

Pain profile of premature infants during routine procedures in neonatal intensive care: An observational study

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ABSTRACT

Background: Premature neonates receive a large number of painful procedures during their stay in the neonatal intensive care unit (NICU). However, there are many other processes that happen in the NICU, which may not be considered painful but can cause discomfort and/or stress to the neonate. **Method:** Pain profile during routine procedures in NICU was assessed using the premature infant pain profile (PIPP) score. Neonates of gestational age >26 weeks, less than 7 days old and admitted for less than 7 days in the NICU were included. **Results:** A total of 662 procedures were observed in 132 (78 M, 54 F) neonates. The mean (SD) age of the neonates was 2.4 (1.8) days and the mean (SD) birth weight was 2.3 (0.6) kg. 63 (54.5%) were of low birth weight (LBW), 85 (64.39%) were full term. High PIPP score was noted in blood sampling, heel prick, suction, and weight measurement. Significant differences were observed in the PIPP score during blood sampling and suction across gender. Some ordinary and non-stressful procedures also scored very high on the PIPP scale. **Conclusions:** The validity of PIPP needs to be reexamined. Our understanding of pain during routine procedures may need to be revisited.

Keywords: Intensive care, neonatal pain, non-stressful procedures, pain assessment, validity

Introduction

In the past few years, a lot of research work was done regarding the physiology of neonatal pain,^[1-3] the formulation of various guidelines for pain management in newborns,^[4-12] knowledge of pain in neonatal intensive care unit (NICU) nursing staff,^[13-17] kangaroo mother care (KMC) and its relation with pain relief during procedures such as heel prick,^[6-8] use of oral sucrose for pain relief during echocardiography,^[9] etc., Newborns are

subjected to multiple diagnostic and therapeutic procedures at regular intervals, which are both painful and non-painful but medically necessary for their care.^[10,11] Some other researchers found that infants born at 25–42 weeks gestation experience an average of 14 painful procedures per day during the first 2 weeks of life.^[12] Recent literature has demonstrated that the pain associated with routine procedures in preterm neonates is associated with abnormal neurodevelopment,^[18-21] the effects of which may be persistent.^[20] Pain is a subjective sensation, and hence, “self-reporting” is considered the gold standard method for assessing the degree of pain by health care providers. Caregivers need to recognize and intervene whenever the newborn is in pain.^[14-17]

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However, neonatal pain assessment of routine procedures isn't always reliable, especially for procedures such as diaper change, temperature measurement, and abdominal girth measurement; these maneuvers are thought to be less painful, but there is little evidence or research demonstrating the amplitude of pain experienced by neonates during the procedures.^[15] If we can determine whether these maneuvers are really painful, then we can move further toward establishing baseline scores and pain relief protocols for routine procedures, and toward improving knowledge among nursing staff regarding measures that can be taken to decrease pain during routine procedures.^[14-17]

The objective of the study was to establish a premature infant pain profile (PIPP) score for each of the procedures performed on neonates admitted to the NICU of a tertiary referral center in western India and to, subsequently, form a baseline pain score for the same. This would help in establishing the relevance of the PIPP score in rightly identifying and grading pain during various routine procedures performed on admitted neonates.

Methods

Subjects and procedures

The study was carried out at the Shree Krishna Hospital (SKH) NICU, located in Karamsad, Gujarat and received the approval of the institutional ethics committee. The NICU at SKH has a capacity of 22 beds and provides level III neonatal care. It was an observational cross-sectional study wherein newborn babies delivered and admitted to NICU, SKH, who fulfilled the inclusion criteria, were recruited. Approximately 60 participants per study arm were included in the study.

Inclusion criteria

1. neonate with gestation age more than 26 weeks
2. neonates less than 7 days old
3. neonates within 7 days of admission in the NICU

Exclusion criteria

1. brain death
2. Central nervous system malformations
3. severe birth asphyxia

We selected the 10 most frequently done stressful/disturbing and painful procedures performed on neonates for the study. These were as follows: 1) position change; 2) temperature; 3) abdominal girth; 4) diaper change; 5) physical examination; 6) noninvasive blood pressure; 7) heel prick; 8) weight; 9) oropharyngeal suction; and 10) blood sampling.

