

## Pain in Neonates and Possibilities of its non-pharmacological Control

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### ABSTRACT

**Aim:** The aim of study is a literary analysis of the current most used non-pharmacological methods of relieving pain in neonates for the best evidence-based practice.

**Methods:** For obtain data for the period 2000–2012 were used e-licensed and freely accessible database. Evaluation of the evidence found was carried out according to the methodology Fineout-Overholt, Johnston (2005), who put the study according to specific criteria in seven categories. The selection of the present study were classified evidence level I, II, III. Selected criteria met the 42 studies (4 meta-analyzes, 6 systematic reviews, 1 multicenter study and 31 randomized controlled study).

**Results:** Non-pharmacological methods used to control pain in neonates are much more effective when used in combination with other non-pharmacological methods, such as swaddling, facilitated tucking, multisensory stimulation, kangaroo care and non-nutritive and nutritive sucking.

**Conclusion:** Non-pharmacological methods are effective and lead to effective pain relief especially when minor procedural performance as the heel lanceting, venipuncture, etc. Treatment of pain and management prevention should be an essential part of the standard and intensive care of the newborn.

### KEY WORDS

non-pharmacological methods, damping pain, newborn, evidence based practice

### INTRODUCTION

Paediatric pain is a phenomenon that has until recently been ignored by physicians as a specific problem. Research into children's pain began to draw larger attention only as late as the 1980s and 1990s (Palyzová, 2004). In literature, there are multiple definitions and explanations of 'pain'. Definition made by the International Association for the Study of Pain in 1979 ranks among the most widespread: „Pain is an unpleasant sensory and emotional experience associated with actual or potential tissue damage, or described in terms of such damage.“

In recent years, specialized literature that focuses on neonatal pain has established that neonates are able to perceive and experience pain. The perception of pain is affected by the child's health and mental state, the environment and time of day, gestational age, and the sleep and wake cycle (Fendrychová, Borek, 2007). Delivery itself – the child's transition from the foetal period into the neonatal period – is one of the most dynamic and at the same time most hazardous situations in human life that are highly

stressful (Ezrová, 2011). Already in the delivery and the early adaptation stage of the post-delivery period, neonates face a varying external environment while being exposed to a number of invasive interventions, the resulting perception of which is pain (Palyzová, 2004). Perinatal traumas or early adverse experiences are assumed to potentially lead to psychosomatic or functional diseases later in life (Mydlinová, 2005).

Neonates, in particular preterm neonates, are more sensitive to pain than older children and adults (Belieni et al., 2003, Buvanendran et al., 2006). In prematurely born children, the lower pain threshold is associated with the immaturity of the neural system, which contributes to hypersensitivity to repeated painful procedures (Fitzgerald et al., 2000). Carbajal (2008) and Lago (2005) highlight that neonates undergo the average of 16 painful procedures a day. Premature children that were born too early are subjected up to 100 painful procedures within the first 2 weeks of hospitalization (Liaw, 2011). Intensive care for pathological mature, immature and premature neonates inherently involves a number

of examination and therapeutic methods (repeated heel lances, venepuncture, physiological monitoring, catheterization, alternative dietary options, etc.) associated with procedural painful perceptions (Palyzová, 2004). Evidence suggests that repeated exposure to pain modifies the subsequent processing of pain, long-term development, and behaviour in neonates. Neonatal pain leads to both psychological and physiological consequences; pain provokes hypoxemia, hypertension, tachycardia, higher heart rate variability and intracranial pressure (Gitto, 2011).

Pain needs to be one of the first items to examine in children, while pain treatment needs to be one of the first aspects to focus on (McGonigle, 2006). Effectively and adequately evaluated and treated pain is one of the essential requirements of meeting the needs of every individual. Everyone has a basic human right not to suffer from pain, and the ensuing right for timely and professional treatment of pain (IASP, 2004).

## NON-PHARMACOLOGICAL APPROACHES TO PAIN MANAGEMENT

Non-pharmacological methods are characterized by short-term efficiency but also good tolerability, and are recommended for pain prevention and management (Walter-Nicolet et al., 2010, Cignacco et al., 2007, Anand et al., 2001). In neonates, non-pharmacological interventions of pain management primarily serve to decrease stress, anxiety, and provide comfort and security. Non-pharmacological methods do not have any adverse effects, do not require any special equipment, and can be applied anytime (McGonigle et al., 2006). They work best if used systematically ahead of painful or stressful procedures and operations.

