

The effectiveness of sucrose analgesia for procedural pain in term neonates

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Abstract

Treating pain in the newborn is essential for many reasons: pain can be harmful due to decreased oxygenation, hemodynamic instability, and increased intracranial pressure. The International Evidence-Based Group for Neonatal Pain recommends that the combination of a variety of pharmacological and behavioral interventions during painful procedures has synergistic effects. Data were collected during heel lance and venipuncture performed as part of routine clinical care for the estimation of glucose and bilirubin, thyroid function tests respectively. The infants in the control group (n=64) received 10% dextrose. In the experimental group, 24% sucrose solution was used. When compared to 10% dextrose, no. of babies who received sucrose and fall into NIPS score <4 category at 1 min and 3 min during the procedure were more. Hence 24% sucrose has better analgesic effect than 10% dextrose. However statistically when Fischer exact test was applied between the groups there were no significant differences between 24% sucrose and 10% dextrose.

Keywords: Sucrose, analgesia, term neonates

Introduction

It is the basic right of every individual, irrespective of age or size, to have alleviation of pain. Pain in newborn infants is a universal phenomenon. Neonates in the hospital setting are routinely subjected to painful procedures from very early in their lives. All neonates will experience iatrogenic pain in the first days of life, beginning with vitamin K injection and blood collection for sugars, bilirubin or lately metabolic screening before discharge from the hospital. Recognition that both premature and full-term infants experience pain¹ has led to increasing appreciation of the prevalent problem of under-treatment of stress and pain of

infants hospitalized in the newborn intensive care unit. Both humanitarian considerations and scientific principles favor improved management strategies to prevent pain and stress whenever possible and when discomfort is unavoidable, to provide prompt and appropriate treatment. Neonates admitted to present day neonatal intensive care units (NICU) are constantly exposed to pain, discomfort or noxious stimuli of variable intensities for many reasons. These include major and minor surgical procedures, needle pricks for blood drawing and insertion of IV cannulas. The experience of pain is always subjective. Hence, verbalization of nociceptive sensation is the gold standard for assessment of pain^[2]. Since neonates cannot express their pain, the recognition and management of pain in newborn babies is still suboptimal in NICUs. Studies have documented that babies born at less than 32 weeks of gestation are exposed to 10-15 painful procedures each day during the first few weeks of life and in almost 80% no treatment for pain relief is offered^[3].

The painful situation may be short lived or chronic as in the case of necrotizing enterocolitis and prolonged mechanical ventilation. Even apparently innocuous care providing procedures like diaper changes, daily weighing and removing adhesive tape results in noxious stimuli. All these events, especially in preterm infants individually or cumulatively, result in adverse sequelae in the form of poor neurologic outcomes, abnormal somatization and response to pain later in life. Both humanitarian considerations and scientific principles favor improved management strategies to prevent pain and stress whenever possible and when discomfort is unavoidable, to provide prompt and appropriate treatment^[3, 4].

Treating pain in the newborn is essential for many reasons: pain can be harmful due to decreased oxygenation, hemodynamic instability and increased intracranial pressure^[4]. The International Evidence-Based Group for Neonatal Pain recommends that the combination of a variety of pharmacological and behavioral interventions during painful procedures has synergistic effects^[5]. Recent studies have shown that the combination of oral sucrose and a pacifier was the most clinically safe and effective method for the management of painful procedures in neonates. The salivary cortisol level is a reasonable reflection of the hypothalamic-pituitary-adrenal axis function. Salivary cortisol has been measured in infants subjected to major stressful situations, such as painful procedures, making it a useful alternative to blood sampling. However, other studies did not demonstrate the effects of oral sucrose on salivary cortisol changes during painful procedures in newborn infants^[5]. So, more explanative studies concerning the effects of sucrose on newborn infants by identifying salivary cortisol changes are needed. Little is known about the effects of oral sucrose on the overall physiological and behavioral stability of newborns during painful procedures, although infant pain is a multidimensional phenomenon. In the current study, we compared pre and post-test stress response between a routine procedure with placebo and orally administered sucrose solution by observing physiological (heart rate, oxygen saturation, and salivary cortisol) and behavioral (NIPS score and total cry time) changes^[6].

Methodology

Study design: A double blinded randomized controlled trial.

Target population: Term neonates who were admitted in postnatal ward under Neonatology division.

Sample size: 64 controls and 64 test samples, a total of 128.

Sampling method: Random sampling method using computer generated random numbers.

Inclusion criteria

1. Term neonates (gestational age > 37 weeks).
2. Clinically stable and requiring investigations for clinical evaluation.

