Kangaroo care in the NICU, part 1:

Understanding the impact of kangaroo care on neonatal vital signs

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Article purpose

Designed for registered nurses, this article presents clinical scenarios related to kangaroo care (KC) that require critical thinking and clinical expertise to assess. Evidence-based rationale and biobehavioral mechanisms of KC that support practice decisions are provided, along with directions for applying the knowledge gained from the clinical scenarios.

Objectives

After reading this offering, the learner will be able to:

1. Describe the physiologic impact of kangaroo care on neonatal heart and respiratory rates and patterns, temperature, oxygenation, blood pressure, pain and physiologic stability.
2. Explain the appropriateness of kangaroo care for mother-infant dyads experiencing common clinical situations in the neonatal intensive care unit (NICU).
3. Assess the neonate's response to kangaroo care and take appropriate actions.
4. Assess the degree to which the nurses's clinical setting meets the intent of the Bogota Declaration and the Humane Care Initiative.

Introduction

Kangaroo care in the NICU is a two-part article. Part 1 presents the historical background of KC and recommendations on KC by professional organizations. It provides clinical scenarios on the effects of kangaroo care on heart rate, respiratory rate, blood pressure, oxygenation, temperature and pain. These scenarios require review of the evidence-base and the physiologic mechanisms to assess the clinical application of KC. Part 1 concludes with eight actions to be taken to enhance kangaroo care's use in the clinical setting.

Part 2 provides clinical scenarios related to infant metabolic processes (hypoglycemia and hyperbilirubinemia), immunologic benefits

(reduced infections), and mental, motor, state and feeding outcomes of KC. It also addresses the maternal and paternal effects of KC.

Kangaroo care is chest-to-chest, skin-to-skin placement of a newborn against a human chest, ideally his mother's chest, to give the infant unlimited access to the breast for infant-led feeding. Many consider kangaroo care a "position" for delivering infant care (Nyqvist et al., 2010b); others consider it the natural habitat (ecological niche) of the newborn (Bergman, 2005; Bergman, Carney & Ludington-Hoe, 2010) or an intervention or therapy for an infant (Ludington-Hoe, 2013b).

KC's origins began in the early 1970s when Klaus and colleagues proposed skin-to-skin contact for the first 2 hours after birth for full-term infants as a therapy to promote maternal-infant attachment (Klaus et al., 1972). Later, Dr. Edgar Rey applied the position to preterm infants, and Drs. Hector Martinez and Luis Navarrete refined the technique for all preterm infants (United States Agency for International Development, 2012).

The practice of KC has spread due to the documentation of a substantial evidence base of studies showing many benefits of KC for preterm and full-term infants (Conde-Agudelo, Bellizan & Diaz-Rosello, 2011; Moore, Anderson, Bergman & Dowswell, 2012), parents (Flacking et al., 2012; Tessier et al., 2009, 2011) and staff (Chia et al., 2006). However, routine and consistent use of KC is rare in the United States (AAP Section on Breastfeeding, 2012; Ludington-Hoe, 2011b; Tozier, 2012).

Recommendations for kangaroo care in the clinical setting

For many years, several professional health care organizations, including the American Academy of Pediatrics (AAP), the Association of Women's Health, Obstetric and Neonatal Nurses (AWHONN) and the National Association of Neonatal Nurses (NANN), have recommended kangaroo care as a clinical practice that promotes numerous health benefits for infants and their families. These organizations have consistently and clearly recommended as much skin-to-skin contact as possible for preterm infants because of the benefits KC all provides to both the baby and the family (Table 1).

Table 1. Summary of benefits of KC

For preterm infants	• Enhances physiologic stability • Improves immunity • Improves weight gain • Shortens length of stay • Enhances metabolic functions • Decreases stress • Decreases crying • Enhances bonding • Eases physiologic transitions • Increases initiation-duration-exclusivity-success of breastfeeding • Provides better temperature regulation than in an incubator • Greatly minimizes pain • Improves sleep • Improves brain, cognitive and psychomotor development • Keeps infants warm • Stabilizes blood pressure (BP) through parasympathetic control • Prevents hypoglycemia • Improves respirations • Provides respite from stressful NICU environment
For families of preterm infants	• Enhances maternal and paternal attachment • Enhances sensitivity and responsiveness to the infant • Increases confidence and competence in providing infant care • Creates more nurturing interactions • Facilitates transition to the home environment • Empowers parents

In 2000, the International Network of Kangaroo Mother Care wrote **The Bogota Declaration** at its meeting in Bogota, Colombia. The Bogota Declaration reflects the KC knowledge base at that time and is intended to inspire increased application and study of kangaroo care. The Bogota Declaration states: "Kangaroo mother care is a basic right of the newborn and should be an integral part of the low-birthweight and full-term newborn's care, in all settings, in all levels of care, and in all countries" (Charpak, de Calume & Ruiz, 2000, p. 1140).

The Humane Care Initiative originated in Estonia for the purpose of advocating unlimited visiting of infants in NICUs by parents and family members. Step 8 of the initiative specifically addresses kangaroo care by stating "Mother and child skin-to-skin contact should be used as much as possible, and the use of technical equipment in child care should be reduced. The mother is the biological incubator for the infant"(Levin, 1999, p. 354).

Recommendations from professional health organizations in the United States, along with the Bogota Declaration and the Humane Neonatal Care Initiative, serve as catalysts for a new era in which kangaroo care is routinely used 24/7 in every NICU.