Available literature shows a broad scope of evidence testifying to the efficiency of these methods of pain management in children (Good et al., 1999, Kolk et al., 2000, Saeki et al., 2002, Hunt et al., 2004, Pölki et al., 2008, So et al., 2008). Non-pharmacological treatment is not a mere alternative; it complements pharmacological interventions that must be used if necessary (Walter-Nicolet et al., 2010).

Pilal Riddell (2011) classifies these non-pharmacological methods of pain management into three groups: contextual, cognitive, and behavioural.

Contextual strategies include comprehensive nursing care that protects the child from adverse external stimuli – excessive noise, sharp light, a hot or cold stress factor, inadequate stimulation or being isolated from parents. The formation, duration, and effects of pain are also influenced by the environ-

ment in which the painful procedure has been carried out (Fendrychová, Borek, 2007).

Cognitive strategies help distract attention away from pain, for example by using various audiovisual stimuli. There are also various behavioural techniques such as positioning, facilitated tucking, swaddling, non-nutritive and nutritive sucking, kangarooing, etc. (Pillai Riddell, 2011).

## AIM

The study aimed to analyze the current, most widespread non-pharmacological methods of pain management in neonates for evidence-based best practice.

## METHODS

Research question: How do non-pharmacological methods affect pain management in neonates?

Data were processed using the method of evidence-based practice. The analysed data on the effects of non-pharmacological methods of pain management in neonates were sourced from licensed and freely accessible electronic databases (Medline, ProQuest, Google, Google Scholar, Web of Science, Springer, Blackwell, Wiley, Science Direct, Cochrane Collaboration). In order to be included in our study, articles/research papers had to publish their outputs/evidence in the years 2000 through 2012. The following key words were used in the search: non-pharmacological methods – damping – pain – neonates – evidence based practice.

The evidence found was assessed based on an evidence level table (Table 1), whose authors (Finneout-Overholt, Johnston, 2005) distinguish seven specific categories of these studies. Evidence Level 1, 2, and 3 were included in our study.

**Table 1** Evidence level in deciding on intervention

Level 1	Evidence from systematic reviews or meta-analyses of all relevant randomized controlled trials (RCTs)
Level 2	Evidence obtained from practical clinical guideline processed based on systematic reviews and RCTs
Level 3	Evidence obtained from at least one duly-prepared randomized controlled trial
Level 4	Evidence from a duly-prepared non-randomized controlled trial and a duly-prepared case study and a cohort study
Level 5	Evidence from the systematic review of a descriptive and qualitative study
Level 6	Evidence from one descriptive and qualitative study
Level 7	Evidence from an authority's opinion and/or an expert committee report

The analysis eliminated studies that document health care in a language other than Czech or English, and studies of evidence lower than Level 3. In order to ensure maximum possible objectivity of results, systematic reviews were also incorporated in the study.

A total of 42 studies met the criteria required for inclusion in the study. These were further divided into 4 meta-analyses, 6 systematic reviews, 1 multicentre trial, and 31 randomized controlled trials (RCTs). The established evidence that was incorporated in our study was from various countries in Europe (Germany, France, Italy, UK, Netherlands, Switzerland), America (USA, Canada, Brazil), and Asia (Israel, Jordan, Saudi Arabia, Turkey, India, China). Over 13,600 neonates, both preterm and term ones, were included in all the analysed studies.

## RESULTS

At present, specialized literature provides a lot of information on varied non-pharmacological methods, and their use in pain management in neonates. Analysing 42 found studies that deal with the issue, most of them confirm the positive results of non-pharmacological methods used in both preterm and term infants. These studies assess, above all, procedural pain caused by diagnostic and therapeutic interventions such as venepuncture, heel lance, and aspiration.

Analysis of the found evidence suggests that the most widespread non-pharmacological methods of pain management in infants include multisensory stimulation, swaddling, facilitated tucking, skin-to-skin contact, acupuncture, non-nutritive and nutritive sucking.

