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Effect of repeated Kangaroo Mother Care on repeated procedural pain in preterm infants: A randomized controlled trial

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ABSTRACT

Background: Preterm infants' repeated exposure to painful procedures may lead to negative consequences. Thus, non-pharmacological pain management is essential due to medication side effects. Kangaroo Mother Care, which aims at offering human care to neonates, has been established for the treatment of a single painful procedure, but the effectiveness of Kangaroo Mother Care across repeated painful procedures is unknown.
Objective: To test the effectiveness of repeated Kangaroo Mother Care on repeated heel-stick pain in preterm neonates.
Design: Randomized controlled trial.
Setting: Level III Neonatal Intensive Care Unit at a large teaching hospital in northeast China.
Method: Preterm infants (gestational age less than 37 weeks) ($n = 80$) were recruited and randomly assigned using a random table format to either an incubator group ($n = 40$) or Kangaroo Mother Care group ($n = 40$). Pain assessments were carried out during four routine heel stick procedures. For the first heel stick, preterm infants in each group received no intervention (routinely stayed in incubator). During the next three heel sticks, the infants in Kangaroo Mother Care group received heel sticks during Kangaroo Mother Care, while infants in the incubator group received heel sticks in incubator. The procedure of each heel stick included 3 phases: baseline, blood collection and recovery. Crying, grimacing and heart rate in response to pain were evaluated at each phase across four heel sticks by three trained independent observers who were blinded to the purpose of the study. Data were analyzed by analysis of variance (ANOVA), with repeated measures at different evaluation phases of heel stick.
Results: 75 preterm infants completed the protocol. Between-group comparison revealed that preterm infants' heart rate was significantly lower, and the duration of crying and facial grimacing were both significantly shorter in the Kangaroo Mother Care group ($n = 38$) than the incubator group ($n = 37$) from the blood collection phase to recovery phase during repeated heel sticks. No significant within-group difference was found in heart rate between the baseline phase and recovery phase through repeated heel sticks for Kangaroo Mother Care group. In contrast, the incubator group experienced significant

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within group differences in heart rate between baseline and recovery through repeated heel sticks.

Conclusion: The effect of repeated Kangaroo Mother Care analgesia remains stable in preterm infants over repeated painful procedures. Given the many invasive procedures that are part of clinical care in preterm infants and most mothers preferred to provide comfort for their infants during painful procedures, Kangaroo Mother Care may be a safe analgesic alternative in preterm infants in whom it is feasible.

What is already known about the topic?

- Hospitalization in neonatal intensive care units is required by the preterm infants; various diagnostic, surgical, or therapeutic procedures could be unpreventable and resulted in pain experiences.
- Exposure to repeated neonatal pain-related stress may lead to poorer cognitive, motor, and behavioral neurodevelopment in infants and children born very preterm.
- Kangaroo Mother Care, as one non-pharmacological method, has been established for the treatment of a single painful procedure, but the effectiveness of Kangaroo Mother Care across repeated painful procedures is unknown.

What this paper adds

- The effect of repeated Kangaroo Mother Care analgesia remains stable in preterm infants over repeated painful procedures.
- Kangaroo Mother Care facilitated preterm infants' behavioral and physical responses to return to the baseline phase more quickly than incubator care after repeated painful procedures.

1. Introduction

The World Health Organization (WHO) reports that 15 million babies are prematurely born annually in the world (WHO, 2014). China contributes to 7.8% of these global preterm births, second only to India which is at the top of the list at 23.6% (Blencowe et al., 2012). Zhao and colleagues (2011) reported a 14% increase in preterm births from 2005 to 2009 in China; it is predicted more than 1.5 million preterm births will occur in China by 2015 (Zhao et al., 2012). Hospitalization in neonatal intensive care units (NICU) is required by preterm infants; however, various unpreventable therapeutic procedures could result in pain experiences for neonates (Evans et al., 2005; Lago et al., 2005).

Neonatal rat models have demonstrated that persistent or repeated pain experiences increase apoptosis of neurons, and neonatal pain and stress lead to anxiety-like behaviors during adulthood (Knaepen et al., 2013). Among preterm infants and children, repeated exposure to neonatal pain-related stress has been associated with altered brain microstructure and stress hormone levels, and poorer cognitive, motor, and behavioral neurodevelopment (Vinall and Grunau, 2014). Thus, pain management is a critical issue in current neonatal practice.

Preterm infants' pain might not be effectively managed by opioids (Axelin et al., 2009; Carbajal et al., 2005), and pharmacological pain management may not be ideal due to medication side effects (Anand et al., 2004). Therefore, non-pharmacological pain management for preterm infants is essential in neonatal practice for pain management. One inexpensive and safe non-pharmacological strategy, which would also provide mothers an opportunity to comfort their infant during painful procedures in a technologically invasive environment, is Kangaroo Mother Care.

Kangaroo Mother Care is operationally defined as the upright prone positioning of the diaper-clad infant, skin-to-skin and chest-to-chest with an adult. The Kangaroo Mother Care method, which is aimed at offering human care to neonates, has been formally endorsed by the WHO (Department of Reproductive Health and Research, 2003). Many randomized controlled trials examining the management of pain during heel sticks and vaccinations have found Kangaroo Mother Care to have an analgesic effect on neonates (Akcan et al., 2009; Castral et al., 2008; Cong et al., 2009, 2011, 2012; Freire et al., 2008; Johnston et al., 2003, 2008, 2009; Kostandy et al., 2008; Ludington-Hoe et al., 2005; Nimbalkar et al., 2013; Okan et al., 2010; Saeidi et al., 2011). Furthermore, a recent systematic review concluded that skin to skin care appears to be effective and safe for a single painful procedure such as a heel stick (Johnston et al., 2014).

However, there have been no studies examining the effectiveness of Kangaroo Mother Care across repeated painful procedures. Therefore, the purpose of this study was to determine if the analgesic effect changed with repeated Kangaroo Mother Care used in repeated painful events. We hypothesized that the effect of repeated Kangaroo Mother Care analgesia remains stable over repeated painful procedures.

Behavioral and physiological outcomes are important to measure because they characterize preterm infants' responses to pain. Young preterm infants often respond to pain differently in behavioral and physiologic measures (Cong et al., 2012; Sellam et al., 2011). Behavioral indicators for pain could include facial activity, cry, body movements and resting positions, fussiness/consolability, and sleeplessness. Crying is a common response to pain in infants (Gibbins and Stevens, 2001) and is considered to be a sensitive method for assessment of pain (Stevens et al., 2006). Some preterm and acutely ill infants may not cry during painful procedures, which may be due to depleted energy reserves, or an inability to cry because of the presence of an endotracheal tube (Johnston et al., 1999;