Each of these procedures was observed and filmed using either on a video camera in the tablets used by staff in the NICU or by the mobile phone cameras of fellows or residents or interns posted in the NICU. A total of 132 neonates undergoing procedures were filmed. The investigators did not intervene in the unit's pain management practices. A blinded investigator evaluated the pain by grading it based on the PIPP score. All of the data, including

the PIPP scores and other general information, were collected from medical records of the neonates, either from respective files or computerized data material in the NICU.

Statistical analysis

The analysis was performed using the STATA version (14.2). Descriptive statistics including mean, standard deviation, frequency, and percentage were used to depict the profile of study participants and pain assessment using the PIPP scoring system. A Chi-square test was used to compare pain scores with gender.

Results

A total of 662 procedures were observed in 132 neonates (78 males and 54 females). The mean age of the neonates included in the study is 2.4 days, and the mean birth weight is 2.3 kg. 63 neonates were of LBW and 60 were of normal birth weight. 85 neonates were full-term babies and 45 were preterm newborns. 73 neonates were admitted after the lower segment cesarean section (LSCS) and 59 admitted after a normal vaginal delivery (NVD). As shown in Table 1, no pre-procedure medications were administered to prevent pain in any of the 662 procedures.

The highest PIPP scores were noted in blood sampling, heel prick, suction, and weight measurement. The rest of the procedures had a PIPP score of less than 5, with the minimum PIPP score

Table 1: Characteristics of newborns included in the study

Frequency (percentage)			
78 (59.1)	Male	Gender	
54 (40.9)	Female		
29 (22)	Abdominal girth	Routine procedures	
33 (25)	Blood sample		
2 (1.5)	Diaper change		
9 (6.8)	Heel prick		
9 (6.8)	Noninvasive blood pressure		
21 (15.9)	Physical examination		
1 (0.8)	Position change		
7 (5.3)	Suction		
21 (15.9)	Weight		
60 (45.5)	Normal	Birth weight categories	
63 (47.7)	Low		
8 (6.1)	Very low		
1 (0.8)	Extremely low		
59 (44.7)	NVD	Type of Delivery	
73 (55.3)	LSCS		
51 (38.6)	=<36	Gestational Age (In Weeks)	
26 (19.7)	36-38		
55 (41.7)	38-40		
Median (IQR)	Mean (SD)		
2 (1.3)	2.4 (1.8)	Age (In Days)	
2.4 (0.9)	2.3 (0.6)	Birth Weight (In Kilograms)	

NVD: Normal vaginal delivery; LSCS: Lower segment cesarean section; IQR: Inter quartile range; SD: Standard deviation

in abdominal girth measurement as a mean value of 3.5. Some ordinary/routine and non-stressful procedures like abdominal girth, temperature measurement, and weight measurement also scored very high on the PIPP scores [Table 2, Figure 1].

For blood sampling, a significant difference was found between male and female neonates in PIPP score values. There was also a significant difference across gender in other procedures such as temperature measurement, suction, and physical examination, there was also a difference noted [Table 2].

Discussion

According to the recent literature, pain associated with routine procedures in preterm neonates is associated with abnormal

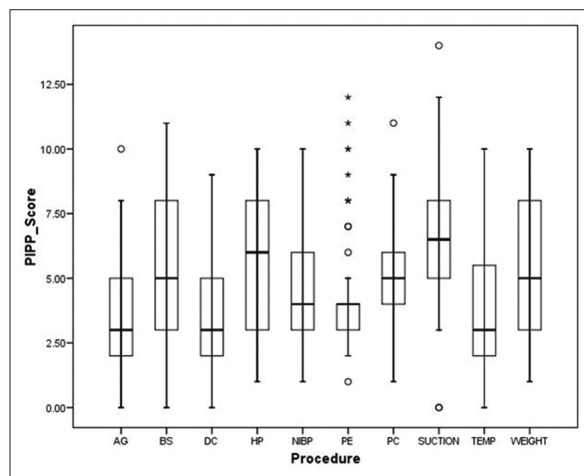


Figure 1: Premature infant pain profile (PIPP) scores of some ordinary/routine and non-stressful procedures

neurodevelopment,^[18-21] the effects of which may be persistent.^[20] Therefore, caregivers need to recognize and intervene whenever the child is in pain.^[14-17] For this same purpose, there are many scoring systems available to systematically assess the pain occurring during various day-to-day procedures in neonates. PIPP is one of the scoring systems used to grade pain in neonates.^[22]

