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A QUALITY IMPROVEMENT INITIATIVE TO IMPROVE THE MANAGEMENT OF PROCEDURAL PAIN IN NEONATES

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ABSTRACT

Background- The concept of pain in neonates is evolving and short-term and long-term concerns of pain in neonates are well known. Short-term effects of untreated pain are enhanced catabolism, altered immunological function, delayed healing, and impaired emotional bonding. As newborn survival improves, they are frequently exposed to painful procedures as a part of monitoring or treatment. Long-term effects of untreated pain are memory of pain, developmental retardation, and alteration in response to subsequent painful experiences.

Objectives: 1. Universal implementation of pain control interventions during painful procedures.2.To study the impact of quality interventions on overall compliance with pain control measures.3. To achieve a target of >85% implementation of non-pharmacological pain control interventions in painful procedures.

Methods: The study was conducted in a level 3 NICU with two branches having 24-bed and 19-bed Neonatal care units respectively. It was observed by the team that pain control measures were overlooked in newborns undergoing painful procedures. We included hemodynamically stable newborns, weighing more than 1000gms, without respiratory distress. We identified twelve commonly performed invasive procedures in this group of neonates; Heel prick for Random Blood Sugar, Intravenous (IV) sampling, IV cannulation, nasal-oral suction, CVL insertion, umbilical venous line insertion, umbilical arterial line insertion, lumbar puncture, arterial gas sampling, retinopathy of prematurity examination, retinopathy of prematurity treatment and urinary catheter insertion. We identified suitable pain control interventions while performing invasive procedures; swaddling, facilitated tucking, Skin-to-skin contact or KMC, Direct breastfeeding, EBM by mouth, and sensorial stimulation.Our key outcome measure was the proportion of occasions any of the pain control interventions were taken before performing any of the identified painful procedures. The baseline data collection was conducted for 2 weeks starting from 17th November 2023. Then it was continued throughout the study period and four more weeks after we succeeded in achieving 85%. Retention analysis was done for a month from 7th March 2024 to 6th April 2024.

Results: Over 5 months, 420 patients were admitted to our neonatal Unit at both branches. Among them, the study was carried out. After completing the baseline data collection, we started 1st PDSA cycle with a lecture series by fellows at both NICU branches.In the 2nd PDSA cycle audio-visual animations, images, posters, and YouTube videos show how to perform interventions to prevent pain. In the 3rd PDSA cycle, to improve the involvement of nursing staff two staff nurses were selected as in-charge sisters of the pain-intervention study, they were given the task of creating awareness of this in nursing staff.

Conclusions: We can greatly extend the proportion of utilization of non-pharmacological measures to relieve procedural pain by implementing basic measures as part of a quality improvement project, along with increasing nursing staff education and involvement of all NICU caretakers

INTRODUCTION

The conceptof pain in neonatesis evolvingand now short-term and long-term concerns of pain in neonates are well known. Short-term effects of untreated pain are enhanced catabolism, altered immunological function, delayed healing, and impaired emotional bonding. (Fisk NM *et al.*, 2001) Studies say that almost 80% of peri-operated hospitalized children experience moderate to severe pain. (PölkkiT *et al.*,2003)Inadequately treatedor mismanagedpainis foundto adverselyaffectthecardiovascular,respiratory,and gastrointestinal systems as well as immunological function, and hence indirectly delays recovery, prolongs hospitalization, or worsens illness.(Al-Atiyyat NM *et al.*,2008) Despite such serious implications, suboptimal pain management is common.Multiple studies testify to a lack of sufficient knowledge in tackling pain among health care providers—both nursing staff and doctors.Pain in children is an even more complex issue. Some multiple misconceptions and beliefs impair healthcare provider's ability to identify and treat pain, especially in neonates. (Nimbalkar AS *et al.*, 2014)

1.1. Local issue: In November 2023, data was gathered to determine the percentage of utilization of non-pharmacological measures to control procedural pain for neonates hospitalized in the neonatal intensive care unit (NICU) at Arpan Newborn Care Center in Ahmedabad, Gujarat. Our unit observed that out of eligible neonates, only 4.5% were receiving non-pharmacological measures for procedural pain at start of QI study.