Clinical scenarios on the effects of kangaroo care

Nurses are concerned about how the infant responds to KC, including vital signs first and foremost and other important physiologic functions, such as weight gain and immunologic, metabolic and hormonal effects. The following scenarios reflect the use and relevance of KC in the clinical setting. Each presents a clinical situation, a nurse's action/response to the situation and evidence for accepting or rejecting the nurse's action/response.

Clinical scenario 1: Heart rate

Baby Cynthia is:

- 25 weeks gestational age (GA)
- 27 weeks postmenstrual age (PMA)
- In an incubator on room air (21 percent O_2)
- Heart rate (HR) is fluctuating between 130 and 170 beats per minute (BPM).

Ms. Canten, Baby Cynthia's mother, sits next to the incubator with her hand on Cynthia's thigh.

NURSE MARIA: Would you like to hold Cynthia skin-to-skin? We can do that now.

MS. CANTEN: We can? I thought when her heart rate is going up and down like that (pointing to the monitor) she needs to stay in the incubator. I would love to hold her skin-to-skin if it's alright for her.

NURSE MARIA: Her heart rate will be OK and even more stable when you hold her than when she's in the incubator. Let's give it a try.

What do you think?

- Is Nurse Maria's response correct?
- Why or why not?

Answers

Nurse Maria's response is correct. Better stability of heart rate occurs during KC than when the infant is in an incubator, in an open-air crib or when held swaddled.

Evidence for the answers

The infant's HR is expected to stay within clinically acceptable ranges because usually preterm infant HR in KC is similar to incubator values; if the HR does change, changes are minimal and remain within each infant's clinically acceptable range

(Ludington-Hoe, 2011a). Even twins and triplets have greater HR stability in KC than in incubators.

KC also benefits cardiorespiratory stability during interhospital ambulance transport (Funk, Tilney, Mitchell & Walker, 2012; Sontheimer, Fischer & Buch, 2004). The Transport Risk Index of Physiologic Stability (TRIPS) scale identifies temperature, BP, respiratory status and response to noxious stimuli as the main predictors of illness severity upon admission to the NICU (Lee, Martin-Anderson & Dudley, 2012; Lee et al., 2012). KC benefits address all of these predictors, making kangaroo care transport a better practice than transport in an incubator. In light of these benefits, the University of Louisville is educating emergency medical services staff in Louisville, Kentucky to transport in kangaroo care infants born outside the hospital so they arrive warm and stable (Barbier, 2013). No other cities are known to have a similar KC transport policy at this time.

Clinical scenario 2: Respiratory rate

Baby Tommy is:

- 10 days old
- 31 weeks GA
- 32 3/7 weeks PMA
- In an incubator on room air
- On caffeine
- A stable "gainer and grower," gaining about 20 grams per day
- Receiving expressed breast milk by gavage

Vital signs:

- Two to three apneas a day
- Temperature = 36.8 C (by incubator's skin temp probe)
- HR = 136
- Respiratory rate (RR) = 42
- Pulse oximetry = 99 percent

Ms. Jackson has been holding her son Tommy in KC for 55 minutes. She is rooming-in with him in a single-family NICU room and has been holding him in KC for prolonged periods every day.

Tommy is breathing comfortably without retractions, grunting or nasal flaring. His color is pink all over. One hour later, Nurse Cindy checks in on Ms. Jackson and Tommy and records:

- Temperature = 37.2 C
- HR = 154
- RR = 24
- Pulse oximetry = 100 percent

Tommy is sleeping quietly, his respiratory effort is unchanged, and his color is still pink. But Nurse Cindy is concerned about Tommy's RR of 24. She completes a full respiratory assessment by evaluating:

- Skin color
- Presence and severity of retractions
- Nasal flaring
- Expiratory grunting
- Air exchange by auscultation
- Pulse oximetry data

Nurse Cindy thinks she needs to tell Ms. Jackson that Tommy needs to go back in the incubator so they can evaluate the low RR. Before she talks to Ms. Jackson, Nurse Cindy discusses Tommy's condition with her colleague Nurse Susie who is certified in kangaroo care by the United States Institute for Kangaroo Care.

What do you think?

- Should Nurse Cindy remove Tommy from KC?
- Why or why not?
- How can Nurse Susie guide Nurse Cindy and/or explain the low RR finding to Ms. Jackson?

Answers

Tommy does not have to be removed from KC because his breathing is not impaired. Nurse Susie can explain the lower RR as normal brain stem response to central (in the brain) oxytocin effects on the medulla oblongata in the brain stem. Continued monitoring is required each and every time the nurse sees the baby, whether in KC or not.

Evidence for the answers

Tommy's respiratory rate of 24 is clearly below normal limits (a condition known as hypopnea) and deserves scrutiny. But Nurse Cindy's assessment reveals that Tommy is not in respiratory distress. Having cerebral oxygenation data would be helpful, too, but without signs of respiratory distress, Nurse Cindy can expect cerebral oxygenation to be between 65 to 80 percent during KC, which is within normal range (Martin & Ludington-Hoe, 2010; Roche-Labarbe et al., 2012). Continuous monitoring of cerebral oxygenation may soon be part of routine NICU monitoring as NICUs transition to neonatal neurointensive care units (Greisen, Leung & Wolf, 2011; Marin & Moore, 2011; Scher, 2008, 2012).

