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Case Study

The application of facilitated tucking in premature infants on pain response during care procedures

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Abstract:
Premature infants have a lower pain threshold due to the immaturity of their nervous system, making them more sensitive to invasive procedures during hospitalization. Repeated pain responses can have long-term impacts on neurological development. One non-pharmacological technique proven effective in reducing pain in neonates is facilitated tucking. This study aimed to analyze the effectiveness of facilitated tucking in reducing pain responses in premature infants during invasive care procedures. This study is a qualitative case study conducted at Jember regional hospital. Samples were selected using purposive sampling. Pain responses were measured using the Premature Infant Pain Profile-Revised (PIPP-R) instrument, before, during, and after the procedure. The facilitated tucking intervention showed a reduction in Premature Infant Pain Profile-Revised (PIPP-R) scores across all observed procedures. Facilitated tucking performed before, during and after the procedure was associated with improved physiological and behavioural stability, as indicated by PIPP-R (lower heart rate and respiratory rate, increased oxygen saturation, nasolabial furrow, eyes squeeze, and brow bulge), compared to when the intervention was not applied or the baseline condition. On average, infants returned to their baseline condition within one minute after the procedure. Facilitated tucking is effective in reducing pain responses in premature infants during invasive procedures such as blood sampling, intravenous insertion and OGT, this pain management can be utilized as a non-pharmacological intervention.

Keywords:
facilitated tucking, premature infants, premature, pain management

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INTRODUCTION

Pain is an emotional and sensory experience resulting from actual or potential tissue damage. In each individual, pain is a subjective response (Bahrudin, 2018). According to the International Association for the Study of Pain (IASP), pain in neonates is defined as an unpleasant sensory and emotional experience associated with actual or potential tissue damage. Pain management is an essential component of developmental care provided to neonates (Setyaningsih & Ramawati, 2024). Infants, including preterm neonates, possess the ability to perceive and respond to pain; however,

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the pain-inhibitory mechanisms in preterm infants are not yet fully developed, making them more sensitive to painful stimuli (Perry et al., 2018). Repeated exposure to pain during early life can lead to disturbances in neurological development, including decreased pain thresholds, hyperalgesia, allodynia, and impaired synapse formation in the brain (Todorović & Petrović-Lazić, 2021).

In developing countries, infants weighing less than 2000 grams (with a gestational age of 32 weeks and without intrauterine growth restriction) have a low chance of survival. In contrast, in developed countries, neonatal intensive care units (NICUs) are accessible to preterm infants with a gestational age of 32 weeks, and even those born at 25 weeks have a survival rate of approximately 50% (Herman & Joewono, 2020). During intensive hospital care, preterm infants may undergo between 6,832 and 42,413 invasive procedures, averaging 7.5 to 17.3 procedures per day (Fatollahzade et al., 2022; Wayuni et al., 2025). Alarmingly, approximately 80% of neonates do not receive adequate pain management (Costa et al., 2017), despite the frequent administration of invasive procedures such as blood sampling, injections, and immunizations (Williams & Lascelles, 2020). Inadequate pain management may increase stress and have long-term consequences, including reduced pain tolerance and a higher risk of chronic pain later in life (Nugrawati et al., 2024).

Pharmacological approaches to pain relief often raise concerns regarding potential side effects and associated risks (Subedi et al., 2024), thus highlighting the importance of non-pharmacological interventions as safe and effective alternatives. One recommended method is facilitated tucking, a positioning technique that simulates the fetal position by gently flexing and supporting the infant's limbs. This method has been shown to reduce pain, stabilize physiological parameters, promote a sense of security, and support motor and emotional development in infants (Altay & Kucukoglu, 2022; Subedi et al., 2024). Facilitated tucking can be performed by nurses or other healthcare professionals as part of developmental care practices (Salah Eldin Mohamed Diab, 2023). Therefore, the present study aims to examine the effectiveness of facilitated tucking in reducing pain responses in preterm infants.