Caregivers such as nurses and parents have empathy with the neonates and seeing the neonates in pain can have increased anxiety and stress in mothers and nurses. The level of stress is quite high in nurses working in neonatal intensive care in India.^[23] Even the mothers of babies admitted to NICU have high levels of stress in India.^[24] Mothers who witness neonatal pain in the NICU have increased chances of stress and anxiety. Family physicians who interact with mothers and their children should ensure that they inform the parents of measures available to reduce pain. Decreasing the pain-inducing interventions and relieving the pain of the neonate at every opportunity can reduce parental stress and improve parental role attainment following hospitalization.^[25] Family physicians should be alert to the possibility of post-traumatic stress disorder symptoms in mothers presenting to their clinics with vague symptoms since these can manifest for a long time after the discharge of their preterm newborn from neonatal intensive care. It was shown that “Greater neonatal exposure to invasive procedures and mothers’ recall of these procedures were related to mothers’ post-traumatic stress symptomatology at discharge” in a study published in Canada.^[26]

Studies related to pain during routine procedures such as abdominal girth, temperature measurement, heel prick, etc., are limited. There was a vast gap between the knowledge among

Table 2: Comparison of pain scores of routine procedures across genders

	Premature infant pain profile score			P	
	Male	Female	Overall		
Abdominal girth (74)	3.17 (2.28) 3 (3.5)	3.71 (2.40) 3 (4)	3.5 (2.35) 3 (3)	Mean (SD) Median (IQR)	0.34
Blood sampling (65)	4.73 (2.77) 3 (4)	6.69 (2.24) 7 (3)	5.43 (2.80) 5 (5)	Mean (SD) Median (IQR)	0.006
Diaper change (57)	3.33 (2.74) 2 (4.25)	3.58 (1.87) 3 (3)	3.5 (2.16) 3 (3)	Mean (SD) Median (IQR)	0.68
Heel prick (67)	5.39 (2.55) 5 (5)	5.95 (2.15) 6 (4)	5.56 (2.43) 6 (5)	Mean (SD) Median (IQR)	0.38
Noninvasive blood pressure (57)	4.57 (2.35) 3.50 (9)	4.33 (2.38) 4 (2)	4.5 (2.34) 4 (3.5)	Mean (SD) Median (IQR)	0.73
Physical examination (63)	4.42 (2.68) 4 (1.5)	3.92 (1.75) 4 (1)	4.22 (2.35) 4 (1)	Mean (SD) Median (IQR)	0.02
Position change (77)	5.03 (2.02) 5 (3)	5.22 (1.63) 5 (2)	5.15 (1.77) 5 (2)	Mean (SD) Median (IQR)	0.04
Suction (50)	6.16 (2.91) 6.5 (12)	7.14 (2.47) 6.5 (10)	6.44 (2.80) 6.5 (3.5)	Mean (SD) Median (IQR)	0.274
Temperature measurement (87)	4.48 (2.60) 3 (4)	3.55 (2.23) 3.5 (3)	3.93 (2.41) 3 (4)	Mean (SD) Median (IQR)	0.07
Weight (65)	5.22 (2.99) 4 (5)	5.73 (2.72) 6 (5)	5.46 (2.86) 5 (5)	Mean (SD) Median (IQR)	0.483

the nursing staff and its application toward pain management in admitted neonates. Sometimes, only facial expressions and crying were identified by nursing staff as signs of pain. This is an improper application of the PIPP scoring system.^[14]

Some procedures are performed several times in a day on the same newborn such as temperature measurement, abdominal girth, position change, etc., If any pre-procedure medication is administered, the pain score of that specific procedure decreases^[5-9]; however, in this study, no pain medications were administered before any of the procedures.