1.2. Intended improvement Based on the data showing suboptimal utilization of non-pharmacological measures to control procedural pain in neonates admitted to our unit, we decided to use QI methods to improve and increase the utilization of such in procedural pain.

1.3. SMART goal to effectively address this issue, a Quality Improvement (QI) initiative was initiated with a SMART

goal: to increase the utilization of non-pharmacological measures to control procedural pain in our unit from a baseline average of 4.5% to 85%.

1.4. Need for study: In recent decades, advances in neonatal care which have increased the survival of premature and sick neonates have led to a rise in several invasive procedures that may cause pain in these vulnerable neonates. It is also an ethical obligation to prevent pain in critically ill neonates. Simultaneously, it also averts immediate and long-term adverse consequences. (Batton DG et.al., ,2006)Painful stimulation elicits graded physiologic and behavioral responses in newborns to increasingly invasive procedures,activation of the somatosensory cortex, and neuroendocrine stress responses.(Grunau RE *et al.*,2008)

Repetitivepainleadstoalteredpainsensitivitywithdampenedbehavioralresponses to pain reflecting interrupted development mentor heightened peripheral sensitivity. Grunau*et al.*[93]foundgreaterreactivityofpreterm infants to suctioning via endotracheal tube on the previous day. Thus, it is an hour of need to develop strategies to decrease the procedural pain in neonates. The American Academy of Pediatrics (AAP) recently emphasized that there is a need to incorporate a principle of minimizing thepainfuldisruptions inneonatalcareprotocols. Skin to skin contact, with either oral glucose or oral sucrose administration, can decrease the magnitude of pain perceived in preterm and term infants.(JohnstonC *et al.*,2014)

An analysis of 19 studies that examined the effects of SSC on neonatal pain caused by single needle-related procedures. It did not find any statistical benefit for physiologic indicators of pain. However, it successfully showed benefits for composite painscoreitems. (JohnstonC *et al.*,2014) This meta-analysis of 20 randomized controlled trials (RCTs)/quasi-RCTs also found that providing supplemental expressed mother's milk was as effective as providing oral sucrose or oral glucose for pain relief in term neonates.

Sensorial stimulation (SS) which is a method of gentle stimulation of the tactile, auditory, gustatory,andvisualsystems,hasshowneffectivenessindecreasingpainduringminorprocedures such as heel lance. SS is achieved by looking at and gently talking to the infant while stroking or massaging the face or back, and providing oral sucrose or glucose solution before a painful procedure.Asystematicreview hasdemonstratedthatSSwasmoreeffectivethansucrosewhen all elements of SS were used.(Bellieni CV *et al.*,2009) A study has suggested that SS can play an important role in non-pharmacologic management of procedural pain for neonates.(GittoE *et al.*, 2012)

METHODOLOGY

The study was conducted in a level 3 NICU chain with two branches having 24-bed and 19-bed Neonatal care units respectively. Clinical care is provided by six consultantsandsix fellowswithalargenumberofnurseswhohaveclinicalexperienceinneonatal care. A quality improvement team was formed to address this issue, consisting of two consultants, two fellows, and four nursing staff.

It was observed by the team that pain control measures were overlooked in newborns undergoing various routine invasive procedures. We included hemodynamically stable newborns, weighing more than 1000gms, without respiratory distress or shock, and neurologically normal. Newborns with any surgical condition, on invasive mechanical ventilation were excluded. On assessing the records, we identified twelve commonly performed invasive procedures in this group of neonates; Heel prick for Random Blood Sugar (RBS) monitoring, Intravenous(IV)sampling,IV cannulation, nasal-oral suction, Central venous line insertion, umbilical venous line insertion, umbilical arterial line insertion, lumbar puncture, arterial gas sampling, retinopathy of prematurity examination, retinopathy of prematurity treatment andurinary catheter insertion.Anyofthepain control measures were often overlooked in the given subset of patients undergoing selected procedures.Weidentified suitable pain control interventions while performing invasive procedures; swaddling, facilitated tucking, Skin-to-skin contact or KMC, Direct breastfeeding, EBM by mouth, and sensorial stimulation.

