Cobedding and Recovery Time After Heel Lance in Preterm Twins: Results of a Randomized Trial

WHAT’S KNOWN ON THIS SUBJECT: Skin-to-skin contact with mothers and fathers has been associated with lower pain reactivity and enhanced physiologic recovery after heel lance. The effect of skin-to-skin contact between preterm twins during cobedding on pain response has yet to be studied.

WHAT THIS STUDY ADDS: We demonstrate that cobedding significantly diminished time to recovery in preterm twins after heel lance but did not lower pain reactivity.

abstract

OBJECTIVES: Cobedding of preterm twin infants provides tactile, olfactory, and auditory stimulation and may affect pain reactivity. We carried out a randomized trial to assess the effect of cobedding on pain reactivity and recovery in preterm twin neonates.

METHODS: Stable preterm twins (n = 67 sets) between 28 and 36 weeks of gestational age were randomly assigned to a cobedding group (cared for in the same incubator or crib) or a standard care group (cared for in separate incubators or cribs). Pain response (determined by the Premature Infant Pain Profile [PIPP]) and time to return to physiologic baseline parameters were compared between groups with adjustment for the nonindependence of twin infants.

RESULTS: Maternal and infant characteristics were not significantly different between twin infants in the cobedding and standard care groups except for 5-minute Apgar <7 and postnatal age and corrected gestational age on the day of the heel lance. Mean PIPP scores were not different between groups at 30, 60, or 120 seconds. At 90 seconds, mean PIPP scores were higher in the cobedding group (6.0 vs 5.0, P = .04). Recovery time was shorter in the cobedding group compared with the standard care group, (mean = 75.6 seconds versus 142.1 seconds, P = .001). No significant adverse events were associated with cobedding. Adjustment for nonindependence between twins and differences in baseline characteristics did not change the results.

CONCLUSIONS: Cobedding enhanced the physiologic recovery of preterm twins undergoing heel lance, but did not lead to lower pain scores. Pediatrics 2012;130:500–506

AUTHORS: Marsha L. Campbell-Yeo, PhD, RN,a,b C. Celeste Johnston, DD,a K.S. Joseph, PhD, MD,a Nancy Feeley, PhD, RN,Christine T. Chambers, PhD,a and Keith J. Barrington, MD

Women’s and Newborn Health Program, Centre for Pediatric Pain Research and the Departments of Pediatrics and Psychology, IWK Health Centre, Halifax, Nova Scotia, Canada; McGill University, Montreal, Quebec, Canada; Department of Obstetrics and Gynaecology and the School of Population and Public Health, University of British Columbia and the Children’s and Women’s Hospital of British Columbia, Vancouver, British Columbia, Canada; Centre for Nursing Research, Jewish General Hospital and The Quebec Interuniversity Nursing Intervention Research Group, Montreal, Quebec, Canada; and Division of Neonatology, Sainte-Justine University Hospital and Université du Montréal, Montreal, Quebec

KEY WORDS cobedding, twin, pain, preterm, infant, physiologic stability, recovery

ABBREVIATIONS GEE—generalized estimating equation
PIPP—Premature Infant Pain Profile

Dr Campbell-Yeo was responsible for all parts of the study, including conception and design, attainment of funding, acquisition, analysis, and interpretation of the data; and drafting the article. Dr Johnston provided supervision and contributed to the conception and design, attainment of funding, analysis and interpretation of the data, and intellectual revision of the article. Dr Joseph contributed to the conception and design, attainment of funding, analysis and interpretation of the data, and intellectual revision of the article. Drs Feeley and Barrington contributed to the conception and design, interpretation of the data, and intellectual revision of the article. Dr Chambers contributed to the conception and design, attainment of funding, interpretation of the data, and intellectual revision of the article. All authors have read and approved the final version submitted for publication.

