ANALGESIC EFFECT OF SUCROSE OBSERVED DURING HEEL PRICK IN HEALTHY NEONATES

Shoaib Ali Khan, Mohammad Afzal*, Lutfullah Jillani, Mehboob Sultan, Mudassar Hussain

Combined Military Hospital Multan, Combined Military Hospital Rawalpindi*

ABSTRACT

Objective: To assess pain response during heel prick and compare analgesic effect of oral sucrose with placebo in response to pain associated with this procedure in healthy neonates.

Study Design: Randamoized controlled study

Place and Duration of Study: Neonatal Unit Combined Military Hospital Multan from December 2006 to June 2007.

Material and Methods: This study was conducted on 60 healthy full term neonates with postnatal age 1-7 days who were assessed for pain response after heel prick. They were randomized into two groups. Newborns in group A were given 2ml 25% sucrose solution and group B neonates received 2ml sterile water as placebo 2 minutes before heel prick procedure. Pain was assessed by Premature Infant Pain Profile (PIPP) score and total duration of first cry.

Results: Increase in heart rate and decrease in oxygen saturation along with behavioral changes were observed in significant number of newborns who received placebo (group B). While significant reduction in PIPP score and total duration of first cry was noted in neonates who were given oral sucrose (group A.)

Conclusion: Perception of pain decreased significantly with oral sucrose. Sucrose can be used as safe and effective analgesic for minor procedure related pain.

Keywords: Pain, Sucrose, heel prick.

INTRODUCTION

To provide relief from pain is one of major objectives of medical science, yet in practice, pain management is often an ignored aspect. This is especially true in pediatric population and more so in neonates, which may in part be due to myth that neonates do not feel pain because of neurological immaturity. However studies have documented well developed physiological and behavioral responses to painful stimuli in neonates [1].

Infants, including newborn babies, experience pain similarly and probably more intensely than older children and adults. They are also at risk of adverse long term effects on behavior and development including reaction to pain [2, 3]. However, the issue of analgesia in young babies has been largely neglected in most clinical settings [4], despite subjecting them to painful diagnostic and therapeutic procedures.

Pain is associated with physiological, biochemical, behavioral, and psychological alterations that can be recorded and to some extent, quantified. These physiological parameters can be assessed by alteration in heart rate and oxygen saturation. These measurements coupled with certain consistent behavioral responses like facial expression of the baby is considered the most reliable and consistent indicators. For this, various pain assessment scales have been devised with combined physiological and behavioral scoring systems like Premature Infant Pain Profile (PIPP) [5] validated for newborn term infants as well and this pain scoring system has been used in this study.

Despite compelling medical evidence of neonatal pain during venepuncture, heel prick test and other procedures, medical and paramedical staff involved in neonatal care

Correspondence: Col Mohammad Afzal, Classified Child Specialist, Combined Military Hospital Rawalpindi

Received: 23 Dec 2008: Accepted 12 June 2009

usually ignore pain during these procedures. There are wide variety of pharmacological and non pharmacological interventions for pain management in neonates. Pharmacological agents are usually avoided in neonates because of possible adverse effects they can produce.

Non pharmacological intervention is a more feasible and practical alternative. Non Pharmacological interventions ranging from cuddling, vocal stimulation, non-nutritive sucking, breast feeding and feeding of sweet compounds such as sucrose, glucose and saccharine are commonly used for local procedures. General tendency among those caring for young babies is to treat pain after it has been inflicted. However, prevention being better than the cure, it is desirable that perception of pain be anticipated and appropriate measures instituted before painful procedure. Oral Sucrose solution (table sugar) is being currently recommended as an effective analgesic which acts by raising the pain threshold, presumably mediated by endogenous opioids [6].

The purported significance of this study is to highlight perception of pain by neonates during heel prick and develop pain management plan for them. Sucrose or table sugar is cheap, easy to prepare, commonly available and easy to administer .Our objective was to assess neonatal pain perception and compare analgesic effect of oral sucrose with placebo in response to heel prick.

MATERIALS AND METHODS

This study was conducted in Neonatal unit of Combined Military Hospital Multan over a period of six months from December 2006 to June 2007. Study was conducted on 60 full term healthy neonates delivered in hospital.

Inclusion and Exclusion Criteria

1. Admitted in Neonatal unit and Post natal ward for observation following elective lower segment cesarean section(LSCS)
2. Infants of diabetic mothers (IDM) kept under observation for monitoring of blood glucose
3. Newborns from post natal ward who underwent heel prick for estimation of serum Bilirubin and glucose following minor complaints of lethargy, jaundice, poorfeeding. Babies with history of birth asphyxia, convulsions, cyanosis, tachypnea and refusal to feed were excluded from study. All selected newborns cried spontaneously on birth, did not require resuscitation and had good APGAR scores.
4. Newborns were randomly distributed into two groups, each comprising of 30 cases. Those assigned to group A were given 2 ml of 25 % sucrose solution over 30 seconds with the help of a syringe allowing infant to suck on solution. Sucrose solution was made by adding 25 gm of table sugar in 100ml of sterile water available commercially for injection use. Group B assigned as placebo group was given 2 ml of sterile water available commercially for injection use. Their behavioral state according to PIPP scale was recorded. The probe of Pulse oxymeter Bitmos Sat801 was applied on the thumb and baseline heart rate and transcutaneous oxygen saturation recorded.