Our key outcome measure was the proportion of occasions any of the pain control interventions taken before performing any of the twelve identified painful procedures in the neonates. Data were collected for each such occasion and expressed every fortnight in a percentage proportion.In the morning of each day, neonates were identified based on inclusion criteria. The baseline data collection was conducted for 2 weeks starting from 17thNovember2023.Thenitwascontinuedthroughoutthestudyperiodandfourmoreweeks afterwe succeeded in achieving the 85%. Retentionanalysiswasdone for a month from 7th March 2024 to 6th April 2024.

Onanalyzingthesystem, the firstproblemidentifiedwas a lackofawarenessandeducationamong the healthcare team about neonatal pain management. Thus, at the outset, the first intervention was an educational session of nursing staff with fellow doctors and consultants. We identified potential interventions based on this data. A priority matrix was created to determine the sequence for testing. The changes underwent testing as part of the Plan-Do-Study-Act (PDSA) cycle. We completed three PDSA cycles. The proportion of non-pharmacological interventions performed for procedural pain, was considered the principal outcome indicator. The responsibility of collecting daily data collection was delegated to a

research staff nurses employed in both units. In the post-implementation phase, the QI team participated in monthly meetings, evaluated relevant data, and provided ongoing feedback to all staff to ensure the improvement's sustainability. A run chart was utilized to chart the proportion of utilization of non-pharmacological interventions performed.

RESULTS

Over 5 months, 420 patients were admitted to our neonatal Unit at both branches. Among them, the study was carried out. ThisQIwasdoneforpaincontrolinterventionsfortwelveprocedures.

After completing the baseline data collection, we started 1st PDSA cycle with a lecture series by fellow doctors at both NICU branches with a Microsoft PowerPoint presentation consisting of basic non-pharmacological interventions. In total 12 such lectures with proper instructions for when and where to follow such interventions were given.

In the 2nd PDSA cycle audio-visual animations, images, posters, and YouTube videos show how to perform interventions to prevent pain. Meanwhile, at both the centers three sessions of question-answer were also taken by two fellow doctors to deal with basic queries and misconceptions that nursing staff had regarding this topic.

In the 3rd PDSA cycle, to improve the involvement of nursing staff two staff nurses were selected as in-charge sisters of the pain-intervention study, they were given the task of creating awareness of this in nursing staff by approaching every staff individually and planning multiple group meetings. One fellow and one consultant at both centers started interactive sessions with every staff in morning rounds regarding Interventions they are using for different painful procedures.

Table 1: Frequency of performed non-pharmacological interventions in procedures with a timeline

Weeks	Interventions at A branch (%)	Interventions at B branch (%)	Combined interventions at both branches (%)
2nd (Baseline data)	4.8	4.3	4.5
6th (Post 1st PDSA cycle)	8.9	5.7	6.7
10th (Post 2nd PDSA cycle)	51.6	55	53.1
14th (Post 3rd PDSA cycle)	89.4	87	88.3
21st (Retention analysis)	85.9	86	86