Usually, the PIPP score is divided into three separate categories: a mild score of 0–6, a moderate score of 7–12, and a severe score of 13–15.^[22] The highest PIPP scores were noted in blood sampling, heel prick, suction, and weight measurement. Some ordinary/routine and non-stressful procedures such as abdominal girth, temperature measurement, and weight measurement also scored very high on the PIPP scores in this study, with *P* values of 0.34, 0.07, and 0.483, respectively. It raises the question: Is the PIPP scale appropriate for pain scoring, or is our perception regarding routine procedures as less painful and less stressful invalid? The validity of PIPP needs to be reexamined.

Differences in mean PIPP scores across gender were noted in some procedures such as blood sampling, physical examination, temperature measurement, and suction, etc., This raises the question of whether this difference in PIPP scores between genders is significant or not, and implies a need for this to be studied further. The study should be repeated for these procedures on neonates of various gestational ages, and the reason behind the differences between male and female neonates should be determined.

PIPP scores can also vary from region to region and from NICU to NICU. It can be dependent upon various factors such as the diagnosis of the admitted newborns, gestational age, premedication administration protocols of the specific region or NICU and whether the protocols are followed, presence of any neonatal handling by staff during the procedure, whether the procedure is performed done by a well-trained or poorly trained staff member, assessment differences from person to person, relation of procedure with time of feeding, relation of procedure with time of KMC (before or after), whether the mother has been educated, the number of times a procedure is repeated at the particular time, the procedure duration, the temperature of the NICU environment, the temperature of the newborn handler's hands during the procedure, temperature of weighing scale or sterile draw sheets used during weight measurement, whether the newborn is intubated or on Continuous positive airway pressure (CPAP) or on-air, the noise level of surroundings during the procedure, conversing among the handling persons during procedure, alarms during procedures, total time spent during procedure with newborn, etc.^[10-12] These various factors and their association with the PIPP score need to be studied further.

If regional reference values for PIPP scores are established for each region, we can compare PIPP scores between routine procedures performed at NICUs of various regions, and therefore the PIPP score can be established as a quality indicator (QI) of a particular unit. If the PIPP score of one unit is significantly higher than the regional reference value, then we would have to determine the factors responsible for the high PIPP score and possible measures that can be taken to reduce the pain occurring during routine procedures. Further studies are needed to determine whether PIPP scores are not appropriate for the scoring of pain in newborns or our perception regarding some routine procedures as non-painful or less stressful is invalid.

Conclusion

It is to be resolved whether PIPP scores are appropriate for pain scoring, or whether the understanding of pain during these common procedures need to be revisited. If only PIPP scores are used for deciding pain relief then the neonate might end up receiving more medications than necessary. Hence, further studies are needed to determine and enhance our understanding of pain.

Compliance with ethical standards

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Conflicts of interest

There are no conflicts of interest.

References

1. Anand KJ, Craig KD. New perspectives on the definition of pain. *Pain* 1996;67:3-6.
2. Vani S, Thakre R, Nimbalkar S. Research issues in assessment and management of pain in newborns. *J Neonatol* 2009;24:358-63.
3. Maxwell LG, Fraga MV, Malavolta CP. Assessment of pain in the newborn: An update. *Clin Perinatol* 2019;46:693-707.
4. Walker SM. Management of procedural pain in NICUs remains problematic. *Paediatr Anaesth* 2005;15:909-12.
5. Mountcastle K. An ounce of prevention: Decreasing painful interventions in the NICU. *Neonatal Netw* 2010;29:353-8.
6. Nimbalkar S, Sinojia A, Dongara A. Reduction of neonatal pain following administration of 25% lingual dextrose: A randomized control trial. *J Trop Pediatr* 2013;59:223-5.
7. Nimbalkar SM, Chaudhary NS, Gadhavi KV, Phatak A. Kangaroo mother care in reducing pain in preterm neonates on heel prick. *Indian J Pediatr* 2013;80:6-10.
8. Chermont AG, Falcão LF, de Souza Silva EH, de Cássia Xavier Balda R, Guinsburg R. Skin-to-skin contact and/or oral 25% dextrose for procedural pain relief for term newborn infants. *Pediatrics* 2009;124:e1101.
9. Nimbalkar SM, Potana NT, Dongara AR, Patel DV,

