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Evaluating the Effect of Expressed Breast Milk and 10% Dextrose in Procedural Pain Relief in Neonates

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ABSTRACT

Background: In neonates painful procedures are performed with minimum to no regard for pain relief. Even if neonates are unable to communicate pain, it doesn't negate their ability to experience it. This study observed the effect of expressed breast milk (EBM) and 10% dextrose (10%D) during venipuncture in neonates.

Methods: A hospital based cross sectional comparative study was conducted from November 2021 to October 2022. Purposive sampling of 110 neonates who received expressed breast milk and 10% dextrose were assessed via Premature Infant Pain Profile - Revised (PIPP-R) pain assessment tool along with heart rate (HR), oxygen saturation (SpO_2) and duration of cry. Data was collected and analyzed via independent t test using Statistical Package for Social Sciences version 25.

Results: The mean ± standard deviation of heart rate and oxygen saturation in expressed breast milk group was 168.57 ± 8.9 per minutes (min) and 95.31 ± 1.42% and in 10% dextrose group was 174.27 ± 9.02 per min and 93.80 ± 1.15% respectively. Mean duration of cry in expressed breast milk group was 51.89 ± 16.66 seconds (sec) and 10% dextrose group was 73.55 ± 24.05 sec with a significant difference (p=0.001). The premature infant pain profile revised score was recorded at 30 sec, 1 min and 3 min and 5 min and a significant difference was noted at 30 sec (p=0.000) and 1 min (p=0.047) after venipuncture.

Conclusions: Expressed breast milk have better analgesic effect than 10% dextrose.

Keywords: Expressed breast milk; neonate; neonatal pain; oral dextrose; PIPP

INTRODUCTION

Until late-1980s clinicians widely reasoned that neonates did not experience pain due to their underdeveloped nervous system for pain sensation.[1] However recent studies demonstrated that the immature nervous system of newborns made them hypersensitive to painful stimuli.[1, 2]

Since infants are unable to self-report pain verbally, multiple pain assessment tools were created and assessed over time.[3] One such pain assessment tool is Premature Infant Pain Profile - Revised (PIPP-R) score used in this study.[3, 4] After establishing neonatal pain we need to alleviate it. Neonatal pain management is a multi-directional approach which includes both non-pharmacologic and pharmacologic modalities.[5] The non-pharmacologic methods include swaddling, non nutritive sucking, breast milk, sweet tasting solutions like oral sucrose, dextrose, etc. [1, 5]

This study aims to evaluate the effect of two of the most commonly available non-pharmacological methods - expressed breast milk (EBM) and 10% Dextrose(10%D) for pain relief in neonates.

METHODS

This is a cross sectional study conducted in Nepal Medical College Teaching Hospital (NMCTH), a tertiary level hospital in Kathmandu, Nepal from November 2021 to October 2022 after ethical approval from the NMCTH

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- Institutional Review Committee (Ref.: ThesisProp 07-078/079). Sample size was calculated with the formula $[2 X (Z\alpha + Z\beta) X S^2] / d^2$. The confidence interval was 95% ($Z\alpha$= 1.96) with 80% power ($Z\beta$= 0.84). Data for pooled variance was extracted from a study done by Rawal S et al.[6] in New Delhi in 2018 where S_1= 1.76 and S_2= 1.34 and difference in mean was d = [(3.76 – 2.90) = 0.86]. The minimum sample size was calculated as 52 in each group and the final sample size taken was 110. Total 54 neonates were present in EBM group, designated as Group A and 56 neonates in 10%D group, designated as Group B.

Purposive sampling of all term neonates from birth to seven days of life with APGAR score more than or equal to seven at five min of life, requiring venipuncture, one hour after feeding and who received EBM or 10%D before venipuncture were included in the study. Consent was taken from the guardian of all neonates involved in the study. Neonates who required more than 40% oxygen support, who had received sedatives within five days of life, required more than one prick during venipuncture, who were nil per oral, had feed intolerance and congenital malformations were excluded from the study.