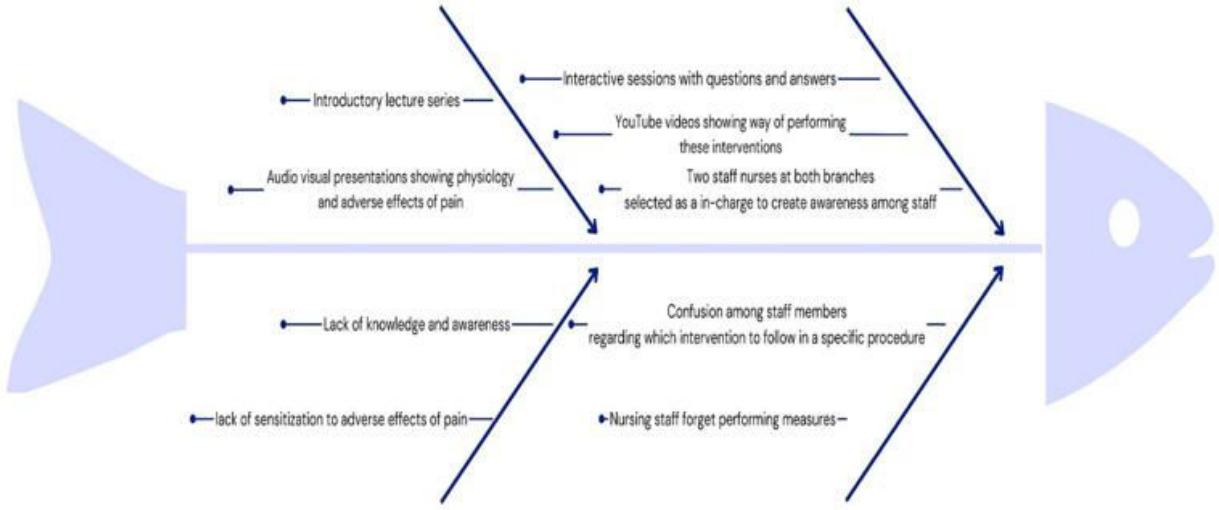

Figure 1: Fishbone Diagram of identification of problems and appropriate interventions for improving utilization of non-pharmacological measures for procedural pain

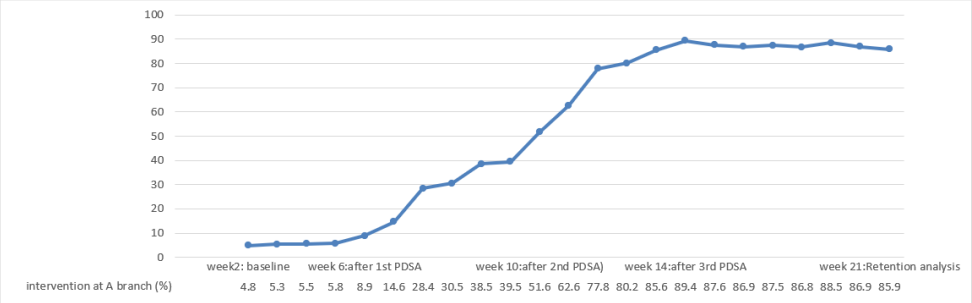

Figure 2: Run chart of proportion of interventions performed at A branch (%)

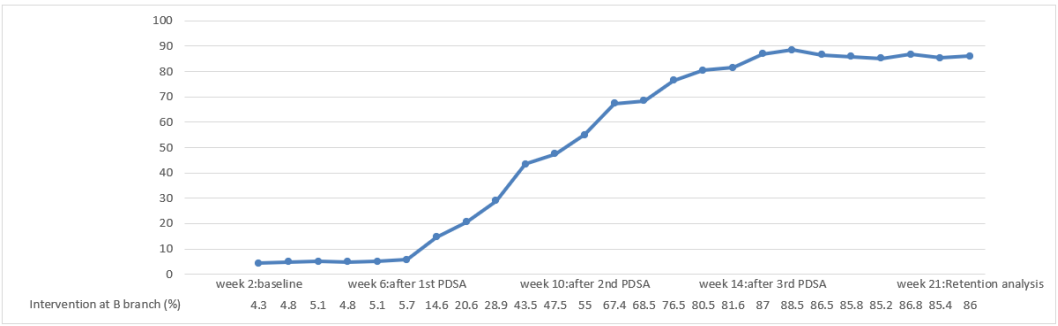

Figure 3: Run chart of proportion of interventions performed at B branch (%)