During KC, the c-afferent nerves of the mother's and infant's chest surfaces respond to the pleasing human touch of KC and send the pleasing touch message straight to the insular cortex of the limbic area of the brain. Upon pleasing touch stimulation, oxytocin is released within the brain and travels along neurons to 14 different areas of the brain. The first target is the brain stem where oxytocin immediately calms and stabilizes cardiorespiratory variables as the brain stem shifts from sympathetic (stress, hyperalertness and reactivity, sense of threat) to parasympathetic (relaxation, calm, contentment, safety) control. Under parasympathetic control, which occurs during KC (Begum et al., 2008; Bystrova, 2009; Cong, Ludington-Hoe, McCain & Fu, 2009; Cong et al., 2012; McCain, Ludington-Hoe, Swinth & Hadeed, 2005; Uvnas-Moberg, Arn & Magnusson, 2005), respiratory rate decreases.

Quiet sleep is quiet, regular breathing sleep; it is the predominant form of sleep in KC, but not in an incubator (Ludington-Hoe et al., 2006). When quiet sleep accompanies a parasympathetic-induced low RR, RR can decrease even more. Table 2 identifies respiratory status criteria for an infant to remain in KC.

During KC, an infant's RR may increase slightly or decrease by three to six breaths/minute (Boju et al., 2012). Decreases in RR accompanied by normal breathing patterns are attributable, in part, to the infant being in a head-up, tilted position (Jenni et al., 1997; Schrod & Walter, 2002) or in a prone position (Ammari et al., 2009). This is especially true in the second or third hour of KC when warmth alters respiratory drive by stimulating the thermally sensitive adenosinergic prolongation of the Hering Breuer Reflex (Arnal, Gore, Rudkin, Bartlett & Leiter, 2013).

Table 2. Respiratory criteria for KC

The infant:
- Looks pink
- Has easy respiratory efforts
- Has SaO_2 above 88 percent
- Has no grunting, nasal flaring or retractions

Respiratory rate during KC may be the same as in the incubator (Lai et al., 2006; Ludington-Hoe Anderson, Swinth, Thompson & Hadeed, 2004), even in micropreemies (Heimann et al., 2010; Maastrup & Greisen, 2010) and in ventilated infants (Azevedo, Xavier & Gontijo, 2012). Respiratory rate also has demonstrated increased stability within minutes of onset of KC (Bouloumie, 2008; Parmar et al., 2009).

Despite some variation, RR responses have remained within clinically acceptable ranges and/or have not induced any physiologic compromise. KC is safe in regard to its impact on respirations.

Clinical scenario 3: Apneas and bradycardias

Baby Lidia is:
- 2 weeks old
- 29 weeks GA
- In an incubator
- On a nasal cannula 1 liter per minute (LPM) with 35-percent FiO_2
- On caffeine

Vital signs:

An average of three to four apneas per day, with or without bradycardias

Ms. Jones is sitting by her daughter Lidia. She states that she would love to hold Lidia in KC again today.

Nurse Ricky, who has not taken care of Lidia before, tells Ms. Jones that Lidia has had four episodes of apnea and bradycardia (A/B) today. Lidia is otherwise stable and tolerating her gavage feeds of expressed breast milk well, but Nurse Ricky thinks Lidia needs to rest in the incubator today so she does not have more A/Bs. Nurse Ricky recommends that Ms. Jones wait until tomorrow to do KC.

What do you think?

- Is Nurse Ricky's response correct?
- Why or why not?

Answers

No. The correct response is "Let's try KC; there probably will be fewer A/Bs during KC."

Evidence for the answers

Nurses often incorrectly worry that KC will cause an increase in A/Bs (Mallet et al., 2007). Studies show that A/B events usually do not occur during KC or decrease by 50 to 75 percent compared to frequency in an incubator (Hadeed, Ludington & Siegal, 1995; Masstrup & Greisen, 2010). These findings are true even in extremely low-birthweight (ELBW) infants at 25 weeks postconceptional age (Maastrup & Greisen, 2010). KC limits A/B events due to infant positioning and reduced transitions during sleep and reduced arousals from sleep.

KC also maintains long quiet sleep periods (Ludington-Hoe et al., 2006), dramatically reducing the number of sleep transitions. Apneas usually occur when infants transition between active and quiet sleep (Lehtonen & Martin, 2004). Active sleep predominates when the infant is in an incubator (Lehtonen & Martin, 2004). In active sleep, preterm infants have more irregular breathing with unstable baseline oxygen saturation (Poets & Bodman, 2008). Therefore, apnea occurs more frequently in active sleep than in quiet sleep (Lehtonen & Martin, 2004; Sale, 2010).

KC dramatically reduces arousals from sleep (Ludington-Hoe et al., 2006). Arousals from active sleep predispose preterm infants to apnea with oxygen desaturations because motor activities after arousal from active sleep are frequently accompanied by laryngeal closure (Lehtonen & Martin, 2004). Laryngeal closure is a cause of obstructive apnea.

The infant's upright and prone positioning during KC limits A/B events. Infants elevated 15 to 30 degrees in the KC position have fewer A/B events than infants in horizontal positions (Jenni et al., 1979). Prone positioning improves lung function and optimizes breathing (Gouna et al., 2013).

Many randomized controlled trials have found that the number of A/B events remains the same in KC as in an incubator and that A/B events do not increase during KC, even in ELBW 24-week infants (Ghavane et al., 2012; Hadeed et al., 2005; Heimann et al., 2010). Based on these findings, Jefferies and the Canadian Pediatric Society (2012) conclude that KC is safe to use for infants with mild to moderate apnea.