METHOD

This study was conducted in the Perinatology Unit of Jember Regional Hospital starting in November 2024. A qualitative research design with a case study approach was employed to evaluate the effect of facilitated tucking on the pain response of premature infants undergoing invasive procedures (blood sampling, intravenous insertion, and oral gastric tube (OGT)). Sampling was carried out using a non-probability sampling method with a purposive sampling technique. The inclusion criteria included premature infants admitted to the perinatology unit, while the exclusion criteria comprised infants undergoing or indicated for surgery, such as those with Hirschsprung's disease, anal atresia, or congenital heart disease that may affect pain receptor sensitivity.

Data collection utilized both primary and secondary sources. Primary data were obtained through nursing assessments and direct observations, whereas secondary data were derived from patient medical records. Pain responses were measured using the Premature Infant Pain Profile-Revised (PIPP-R) instrument, which has already been translated into Indonesian form (Fitri et al., 2019) and assesses five indicators: oxygen saturation (SpO_2), heart rate, brow bulge, nasolabial furrow, facial expression, gestational weeks, and baseline behavioral before intervention. The

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facilitated tucking intervention was implemented in three phases: 15 minutes before, during, and 15 minutes after invasive procedures, including orogastric tube (OGT) insertion, blood sampling, and intravenous catheter placement. Tools used in this study included PIPP-R observation sheets, pulse oximeters, stethoscopes, and PIPP-R instrument assessment forms. Pain scale interpretation based on PIPP-R scores is as follows: a score of 0 indicates no pain; 1–6.9 indicates mild pain; 7–11.9 indicates moderate pain; and ≥12 indicates severe pain. The total score range for the PIPP-R is 0 to 21.

Data were analyzed descriptively using a qualitative approach, following the stages of the nursing process: assessment, nursing diagnosis, planning, implementation, and evaluation. Ethical considerations were addressed based on the principles outlined in The Belmont Report (1979), including respect for persons (autonomy), beneficence and non-maleficence, and justice. Informed consent was obtained from the infant's family, and confidentiality of the data was maintained throughout the research process (Adiputra et al., 2021).

RESULT

The subject of this case study was a 9-day-old male infant, referred to as Mrs. Y's infant, born to a gravida 2, para 2, abortus 0 mother through a cesarean section at Jember Regional Hospital, due to status epilepticus with suspected meningioma. The delivery was assisted by a physician. The infant was born with no immediate cry, with APGAR scores of 4 at 1 minute and 6 at 5 minutes. The amniotic fluid was clear at birth, with a gestational age of 32 weeks. The physical examination revealed a patent anus and normal genitalia, with no signs of caput succedaneum or cephalhematoma. The newborn weighed 1,695 grams, with a body length of 40 cm, a head circumference of 30 cm, a chest circumference of 28 cm, and an abdominal circumference of 26 cm. Following birth, the infant cried spontaneously and was immediately transferred to the Perinatology Unit at 17:30 local time.

During the initial assessment, the infant appeared weak. An orogastric tube (OGT) was inserted due to an underdeveloped swallowing reflex, and gastric secretions were suctioned. The infant also received a 1 mg injection of vitamin K, gentamycin eye drops, umbilical cord care, and temperature regulation using an incubator. Upon further assessment, the infant was observed in a weakened but actively crying state and received 1 liter per minute of oxygen via nasal cannula. The vital signs at the time were as follows: a heart rate (HR) of 138 bpm, a temperature of 36.3°C, an oxygen saturation (SpO_2) of 100%, and a respiratory rate (RR) of 50 breaths per minute.

Preterm infants are highly vulnerable to extrauterine risks that can lead to complications. Literature indicates that hospitalized preterm infants may undergo more than 10 painful procedures within the first two weeks of life (Medise, 2021). Inadequate pain management increases procedural stress and may cause long-term effects (Khasanah & Rustina, 2017). Therefore, a pain management intervention was implemented using the facilitated tucking technique, which involves placing the infant in a flexed, midline posture (lateral, supine, or prone) mimicking the fetal position. Pain was assessed using the Premature Infant Pain Profile-Revised (PIPP-R) instrument, which measures pain intensity before, during, and after nursing procedures.

