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Evaluation comparative study of analgesic effect of breast feeding and dextrose of the heel lance in neonates

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Abstract
During short term painful procedures in neonates (heel lancing), non-pharmacological pain relieving interventions are effective, economical and safe as compared to pharmacological pain relieving interventions. Non- pharmacological procedures such as oral dextrose solution, nonnutritive sucking (NNS), swaddling, breast feeding, facilitated tucking and skinto-skin contact had been effectively used for amelioration of minor painful procedures in neonates. Hence based on above findings the present study was planned for Evaluation Comparative Study of Analgesic Effect of Breast Feeding and Dextrose of the Heel Lance in Neonates.
The present study was planned in Department of Pediatrics, Anugrah Narayan Magadh Medical College and Hospital, Gaya, Bihar, India. The study was conducted from the June 2018 to December 2018. In the present study 25 Neonates 0 to 28 days of age (with gestational age 34 weeks to 42 weeks) who are undergoing heel lance procedure for blood sugar estimation and those babies on exclusive or partial breast feed were enrolled.
The data generated from the present study concluded that none of the children in breast feeding group showed features of severe pain. Lesser mean score in breast feeding group signifies the importance of breast feeding during painful procedures as compared to dextrose. It is clear in our study that breast feeding more effectively reduces the pain among neonates in comparison to dextrose during heel lance.

Keywords: breast feeding, dextrose, analgesic effect, heel lance, etc

Introduction
Heel stick is a minimally invasive and easily accessible way of obtaining capillary blood samples for various laboratory tests, especially newborn screens and glucose levels. However, thanks to improved laboratory techniques that require smaller sample volumes and improved automated heel lancing devices that minimize trauma and pain [1], heel stick is a viable method of obtaining blood for many routine blood tests [2]. Heel stick sampling can also help preserve venous access for future intravenous (IV) lines.
Some evidence exists that in term neonates, skilled venipuncture may result in fewer total punctures and less pain than heel stick. A Cochrane review first published in 1999 and updated in 2011 suggests that it may in fact be the procedure of choice in this population [3]. However, these results may not be extrapolatable to preterm infants or infants who require multiple or frequent blood sampling [4]. In addition, the development of newer, more effective, and less painful lancing devices may increase the relative utility of heel stick. Heel stick should not be performed if any significant injury, infection, anomaly, or edema is present on the sampling area of the heel.
At present, coagulation studies may not be performed with capillary samples. Blood tests that require relatively larger sample volumes may not be feasible with heel stick samples. Blood cultures require perfectly sterile technique and, therefore, may not be done with samples obtained via heel stick. Certain other sophisticated tests may also not be performed on heel stick samples (eg, chromosomal analyses and certain immunoglobulins and titers).
When ordering a laboratory test that is sent to another facility or is out of the ordinary, check with the laboratory to determine which type of blood sample is required. Standard local or systemic pharmacologic anesthesia is not required for heel stick sampling. Local anesthetics may interfere with the quality of the blood sample. Anesthesia for heel stick in infants can involve oral sucrose, ambient light and noise reduction, and swaddling. Sucrose has been shown to have a substantial anesthetic effect in multiple trials, though an optimal dose has not been definitively established. It may be administered with a dropper, a needleless syringe, or a pacifier dipped in a dose of approximately 0.1-1 mL. Swaddling, bringing the infant's hands to the midline, and minimizing environmental stimulation has also been shown to have an effect on how infants tolerate this painful procedure [5].
Immunization is a process of protecting an individual from a disease through the introduction of live, killed or attenuated organisms in the individual system. Immunization is an important part of health promotion and disease prevention strategy for all children. It is a mass means of protecting the largest number of people from various diseases [6].
One of the most dramatic advances in paediatrics has been the decline of infectious diseases because of the widespread use of immunization for preventable diseases. Children continue to be subjected to pain and distress during immunization, despite recent advances in the assessment and management of acute pediatric pain. Reports from children, parents and nurses consistently indicate that many children do indeed fear the “shot.” This finding is also supported by research indicating that a minority of the adult population also suffer from fear involving needles [7].

Healthy newborns routinely experience acute pain during blood sampling for metabolic screening, injection of vitamin K or hepatitis vaccine and circumcision. Children are similarly exposed to acute pain due to vaccination, invasive procedures or trauma. Acute pain caused by skin-breaking procedures can lead to physiologic instability and behavioral distress, and it has downstream effects on subsequent pain processing, development and stress responsivity. Because of these detrimental effects of injections reduction or prevention of pain is worthy clinical goal, which is also expected by most parents [8].