Multisensory stimulation mainly consists of tactile, olfactory, auditory (voice), and gustatory stimulation and visual contact. Familiar smells or familiar multisensory (tactile, auditory, gustatory, olfactory) stimulations can calm the infant down (Marešová, 2007). Sensory saturation improves the quality of life of newborns at the neonatal intensive care unit (Bernardini, 2011). Most authors, nevertheless, prefer combining the multisensory stimulation with other non-pharmacological methods of pain management (Cignacco et al., 2007, Golianu et al., 2007, Johnston et al., 2009, Campel-Yeo, 2011). Sensory saturation in newborn infants is an effective analgesic method that potentiates the analgesic effects of oral sucrose. It is used primarily in minor painful procedures and interventions carried out on newborns (Bellieni et al., 2002). Gitto et al., 2011 recommend multisensory stimulation even in preterm neonates from 27 weeks of gestation on.

Wrapping the infant in cloth makes the newborn feel safe, secure, and calmer. It also improves the infant's physiological functions and behaviour (Liaw, 2011). In preterm infants, it prolongs the duration of sleep, improves the motor and neuromuscular development, while alleviating the physiological distress (Sleuwen, 2007). This non-pharmacological method has minimum adverse effects (Prasopkittikun, 2003). In their research, many authors highlight the desirability of combining swaddling with other non-pharmacological methods to enhance the effect when dampening procedural pain. (Walter-Nicolet et al., 2010, Cignacco et al., 2007, Golianu et al., 2007, Lossaco et al., 2011, Leslie, Marlow, 2006, Shendurnikar, Gandhi, 2005). If none of the other non-pharmacological methods of pain management is feasible, it is recommended to at least swaddle the child or apply the pacifier (Shah, Aliwalas).

Facilitated tucking is a developmentally sensitive non-pharmacological measure that effectively alleviates pain in neonates (Cignacco et al., 2007, Leslie, Marlow, 2006, Ward-Larson et al., 2004, Axelin, 2006, Axelin 2009). In this position, the newborn's limbs are held in a flexed position close to the trunk. The position reduces elevated heart rate, improves oxygen saturation, sleep, and waking in preterm infants in procedural pain (Obeida et al., 2009). Facilitated tucking is not as effective an intervention as sucrose is, and cannot be recommended as an auxiliary non-pharmacological treatment in repeated exposures to pain (Cignacco, 2012).

Kangarooing is a close contact between the mother and her child, skin-to-skin contact. Kangarooing provides the infant with tactile and olfactory stimuli, as well as auditory and vestibular stimuli when the mother speaks to her child (Johnston et al., 2009). Kangarooing reduces pain during and after invasive interventions in preterm and term neonates (Johnston et al., 2008, 2009, Akcan et al., 2009, Ferber, Makhoul, 2008, Castral et al., 2008, Ludington-Hoe et al., 2005).

Kangaroo care should be complemented with sensory stimulation (tactile, visual, olfactory or gustatory contact) (Johnston et al., 2009). Kangarooing reduces stress in term and preterm infants (Ferber, Makhoul, 2008). It dampens the infant's overall response to pain (lower heart rate elevation, shorter interval of crying, and less grimacing). Skin-to-skin contact is recommended as a non-pharmacological intervention reducing acute pain in newborns (Johnston et al., 2008, Castral et al., 2008, Ludington-Hoe et al., 2005).

Another widespread non-pharmacological method with a positive impact on pain in neonates is non-nutritive sucking. This involves using the pacifier to

calm the child, instead of feeding it (Marešová, 2007). Non-nutritive sucking reduces infants' anxiety and interval of crying during routine procedures (Corbo, 2000). Non-nutritive sucking is more efficient in dampening pain in preterm infants than swaddling or sucrose or glucose administration (Liaw et al., 2012, Liu et al., 2010). Multisensory stimulation and non-nutritive sucking by means of a pacifier are more effective in dampening pain than nutritive sucking or massaging the injection site in newborns (Mathai et al., 2008).

Today, many authors consider the non-pharmacological method of non-nutritive sucking an effective method of pain management in neonates. In terms of nutritive sucking, the authors of research studies included in our study investigated the influence of breast milk and formula, sucrose, and glucose (Shah et al., Shendurnikar, Gandhi, 2005, Bellieni et al., 2002, Elserafy et al., 2009, Uga et al., 2008, Philips et al., 2005, Carbajal et al., 2003, Gray et al., 2002, Gibbins et al., 2002, Deshmukh, Udani, 2002, Carbajal et al., 2002, Bilgen et al., 2001, Slater, 2010, Hogan, 2012). Breast milk is supportive, providing a psychological advantage in reducing pain in neonates.