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Evaluation of evidence-based nursing (EBN) implementation was conducted over three consecutive days. On the first day, facilitated tucking was applied during a blood sampling procedure and OGT, performed for 15 minutes before, during, and after the procedure. Pain was assessed using the PIPP-R scale at two time points (during and after): 10 minutes before the procedure (seeing the baseline of the patient's condition), 1–5 minutes during the procedure (assessing PIPP-R), and 10 minutes after the procedure (assessing PIPP-R). Observations of indicator PIPP-R pain levels showed a consistent and significant reduction in PIPP-R scores across the three days, as summarized in Figure 1 – 3 and Table 1.

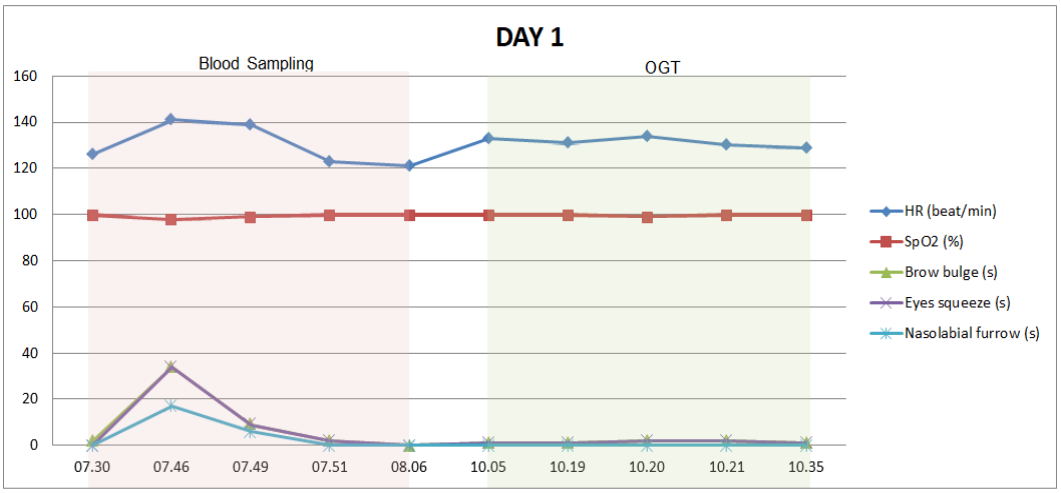

Figure 1. Day 1 PIPP-R indicator detail

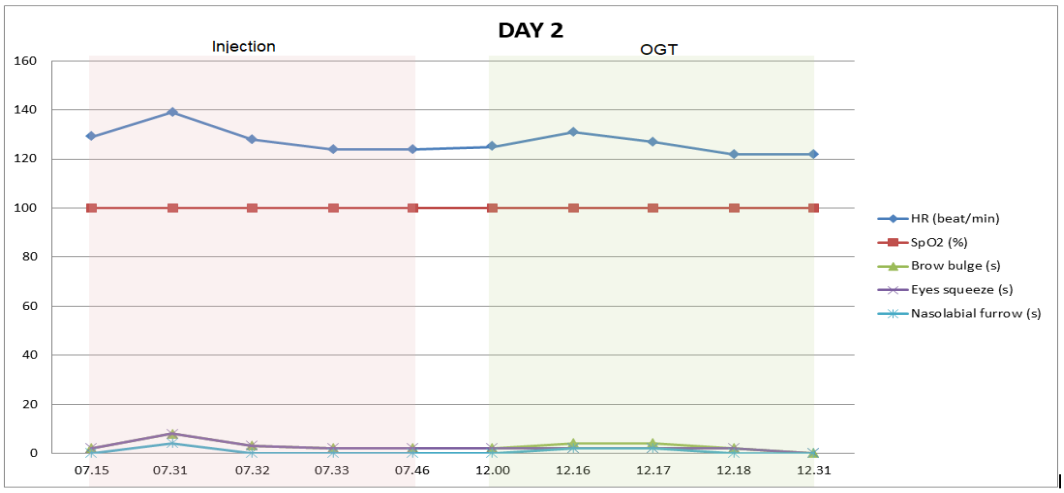

Figure 2. Day 2 PIPP-R indicator detail

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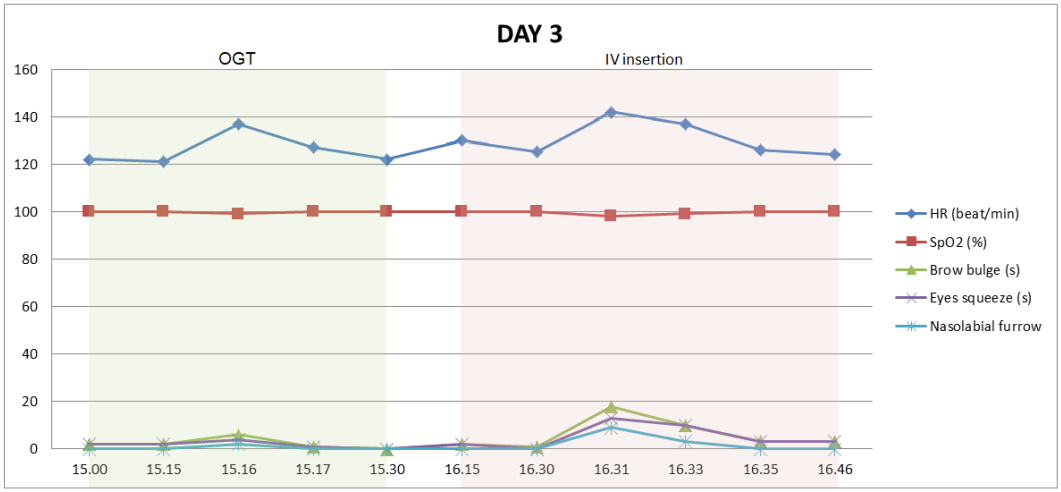

Figure 3. Day 3 PIPP-R indicator detail

Table 1. Three Days PIPP-R Score

Day	Intervention	PIPP-R Score during intervention	PIPP-R Score after intervention	Difference	Information
1	Blood Samples OGT	11 3	2 2	9 1	Post phototerapy, The patient experienced weight loss 16.5%
2	Injection OGT	7 3	3 2	4 1	Patient is stable Weight loss 15.6%
3	OGT Intravenous insertion	4 11	2 3	2 8	Temperature elevation at 37.3 ^{0}C (average at 36.1 – 36.6 ^{0}C)

The table indicates that on Day 1, the PIPP-R score during blood sampling reached 11 and decreased to 2 after the procedure. A similar result was observed in the OGT procedure, with a score decreasing from 3 to 2. On Day 2, medication injection showed a decrease from 7 to 3, while the OGT procedure remained stable. On Day 3, intravenous insertion resulted in a PIPP-R score of 11, which decreased to 3 post-procedure. Overall, the findings showed that post-procedural PIPP-R scores were consistently lower than scores recorded during the procedures.