A nurse's reticence to permit KC when A/Bs are present is common (Mallet et al., 2007). It may reflect knowledge that increased body warmth, which clearly occurs in KC (Moore, Anderson & Bergman, 2007; Mori, Khanna, Pledge & Nakayama, 2010), contributes to increased apnea (Tourneux et al., 2008). But during KC, the infant's temperature does not rise above 37.5 C due to maternal regulation (Ludington-Hoe et al., 2000). Body temperature greater than 37.5 C is associated with increased apneic events (Bohnhorst, Heyne, Peter & Poets, 2001; Sale, 2010).

Baby Lidia was having her usual number of A/B events, and one could expect them to decrease in KC. If she was having an increased number of A/Bs while in the incubator, or if the A/Bs required stimulation to resolve or were prolonged in their resolution, then the nurse would be correct in postponing KC. An increase in the usual number of A/Bs is considered by some to be a contraindication to KC (Nyqvist, 2005; Nyqvist, et al., 2010a) because they may signal the onset of an underlying illness (Bekhof, Reitsma, Kok & van Straaten, 2012).

Clinical scenario 4: Temperature

Baby Jada is:

- 3 weeks old
- 26 weeks GA
- 29 weeks PMA
- On a nasal cannula at 1 LPM with
- 25-percent FiO2
- In an incubator within her neutralthermal environment

Vital signs:

Temperature is within normal limits.

Ms. Fan is visiting her daughter Jada. Nurse Simone notes that Ms. Fan has not had an opportunity to hold Jada in the last 3 to 4 days.

> NURSE SIMONE: Would you like to hold Jada in kangaroo care, skin-to-skin against your chest?
>
> MS. FAN: Yesterday Nurse Barbara told me Jada had to stay in her incubator to stay warm. She said Jada is so small that she'll get cold if we take her out and that kangaroo care would not keep her warm. She told me that it would be too stressful for Jada. I'm afraid that her temperature will drop too low.
>
> NURSE SIMONE: Ms. Fan, Jada will be warm enough in kangaroo care. Your breasts will keep Jada warm as long as you hold her skin-to-skin, chest-to-chest.

What do you think?

- Which nurse is correct, Nurse Simone or Nurse Barbara?
- Why?

Answers

Nurse Simone is correct. KC will keep Jada warm.

Evidence for the answers

Preterm infants do need heat and moisture to maintain their temperature. Evaporative and convective losses can occur if the chest and back are exposed during transfer and throughout KC. Therefore, the infant should be covered during transfer and throughout KC. Stress is greater when an infant is not covered (Newnham, Inder & Milgram, 2009).

As soon as KC begins, transfer of heat from parent to infant occurs, sufficiently compensating for any evaporative and convective losses (Karlsson, Heinemann, Sjors, Nyqvist & Agren, 2012). Preterm and ELBW preterm infants gain body heat during KC (Johanson, Spencer, Rolfe, Jones & Malla, 1992; Ludington-Hoe & Dorsey, 1998; McCall, Alderice, Halliday, Jenkins & Vohra, 2008; Mori et al., 2010). Thermography has confirmed that infant body temperature increases during KC (Heimann et al., 2013), and five meta-analyses have confirmed that KC prevents hypothermia (Conde-Agudelo, Diaz-Rosello & Belizan, 2003, Conde-Agudelo et al., 2012; Ludington-Hoe & Dorsey, 1998; Moore, Anderson & Bergman, 2007; Mori et al., 2010).

During KC, the infant's incubator-based temperature is easily maintained (Heimann et al., 2010). Prevention of hypothermia is expected, as supported by a Cochrane meta-analysis (Conde-Agudelo et al., 2011). Increased water loss through the skin during skin-to-skin contact is small and should not affect the infant's fluid balance (Abouelfettoh, Ludington-Hoe, Burant, Visscher et al., 2011; Karlsson et al., 2012). Because 40 percent of body heat is lost through unprotected heads, even during KC (Karlsson et al., 2012), infants should wear head caps, especially those weighing <1,000 grams or <28 weeks postmenstrual age. Humidity provided by KC is sufficient for small preterm infants (Abouelfettoh et al., 2011; Karlsson et al., 2012).

Nurse Simone's concern about hypothermia in Baby Jada may be based on reports that 25- to 28-week postmenstrual-age infants are not able to be warmed from the heat generated by the mother (Bauer, Pyper, Sperling, Uhrig & Versmold,

1998; Bauer, Sontheimer, Fischer & Linderkamp, 1996; van Zanten, Havenaar, Stight, Ligthart & Walther, 2007). Many nurses have had the same concern (Mallet et al., 2007). However, Karlsson and colleagues' (2012) precise measurements of heat conduction and uptake during KC with ELBW preterm infants suggest that earlier findings are not consistently true. More randomized controlled trial evidence is needed to recommend KC in infants for whom transepidermal water loss is a major concern. However, nurses commonly let mothers hold swaddled very low-birthweight (VLBW) and LBW preterm infants, thinking that swaddling prevents hypothermia better than KC; this is not true (Bonner, 2008; Chwo, Anderson, Good, Dowling & Shiau, 2002; Van Sleuwen et al., 2007).