This trial has been registered at www.clinicaltrials.gov (identifier NCT00917631).

doi:10.1542/peds.2012-0010
Accepted for publication Apr 30, 2012
Address correspondence to Marsha Campbell-Yeo, PhD, RN, Neonatal Nurse Practitioner, NICU, L3074.1, IWK Health Centre, 5850/5880 University Ave, P O Box 9700, Halifax, Nova Scotia, B3K 6R8, Canada. E-mail: marsha.campbell-yeo@iwk.nshealth.ca

(Continued on last page)
Twins, most of whom are born preterm, often require admission to a NICU for ongoing medical care. Preterm twins are exposed to numerous repeated painful procedures as part of their essential medical care, with as many as half of these procedures going untreated.1-3 The adverse effects associated with these procedures are both immediate and potentially long-term, affecting future sensation and behavior.4-6 At birth, preterm twins are typically separated as individual health needs are met. Cobedding, a developmental care practice, involves caring for twins and higher order multiples in one incubator versus separating and caring for each infant in a separate incubator.7,8 Twins are generally diaper clad and swaddled together within a similar boundary, thus creating the opportunity for skin-to-skin contact and touch between them.9 Cobedding allows twins to remain in close proximity and have skin-to-skin contact with each other, thus creating opportunity for familiar recognition of auditory and olfactory stimuli and for a continuation of the twin relationship that began in utero. Findings from studies examining the effect of skin-to-skin contact on preterm and term infants with their mothers during heel lance and intramuscular injection have consistently reported less pain response and enhanced physiologic stability.10 No study has been conducted examining the effect of cobedding on twin comfort during painful procedures in the NICU.

Given that the practice of cobedding simulates numerous aspects of environmental and maternal context (proximity, tactile, olfactory, auditory, and memory) that have been shown to provide comfort to newborns,9,9,11-19 it was reasonable to propose that contact with or the presence of a twin who has shared the same uterine space since conception would have a similar comforting effect. Therefore, we conducted a randomized controlled intervention trial to determine the efficacy of cobedding preterm twins during a tissue breaking procedure (heel lance) in the NICU.

METHODS

Study Setting and Population

A detailed description of the study procedure has been published previously.20 In brief, this trial was conducted after receipt of institutional ethics approval at 3 tertiary-level university affiliated NICUs in eastern Canada. Twins were considered eligible for recruitment if they were heavier than 1000 g, without major anomalies, requiring at least 1 medically indicated heel lance for blood procurement, and considered medically stable (without infection, indwelling chest tubes or umbilical catheters, or need for mechanical ventilation). Twins were not considered eligible if only 1 twin required overhead phototherapy at time of the heel lance.

Study Outcomes

The primary outcome was pain response measured by the Premature Infant Pain Profile (PIPP), a reliable and well-validated composite measure developed specifically for procedural pain in preterm neonates.21,22 Secondary outcomes included the physiologic recovery in response to heel lance determined by the length of time for heart rate and oxygen saturation to return to normal (baseline). Other outcomes of interest included frequency of the need for additional 24% sucrose administration and adverse outcomes, such as episodes of apnea, bradycardia, infection, and caregiver error.

Study Design and Intervention

After parental consent, eligible twins stratified by gestational age (≤ and >32 weeks) and site were randomized, using randomly permuted blocks of 2, 4, or 6, via a computerized off-site Web site accessed by the principal investigator (M.C.Y.) or research nurse.

Cobeding Care

Twins randomized to the cobedding group were placed diaper clad together in a Giraffe incubator close to each other (lying face-to-face, back-to-back, or in spooning positions), permitting them to touch each other. Larger infants were partially clothed in an open crib but still able to freely touch each other and remain nested together. All infants had cardiorespiratory monitoring while cobedding. One side of the incubator/crib was for twin “a,” the other side for twin “b,” and infants and their equipment were color coded. All infants were cobedded for no less than 24 hours before heel lance to allow for stabilization after transfer.

Standard Care

Twins who were randomized to receive standard care remained in a separate incubator as per NICU policy. Infants underwent a medically indicated heel lance in the incubator or crib just as twins in the cobedding group.