Neonates whose mother were able to express adequate breast milk received EBM and the remaining received 10%D. The type of solution received by the neonate was revealed to the investigator after all data were collected in both groups. Venipuncture was done with a 22-gauge needle with the neonate in supine position, beneath the radiant warmer. A timer was used to collect data at specific times. Two mL of either EBM or 10%D was given two min before venipuncture and baseline heart rate (HR), oxygen saturation (SpO_2), facial changes and behavioral state were recorded in the PIPP-R[4] chart (Table 1). The visual representation of facial changes of a neonate experiencing pain is shown in Figure 1.[7] Two minutes after giving the oral solution, venipuncture was done. After collecting required blood, needle was removed, and the immediate first reading of neonate's heart rate and oxygen saturation was recorded and PIPP-R[4] score was noted at 30 sec, 1 min, 3 min and 5 min respectively at real time. The duration of audible cry of the neonate was noted immediately after removal of needle used for venipuncture. The collected data were entered in a database and analyzed via independent t test to compare between two means using Statistical Package for Social Sciences (SPSS) version 25 software.

RESULTS

Among 110 neonates, the median age of neonates was three days of life, mean gestational age was 38.45 ± 1.11 and mean birth weight was 3.0 ± 0.49 kg. Among the neonates 64.5% were male and 91.8% had normal birth weight. The demographic details of the neonates is given in Table 2.

The mean ± standard deviation (SD) of heart rate after venipuncture among neonates who received EBM (168.57 ± 8.90) was lower than 10%D group (174.27 ± 9.02) but the difference was not statistically significant (p=0.708). The oxygen saturation after venipuncture in EBM group (95.31 ± 1.42) was higher than 10%D group (93.80 ± 1.15) with no significant difference (p=0.097). The mean duration of cry in EBM group (51.89 ± 16.66 sec) was lower than 10%D group (73.55 ± 24.05 sec) with significant difference (p=0.001). (Table 3)

The PIPP-R score in EBM group (13.19 ± 2.42) was lower than 10%D (14.66 ± 1.43) at 30 sec with significant difference (p=0.000). PIPP-R at 1 min was also lower in EBM group (6.41 ± 3.06) than 10%D group (8.61 ± 3.83) with significant difference (p=0.047). There was no significant difference between two groups at 3 min (p=0.243) and 5 min (p=0.194). (Table 4)

The PIPP-R before and after venipuncture in EBM group showed significant difference at 30 sec (p=0.000) and 1 min (p=0.000) but no significant difference at 3 min (p=0.523) and 5 min (p=0.998) suggesting pain relief between 1 and 3 mins. In 10%D group, the PIPP-R score before and after venipuncture had significant difference at 30 sec (p=0.000), 1 min (p=0.000) and 3 min (p=0.008) and no significant difference at 5 min (p=1.000) suggesting pain relief between 3 and 5 mins.

Table 1. The Premature Infant Pain Profile - Revised[4].

Infant Indicator	Score				Infant Indicator Score
	0	+1	+2	+3	
Gestational age (Weeks + Days)	>36 wks	32-35 wks 6 days	28-31 wks 6 days	< 28 wks	
Baseline behavioral state	Active and awake	Quiet and awake	Active and asleep	Quiet and asleep	
Changes in heart rate (bpm)	0-4	5-14	15-24	>24	
Decrease in oxygen saturation (%)	0-2	3-5	6-8	>8 or increase in O_2	
Brow bulge (sec)	None (<3)	Minimal (3-10)	Moderate (11-20)	Maximal (>20)	
Eye squeeze (sec)	None (<3)	Minimal (3-10)	Moderate (11-20)	Maximal (>20)	
Naso-labial furrow (sec)	None (<3)	Minimal (3-10)	Moderate (11-20)	Maximal (>20)	
#Total Score					

Table 2. Demographic Information of Neonates.