Nurse Simone is correct because baby Jada is now 29 weeks postmenstrual age and will gain body heat during KC. When transferring Jada from incubator to mother and back, Jada will not lose body temperature if she is covered during transfer (Neu, Browne & Vojir, 2000). Nurse Simone's decision is supported by the recommended use of KC immediately after birth for preterm infants (Clarke, 2009; Munson, Saatkamp & West, 2012) and for rewarming and maintaining warmth during NICU care (Conde-Agudelo et al., 2011; McCall et al., 2008; Munson et al., 2012; World Health Organization Department of Reproductive Health and Research, 2003).

Clinical scenario 5: Blood pressure

Baby Jack is:

- 4 days old
- 25 weeks GA
- 1,450 grams
- On mechanical ventilation at settings of:
  - FiO_2 = 30-percent
  - Intermittent mandatory ventilation (IMV) = 16
  - Peak inspiratory pressure (PIP) = 22
  - Positive-end expiratory pressure (PEEP) = +5

Baby Jack's medical history:

Day 1: Received surfactant two times

Day 2: Failed extubation to nasal continuous positive airway pressure (N-CPAP) when he had a drop in BP/mean arterial pressure (MAP); this required a fluid bolus while being cared for in an incubator.

Day 3: Had a head ultrasound that revealed a Grade I intraventricular hemorrhage (IVH)

Day 4: Has had stable BP for 48 hours. Low volume nasogastric feeds of expressed breast milk (EBM) start tomorrow.

Ms. Peterson is visiting her son Jack. She has not had an opportunity to hold Jack yet because he's been too unstable, according to the nurses and physicians. Ms. Peterson asks Nurse Judy if she can hold Jack in kangaroo care today.

What do you think?

- How should Nurse Judy respond to Ms. Peterson?
- What is necessary to allow Ms. Peterson to start KC?

Answers

Nurse Judy should respond: "Today we can let Jack try KC because his blood pressure has been stable for 48 hours. Because his blood pressure has been unstable before, I will watch him closely to be sure that he tolerates both the transfer and KC. If his blood pressure is not stable in 15 minutes, he will have to go back to the incubator."

KC can be allowed if accompanied by close observation for hemodynamic instability.

Evidence for the answers

Most infants have mild vital-sign disturbances in response to transfer from incubator/crib to KC (Neu et al., 2000; Hedberg Nyqvist & Heinemann,

2011). These disturbances usually disappear within 10 to 15 minutes after KC starts (Ludington-Hoe, Morgan & Abouellfettoh, 2008). If Jack's BP does not return to pre-transfer baseline within 15 minutes, his BP may be vacillating.

Both increases and decreases in blood pressure (BP) increase the risk of IVH (Toth-Heyn & Cataldi, 2012). Jack's birthweight was <1,500 grams. Twenty to 25 percent of infants with birthweight <1,500 grams develop IVH (Douglas-Escobar & Weiss, 2012). LBW and an episode of systemic hypotension may have contributed to Jack's IVH (Toth-Heyn & Cataldi, 2012).

Because Jack's BP has been stable for 48 hours, KC can be tried with close monitoring. Stable BP often is used to determine eligibility for KC (Lee, Martin-Anderson & Dudley, 2012), and each institution may have other determinants of eligibility, but a consensus definition of stable BP has not been reached.

Van Zanten and colleagues (2007) measured MAP before, during and after KC in ventilated infants <28 weeks postmenstrual age and in ventilated infants 28 to 30 weeks postmenstrual age. Aggregate data showed that MAP rose during KC and returned to less than pretest values after KC. Infants who were <28 weeks postmenstrual age experienced a mean MAP rise of 8.3 percent during KC (a statistically significant but not clinically significant increase) and a decrease to 2 percent below pretest values after KC (a statistically and clinically insignificant decrease). The MAP of babies born at 28 to 30 weeks rose 6.8 percent during KC (a statistically significant rise) and was 1.4 percent less than pretest values after KC (not significant). Azevedo and colleagues (2012) found that MAP increased slightly (4.0 mmHg) during KC in 43 premature infants who were in an incubator without ventilator support, then in KC and then back in the incubator. The slight increase in MAP was not clinically significant and was probably due to the head-up, inclined position of the infant during KC. When studying positional changes of preterm infants in an incubator, Schrod and Walter (2002) concluded that "orthostatic stress associated with the KC position is insignificant" (pg. 259).

To minimize orthostatic effects on infant MAP, nurses can avoid abrupt tilting of the infant and use sitting transfer to place the infant on the mother who is fully reclined. The mother can slowly be raised to a slightly inclined (30 to 40 degrees) position. Administration of vasopressors is a current contraindication to KC (Ludington-Hoe et al., 2008; Nyqvist et al., 2010b).

Clinical scenario 6. Pain, the fifth vital sign

Baby Mary is:
- 4 days old
- 32 weeks GA
- Getting a heelstick for labs today

Ms. Morgan is visiting her daughter Mary. She asks if she can do kangaroo care today. Nurse Carla says she can hold Mary in KC to comfort her after the heelstick. Ms. Morgan says, "She always cries when they draw her labs. I'm sure it's painful for her. I wish I could help her so it doesn't hurt so much."

What do you think?

What should Nurse Carla tell Ms. Morgan about pain associated with Mary's heelstick?

Answer

Nurse Carla should reply: "Ms. Morgan, you're right that heelsticks are painful for preterm babies. You can really help reduce Mary's pain if you hold her skin-to-skin, chest-to-chest while the labs are drawn. Mary may not cry at all, and she'll have less pain and less reactivity to pain in the years ahead."