Procedure

Physiologic data on heart rate was collected by using a Somte (McArthur Medical, Rockton, Ontario) data acquisition system with a sampling rate of 100 Hz averaged on a beat-to-beat basis. Transcutaneous oxygen saturation was collected via infrared oximeter (Massimo Radical, Irvine, CA) placed on a hand or the unaffected foot of the infant and connected to the data acquisition system. Close-up video recordings that focused solely on 1 twin’s face were made by using a Sony (Toronto, Ontario) digital camera. Simultaneous monitoring and videotape recording obtained from the twin undergoing the heel lance and his or her
cotwin not receiving but observing the heel lance lasted ∼15 to 25 minutes and encompassed 4 phases: baseline (1–2 minutes), warming (3–5 minutes), heel lance (2–6 minutes), and recovery (up to 11 minutes). Facial pain responses were coded second-to-second on a stop frame system in 30-second epochs as indicated using unmarked colored markers. Coders were not aware of the purpose of the markers or study objective. Coders were trained on pain responses with infant face images obtained from similar studies; interrater reliability after training was estimated to be more than 85%. One coder coded the infants in cobedding care and another coder coded infants assigned to standard care. During the study period, intrarater reliability of coders, checked every 3 months, remained over 90%. At the end of the coding period, the coder who had coded infants in the standard care group, with over 90% agreement, recoded 6 videos from the cobedding group.

The instant of the heel lance indicated the invasive part of the procedure and data were analyzed in 30-second epochs until the application of the bandage to the heel, which indicated the end of the procedure. The point at which the baseline heart rate and oxygen saturations were reached after the heel lance indicated recovery. The research nurse indicated phases with an unmarked colored card held briefly in front of the camera and confirmed with manually recorded phase times. The neurobehavioral state component of the PIPP was determined according to Prechtl’s categories of quiet sleep, quiet awake, active sleep, or active awake at baseline.\textsuperscript{23,24} The study heel lance occurred within 10 days after randomization. If both twins underwent a heel lance on the same day, the lance occurred no less than 20 minutes apart between the twins. Order of heel lance was randomly assigned if they occurred on the same day with no order effect found effecting reported pain scores. Gestational age information, based on ultrasound estimation at 16 to 18 weeks, was obtained from the medical chart. Demographic characteristics and number of previous painful procedures were also collected by using chart review. Previous painful procedures included all procedures from birth until completion of heel lance. In compliance with current NICU best evidence and practice recommendations\textsuperscript{25} and per protocol approved by the institutional ethics board, all twins in each of the participating NICUs, regardless of group assignment, received 1 dose of 24% sucrose 2 minutes before the heel lance and were also offered a pacifier. Additional (rescue) doses of 24% sucrose were offered as deemed necessary by the nurse caring for the twins as per usual care practices.

Designated NICU nurses who had performed heel-lance procedures in previous studies in the NICU in a standardized manner, according to the institutional and NICU policies, performed the heel lance. All data were collected after randomization and data collection continued until completion of the study heel lance. Intervention fidelity was monitored and recorded daily to ensure that adherence to the study protocol was maintained. Infants assigned to the cobedding group were allowed to continue cobedding until 48 hours before discharge, at which time monitors were disconnected and the twins were...
separated. NICU staff and parents were informed that cobedding of twins in the NICU was for the purposes of research only.

Sample Size

Given that 24% sucrose has a known pain-relieving effect, the intervention of cobedding was considered an additional comfort measure. Based on a priori data,26,27 sample size was calculated by using a 2-sided \( \alpha \) error of 0.05 and a power of 80%. The study was designed to detect a between group mean difference of 1 point or greater (SD 2.0) in the PIPP score; 128 participants, 64 assigned to the cobedding group and 64 to the standard group were required to identify this difference. Cobedding was considered an additional comfort measure. Based on a priori data,26,27 sample size was calculated by using a 2-sided \( \alpha \) error of 0.05 and a power of 80%. The study was designed to detect a between group mean difference of 1 point or greater (SD 2.0) in the PIPP score; 128 participants, 64 assigned to the cobedding group and 64 to the standard group were required to identify this difference in the PIPP score (http://stat.ubc.ca/~rollin/stats/ssize/n2.html). Twins were randomized as a pair (total 64 sets) but each twin was considered a participant. This sample size also provided >95% power to detect a >15-second mean difference in physiologic recovery (heart rate and oxygen saturation) between groups.