Demographic Details		EBM (n=54)	10%D (n=56)	Total (n=110)
Age (days)	< 7	49 (90.7%)	54 (96.4%)	103 (93.6%)
	≥ 7	5 (9.3%)	2 (3.6%)	7 (6.4%)
Sex	Male	36 (66.6%)	35 (62.5%)	71 (64.5%)
	Female	18 (33.4%)	21 (37.5%)	39 (35.5%)
Birth weight (kg)	< 2.5	5 (9.3%)	3 (5.4%)	8 (7.3%)
	2.5 -4	49 (90.7%)	52 (92.9%)	101 (91.8%)
	> 4	0	1 (1.7%)	1 (0.9%)
Gestational age (wk)	37 to <40	48 (88.9%)	49 (87.5%)	97 (88.2%)
	≥40 to 42	5 (9.2%)	7 (12.5%)	12 (10.9%)
	≥ 42	1 (1.9%)	0	1 (0.9%)
Mode of delivery	NVD	12 (22.2%)	16 (28.5%)	28 (25.4%)
	Assisted Delivery	0	1 (1.8%)	1 (0.9%)
	LSCS	42 (77.8%)	39 (69.7%)	81 (73.7%)

Table 3. Variation in heart rate, oxygen saturation and duration of cry among study groups.

Mean ± SD	EBM	10%D	p value
Baseline HR	128.67 ± 7.31	125.57 ± 6.89	0.622
Baseline SpO_2	98.19 ± 0.84	98.20 ± 0.64	0.396
HR (After)	168.57 ± 8.90	174.27 ± 9.02	0.708
SpO_2 (After)	95.31 ± 1.42	93.80 ± 1.15	0.097
Duration of Cry	51.89 ± 16.66	73.55 ± 24.05	0.001

Table 4. Comparison of PIPP-R score across specific times in study groups.			
Time Mean ± SD	**EBM**	**10%D**	**p value**
Before	2.04 ± 1.01	1.79 ± 0.98	0.130
30 sec	13.19 ± 2.42	14.66 ± 1.43	0.000
1 min	6.41 ± 3.06	8.61 ± 3.83	0.047
3 min	2.63 ± 1.35	3.05 ± 1.13	0.243
5 min	1.93 ± 1.14	1.75 ± 1.06	0.194