Evidence shows that breastfeeding reduces heart rate and the interval of crying more than formula-based feeding. Campbell-Yeo (2011) recommends using breast milk for its analgesic effect only during standard heel lance or venepuncture. The analgesic qualities of breastfeeding have the same effect as a combination of 30% glucose and the pacifier (Carbajal et al., 2002). Administration of 25% glucose significantly reduces the interval of crying (by 91%), grimacing (by 84%), and has a considerable impact on heart rate, breathing, and oxygen saturation. A concentrated solution of glucose dampens pain and may be a useful and safe analgesic in neonates during minor procedural interventions (Deshmukh, Udani, 2002). Administration of 25% sucrose represents a better pain reliever than breastfeeding. This affects mainly the interval of crying and behavioural variables (Beligen et al., 2001). Sucrose works immediately with permanent effects, while stimulating the release of endorphins (Lossaco et al., 2011). In neonates, the pain relief dosage is either 0.24 g as 2 ml of 12% sucrose solution or 0.50 g as 2 ml of 25% sucrose solution (Palyzová, 2004). The dosage is recommended to be administered about 2 minutes prior to the procedure (Stevens et al., 2010). However, Slater (2010) notes that the oral administration of sucrose has no major impact on the activity in the neonatal brain or spinal nociceptive circuits, and thus need not be an effective analgesic intervention. Given that the

oral administration of sucrose reduces and not completely eliminates pain in infants, it should be used with other non-pharmacological methods to increase its efficiency.

Recently, the available literature has been seeing research that is focused on acupuncture and its pain dampening effects. Acupuncture can provide an effective approach to non-pharmacological treatment of pain in the newborn, including moderate pain. If performed by appropriately trained professionals, the method is safe, without any side effects (Adams et al., 2011). Acupuncture should be included in the multidisciplinary algorithm for pain management in neonates (Golianu, et al., 2007).

## CONCLUSION

In recent years there has been significant progress in understanding the physiology of neonatal pain, as well as the effectiveness of non-pharmacological interventions. This article deals with the use of the most common non-pharmacological methods to control procedural pain in both preterm and term neonates. According to the authors of the analyzed studies, the most effective method for the control of pain, discomfort, and stress in neonates is nutritive sucking, especially using sucrose.

Administered prior to a painful intervention, sucrose demonstrably reduces the elevation of heart rate, duration of crying, reactions of the face and limbs connected to pain, while maintaining normal oxygen saturation. However, it requires further attention and research. Even greater pain relief can be achieved by combining nutritive suction with other non-pharmacological interventions.

Some recent surveys indicate that most procedural interventions are still performed without effective pain management measures (Carbajal et al., 2008, Lago et al., 2005). Therefore, adequate management and prevention of pain should be integral to both standard and intensive neonatal care.

## SUMMARY RECOMMENDATIONS FOR NEONATAL CARE

- Protect the child from hyper stress (caused by excessive and frequent handling, sharp and bright light, cold, and noise), reduce the frequency of painful procedures to minimum.
- Correct, effective, and flexible approach to evaluating, assessing, and controlling pain in newborns.
- Use non-pharmacological pain relieving methods during each procedure carried out on infants; it is recommended to combine these methods and



also allow contact between child and mother during procedure.

- With a larger number of painful procedures and greater pain intensity, adequately combine non-pharmacological and pharmacological interventions.
- Educate medical staff about the evaluation, assessment, and pain management options.

## EXPLANATION OF TERMS

- *Facilitated tucking* – holding the infant's limbs in a flexed position close to the trunk.
- *Swaddling* – wrapping the infant in cloth.
- *Multisensory stimulation* – tactile, olfactory, auditory (voice), gustatory stimulation, and visual contact.
- *Kangarooing* – close mother-infant contact, skin to skin contact.
- *Non-nutritive sucking* – sucking the pacifier (dummy).
- *Nutritive sucking* – infant sucks breast milk, formula, sucrose and glucose.

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