Heel pricks were carried out in all the newborns with mechanical lancet after at least 2 minutes of feeding the oral sucrose or placebo solution. Care was taken to control the depth of prick to be uniform and the heel was squeezed for two seconds in all the cases. Response to painful stimulus was assessed according to PIPP scale, comprising of change

in facial expression (brow bulge, eye squeeze and nasolabial furrow), increase in heart rate and drop in oxygen saturation noted at the end of one minute. Total duration of cry was recorded from the time of the first cry till the infant became quiet. Any subsequent cries occurring after that time were not recorded. Total duration of first cry was recorded in seconds. Total pain score was calculated and recorded according to PIPP scale.

All the data collected was entered in computer SPSS version 10.0. The measure for central dispersion that is mean and standard deviation for variables of interest like PIPP score and total duration of first cry between two study groups in response to heel prick was calculated and analyzed by applying t-test for significance.

RESULTS

Total 60 selected newborns fulfilling the inclusion criteria were divided in two equal groups to check response on heel prick test. Mean age was 1.47 days ranging from minimum age of 1 day to maximum of 7 days (standard deviation + 0.96). 52% were males (n=31) and 48% females (n=29). Mean weight was 3.18 kg ranging from2.9 kg to4.0 kg (standard deviation + 0.28). 40% cases were referred following elective LSCS (n=24) while 14% were IDM babies (n=8) and rest 46% were under observation following normal delivery (n=28).

As shown in (Figure) babies in group B showed greater rise in heart rate as compared to group A after heel prick. Another variable monitored was decrease in oxygen saturation in response to heel prick at the end of one minute. It showed that in group B even though there was no substantial decrease in oxygen saturation in response to heel prick but it was significant when compared to group A (Table).

Another variable of comparison was PIPP score. In group A mean PIPP score was 4.47 ranging from minimum of 2 to maximum of 10 (SD + 1.94). While in group B mean PIPP score was 10.37 ranging from minimum of 4 to highest of 14 (SD + 2.91).This shows that newborns receiving sucrose had considerably lower PIPP score.

Table: Oxygen saturation decrease following heel prick (N=30)

Group A			Group B		
Decrease in Oxygen Saturation	**No (n)**	**Percent (%)**	**Decrease in Oxygen Saturation**	**No(n)**	**Percent (%)**
0 – 2.4%	29	96.7	0 - 2.4%	19	63.3
2.5 - 4.9%	1	3.3	2.5 - 4.9%	10	33.3
5 - 7.4%	0	0	5 - 7.4%	1	3.3
> 7.4%	0	0	> 7.4%	0	0
Total	**30**	**100**	**Total**	**30**	**100**

Fourth variable was total duration of first cry. In group A, mean of total duration of first cry was 18.13 seconds with minimum duration of 10 seconds to maximum of 50 seconds (SD+ 10.97). While in group B the mean of total duration of first cry was 41.00 secs, minimum being 15 seconds to maximum of 65 seconds (SD+12.48). This revealed that duration of cry was considerably less in newborns who received sucrose before heel prick.

The t-test was applied to know the significance in difference of PIPP score and total duration of first cry between two groups which showed effect of sucrose significant ($p < 0.01$).

DISCUSSION

Newborns are subjected to minor painful procedures right since birth which may be in the form of venepuncture, heelpricks, vaccination etc to more painful procedures like circumcision. They are routinely subjected to these painful procedures without any consideration of analgesia. The consequences of these procedural pain are well documented in literature but still the practice of pre-emptive analgesia is non-existent by and large globally and especially

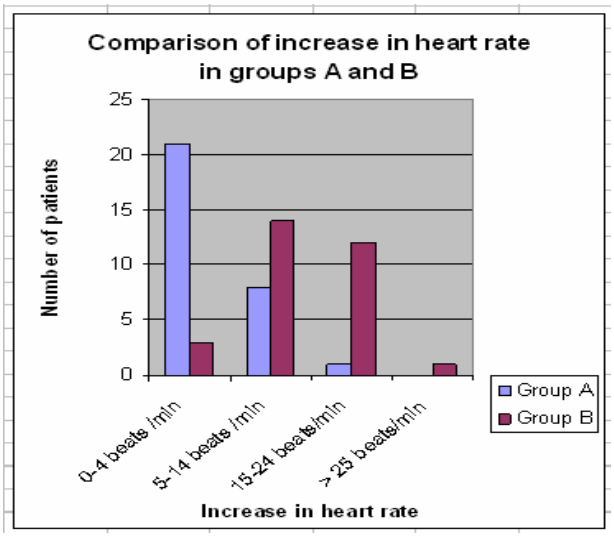

Figure: Comparison of increase in heart rate in Groups A & B.

in our country [7]. Neonates who require intensive care are more vulnerable to persistent and repeated painful procedures and may experience 5 to 15 invasive, painful procedures in a day [8]. Babies who are very sick, undergoing major surgery or being mechanically ventilated may receive analgesia but the babies who are otherwise considered healthy undergo minor procedural pain without any analgesia. The results of this study may help in addressing this issue by formulating local guidelines for analgesia related to procedural pain.