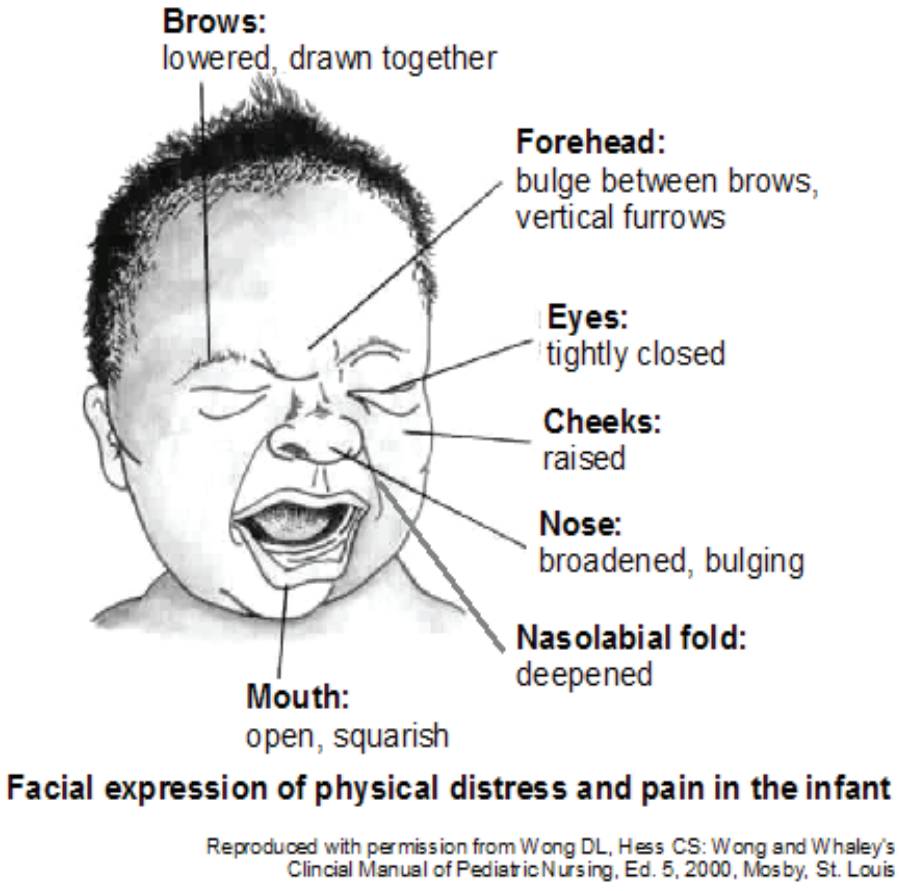

Figure 1. Visual representation of the facial changes seen in a neonate experiencing pain.[7]

DISCUSSION

This study selected two of the most readily available non-pharmacological solutions in NICU for pain relief in neonates. The analgesic effect of dextrose is due to the sweet taste which releases endogenous opioid after contact with tongue. The opioid release peaks at 2 min and persists around 5 to 8 mins.[8, 9] Similarly, the sweet taste of lactose and the high concentration of tryptophan is related to the analgesic effect of breast milk. Tryptophan is a precursor of melatonin which increases the concentration of beta endorphins.[10, 11]

In our study the increase in heart rate and decrease in oxygen saturation after venipuncture was lower in EBM group than 10%D group. This finding was similar to study done by Vohra et al. which compared EBM with sucrose.[11] Another study by Dasari et al analyzed the opposite however the differences did not show a statistical significance.[12] The duration of cry was significantly lower in EBM group than 10%D group which was similar in study done by Vohra et al and Dasari et al but contradictory to study done by Patel et al.[11-13] The different findings across studies suggest the need for more robust research regarding pain relief in neonates.

In our study the PIPP-R score revealed that EBM had significant analgesia compared to 10%D at 30 sec and 1 min after venipuncture. Similar findings was seen in a study by Dasari et al which noted that EBM had significant pain relief during the first 30 sec after heel prick procedure.[12] Another study done by Rodrigues et al revealed no significant difference in PIPP score between EBM and 25%D group and concluded that both solutions decreased pain but EBM had sustained pain relief for up to 5 mins after nasopharyngeal suctioning.[14] Jatana et al compared EBM with various concentrations of oral glucose and concluded that EBM and 10% glucose had equal analgesic effect but was less effective than both 25% and 50% glucose.[15] Nayak et al concluded no significant difference in PIPP score in EBM and 10%D groups in preterm neonates during ROP screening.[16]

Contrary to our findings, Shanthi et al noted significant lower PIPP-R score in 10%D group than EBM group across different timelines and concluded 10%D to be superior to EBM.[17] Studies by Rawal et al and Sahoo et al concluded that both 25%D and EBM had analgesic effect but 25%D had lower PIPP score and showed better analgesia than EBM.[6, 18] These contradictions could suggest the possibility of different variables like pain tolerance of neonate on the basis of gender, race, ethnicity, type of painful procedure resulting in different findings and the need to address these variables across different studies.

There were also certain limitations to this study. This was a single centre study carried out in a small sample size over a short period of time. A multi-center study with larger sample size over longer duration could provide for better generalization of the study. In addition, matching of two groups was not done in this study. This study also did not consider other variables like duration of venipuncture, instinctive positioning of a distressed neonate after venipuncture by the caregiver, previous history of exposure to similar pain, etc. that could have caused the neonate to experience variable intensity of pain. In addition, the efficacy of the solution in preterm neonates undergoing painful procedures could not be studied. Since there was no follow-up, the long term effects of pain relief solution were not investigated.

CONCLUSIONS

This study concluded that both EBM and 10%D were able to relive pain in neonates and EBM was concluded to be superior to 10%D in managing pain during venipuncture. Every neonate is unique and not all can tolerate oral dextrose; in such cases breast milk will be a better and accessible alternative. However the review of various literature revealed contrasting findings. This indicates the need for more through research and to address variables that affect how the neonate experiences pain. This study also highlights the need to consider neonatal pain during every procedure and consider measures to alleviate it.

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CONFLICT OF INTEREST

Authors declare there are no any conflicts of Interest.

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