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## Prevention and non-pharmacological management of pain in newborns

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### ABSTRACT

**Objective:** to describe the main non-pharmacological interventions for pain relief in newborns available in Neonatal Intensive Care Unit. **Method:** an exploratory search of the MedLine, Lilacs and Scielo online databases was conducted to retrieve references of studies published from 2004 to 2013. **Results:** several non-pharmacological interventions were shown to be effective, to represent low risk for neonates and to have a low operational cost. The ones most often discussed in the literature were: oral administration of glucose/sucrose, non-nutritive sucking, breastfeeding, skin-to-skin contact, facilitated tucking and swaddling. **Conclusion:** healthcare teams should be familiar with these methods and use them more effectively in Neonatal Intensive Care Unit daily routines, so as to ensure that newborns receive qualified and more human care.

**Key words:** Pain; Newborn Infant; Pain Management.

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## INTRODUCTION

Pain management in the neonatal period should base on accurately identifying the presence of pain as the first step for its optimal management. The main goal of pain management in the newborn (NB) is the use of interventions to minimize its intensity and duration, helping newborns to reorganize and recover from this stressful experience. Pain treatment should occupy a prominent place within the activities in the Neonatal Intensive Care Unit (NICU). Thus, prevention and control of pain should be a priority throughout the newborns' hospital stay<sup>(1-2)</sup>.

However, there are knowledge gaps regarding the most effective way to carry out the proper pain management. Although its complete elimination for newborns may be difficult, much can be done for reducing pain quantity and intensity<sup>(3)</sup>. Non-pharmacological management measures may be used to this end, such as environmental, behavioral and pharmacological measures. Knowledge of these strategies is essential, since the use of different methods associated may potentiate the analgesic effect<sup>(1)</sup>.

The most effective way to reduce pain in newborns is decreasing the number of procedures performed, which can start by reducing the number of interruptions to the newborns' rest period. Other important strategies are to eliminate unnecessary procedures and avoid repeating procedures after unsuccessful attempts<sup>(3)</sup>. The literature is controversial in relation to grouped procedures as a means of stress reduction. While a trend shows it as a useful strategy for reducing pain, especially if followed by a comforting event, such as feeding<sup>(4)</sup>, another line recommends to avoid grouped procedures, as this may trigger a longer period of pain, discomfort and stress in newborns, resulting in a time consuming return to the physiological and behavioral pre-procedure state<sup>(2)</sup>.

Non-pharmacological or pharmacological interventions may be used for pain management in newborns, according to the need. Once the intervention is performed, it is important to reassess the pain between 30 minutes and 1 hour later to ensure treatment effectiveness<sup>(1-3,5)</sup>. In this context, this study aims to present the main non-pharmacological methods of pain relief in newborns available in the NICU.

## METHOD

A literature search of the exploratory type was conducted. The literature search is based on previously developed materials, mainly scientific books and articles, and is considered an appropriate method for describing the history or development of a given problem and its management<sup>(6)</sup>. Articles from scientific journals, theses and books published from 2004 to 2013, in Portuguese and English were used as bibliographic source. The search for material was carried out in the online databases MEDLINE, LILACS and SciELO, members of BIREME system. The keywords used in the search were *Pain*, *Newborn* and *Pain management*. Initially, we conducted an exploratory reading of the material found to verify how the information would be of interest to the study. The next step was a selective reading to determine which material actually contemplated

the research objective. Following, came an analytical reading with the objective to organize and summarize information, enabling to find answers to the research question. Finally, the interpretative reading of material had the objective of relating the author's knowledge with the research problem<sup>(6)</sup>. In accordance with the resolutions of the Copyright Law No. 9610 of February 19, 1998, the works and authors used were properly referenced in the text, respecting the ethical principles<sup>(7)</sup>.

## NON-PHARMACOLOGICAL PAIN MANAGEMENT IN THE NEWBORN

A variety of non-pharmacological interventions has demonstrated effectiveness in the prevention and relief of acute pain in newborns undergoing minor procedures. They have proven efficacy and low risk for newborns, as well as low operating costs<sup>(2-3,8-9)</sup>.

### Glucose/sucrose per oral

Administration of sweetened solutions directly on the newborn's tongue about two minutes before painful procedures causes release of endogenous opioids that have intrinsic analgesic properties, blocking the pain pathways. Sweetened solutions reduce the duration of crying, attenuate facial expressions of pain, minimize the elevated heart rate and the scores in the application of pain assessment scales<sup>(1,8)</sup>.