The International Association for the Study of pain has defined pain as "an unpleasant sensory and emotional experience connected with actual or potential tissue damage or described in terms of such damage". The myth regarding neonatal pain suggests that because of neurological immaturity, neonates do not experience pain. Studies have shown that pain pathways as well as cortical and subcortical centers, necessary for pain perception are well developed late in gestation and physiological and behavioral responses to pain are well documented in neonates [9].

The response of children to an injection depends in part on their developmental ages, cognitive processes and their previous experiences with "shots". A child's anxiety and fear of a procedure and actual pain experience during the procedure often are manifested by the child's distress behavior such as crying, flailing and refusal to cooperate. The child's distress is upsetting not only for the child but also for the adults involved, both parents and professionals, and it often makes more difficult to complete the needed procedure. A neonate reacts in a diffuse way by crying and making generalized body movements. During infancy reflexive behavior is dominant. Between 3 and 10 months of age, they are able to localize pain as they withdraw their limbs, or hiccough or cry. These older infants react intensively with physical resistance and uncooperativeness. During the second half of the first year, the infant begins to cry when the nurse approaches with a syringe and needle. The toddlers know what is going to happen when they see the needle and syringe and squirm to get away. Preschool children can have limited ability to understand anything beyond the immediate event. They may try to delay until they feel some control over the situation. School age children may try to be brave when experiencing pain and they use self-initiated coping strategies [10].

The relief of pain is felt to be a cardinal principle of compassionate medicine, yet in practice, pain management is often an ignored aspect of care. Though this unfortunate state has improved somewhat for older children and adults, yet young infants continue to receive limited attention and are treated far less vigorously than older children and adults.4 In addition to pain and distress, lack of pain control for injection is a barrier to immunization. Many physicians withhold scheduled vaccines out of concern for the excessive pain for simultaneous immunization. The pain associated with immunization is a source of anxiety and distress for the children receiving immunizations, their parents and the providers who must administer them [11].

Health care professionals should anticipate predictable painful experiences and monitor the condition of patients accordingly. To treat pain adequately, ongoing assessment of the presence and severity of pain and the child's response to treatment is essential. Reliable, valid, and clinically sensitive assessment tools are available for neonates through adolescents. Pain can be assessed using self-report, behavioral observation, or physiologic measures, depending on the age of the child and his or her communication capabilities. Specific measures vary in their validity and usefulness. Accurate acute pain assessment requires consideration of the plasticity and complexity of children's pain perception, the influence of psychological and developmental factors, and the appreciation of the potential severity and specific types of pain experienced [12].

Treating procedural pain has become a crucial part of neonatal care. In healthy infants, the most common painful procedures are heel lance and venipuncture. Pharmacological treatments are rarely used during these procedures because of concerns about their effectiveness and potential adverse effects. Therefore, non-pharmacological interventions are valuable alternatives.4 several therapeutic and preventive strategies, including systemic and local pharmacological and non-pharmacological interventions, are reported to be effective in relieving pain in infants. A judicious application of these interventions, backed by awareness and sensitivity to pain perception, on the part of the caregivers is likely to yield the best results [13].

During short term painful procedures in neonates (heel lancing), non-pharmacological pain relieving interventions are effective, economical and safe as compared to pharmacological pain relieving interventions. Non-pharmacological procedures such as oral dextrose solution, nonnutritive sucking (NNS), swaddling, breast feeding, facilitated tucking and skinto-skin contact had been effectively used for amelioration of minor painful procedures in neonates [14]. Hence based on above findings the present study was planned for Evaluation Comparative Study of Analgesic Effect of Breast Feeding and Dextrose of the Heel Lance in Neonates.

Methodology

The present study was planned in Department of Pediatrics, Anugrah Narayan Magadh Medical College and Hospital, Gaya, Bihar, India. The study was conducted from the June 2018 to Dec 2018. In the present study 25 Neonates 0 to 28 days of age (with gestational age 34 weeks to 42 weeks) who are undergoing heel lance procedure for blood sugar estimation and those babies on exclusive or partial breast feed were enrolled.

All the patients were informed consents. The aim and the objective of the present study were conveyed to them. Approval of the institutional ethical committee was taken prior to conduct of this study.