Key to manage procedure-related pain and distress is anticipation. Sucrose or table sugar administration is the most widely studied non pharmacologic intervention for infant pain management. Sucrose is easily available, cheap, easy to administer with no reported side effects after use as analgesic for procedural pain.

Sucrose has been used since ancient times and its analgesic effect is highlighted by the fact that practicing muslims all over the world rub pieces of chewed dates inside mouth of newborn babies before circumcision in following of the sacred SUNNAH of last Prophet Muhammad (PBUH) who did this many times to newborn children undergoing circumcision [9]. By following this SUNNAH muslims are also supporting medical wisdom of giving dates (which are 70-80% sugar in the form of glucose and fructose). Oral sucrose used alone is appropriate only for minor procedure pain of very short duration (2 to 3 min), such as heel prick and venipuncture related pain in infants [10].

In our study to minimize the bias, considerable care was taken to control environmental conditions as all the babies were kept in cot, fully clothed, with minimum handling before the heel prick. All the babies had no oral feed at least one hour before heel prick. Assessment of behavioral state and pain was done mainly by PIPP score and total duration of first cry at the end of one minute. The t- test applied to show the level of significance of this difference between two groups revealed that sucrose had significant effect on PIPP score and total duration of first cry over placebo ($p < 0.01$). This supports the hypothesis that perception of pain in neonates decreases significantly with sucrose.

Results of our study are comparable with that of Gibbins [11] which showed that oral sucrose significantly reduced pain scores and by Haouari [10] and Bilqen [12] and their colleagues which showed that sucrose significantly reduced crying time. It has also been validated from various clinical trials that

analgesic effect is more pronounced with concentrated sucrose solutions, effect becoming noticeable with 25% sucrose solution (the strength used in this study) [10, 13]. So the results of our study are consistent with various international studies.

The practice of analgesia in Neonatal units has long been ignored especially procedure related pain has not been acknowledged, as there is no data on local studies conducted on neonatal analgesia. This reflects the need to develop institutional guidelines relating to procedure related analgesia and their implementation in Neonatal units.

CONCLUSION

Pain in newborn is a reality, especially procedure related pain as evidenced by behavioral and physiological parameters. Oral sucrose administered before procedure related pain has significant analgesic effect as compared to placebo in newborns.

REFERENCES

1. Rushforth JA, Levene MI. Behavioral response to pain in healthy neonates. Arch Dis Child1994; 70: 174-6.
2. Larsson BA .Pain and pain relief during neonatal period. Early pain experience can result in negative late-effects. Lakartidningen 2001; 98: 1656-62.
3. Taddio A, Katz J, llersich AL, Koren G .Effect of neonatal circumcision on pain response during subsequent routine vaccination. Lancet 1997; 349: 599-603 .
4. Gray PH, Trotter JA, Langbridge P, Doherty CV. Pain relief for neonates in Australian hospitals: a need to improve evidence-based practice. J Paediatr Child Health 2006; 42: 10-3 .
5. Steven B, Johnston C, Petryshen P, Taddio A. Premature Infant Pain Profile: Development and initial evaluation. Clinical Journal of Pain1996; 12: 13-22.
6. Thompson DG. Utilizing an oral sucrose solution to minimize neonatal pain. J Spec Pediatr Nurs 2005;10:3-10.
7. Anand KJS, Scalzo FM. Can adverse neonatal experiences alter brain development and subsequent behavior.Biology of the Neonate 2000: 77; 69-82
8. Simons SHP, van Dijk M, Anand KJS, Roofthooft D, van Lingen RA, Tibboel D. Do we still hurt newborn babies? A prospective study of procedural pain and analgesia in neonates. Arch Pediatr Adolesc Med 2003; 157: 1058 –64 .
9. Katme AM.Analgesic effects of sucrose were known to the prophet (PBUH). BMJ 1995; 311: 1169.
10. Haouari N, Wood C, Griffith G, Levene M.The analgesic effect of sucrose in full term infants: a randomized clinical trial .BMJ 1995; 310: 1498-1500.
11. Gibbins S, Steven B, Hodnett E, Pinelli J, Ohlsson A, Darlington G. Efficacy and safety of Sucrose for procedural pain relief in preterm and term neonates. Nurs Res 2002; 5: 375-82 .
12. Bilqen H, Ozek E, Cebeci D, Ors R. Comparison of sucrose, expressed breast milk, and breast-feeding on the neonatal response to heel prick. J Pain 2001; 2: 301-5.
13. Guala A, Pastore G, Liverani ME, Giroletti G, Gulino E, Licardi G et al. Glucose or sucrose as an analgesic for newborns :a randomized controlled blind trial. Minerva Pediatr 2001; 53: 271-4.