The mechanism of action when administering sucrose/glucose orally for pain control is not yet fully defined. Apparently, two mechanisms are involved, namely: firstly, the sweet flavor sensation stimulates the taste and activates cortical areas related to pleasure capable of promoting physiological and sensory effects, with the release of endogenous opioids that occupy their own receptors (mainly  $\mu$  receptors), modulating the painful experience. These benefits are increased when associated with non-nutritive sucking of a pacifier or a gloved finger; the second mechanism is related to the action of endogenous opioids that occupy nociceptors, modulating neuronal transmission of pain stimulus<sup>(10)</sup>.

Sucrose and glucose are among the most studied solutions with best analgesic effect<sup>(1,8)</sup>. However, offering sucrose 24% appears to be more effective than other glucose solutions. It has increased effectiveness when administered together with non-nutritive sucking. Sucrose is indicated in procedures such as capillary blood collection, naso/oropharyngeal and endotracheal aspiration, lumbar puncture, venous or arterial puncture, intramuscular injections, urinary catheterization, passage of gastric/enteral feeding and eye exam (for retinopathy of prematurity). It is also an ancillary therapy to pharmacological management in procedures such as insertion of a peripherally inserted central catheter (PICC), central venous catheter surgically inserted, percutaneous arterial catheter and chest tube<sup>(2,11)</sup>.

The Cochrane database review that used randomized controlled trials with samples of term and preterm newborns shows sucrose is safe and effective for reducing pain related to procedures. The optimal dose could not be identified due to inconsistent use of sucrose dosages in the studies. The review suggests further research into repeated dose administration

and the use of sucrose in combination with other pharmacological and non-pharmacological interventions, as well as larger studies on the use in newborns of extremely low birth weight and unstable or those under mechanical ventilation<sup>(12)</sup>.

A wide range of sucrose doses is used for pain relief, but an optimal dose has not been established. The American Academy of Pediatrics<sup>(3)</sup> recommends doses between 0.012 and 0.12 grams (0.05 to 0.5 ml of 24% solution) and suggests multiple doses (two minutes before and after one to two minutes) are more effective than single doses for painful procedures. A study<sup>(11)</sup> with the collaboration of 12 centers in the *Vermont Oxford Network* aiming to develop better practice guidelines on the use of sucrose for pain relief in neonates reports there are no evidences of dose limits. However, it recommends using the least possible amount for providing pain relief. The authors bring limit doses according to gestational age as follows: 0.5 ml for NBs between 27 and 31 weeks, 1 ml for NBs between 32 and 36 weeks and 2 ml for NBs of 37 weeks gestational age or older.

A review study<sup>(13)</sup> on knowledge about the mechanisms of action of sucrose-induced analgesia shows the duration of effect in healthy newborns varies from 1 to 45 minutes and suggests that administering small amounts of sucrose throughout the painful procedure can guarantee a longer lasting analgesic effect. The study also demonstrates that sucrose is less effective when used for prolonged periods or relief of more intense pain, without specifying the time considered as prolonged use.

A randomized, controlled, double-blind study<sup>(14)</sup> carried out in a NICU in the interior of São Paulo aimed to evaluate the efficiency of administering sucrose 25% orally in repeated doses of 0.5 ml/kg over several days for pain relief in preterm infants. It showed this model is effective for pain relief in premature and did not bring immediate side effects for their state of health.

Sucrose is effective when used in premature infants of 25 weeks gestational age. Nonetheless, the results in the development of premature infants less than 32 weeks' corrected age are concerning due to possible long-term deleterious effect, suggesting judicious use in newborns in this age group<sup>(11)</sup>.

Reported adverse effects involve small falls in saturation during oral administration of sucrose, gagging, coughing or vomiting. Other possible effects include metabolic changes such as hyperglycemia and necrotizing enterocolitis (NEC). As neither hyperglycemia nor NEC have been proven in studies, the adverse effects are still hypothetical<sup>(11)</sup>.

### Non-nutritive sucking

Sucking is a natural reflex of the newborn, and one of the most used behavioral measures in the NICU not only for analgesia, but also for promoting comfort and calmness. The non-nutritive sucking of a pacifier or a gloved finger may decrease hyperactivity and regulate newborns' discomfort. It may also reduce the intensity and duration of acute pain in preterm and full term infants undergoing painful procedures. Its effects are associated with increased oxygenation, improvement in respiratory and gastrointestinal functions (feeding by gavage), decreased heart rate and energy expenditure. The benefits occur

during rhythmic suction and a possible rebound effect with its interruption<sup>(1-2)</sup>.

A study<sup>(15)</sup> comparing the effectiveness of sucrose oral administration and non-nutritive sucking in newborns at term undergoing vaccination against hepatitis B showed that sucrose given two minutes before the procedure was more effective in relieving pain than non-nutritive sucking, although both were more effective than only routine care.