Statistical Analysis

All analyses used an intention-to-treat approach. Data were analyzed by the principal investigator (M.C.-Y.) using SPSS 17 (SPSS Inc, Chicago, IL). Blinding of each facial coder’s group assignment was retained until the analysis was completed. Categorical data were analyzed by using \( \chi^2 \) tests. Primary and secondary outcomes were analyzed by comparing the means between the cobedding and standard care groups. The mean difference in PIPP scores was contrasted between groups using 95% confidence intervals and a \( P \) value from a Student’s \( t \) test. Also, because twin pairs were randomized together (ie, to cobedding or standard care), yet each was considered a participant, the analysis was corrected for potential nonindependence of outcomes between twin pairs with generalized estimating equation (GEE) procedures using SAS software (Proc Genmod, SAS 9.1, SAS Institute Inc, Cary, NC)28 and differences in baseline characteristics were adjusted by using regression techniques. All data were analyzed in a research laboratory off-site from the NICU. Physiologic data were analyzed by using Compumedics E-series Profusion PSG II software (Northern Optoelectronics Inc., Cambridge Ontario).

RESULTS

Study Groups

Of the 178 sets of twins that were screened during the study period (November 2008 and March 2011), 91 sets were eligible for the study and 67 sets provided informed consent and were recruited (Fig 1). Of these, 36 sets (72 infants) were randomly assigned to receive cobedding and 31 (62 infants) to receive standard care. A major reason for not being eligible arose because some twins did not stay long enough in the NICU and were transferred elsewhere before eligibility. The refusal rate was 26%. Primary reasons for refusal were that the mothers felt too overwhelmed or that the parents were not interested in participating in any research. Most maternal and infant characteristics were not significantly different between the cobedding and standard care groups at randomization (Table 1), except 5-minute Apgar <7, postnatal age, and corrected gestational age on the day of the heel lance were different, with the difference being nominally significant (\( P = .06 \) and .05, respectively).

PIPP Scores

In both the cobedding and standard care groups, peak mean PIPP scores were highest in the first minute after the heel stick and decreased over time. The mean PIPP scores were similar in both groups at 30 seconds, 7.1 (SD 2.8) in the cobedding group (\( n = 67 \)) and 7.2

---

### Table 1 Comparison of Maternal and Infant Characteristics between Cobedding and Standard Care Groups at Randomization and Heel Lance

<table>
<thead>
<tr>
<th>Maternal characteristics</th>
<th>Cobedding</th>
<th>Standard Care</th>
<th>( P ) value</th>
</tr>
</thead>
<tbody>
<tr>
<td>Mean age in years (SD)</td>
<td>31.1 (5.5)</td>
<td>29.6 (6.2)</td>
<td>.28</td>
</tr>
<tr>
<td>Primioparous (%)</td>
<td>19 (52.8)</td>
<td>15 (48.4)</td>
<td>1.00</td>
</tr>
<tr>
<td>Monochorionic twin pregnancy (%)</td>
<td>13 (36.1)</td>
<td>8 (25.6)</td>
<td>.60</td>
</tr>
<tr>
<td>Caesarean delivery (%)</td>
<td>23 (63.9)</td>
<td>13 (41.9)</td>
<td>.09</td>
</tr>
<tr>
<td>Antenatal steroids (%)</td>
<td>28 (77.8)</td>
<td>21 (67.7)</td>
<td>.42</td>
</tr>
<tr>
<td>White (%)</td>
<td>36 (100.0)</td>
<td>27 (87.1)</td>
<td>.18</td>
</tr>
<tr>
<td>Family arrangement, 2 parents (%)</td>
<td>36 (100.0)</td>
<td>31 (100.0)</td>
<td>1.00</td>
</tr>
<tr>
<td>Education, some college or university (%)</td>
<td>28 (77.8)</td>
<td>24 (80.0)</td>
<td>1.00</td>
</tr>
<tr>
<td>Smoking (%)</td>
<td>0 (0.0)</td>
<td>3 (9.7)</td>
<td>.09</td>
</tr>
</tbody>
</table>