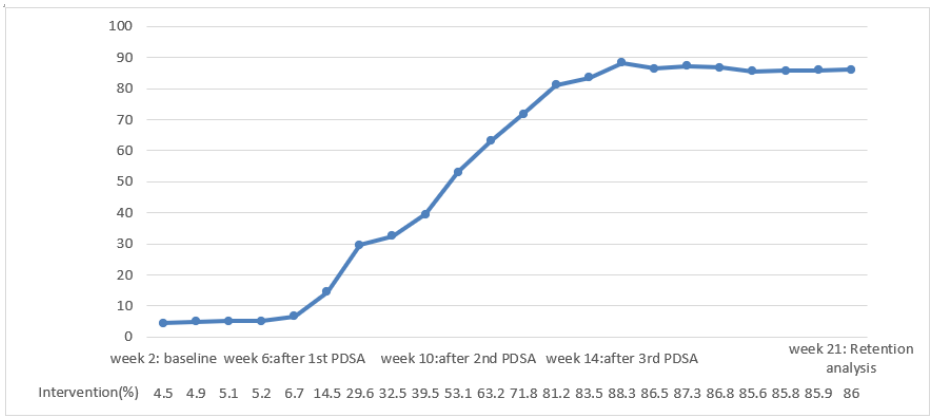

Figure 4: Run chart of proportion of interventions performed at both branches(%)

DISCUSSION

Despite the availability of good quality evidenceof the harmfuleffects of pain in neonates, management of pain in the newborn is hampered by the lack of awareness among health care professionals. They lack awareness that neonates are also capable of perceiving pain, and fear about the adverse effects associated with analgesic use. Current evidence supports the general principles to be followedforpain control measuresfortheroutine managementofneonatesusingsafeandeffective environmental, behavioral, and pharmacological interventions for relieving pain and preventing its adverseconsequences. (Batton DG *et al.*,2008) Healthcareprovidersfrequentlyoverlook theimportance of pain relief measures and seldom use pain control measures. Therefore, systematic approaches to implement and disseminate guidelines to all NICU staff and periodic measurements of compliance arerecommended.(Jeong IS *et al.*,2014)

Ashish R. Dongara *et al.* in their study on "An Educational Intervention to Improve Nurses' UnderstandingofPaininChildreninWesternIndia"showedanimprovementinknowledgeabout paininchildrenaftertraining.Similarimprovementinknowledgewasalsoobservedby Johnston *et al.*and Huth *et al.*

A meta-analysis of non-pharmacological interventions carriedoutduringheellanceandintravenouscatheterinsertion demonstrated thatsucking-related andswaddling/facilitated-tuckinginterventionswerebeneficialforneonatesundergoingnumerous procedures. (Yuwei Weng *et al.*, 2024)

A systematic review by Riyoung Na *et al.*, 2019 demonstrated the importance of skin-to-skin contact and sensory

stimulation in the management of procedural pain. A randomized controlled trial by Anne Perroteau *et al.*, 2018 showed Efficacy of facilitated tucking combined with non-nutritive sucking for faster pain relieving in very preterm infants' pain during the heel-stick procedure. he available people were used to making and maintaining changes. As feedback and auditing are regarded as the pillars of the QI project, we conducted bi-weekly audits to evaluate our performance on the various change concepts that were implemented and the proportion of utilization of non-pharmacological measures to relieve procedural pain. Following the discussion, the necessary changes were made to ensure the change would last.
The primary objective of the study was toidentify thehinderingfactors and suggestpossibleinterventions toimprovecompliance and studytheimpactofqualityinterventionsonoverallcompliancewithpaincontrolmeasures. The limitation of the study was we could not give leadership to the mothers in the decision-making, though we involved mothers in breast feeding or expressing milk to provide analgesia for the pain control measure. We did not assess the severity of pain while doing the procedure as it led to more complexities during the QI.

CONCLUSION

Implementing basic measures as part of a quality improvement project, together with increasing nursing staff education along with sensitization for a topic, and involvement of all caretakers of NICU patients, we can greatly extend the proportion of utilization of non-pharmacological measures to relieve procedural pain.

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Declaration of competing interest: The authors declare that they have no known competing financial interests or personal relationships that could have appeared to influence the work reported in this paper.

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