DISCUSSION

The patient is a female at 32 gestational weeks. Male infants exhibit greater increases in heart rate during heel stick procedures compared to female infants, suggesting higher oxidative stress and potential long-term effects on brain development (Field, 2017). Other studies have also shown that male preterm infants are at increased risk for neurological developmental impairments compared to female preterm infants (Williams & Lascelles, 2020). This aligns with findings indicating that infants born between 28–34 weeks of gestation possess sensory systems capable of detecting stimuli but remain immature, making them more susceptible to sensory developmental disorders due to

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repeated environmental stimuli (Marchal et al., 2021). Gestational age also influences pain modulation, as infants born at <35 weeks often show diffuse and nonspecific brain activity in response to painful stimuli due to immature neurological systems (Verriotis et al., 2018). Premature infants with low birth weight are more vulnerable to early-life pain and stress during hospitalization. The underdeveloped nervous system makes them more sensitive to environmental and procedural stimuli, increasing their risk of neurological deficits, neurobehavioral disorders, and psychosocial problems that extend from infancy to adolescence. Adolescents aged 19 years who were born prematurely or with low birth weight exhibited lower pain thresholds and tolerance. The lower the birth weight, the greater the exposure to painful invasive procedures, increasing the likelihood of long-term changes in pain perception (Eckstein Grunau, 2002; van Ganzewinkel et al., 2017).