#### Infant characteristics

| Mean gestational age in weeks (SD) | 31.6 (2.5) | 32.1 (2.7) | .48 |
| Gestational age <32 wk (%) | 36 (50.0) | 26 (41.9) | .39 |
| Mean birth weight in g (SD) | 1719.2 (477.9) | 1787.9 (508.8) | .42 |
| Gender, male (%) | 42 (58.3) | 34 (48.4) | .75 |
| Mean Apgar at 5 min (SD) | 7.8 (1.7) | 8.2 (1.3) | .11 |
| Apgar at 5 min <7 (%) | 15 (20.8) | 5 (8.1) | .05 |
| Postnatal age at heel lance in days (SD) | 18.7 (20.6) | 12.6 (15.1) | .06 |
| Corrected gestational age at heel lance | 34.2 (4.8) | 33.6 (2.1) | .19 |
| Corrected gestational age <32 wk at heel lance | 2 (2.9) | 8 (12.9) | .05 |
| Mean total painful procedures (SD) | 128.5 (226.0) | 91.3 (209.4) | .34 |
| Mean days mechanical ventilation (SD) | 4.3 (13.6) | 3.6 (12.0) | .73 |
| Mean no. con. sepsis at birth (SD) | 0.32 (0.92) | 0.24 (0.92) | .63 |
| Grade 3 or 4 intraventricular hemorrhage (%) | 2 (2.7) | 1 (3.1) | 1.0 |

\( ^a \) Cobedding, \( n = 36 \); Standard Care, \( n = 31 \). 
\( ^b \) Cobedding, \( n = 72 \); Standard Care, \( n = 62 \).
(SD 3.4) in the standard care group \((n = 57), P = .91\). PIPP scores were not significantly different at 60 or 120 seconds. There was, however, a significant 1 point higher mean score in the cobedding group, 6.0 (SD 3.0) compared with the standard care group, 5.0 (SD 1.8), \(P = .04\) (95% confidence interval \(-1.99\) to \(-0.02\)) at 90 seconds post lance (Fig 2). The remaining PIPP scores were not significantly different between the 2 groups.

GEE adjustment for potential non-independence between twins and regression adjustment for corrected gestational age <32 weeks and postnatal age at heel lance, did not alter the findings and resulted in a \(P\) value of .03 for the difference in mean PIPP score at 90 seconds post heel lance.

**Time to Recovery**

Recovery time, defined as the period of time measured in seconds that elapsed after the application of the adhesive bandage (signifying the end of blood sampling) until the heart rate and oxygen saturations returned to an average baseline condition for a minimum of 5 to 7 beats, was over a minute shorter; mean = 75.6 seconds (SD, 70.0), in the cobedding condition compared with standard care, mean = 142.1 seconds (SD 138.1), \(P = .001\) (Fig 3). Adjustment using GEEs for potential nonindependence among twins and adjustment for corrected gestational age <32 weeks at heel lance did not change these findings and resulted in a \(P\) value of .005, indicating faster recovery after heel lance in the cobedding compared with the standard care group.

**DISCUSSION**

To our knowledge, this is the first study to examine the possible comforting effect of cobedding for twins undergoing a tissue breaking procedure in the NICU. Our study showed that cobedding diminished time to recovery, consistent with other studies examining skin-to-skin contact with mothers. Cobedding did not lower PIPP scores in the initial minute post lance and PIPP scores at 90 seconds post lance were 1 point higher in the cobedding group; however, since the
scores were <6 (a score considered to indicate no or very mild pain), the clinical relevance of this finding is uncertain. An important finding in our study was the significantly quicker time to recovery in cobedding twins. Cobedding twins recovered more than a minute faster than the standard care group as assessed by the return of cardiorespiratory parameters to the baseline state. Pain reactivity or response is controlled by sympathetic activation of central nervous system, whereas recovery appears to be more closely linked with mature parasympathetic control. Both components play an integral part in the signaling and regulating of stress and pain response. The capacity to recover quickly, a sign of ability to maintain homeostasis, is an important maturational task that preterm twins must accomplish to grow and develop.29–32 Facilitation of homeostasis maintenance through cobedding has been reported in connection with short-term growth,11,16 stability in respiratory patterns,15 less central apnea,15 higher self-regulatory behaviors,14 and improved sleep,15 but not in the context of the additional stress of pain. Twin proximity and skin contact may support the acceleration or maturation of the autonomic system and thus facilitate faster recovery. Our findings that mean recovery times for cobedding twins were faster than those reported after 15 minutes of maternal skin-to-skin contact before heel lance33 (76 seconds vs 123 seconds) supports this hypothesis. The longer recovery time after maternal skin-to-skin contact may also reflect the slightly younger infants examined and this is consistent with our finding that gestational age <32 weeks was associated with prolonged recovery.