Exclusion criteria

1. Neonates with gross congenital malformations and neurological symptoms.
2. Neonates delivered under maternal general anesthesia within last 48 hours.
3. Neonates receiving analgesics or sedatives.
4. Neonates who were asphyxiated or depressed at birth.
5. Neonates with transient metabolic problems like hypoglycemia or hypocalcemia.
6. Inadequate salivary sample collection.

Sample size calculation: The sample size was calculated for each arm with 5 percent level of significance and 80 percent power for an effect size of 0.5 and the value was 63 for each arm. For the sake of uniformity in all the four sub groups a total of 128 samples were taken with 64 in each arm.

Subjects were assessed for eligibility and informed consent from the parents was obtained in 128 term neonates. A total of 128 neonates (control group n=64; experimental group n=64) were evaluated. All neonates were healthy and had no congenital malformations.

Data collection: Physiological and behavioral pain indicators were examined to maximize the validity of pain assessment in newborn infants. Data were collected during heel lance and venipuncture performed as part of routine clinical care for the estimation of glucose and bilirubin, thyroid function tests respectively. The infants in the control group (n=64) received 10% dextrose. In the experimental group, 24% sucrose solution was used.

Results and Discussion

Table 1: Demographic Characteristics

Variable	10% Dextrose (n=64)	24% Sucrose (n=64)	p value*
Gender (male/female)	32/32	33/31	0.860
Birth weight (gm)	2955 ± 435	2826 ± 514	0.213
Gestational age (weeks)	38.2 ± 1.0	38.1 ± 1.0	0.732
Postnatal age (hours)	69.0 ± 46.5	68.4 ± 38.5	0.105
Mode of delivery (VD/LSCS)	17/47	23/41	0.253
Apgar score at 5 min	9	9	

Data are expressed as number or mean ± SD (standard deviation)

*p value corresponds to results of independent t-test for continuous data and χ^2 test for categorical data.

The experimental group and the control group did not differ significantly in any of the demographic variables.

Table 2: Comparison of NIPS score at 1 min and 3 min after procedure between the groups

Procedure	Solution received	NIPS att=1 min Median (Q1,Q3)	*p value	NIPS att=3min Median (Q1,Q3)	*p value
Heel lance (n=64)	10% Dextrose (n=32)	7(3,7)	0.814	0(0,3.7)	0.059
	24% Sucrose (n=32)	7(2,7)		0(0,0)	
Venipuncture (n=64)	10% Dextrose (n=32)	7(5,7)	0.102	6(0,7)	0.190
	24% Sucrose (n=32)	7(2,7)		1(0,7)	

*p value corresponds to Mann-Whitney U test.

Heel lance: There were no significant differences for NIPS scores at 1 min and 3 min between 24% sucrose and 10% dextrose groups.

In Studies by *kyonget al.*^[56], *Overgaard et al.*^[87] and *Yilmaz et al.*^[93] there was significant reduction in NIPS scores for sucrose group when compared to the control group.

Venipuncture: The median NIPS scores at 1 min in both the groups were comparable where as there was much difference in median NIPS score at 3 min, for 10% dextrose group it was 6, opposed to 24% sucrose group which was 1. This indicates that 24% sucrose is effective in decreasing the pain at 3 minutes after the procedure. However, there was no statistically significant difference between the groups. There were no studies reported using NIPS score for venipuncture.

Table 3: Comparison of the no. of neonates with NIPS score <4 at 1 minute and 3 minutes after the procedure between 10% Dextrose and 24% Sucrose groups

Procedure	NIPS score <4 at t=1min		*p value	NIPS score <4 at t=3min		*p value
	10% Dextrose (n=32)	24% Sucrose (n=32)		10% Dextrose (n=32)	24% Sucrose (n=32)	
Heel lance (n=32)	9	12	0.595	24	28	0.337
Venipuncture (n=32)	5	12	0.088	14	21	0.131

*p value corresponds to Fischer Exact test.

When compared to 10% dextrose, no. of babies who received sucrose and fall into NIPS score <4 category at 1 min and 3 min during the procedure were more. Hence 24% sucrose has better analgesic effect than 10% dextrose. However statistically when Fischer exact test was applied between the groups there were no significant differences between 24% sucrose and 10% dextrose^[10].

Conclusion

- 24% Sucrose reduced pain to a considerable level (NIPS <4) in 37.5% neonates at 1 min and 87.5% neonates at 3 min when compared to 10% dextrose which reduced only 28.1% and 75% respectively for heel lance.
- 24% Sucrose reduced pain to a considerable level (NIPS <4) in 37.5% neonates at 1 min and 65.6% neonates at 3 min when compared to 10% dextrose which reduced only 15.6% and 43.8% respectively for venipuncture.
- Hence, we can conclude that clinically 24% sucrose is a better analgesic than 10% dextrose for procedural pain in term neonates.

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