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A Comparative Study Between Expressed Breast Milk And Oral Glucose For The Relief Of Pain In Newborns Undergoing Skin Pricking Procedures

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Abstract:
Background: *Newborns frequently undergo numerous painful skin pricking procedures. Many environmental, behavioural, non-pharmacological and pharmacological interventions are available for the management and prevention of pain in neonates and older children. As analgesic medications are deemed to be harmful in neonates, emphasis has been centred on non-pharmacological measures. Breast milk and sweet tasting solutions, like sucrose, glucose etc. have been investigated for the relief of pain in neonates. However, the knowledge and use of pain control for neonates is still limited.*
Objective*: The present study was planned to compare the effect of oral glucose versus expressed breast milk (EBM) for the relief of pain in newborns undergoing skin pricking procedures as assessed by the neonatal infant pain scale(NIPS) and changes in heart rate and duration of crying.*
Methods*: This was a prospective, double blinded randomized controlled trial, carried out in Pediatrics ward of Regional Institute Of Medical Sciences, Imphal.150 babies who required venepuncture for blood sampling and who were on oral feeds were recruited for the study. The babies were randomly divided into 2 groups of 75 each. 2 ml of either oral glucose (10%) or expressed breast milk was given 1 min before the procedure orally. During the blood sampling procedure - heart rate, crying time and the NIPS scores were noted.*
Results*: Neonatal infant pain score (NIPS) for expressed breast milk group was higher than that of oral glucose group (P < 0.001). Similarly, crying time for the former group's babies was significantly longer than crying time for the latter group's babies (P < 0.001).*
Conclusions*: Though both oral glucose and expressed breast milk have pain relieving properties, oral glucose seems to be a better analgesic compared to expressed breast milk.*
Key Words*: Oral glucose, expressed breast milk, pain, newborns.*

I. Introduction

Pain in the newborn is an "unpleasant sensory or emotional experience associated with actual or potential tissue damage" and it encompasses both peripheral physiologic and central cognitive/emotional components.[1] Earlier it was thought that premature infants and newborns, in general, couldn't perceive pain and were not capable of interpreting pain in a manner similar to adults. Lack of myelination has been proposed as an index of the lack of maturity in the neonatal nervous system and is used frequently to support the argument that premature or full term neonates are not capable of pain perception.[2]

Assessing pain in an individual entails much more than merely quantifying it. For infants and non-verbal children, their parents, paediatricians, nurses and other caregivers are constantly challenged to interpret whether the children's distressed behaviours represent pain, fear, hunger, or a range of other perceptions or emotions. As such children cannot express the quantity of pain they experience, several pain scales have been devised in an attempt to quantify pain.[1]

Newborns undergo a wide variety of procedures that induce pain and the most effective way of reducing minor procedural pain is to lessen the number of procedures performed.[1] Although an array of pharmacological preparations e.g. opioid, non-steroidal medications, topical analgesic applications etc. Are available for reducing pain in older children, these are not applicable to newborns. Also, a variety of non-pharmacologic pain prevention and relief techniques have been shown to effectively reduce pain from minor procedures in neonates.[3] These include use of oral sucrose/glucose, breastfeeding, non-nutritive sucking, "kangaroo care" (skin-to-skin contact), facilitated tuck (holding the arms and legs in a flexed position), swaddling and developmental care, which includes limiting environmental stimuli, lateral positioning, use of supportive bedding, and attention to behavioural clues. These measures, when applied in combination have been

shown to be useful in preterm and term neonates in reducing pain from heel prick, venepuncture and subcutaneous injections.[4]

In recent times, sweet-tasting oral solutions like sucrose, glucose, fructose and lactose administered before painful procedures such as heel lancing and venepuncture have been found to have pain-relieving effects in infants.[5,6,7]. They are increasingly being recommended as a strategy for pain management.[3,8,9] However, there are limited studies comparing the relative efficacies of oral sweet solutions and other non-pharmacologic interventions. As glucose solutions are readily available in clinical settings, this study was planned to compare the analgesic efficacy of expressed breast milk to that of oral glucose for the relief of pain in newborns undergoing skin pricking procedures in the Pediatric Ward of RIMS, Imphal.

II. Aims And Objects

To compare the analgesic efficacy of expressed breast milk versus oral glucose for the relief of pain in newborns.

III. Material And Methods

The study, designed as a prospective, randomized clinical trial, was conducted in the Department of Pediatrics, RIMS, and Imphal during the period from November 2010 to April 2012 with the approval of the Institutional Ethics Committee. 150 selected newborns, divided in two groups of 75 each were randomly allocated to the oral glucose and expressed breast milk group, respectively.

Detailed information on socio-demographic profile, heart rate, crying time and behavioral changes were documented on a pre-designed proforma.