Evidence for the answers

Preterm infants do feel pain (Brummelte et al., 2012; Johnston, Fernandes & Campbell-Yeo, 2011). The pain response is a complex neurobehavioral process that can change neuropathways in the brain (Parsons,Young,

Murray, Stein & Kringelbach, 2010). Repeated painful experiences, when left untreated, result in chronic stress for the neonate and hypersensitivity and hyperreactivity to pain in later years (Veenema, 2012; Walker, Xu, Rochford & Johnston, 2008). Pain is undertreated (Hall, 2012). Unrelieved pain is associated with later ailments, including migraine headaches (Maneyapanda & Venkatasubramian, 2005). Relief of pain has many benefits, including improvements in cerebral oxygenation (Ranger, Johnston, Limperopoulos, Rennick & du Plessis, 2011).

Because evaluation of pain in neonates is now a mandated practice, Santos and colleagues (2012) have designated pain as the fifth vital sign. No matter how pain is measured, KC reduces pain in ELBW (Johnston et al., 2008a) and larger infants (Johnston, et al., 2013) (Table 3).

Table 3. Pain measurement and pain reduction in KC

Biomarkers of pain	• Facial actions • Crying • Cortisol secretion • Decreased oxygen saturation • Heart rate variability • Skin conductive measures
Pain reduced by KC	• Heel sticks • Injections • Intravenous line initiations • Intubations

Kangaroo care is now recommended for reducing pain by the AAP and the Canadian Paediatric Society (2006), NANN (2008) and the Canadian Paediatric Society Fetus & Newborn Committee (Jefferies & Canadian Paediatric Society Fetus and Newborn Committee, 2012). However, few health care professionals know that KC reduces pain (Mallet et al., 2007; McGrath & Brock, 2002; Schultz, Loughran-Fowlds & Spence, 2009).

KC also minimizes physiologic instability during painful procedures (Castral, Warnock, Leite, Haas & Schochi, 2008; Freier, Garcia & Lamy, 2008) and promotes faster recovery from pain (Cong, 2009; Johnston, 2008a). Maternal KC works better than many non-pharmacologic approaches for pain reduction, and mother and infant quickly synchronize and reduce their cortisol-based stress level when in KC during painful procedures (Castral, et al., 2012). In addition, KC eradicates the brain's pain memory and pathways that lead to long-term adverse effects of pain (Meek & Huertas, 2012).

KC does a better job of relieving pain than sucrose, swaddling and facilitated tucking together, and when used as single interventions to reduce pain (Meek & Huertas, 2012; Van Sleuwen et al., 2009). Many nurses use sucrose to relieve pain; the physiologic impact is not well understood and the short and long term effects of repeated use have not yet been determined (Asmeron et al., 2013; Stevens, Yamada et al. 2013). KC does not have adverse side effects.

Crying is a sign of pain (Stevens et al., 2010; Ramenghi, et al., 2002). However, crying may not occur at all during painful procedures conducted in KC (Johnston et al., 2003; Kostandy et al., 2008; Ludington-Hoe, Hosseini & Torowicz, 2005).

KC is most effective for pain relief if given by the mother rather than the father (Johnston, Campbell-Yeo & Filion, 2011) or another female (Johnston et al., 2012) or when substituted with a recording of the mother's voice (Johnston, Filion & Nuyt, 2007) and if not embellished (augmented) by rocking, singing and infant sucking (Johnston et al., 2008b). Most mothers want to help alleviate their infant's pain (Axelin, Lehtonen, Pelander & Salantera, 2010; Rennick et al., 2011; Franck, Oulton & Bruce, 2012) and don't want another woman holding their infant in KC (Johnston et al., 2012). The mother's presence alone helps reduce pain in infants (Parsons et al., 2010). When maternal presence is coupled with KC, pain reduction is even better (Parsons et al., 2010; Pillai-Riddell et al., 2011).

Maternal KC is a form of pleasing human touch that stimulates recently discovered, exquisitely sensitive, c-afferent nerves that respond only to pleasing touch that are located on the ventral surface of the infant and mother and across the infant's shoulders (Uvnas-Moberg et al., 2005). The c-afferent nerves activate oxytocin release in

maternal and infant brains (Uvnas-Moberg, 2003). Oxytocin raises the pain threshold (Klaus & Klaus, 2007; Uvnas-Moberg et al., 2005), blocks pain receptors sites (Parsons et al., 2010) and acts as an opioid (Bystrova, 2009), all of which reduce pain perception in many parts of the brain (Lindgren et al., 2011).

Clinical scenario 7: Oxygen saturation and desaturation events

Baby Charles is:

- 4 weeks old
- 26 weeks GA
- 30 weeks PMA
- On a nasal cannula, 1.5 LPM with 30-percent FiO_2
- Weaned today from 32-percent FiO_2
- Appears to be sleeping quietly

Vital signs:

- Temperature = 36.9 C
- HR = 138
- RR = 52
- Has been stable with no issues
- Tolerating feeds per nasogastric tube
- Oxygen saturation is fluctuating between 88 and 96 percent without color change

Ms. Lin is visiting her son Charles. She usually holds him in KC for 2 to 3 hours every day and has asked Nurse Debby if she can hold him today. Nurse Debby says "Because Charles' oxygen saturation is fluctuating so widely, I think it would be best if he stays in his incubator until we see how he tolerates being weaned from higher oxygenation."

What do you think?

- Is Nurse Debby's response correct?
- Why or why not?