- Nimbalkar AS, Phatak A. Oral sucrose for pain in neonates during echocardiography: A randomized controlled trial. *Indian Pediatr* 2015;52:493-7.
10. Orovec A, Disher T, Caddell K, Campbell-Yeo M. Assessment and management of procedural pain during the entire neonatal intensive care unit hospitalization. *Pain Manag Nurs* 2019;20:503-11.
 11. Stevens, *et al.* 2007, as quoted by Walden M, Gibbins S. *Pain Assessment and Management Guideline for Practice*. 2nd ed. Illinois, Chicago: National Association of Neonatal Nurses; 2007.
 12. Kothari SY, Dongara AR, Nimbalkar SM, Phatak A, Nimbalkar AS. Missed opportunities for sedation and pain management at a level III neonatal intensive care unit, India. *Front Pediatr* 2016;4:7, Published online 2016 Feb 23. doi: 10.3389/fped. 2016. doi: 10.3389/fped.2016.00007.
 13. Anderson RD, Greve-Isdahl M, Jylli L. The opinions of clinical staff regarding neonatal procedural pain in two Norwegian neonatal intensive care units. *Acta Paediatr* 2007;96:1000-3.
 14. Nimbalkar AS, Dongara AR, Ganjiwale JD, Nimbalkar SM. Pain in children: Knowledge and perceptions of the nursing staff at a rural tertiary care teaching hospital in India. *Indian J Pediatr* 2013;80:470-5.
 15. Nimbalkar AS, Dongara AR, Phatak AG, Nimbalkar SM. Knowledge and attitudes regarding neonatal pain among nursing staff of pediatric department: An Indian experience. *Pain ManagNurs* 2014;15:69-6.
 16. Polkki T, Korhonen A, Laukkala H, Saarela T, Vehvilainen-Julkunen K, Pietila AM. Nurses' attitudes and perceptions of pain assessment in neonatal intensive care. *Scand J Caring Sci* 2010;24:49-55.
 17. De Clifford-Faugère G, Aita M, Le May S. Nurses' practices regarding procedural pain management of preterm infants. *Appl Nurs Res* 2019;45:52-4.
 18. Fitzgerald M. The development of nociceptive circuits. *Nat Rev Neurosci* 2005;6:507-20.
 19. Fitzgerald M, Walker SM. Infant pain management: A developmental neurobiological approach. *Nat Clin Pract Neurol* 2009;5:35-50.
 20. Smith GC, Gutovich J, Smyser C, Pineda R, Newnham C, Tjoeng TH, *et al.* Neonatal intensive care unit stress is associated with brain development in preterm infants. *Ann Neurol* 2011;70:541-9.
 21. Brummelte S, Grunau RE, Chau V, Poskitt KJ, Brant R, Vinall J, *et al.* Procedural pain and brain development in premature newborns. *Ann Neurol* 2012;71:385-96.
 22. Ballantyne M, Stevens B, McAllister M, Dionne K, Jack A. Validation of the premature infant pain profile in the clinical setting. *Clin J Pain* 1999;15:297-303.
 23. Amin AA, Vankar JR, Nimbalkar SM, Phatak AG. Perceived stress and quality of life in neonatal intensive care unit nurses in Gujarat, India. *Indian J Pediatr* 2015;82:1001-5.
 24. Varma JR, Nimbalkar SM, Patel D, Phatak AG. The level and sources of stress in mothers of infants admitted in neonatal intensive care unit. *Indian J Psychol Med* 2019;41:338-42.
 25. Kyololo OM, Stevens BJ, Songok J. Mothers' perceptions about pain in hospitalized newborn infants in Kenya. *J Pediatr Nurs* 2019;47:51-7.
 26. Vinall J, Noel M, Disher T, Caddell K, Campbell-Yeo M. Memories of infant pain in the neonatal intensive care unit influence posttraumatic stress symptoms in mothers of infants born preterm. *Clin J Pain* 2018;34:936-43.