For the procedures, the babies were taken to a quiet pre-designated room and vitals before the skin pricking procedure were recorded. Then 2 ml of either glucose (10%) solution or expressed breast milk was given orally 1 min before the procedure. The blood sampling was then performed by one observer and while the procedure was being conducted, heart rate, crying time and the NIPS (Neonatal Infant Pain Scale) [10] scores were noted by another observer.

Statistical analysis was performed using SPSS software. For categorical (qualitative) data, frequency and percentage were calculated and χ^2- test was used for significance test, whilst for quantitative data, mean and standard deviation were calculated and independent sample t-test was applied. Besides, a higher technique viz., multiple logistic regression models was applied in order to assess its impact on the relief of pain in newborns. *P*-values < 0.05 and <0.001 were adopted as the cut off values for significant and highly significant interpretations respectively

Inclusion criteria: Neonates, undergoing routine skin prick procedures, e.g. Venepuncture, blood sampling etc. and given consent by parents and legal guardians.

Exclusion criteria : Neonates with less than 34 weeks gestation, weighing less than 1.5 kgs, cardio-respiratory compromise, sepsis, central nervous system depression and severe congenital malformations.

Assessment of pain:

The clinical assessment of pain will be done according to the Neonatal Infant Pain Scale, developed by the Children's Hospital of Eastern Ontario.[10] which is a behavioural assessment tool for the measurement of pain in term and preterm babies.

IV. Result And Observations

During the study period of 18 months, 150 babies were enrolled with a female to male ratio of 1:0.95 (expressed breast milk and oral glucose babies groups female to male ratios being 1: 0.79 and 1 : 1.14 respectively). No variation of religion composition was observed between the groups (*P* = 0.794), but Hindus were more in number which was followed by Muslims and least by Christians. Most of the babies are born at term in the study sample (94.7% and 89.3% for expressed breast milk and oral glucose groups respectively) and the pattern of gestation was almost similar in both the groups (*P* = 0.229)[Table -1]. Also there no significant differences post natal age, physical and anthropometric measurement between the studied groups.

Table - 1 Group-wise comparison of cases according to the socio-demographic profile

Parameters	**Group**					
	Expressed breast milk No (%)	**Oral glucose No (%)**	**Total No(%)**	**χ^2-value**	**d. f.**	***P*-value**
Sex						
Female	42(56.0)	35(46.7)	77(51.3)	1.308	1	0.253
Male	33(44.0)	40(53.3)	73(48.7)			
Religion						
Hindu	41(54.7)	39(52.0)	80(53.3)			

Muslim	24(32.0)	23(30.7)	47(31.3)	0.463	2	0.794
Christian	10(13.3)	13(17.3)	23(15.3)			
Gestation				1.449	1	0.229
Pre-term	4(5.33)	8(10.7)	12(8)			
Term	71(94.7)	67(89.3)	138(92)			
Total	75(100)	75(100)	150(100)			

χ^2-value: Chi square value; d.f.: degree of freedom; SD: standard deviation

The mean heart rate before blood sampling in the expressed breast milk group was 124.99 per min which was slightly less than the corresponding figure 126.69 per min for oral glucose group (P = 0.002). The heart rate increased after the skin pricking procedure in both the groups, but the difference in heart rate after blood sampling between the groups was not significant (P = 0.110) [Table-2].

Table -2 Group-wise comparison of Mean ± SD according to the Heart rate changes

Parameters	**Mean ± SD**		**t-value**	**d. f.**	***P*-value**
	Expressed breast milk (n = 75)	**Oral glucose(n = 75)**			
Heart rate before blood sampling (per minute)	124.99±3.17	126.69±3.44	3.156	148	0.002
Heart rate after blood sampling (per minute)	130.99±3.29	131.79±2.78	1.607	148	0.110

To assess the behavioral changes of the baby, two parameters viz., neonatal infant pain score (NIPS) and crying time (in seconds) were considered and as shown in Table -3, the NIPS score for expressed breast milk group was higher than that of oral glucose group (P < 0.001). Similarly, crying time for the former group's babies was significantly longer than crying time for the latter group's babies (P < 0.001).

Table - 3 Group-wise comparison of Mean ± SD according to the behavioral changes

Parameters	**Mean ± SD**		**t-value**	**d. f.**	***P*-value**
	Expressed breast milk (n = 75)	**Oral glucose (n = 75)**			
Neonatal infant pain score	4.77±.87	3.60±.94	7.877	148	<0.001
Crying time (sec)	9.48±1.55	6.40±.91	14.789	148	<0.001

In order to assess the analgesic efficacy of expressed breast milk over oral glucose for relief of pain while undergoing skin pricking procedures in newborns, multiple logistic regression model was applied and the changes were measured through odds ratio (OR) [Table – 4]. By oral glucose, newborns have 20.9% {(1-0 .791) x 100%} less chance of neonatal infant pain score than that with expressed breast milk. Nevertheless, oral glucose group have 1.5% more chance of having higher heart rate in comparison with the heart rate of those assigned to expressed breast milk group(OR = 1.015). The same pattern existed in case of crying time too. For instance, OR = 1.873 for crying time indicates the latter group has has 87.3% more chance of having longer duration of crying in comparison with the former group. The changing pattern for heart rate after blood sampling was not significant enough statistically but for Neonatal Infant Pain Score and crying time was very much significant (P = 0.001).