Answers

No. Nurse Debby's response is not correct. Oxygen saturation stabilizes (Heimann et al., 2010) or increases slightly during KC (Fohe, Kropf & Avenarius, 2000; Parmar et al., 2009). Therefore, Baby Charles' oxygen saturation may stabilize or even improve by reducing desaturation events (Rojas et al., 2003) during KC, avoiding some of the mild desaturation events that can be so harmful to long-term neurodevelopment.

Evidence for the answers

Some studies show that oxygen saturation may decrease by 0.6 percent (Mori et al., 2010) to 1 percent (Ludington-Hoe et al., 2004) during KC and the transfer into KC (Neu et al., 2000), but recovery usually occurs within 3 minutes (Ludington-Hoe et al., 2008; Neu et al., 2000). Nurse Debbie can tell Ms. Lin that she can kangaroo Charles and that she will monitor Charles' saturation level closely to determine how Charles is tolerating KC.

Clinical scenario 8: Physiologic stability

Baby Julia is:

- 28 weeks GA
- 29 4/7 weeks PMA
- On a nasal cannula, 1.5 LMP with 35-percent FiO_2
- Lethargic this morning

Ms. Dias is rooming-in with her daughter Julia. Ms. Dias has held Julia in KC every day for extended periods of time, sometimes totaling 8 to 10 hours a day.

Julia had been doing well with expressed breast milk by nasogastric tube until last evening. Overnight Julia had multiple apneas with bradycardias and several desaturations that required an increase in her FiO_2 from 25 percent to 30 percent. Julia also had aspirates before every feed and is NPO (nil per os, nothing by mouth). Julia has just had a complete sepsis evaluation, including lumbar puncture, bladder catheterization,

blood culture and complete blood count with differential. She has been started on antibiotics. Ms. Dias is very worried about Julia and asks if she can do kangaroo care with Julia today.

> NURSE ANA: Julia is too unstable today. You will have to wait until tomorrow to see how Julia is doing.
>
> MS. DIAS: I thought that kangaroo care helps babies be more stable. Isn't that true, even when they're sick?
>
> NURSE ANA: Kangaroo care can help stabilize some babies, but Julia is just too unstable today.

What do you think?

- Is Nurse Ana's response correct?
- Why or why not?

Answers

Nurse Ana is correct. Transfer into KC can cause physiologic compromise in sick preterm infants (Neu et al., 2000). Transfer into KC may not be good for Julia at this time because she may not be able to tolerate the stress of the move or the change in position required for KC.

Evidence for the answers

Baby Julia has had several stressful procedures performed and has notable changes in several physical parameters:

- Increased FiO_2 requirement
- Made NPO
- Multiple A/Bs (more than usual)
- Is lethargic
- Has begun antibiotics

All of these changes may, and likely do, indicate sepsis. After Julia has been on antibiotics for 24 hours, she may be better and may be able to resume KC. KC tomorrow may help her recover and show all the physiologic stability signs that are commonly present with KC. Nurse Ana can suggest that Mom sit beside Julia's incubator today and gently touch and talk to her. Also, Nurse Ana can suggest a prolonged period of KC tomorrow rather than several 2- to 3-hour sessions to promote more physiologic stability. Physiologic stability is more prevalent in KC than in an incubator (Bergman, Linley & Fawcus, 2004; DiMenna, 2006; Jefferies & Canadian Paediatric Society Fetus and Newborn Committee, 2012 Ludington-Hoe et al., 2008; Ludington-Hoe, 2010; Ludington-Hoe, 2011a; Mori et al., 2010).

Clinical stability of a preterm infant is a criterion that many health care providers think must be met prior to the implementation of KC (Nyqvist et al., 2010a). But the definition of clinical stability is determined by different parameters in different NICU settings and means much more than simply being off of oxygen support (Charpak, Ruiz-Pelaez & Charpak, 1994). Intubated infants may be physiologically stable (Azevedo et al., 2012) or have improved physiologic stability (Tornhage, Stuge, Lindberg & Serenius, 1999; van Zanten et al., 2007), and KC may give parents a sense of importance to their baby and decrease their feelings of helplessness (Lasiuk, Comeau & Newburn-Cook, 2013) and stress (Endyarni, Roeslani, Rohsiswatmo & Soediatmiko, 2009; Neu, Laudenslager & Robinson, 2009).

What to do now

These scenarios provide the evidence base regarding clinical benefits of KC for preterm infants. Their purpose is to peak nurses' desire to determine patients' eligibility for KC and to administer it in a safe manner. Suggestions for further actions include:

1. **Stay current with kangaroo care research** findings through continuing education opportunities or regularly reviewing the U.S. Institute for Kangaroo Care's free, annotated bibliography at **www.kanagaroocareusa.org**. Ongoing research may provide stronger evidence, or contradict past evidence, and nurses want to base clinical practice on the latest information. For example, the 2004 contraindication to KC, "an increase in number of apneas during routine care" (Nyqvist 2004, p.73), was no longer a contraindication in 2010 (Nyqvist et al., 2010a).

2. **Change the attitude of your NICU staff about KC** from "a nice thing to do" to something that is necessary to maximize development of the preterm infant.

3. **Use KC more often, for more hours, with more families.** Developing a consistent culture of KC benefits infants, families and health care systems.

4. **Try innovative and unique applications of KC, including those in Table 4.** No matter what nurses are doing with KC, there is still more to be done.