Following was the inclusion and exclusion criteria for the present study.

Inclusion criteria: Neonates 0 to 28 days of age (with gestational age 34 weeks to 42 weeks) who are undergoing heel lance procedure for blood sugar estimation and those babies on exclusive or partial breast feed. Gestational age was estimated by New Ballard's Score.

Exclusion criteria: Sick neonates who are hemodynamically or on oxygen, With neurological abnormalities, or facial palsy, Babies at high risk for necrotizing enterocolitis, Babies with severe birth asphyxia (i.e. Apgar score of 3 or less than 3 at 1 minute), Babies who are nil per oral, Babies with congenital heart disease, Babies with intestinal obstruction or, feed intolerance, Babies with major congenital defects such as cleft lip, tracheal oesophageal

fistula cleft palate or oesophageal atresia, Babies on pharmacological sedated or on other pain medications Research variables.

Results & Discussion

Many newborn babies undergo painful procedures like heel pricks, venepuncture and intramuscular injection for immunization. Such procedures inflict distinct physiological, behavioral, hormonal and metabolic changes. Grunau and Craig have shown that first cry following pain is most sensitive to noxious stimuli. Great emphasis is being laid in minimizing pain during these minor procedures in neonates. Duration of cry has been widely used in various studies as a marker of severity of pain [15]. Dextrose and sucrose in varying concentration have been shown to relieve pain during venepuncture or intramuscular injection [16]. Evidence is emerging that breastfeed/breastmilk has analgesic properties [17].

Ranger, *et al*. [18] suggested that repetitive skin prick procedures in neonates is associated with thinner cortical gray matter during their childhood period. Further research in this matter lead to conclusion that repetitive painful procedures in neonates results in poor cognitive and motor function during their forthcoming development & also sub-optimal behaviors during their later life [19].

Table 1: Demographic Detail

Profile	No. of Cases
Age	1 – 15 days
Sex	
Male	16
Females	9
Birth Weight: gm	1610 – 3470
Analgesic Groups	
Dextrose:	13
Breast Feeding	12
PIPP Score:	3 - 13

Table 2: Pain level

Pain Level	No. of Cases	Dextrose	Breast Feeding
Minimal or no pain	13	4	9
Mild to moderate pain	11	8	3
Moderate to severe pain	1	1	0
Total	25	13	12

Codi Pietro *et al*, [20] in their study of breastfeeding or oral sucrose solution in term neonates receiving heel lance reported that the median difference of PIPP score was 5.0 among the two groups. But Gradin *et al*, [21] during their comparison of analgesic effect of breastfeeding versus glucose alone, 94.8% babies had minimal to moderate pain, with 3(5.3%) having severe pain. But 44(89.8%) babies having no or minimal pain were spotted in breast feeding group, 10.2% suffered from mild to moderate pain. None of the babies in breast feeding group showed symptoms of severe pain.

Gradin *et al*. [21], in their study found that the PIPP score (median) was 7, which is lower in breastfed/glucose group than during breastfeeding alone with mean PIPP score of 10. There was a similar difference between the PIPP scores in the glucose fed group was 9 in comparison to the control groups where PIPP score was 11.

Uga, *et al*. have evaluated analgesic effect of breastfeeding during heel puncture in newborn [13]. Others have demonstrated analgesic effects of skin-toskin contact in procedural pain in healthy term neonates [22, 23]. Efe and Ozer hypothesized that following mechanisms could be attenuating the pain response while direct breastfeeding the baby during the painful procedure [24]. Firstly, suckling at the breast stimulates the infant's oropharyngeal tactile and mechanoreceptor and focuses attention on the mouth, reducing outside influences. Secondly, the sweet flavour of milk stimulates the release of opioids in midbrain of infant which act on receptor that decrease the perception of pain. Thirdly, breastfeeding involves maternal skin to skin contact which stabilizes blood glucose level, body temperature and respiratory rate and reduces release of stress hormone [25]. Finally, breastfeeding involves intimate social interaction between mother and child and may release antistress hormone, oxytocin [26]. The mechanism of relaxation and analgesia probable works synergistically [27, 28] during breastfeeding, only half of face is visible but facial scores can be interpreted due to symmetry of facial response.

