newborns [10,11]. Secondly, breast milk's smell and sweet taste from lactose also helped to relieve pain [12].

Our study findings aligned with previous studies such as Sahoo JP et al who compared the effect of EBM, dextrose, and water on procedural pain in neonates using premature infant pain profile. They observed that EBM significantly reduced procedural pain in neonates though to a lesser extent as compared to 25% dextrose [13]. Another study conducted by Vohra A. et al also observed that EBM was a better analgesic in babies with procedural pain [14]. Similarly, a recent study has demonstrated that EBM is effective in reducing pain due to immunization injection in infants [15].

In contrast, to our study Varughese PM et al [16] found neonates undergoing non-nutritive sucking with dextrose had the lowest pain scores, followed by infants receiving dextrose alone, while those on EBM showed the highest pain scores. All three groups exhibited substantial differences in heart rate and oxygen saturation from baseline, and by the third minute, these variations were diminishing, indicating that 25% dextrose demonstrated the highest potential for rapid stabilization in both procedures. Cry duration was notably shorter in the 25% dextrose group during both invasive procedures. As our study focused on only EBM, Varughese PM et al examined the effects of non-nutritive sucking with dextrose and breast milk and so the physiological effects and pain-relieving mechanisms of these interventions could vary.

Our study findings underscore the potential clinical benefits of using EBM as a non-pharmacological intervention to mitigate pain in neonates undergoing invasive events. Healthcare providers in NICUs could consider incorporating EBM into pain management protocols, alongside established pharmacological methods, to enhance patient comfort and reduce procedural distress.

Despite the promising results, we acknowledge certain limitations. Firstly, the study sample size may not be sufficiently large to generalize findings to broader neonatal populations. Secondly, it was a non-blinded study as it was challenging to eliminate biases in subjective assessments such as pain scoring. Thirdly breast milk composition can vary between mothers and across different feeding sessions. This variability could impact the consistency of pain-relieving properties observed in neonates receiving EBM.

Conclusion

EBM as a non-pharmacological intervention demonstrated superior efficacy in reducing pain responses during IV cannulation in neonates as compared to a placebo.

Declarations

Ethics approval

Not Applicable

Consent to participate

Taken

Data Availability

Not Applicable

Conflicts of Interest

None

Funding Statement

None

Authors' contributions

All authors have contributed, designed and approved the study

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