The pain management intervention provided to By. Ny. Y included identification of nonverbal pain responses, such as changes in heart rate, oxygen saturation, brow bulge, eye squeeze, and nasolabial furrow, as well as environmental stressors, including room temperature. Facilitated tucking, a non-pharmacological technique, was used to reduce pain. Due to their developmental limitations, premature infants often fail to show clear behavioral and physiological pain cues compared to full-term infants. Therefore, the PIPP-R scale is frequently used for preterm populations, as it combines physiological data (heart rate, oxygen saturation), gestational age, and facial expressions (brow bulge, eye squeeze, nasolabial furrow), which helps reduce the misinterpretation of pain, especially in non-crying neonates (Field, 2017).

The implementation of facilitated tucking in this study was appropriate for the clinical needs of premature neonates. The intervention was conducted by preparing U-shaped blankets (nesting), checking the incubator temperature, and positioning the infant laterally with flexed limbs greater than 90° at the midline, supported by the nurse's hands or nesting. This technique has demonstrated positive effects in promoting motor and autonomic stability, as well as reducing stress, through proprioceptive input that modulates pain transmission (Nugrawati et al., 2024). Creating a womb-like environment is crucial for reducing external stressors and promoting optimal neurobehavioral development (OE et al., 2022). Facilitated tucking is ideally performed for a minimum of 30 minutes to reduce pain scores and help stabilize physiological, hormonal, and physical responses (Francisco et al., 2021).

On the first day, during blood sampling, the highest PIPP-R score was 11 (moderate pain), with a heart rate peak of 141 bpm. Facial responses such as brow bulge, eye squeeze, and nasolabial furrow were observed during the needle insertion. After the procedure, heart rate decreased to 121–124 bpm, and facial expressions diminished. During OGT insertion, facilitated tucking helped maintain calm behavior, with minimal pain response (score reduced from 3 to 2). On the second day, during drug injection via the existing IV line, the initial heart rate rose from 129 to 139 bpm, SpO_2 dropped to 97%, and crying lasted about 15 seconds. PIPP-R score decreased from 7 to 3 post-intervention. On day three, IV insertion resulted in the highest pain response, with increased facial activity and crying <20 seconds. The PIPP-R score decreased by 10 points after facilitated tucking. Among all procedures, IV insertion, blood sampling, and OGT placement were associated with different levels of pain. IV insertion showed the highest pain response, likely due to its invasive nature and longer duration. In contrast, OGT insertion, being a familiar routine intervention that did not damage tissue, resulted in minimal score variation. Temperature increase observed during IV insertion (from 36.6–36.8°C to 37.3°C) may indicate an autonomic stress

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response unrelated to pain, such as hunger or environmental change (Topalidou et al., 2019). Over three days, facilitated tucking consistently helped the infant return to baseline physiological and behavioral states, with improvements noted in indicators such as lower heart rate, maximum oxygen saturation, normal respiratory rate, and a calm or sleeping behavioral response within approximately one minute after procedures, resulting in a 54.5% reduction in pain intensity. These findings are supported by Sundaram et al. (2013), who found that PIPP scores in preterm infants were significantly lower during and after heel stick procedures with facilitated tucking compared to those without. A study by Mill & Molly Babu (2020) also confirmed that infants receiving facilitated tucking during routine procedures experienced lower stress levels compared to those without the intervention. Subedi et al. (2024) similarly reported that facilitated tucking is effective in reducing pain scores and maintaining physiological stability during heel stick procedures.

CONCLUSION

This study demonstrates that the application of facilitated tucking is an effective non-pharmacological intervention to reduce pain response in premature infants undergoing invasive procedures such as blood sampling, intravenous insertion, and orogastric tube placement. The implementation of this technique resulted in a significant decrease in PIPP-R scores, with an average pain reduction of 54.5%, and a return to the physiological baseline within approximately one-minute post-procedure. Facilitated tucking not only helped to stabilize heart rate and oxygen saturation but also minimized behavioral indicators of pain, such as brow bulge, eye squeeze, and nasolabial furrow. The technique provided a calming effect by simulating the intrauterine environment and offering proprioceptive input, which is essential for premature neonates with underdeveloped pain modulation systems.

CONFLICT OF INTEREST

The authors declare that they have no conflict of interest.

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