Previous studies have demonstrated pain relief with dextrose in varying concentrations, but no other previous study has directly compared analgesic effect of breastfeeding and dextrose. Skogsdal, *et al*. [29] reported reduction in crying time by 75% in babies receiving 30% glucose compared to no treatment group and the effect was lesser with 10% glucose. Ramenghi, *et al*. [30] found hydrogenated glucose solution as effective as 25% or 50% sucrose in reducing crying time and duration of first cry. A recent Cochrane review has also concluded that if available, breastfeeding or breastmilk should be used to alleviate procedural pain in neonates undergoing a single painful procedure compared to placebo, positioning or no intervention.

A study was conducted to evaluate the pain in healthy newborns requiring blood test by a heel-prick procedure, and different pain management methods. 150 term infants were divided into three randomized groups. The first group received no specific analgesic intervention during blood tests, except usual nursing intervention ("facilitated tucking"). The second and third groups received non-nutritive sucking-placebo and non-nutritive sucking-24% sucrose respectively. The results showed that a proper nursing method, along with a complement of non-nutritive sucking during extraction, significantly decreased the discomfort and crying, it being unnecessary to consider other analgesics.

A study was conducted to investigate the effectiveness of breast-feeding in reducing pain in newborns undergoing heel prick tests. One hundred thirty healthy term infants were randomly allocated to 4 groups, each of 25% sucrose, breast milk, sterile water, and breast-feeding. The median values of crying and recovery time and percent change in heart rate at 1, 2, and 3 minutes were recorded. A behavioral pain scale was applied according to the infant body coding system. The median crying time, duration of recovery time and the percent change in heart rate at 1, 2, and 3 minutes favored the sucrose group. When they compared the groups, the significance remained for the sucrose versus breast milk and water groups for the recovery time and sucrose versus all other groups for the percent change in heart rate at 3 minutes. The infant body coding system showed that babies in the sucrose group had significantly lower scores followed by the breast-fed and breast milk groups. This study revealed that 25% sucrose is superior to breast-feeding in pain relief, which is reflected mainly in crying time and

behavioral variables [31].

A research was conducted to assess the analgesic effect of administration of oral glucose in various concentrations, and to compare with the analgesic effects of breast milk, in neonates undergoing heel punctures during collection of blood for investigations. Neonates divided into 5 groups of 25 each. One group comprised control subjects and was administered sterile water. 3 groups were administered 1 ml of varying strengths of glucose solutions i.e. 10%, 25% and 50% respectively. The last group was given 1 ml of expressed breast milk (EBM). Other parameters like state of arousal, cry baseline heart rate (HR) and transcutaneous oxygen saturation (SpO2) were recorded. Equal strength of painful stimulus given in each procedure. The oral solution was administered before 2 minutes, taking all aseptic precautions Compared to control group, all other administered solutions (10%,25%, 50% glucose and EBM) were found to reduce physiological and behavioral responses in neonates undergoing heel punctures.25% and 50% glucose solutions were found to have maximal analgesic effect and both were found to be equally effective. EBM and10% glucose solution has an equal analgesic effect but less than 25% or 50% glucose [32].

A research was conducted to study how the interventions of pain relief changed over a 6-year period in New Zealand neonatal units. The study reveled that many commonly performed procedures were painful and the number of units using analgesia rose markedly over the same period. The studies showed that, a simple, cheap and effective intervention-oral sucrose-gained more popularity and was used routinely in New Zealand neonatal units [33].

A comparative study was conducted to compare the breastfeeding and breast milk with control (placebo, no treatment, sucrose, glucose, pacifiers, or positioning) for procedural pain in neonates. Marked heterogeneity in control intervention and pain assessment measures was noted. The breastfeeding group had significantly less increase in the heart rate, reduced proportion of crying time and reduced duration of crying compared to the swaddled or pacifier group. PIPP scores were lower in the breastfeeding group when compared to the placebo and the group positioned in mother's arms, but was not different compared to the no-treatment and the glucose groups. Neonates in the supplemental breast milk group had a significantly less increase in the heart rate and Neonatal Facial Coding Score but no significant difference in the duration of crying time and oxygen saturation change compared to the placebo. The inference of the study was, breastfeeding or breast milk is an effective way to alleviate pain in neonates undergoing painful procedure compared to placebo, positioning, or no intervention [34].

Conclusion

The data generated from the present study concluded that none of the children in breast feeding group showed features of severe pain. Lesser mean score in breast feeding group signifies the importance of breast feeding during painful procedures as compared to dextrose. It is clear in our study that breast feeding more effectively reduces the pain among neonates in comparison to dextrose during heel lance.

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