Table 4. Examples of innovation and unique applications of KC

- To prevent seizures in asphyxiated infants who are not undergoing cooling
- To minimize adverse inflammatory responses (i.e., increases in the magnitude and number of pro-inflammatory cytokines released during NICU stay)
- To promote earlier readiness for surgical repair in infants with congenital heart defects (Torowiz, Lisanti, Rim & Medoff-Cooper, 2012; Harrison, 2010)
- To minimize severity of neonatal abstinence syndrome (Ludington-Hoe, 2013a) and Poor Neonatal Adaptation to SSRI Synrdrome (Kiviet et al., 2013)

5. **Recognize that KC can and does help promote exclusive breast milk feeds early in the infant's hospital course.** Nurses can help transition the preterm infant to the breast before discharge (Edwards & Spatz, 2010; Spatz, 2012). KC can help a unit attain and maintain baby-friendly NICU status (Nyqvist et al. 2012; Nyqvist & Kylberg, 2008). Baby-friendly NICU status is an extension of the Baby-Friendly Hospital Initiative, a global program launched by the World Health Organization (WHO) and the United Nations Children's Fund (UNICEF) to recognize hospitals and birthing centers that provide optimum care in infant feeding and mother/baby bonding (Baby-Friendly USA, 2012).

The movement to extend baby-friendly status into the NICU began in 2008 (Nyqvist & Kylberg, 2008) and has resulted in the publication of guiding principles (Nyqvist et al., 2012) and procedures (Nyqvist et al., 2013; Wang & Gau, 2013) to accomplish the goal.

6. **Administer KC safely with good positioning and monitoring, as needed.** Table 5 identifies components of safe KC.

Table 5. Components of safe KC

- Nurses use critical thinking about and have expertise in KC.
- Transfer, either sitting or standing, is done with minimum physiologic and behavioral disruption to the infant.
- The infant is contained in a blanket during transfer into and out of KC to minimize stress and heat loss.
- The infant is upright on his mother's bare chest (without a bra) between the breasts.
- The infant's head and neck are straight, not bent, and the head is turned to one side so nares are uncovered and visible.
- The infant's limbs are flexed.
- The infant's skin color is pink.
- The infant's respiratory effort is easy.
- The infant's back is covered and a head cap is used, when appropriate.
- Vital signs are within normal parameters throughout the KC session.
- All lines and tubings are secured.

7. **Provide parents with the education they need to overcome their reluctance to do KC.** The nurse can help parents understand that their participation is vital to their infant's health development, and increase their willingness to provide long periods of uninterrupted KC.

8. **Involve mother and father as much as possible.** The nurse can encourage 24/7 KC so long-lasting neurodevelopmental benefits can occur. KC is the epitome of the emerging interventions to reduce maternal-infant separation because it provides physical, emotional and social closeness in a way that cannot be replicated

and in a way that is totally natural — no contrived, expensive, artificial mechanics or machines required! The NICU environment is a necessary but often toxic environment for the preterm infant because infants are under constant stress, sleep poorly, and are mostly separated from their mothers (Garner, Shonkoff & Committee on Psychosocial Aspects of Child and Family Health, 2012). Even the common incubator is now considered a toxic environment with profoundly detrimental effects (Garner, Shonkoff & Committee on Psychosocial Aspects of Child and Family Health, 2012). The solution to minimizing the toxic effects of the NICU is non-separation through KC. The mnemonic in Table 6 may help you remember the severity of separation and the non-separation solution. Parents who provide KC gain confidence, competence, a sense of control, a better mood (de Macedo, Cruvinel, Lukasova & D'Antino, 2007) and a reduced sense of helplessness (Lasiuk et al., 2013). All of these feelings are precursors of satisfactory provision of parental care as NICUs move towards the latest model of care called Parents as Primary Providers (Ludington-Hoe, 2011b, 2013; Nqyvist & Engvall, 2009).

Conclusion

Documentation of the substantial evidence base supporting the global application of KC indicates that infants have consistent, hard-wired, not culturally dependent, responses to KC. Babies are programmed to do better on their mothers' chests than anywhere else. Fulfilling the Bogota Declaration and Humane Care Initiative are easily accomplished using evidence-based kangaroo care. Using critical thinking skills to advance evidence-based KC places the nurse in a position to best meet the health care needs of the neonate.

Table 6. The non-separation TOXICC mnemonic

T	The infant was **T**aken away from his mother. Being taken away from Mom is toxic to infant development.
O	The infant was put some **O**ther place than with his mother. Any place other than with Mom is not as good as being with Mom.
X	Stress and an**X**iety increase dramatically in the infant when taken away from Mom and put some other place (Morgan, Horn & Bergman, 2011).
I	The infant needs to be **I**n touch with Mom, who provides physical and emotional care.
CC	The infant needs to be **C**hest-to-**C**hest with Mom, not just skin-to-skin. Skin-to-skin can mean cheek-to-breast, hand-to-thigh, hand-to-head, cheek-to-cheek, etc. Only chest-to-chest activates the c-afferent nerves that travel to the insular cortex in the brain, releasing central oxytocin that goes to 14 places in the brain to: • Stabilize cardiorespiratory status • Diminish pain • Reduce stress • Establish co-regulation of physiologic functions • Promote bonding and positive interaction • Enhance neurologic development • Switch the brain's functioning from sympathetic (fight or flight, high stress, fear, aggression) to parasympathetic (calm, contented, peaceful, connected) control.

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Links for this activity

- Continuing nursing education test
- References