Another prospective, randomized and controlled study<sup>(16)</sup> compared the effectiveness of two non-pharmacological pain relief strategies – non-nutritive sucking and facilitated tucking - with routine care in preterm newborns. The study showed non-nutritive sucking and facilitated tucking reduced pain scores in the PIPP scale (Premature Infant Pain Profile) more effectively than routine care during the heel puncture, and non-nutritive sucking represented an even greater reduction in pain.

### Breastfeeding

The suction of maternal breast for reducing pain responses in healthy newborns undergoing painful procedures (including venous and heel puncture) has demonstrated positive effects<sup>(1)</sup>. In general, the effectiveness of breastfeeding is perceived for acute pain relief in newborns as an intervention, and due to aspects it comprises (skin-to-skin contact, sucking, odor and taste of breast milk). Pain relief is enhanced with combined treatments: skin-to-skin contact and milk or glucose, non-nutritive sucking and glucose, and multisensory stimuli and glucose. Breastfeeding brings together all these elements and is considered an advisable intervention in acute pain procedures in neonates<sup>(17)</sup>.

A study conducted in Brazil compared a group of breastfed newborns with another group that received only maternal lap during blood collection. It concluded that breastfeeding was effective for reducing pain in newborns at term<sup>(18)</sup>.

The same effectiveness is not found in preterm newborns. Neonates between 30 and 36 weeks of gestational age were randomized in the breastfed group or the group that received a pacifier during blood collection, in a study aiming to evaluate the effectiveness of breastfeeding in reducing pain and determine if the breastfeeding ability changed after this treatment. Breastfeeding did not reduce physiological or behavioral response rates to pain during the procedure. However, no immediate adverse effect on the newborns' breastfeeding ability was found when breastfeeding was combined with a painful procedure<sup>(19)</sup>.

The efficacy of administering expressed breast milk versus glucose 25% in response to pain in late preterm newborns during heel puncture was evaluated using the PIPP scale. The results indicate expressed breast milk has less effect than glucose 25%<sup>(20)</sup>.

### Skin-to-skin contact

Skin-to-skin contact during a painful procedure reduces physiological and behavioral signs of pain<sup>(2)</sup>. This strategy has proven effective in reducing the pain of newborns during acute procedures, especially after capillary punctures. Skin-to-skin contact should initiate before the painful procedure and

be kept throughout its duration and after it is finished, when possible<sup>(21)</sup>.

A study tested the effectiveness of skin-to-skin contact between mother and preterm newborns from 30 weeks gestational age during heel puncture. It showed the group receiving skin-to-skin contact had lower pain scores in the NFCS scale (Neonatal Facial coding System) than the group who received only routine care during puncture. The results show skin-to-skin contact can be used as a non-pharmacological intervention for pain relief in stable preterm infants from 30 weeks gestational age<sup>(22)</sup>.

### Facilitated tucking and swaddling

The gentle containment of members near the trunk by bending the lower extremities and aligning the midline of the upper limbs bent, placing the hand near the mouth, is effective in promoting physiological and behavioral stability. When involved in a blanket or nest and contained during painful procedures, preterm infants cry for less time, stabilize the sleep-wake cycle and have fewer changes of heart rate<sup>(1-2)</sup>. A firm containment, but allowing some movement, sends the central nervous system a continuous stream of stimuli that can compete with painful stimuli by modulating pain perception and facilitating self-regulation in less intensive painful procedures<sup>(21)</sup>.

The use of facilitated tucking in preterm newborns of 25-34 weeks gestational age during routine care has reduced pain scores evaluated by the PIPP scale, helping to maintain stability in the autonomic and motor systems and behavioral states<sup>(23)</sup>.

Another systematic review study aimed at reviewing the effectiveness of facilitated tucking as non-pharmacological pain management in preterm newborns. The results suggest facilitated tucking can benefit preterm infants by attenuating their responses to painful procedures<sup>(24)</sup>.

Swaddling may be used in newborns as long as they are adequately monitored and clinically stable. The gentle and constant stimulation of swaddling to the proprioceptive, tactile and thermal receptors provides stimuli that can compete with pain and stress, being more effective when performed before any procedure or maintained most of the time<sup>(21)</sup>.

### CONCLUSIONS

Despite the increasing awareness of health professionals that newborns admitted to the NICU experience pain, relief methods during routine procedures are often not used. The literature shows several non-pharmacological methods of pain relief in the newborn. The knowledge of the health team about these methods is important so they are better used in the NICU on a daily basis. It is important that each health service develops strategies to minimize the number of painful or stressful procedures and provides non-pharmacological or pharmacological effective relief in all procedures performed. In addition, the team must be constantly mobilized for preventing pain and using relief methods. The use of non-pharmacological methods of pain relief is essential to ensure qualified and humanized care to the newborn, and prevent possible damage due to prolonged exposure to pain.

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