Table - 4 Group-wise comparison of analgesic efficacy

Parameters	**B**	**S. E.**	**d. f.**	***P*-value**	**OR**	**95.0% CI for OR**	
						Lower	**Upper**
Neonatal infant pain score	-0.234	0.344	1	0.496	0.791	0.403	1.553
Heart rate after blood sampling (per min)	0.015	0.066	1	0.818	1.015	0.893	1.154
Crying time (secs)	0.628	0.187	1	0.001	1.873	1.298	2.703

B: beta coefficient; S.E.: standard error; d.f.: degree of freedom; OR: odds ratio; CI: confidence interval.

V. Discussion

Withdrawing of blood in neonates for investigation is a common procedure during their stay in the hospital and these procedures are known to cause pain. Furthermore, neonates are more sensitive to nociceptive stimuli than older children or adults and repeated skin punctures affect their subsequent pain perception and their behavioral and autonomic pain reactions.[11, 12, 13, 14] it seems essential, therefore to find a simple and acceptable method for relieving pain. An ideal method or drug for reducing pain in neonates should be easy to use and well tolerated; method of administration should be atraumatic; should have a rapid onset of analgesic

effect and should have minimal side effects. Detection and qualification of pain in neonates is difficult. In this study, easily detectable parameters were used to assess pain while doing blood sampling in newborns. They were namely, duration of crying, change in heart rate, and facial expressions and postural changes as included in the Neonatal Infant Pain Scale (NIPS).[10]

Oral sugar solutions like glucose, sucrose, fructose, lactose have been shown to be effective for treatment of procedural pain in newborns[5, 9, 15] as well as breast feeding or expressed breast milk in neonates.[16] Oral glucose was chosen for this study as it was readily available. In this study, it was demonstrated that 2 ml of glucose(10%) solution given orally before venepuncture reduced NIPS scores and crying time better as compared to expressed breast milk.

The first parameter in this study was heart rate of the neonates, before and after blood sampling. The mean heart rate before blood sampling for the EBM group was 124.99 per min which was significantly less than the corresponding figure for oral glucose group -126.69 per min(P = 0.002). But, the heart rate rose after skin pricking procedures in both the groups, without any significant difference (P = 0.110). Deshmukh et al [(17)] and Ahn et al [(18)] also found no significant effect on heart rate, respiratory rate or oxygen saturation when evaluating different concentrations of glucose in preterm neonates and term neonates.

To assess the behavioral changes of the baby, two parameters viz., neonatal infant pain score (NIPS) and crying time were considered (Table – 3). Neonatal infant pain score for expressed breast milk group was higher than that for oral glucose group (P < 0.001). Similarly, crying time for the former group's babies was significantly longer than crying time for the latter group's babies (P < 0.001).

In a similar study conducted by Bueno *et a*l [(19)] to compare the efficacy of expressed breast milk versus glucose on pain responses of late preterm infants during heel lancing, lower incidence and shorter duration of crying was observed in the glucose group. They concluded that the results, derived from PIPP (Premature Infant Pain Profile) score and crying time, indicate better effects of glucose compared to expressed breast milk during heel lancing.

However, in contrast, Codipietro *L et al* [(20)] suggested that breastfeeding provided superior analgesia to oral sucrose in term neonates during heel lancing. They detected a 5-point difference in terms of PIPP median score (scale range: 0–18). Moreover, the heart rate increase and oxygen saturation decrease that normally accompanies this procedure were significantly lower (P = 0.005 and 0.001, respectively) in the breastfeeding group as compared with the sucrose group, and the outcomes regarding crying behavior were also better in the first group.

So based on the results which were obtained in this study and when compared with other similar studies, it was seen that both oral glucose and expressed breast milk were effective in reducing pain associated with skin pricking procedures but oral glucose was more effective and efficacious as an analgesic than expressed breast milk.

Pain in newborn should be recognized and treated. The prevention of pain in neonates should be the goal of all caregivers, because repeated painful exposures have the potential for deleterious consequences.[13,14] Although there are major gaps in our knowledge regarding the most effective way to prevent and relieve pain in neonates, every health care facility caring for neonates should implement an effective pain-prevention program, which includes strategies for routinely assessing pain, minimizing the number of painful procedures performed, effectively using pharmacologic and nonpharmacologic therapies for the prevention of pain associated with routine minor procedures.

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