As expected, overall pain scores varied across the phases of the procedure, and twins, regardless of group assignment, had significantly higher scores within 30 seconds of the heel lance.34 Our lack of diminished pain scores after cobedding was not in keeping with reports from others examining skin-to-skin contact provided by mothers, which consistently show a lowering of pain scores for infants receiving maternal skin-to-skin contact during a tissue-breaking procedure when compared with no treatment.10,35 This difference may relate to the lack of full ventral skin contact associated with previously studied skin-to-skin contact, as this is not possible among cobedding twins or may simply support the premise that mothers provide something unique when compared with other providers.36,37

The prolonged period of separation of the twins before initiating cobedding (mean 18.7, range 2–87 days) may have diminished recognition of the familiar twin scent and could potentially explain the lack of reduction in pain scores after cobedding. In addition, most cobedding twins (58%) underwent a single heel lance within 3 days of being ceded together. Whether a longer exposure to their twin may lead to an improved pain response during subsequent procedures is uncertain and further investigation of such issues is warranted. Because higher PIPP scores occurred later in the procedure at 90 seconds post lance, another possibility for the higher score may be that the presence of the co-twin created added stimulation.

To date, cobedding has not been associated with any increased risk related to temperature instability, respiratory compromise, infection, or misidentification,18 and our findings add to the current body of evidence related to the safety of cobedding of preterm twins in the NICU setting. Our study is the first to examine the effect of cobedding during a tissue-breaking procedure and no adverse effects were reported for the twin undergoing the heel lance or for the co-twin exposed to their twin’s procedure. Limitations of our study include the inability to blind care providers to the intervention and slight decrease in sample size. Additional studies are needed to confirm our findings and explore the impact of a twin or another person’s presence during painful procedures in the NICU on short- and long-term self-regulation in preterm neonates.

CONCLUSIONS

Cobedding enhanced the physiologic recovery of preterm twins undergoing heel lance, but did not lead to lower pain scores. Cobedding did not lead to a higher rate of adverse effects among twins undergoing heel lance nor among his/her co-twin.

ACKNOWLEDGMENTS

We are grateful to the twins and parents who participated, the NICU and research staff, collaborator, Dr Ermelinda Pelausa, and our research coordinator Kim Caddell.


31. Prechtl HF. The behavioural states of the newborn infant (a review). *Brain Res*. 1974; 76(2):185–212


(Continued from first page)

PEDIATRICS (ISSN Numbers: Print, 0031-4005; Online, 1088-4275).

Copyright © 2012 by the American Academy of Pediatrics

FINANCIAL DISCLOSURE: The authors have indicated they have no financial relationships relevant to this article to disclose.

FUNDING: Partnered funding for this study was obtained from the Groupe de Recherche Interuniversitaire en Interventions en Sciences Infirmieres du Quebec, the Canadian Nurses Foundation Nursing Care Partnership Program, CIHR, and the MK Health Centre. Dr Campbell-Yeo is supported by a Clinical Initiative Fellowship from the Canadian Institutes of Health Research, and has received doctoral fellowship support from the Nova Scotia Health Research Foundation, and the Canadian Nurses Foundation. Dr Feeley is supported by a Clinical Research Scholar award from the Quebec Health Research Fund. Dr Chambers is supported by a Canada Research Chair. Dr Joseph is supported by a salary award from the Child and Family Research Institute.
Cobedding and Recovery Time After Heel Lance in Preterm Twins: Results of a Randomized Trial

*Pediatrics*; originally published online August 27, 2012;
DOI: 10.1542/peds.2012-0010

The online version of this article, along with updated information and services, is located on the World Wide Web at:
/content/early/2012/08/22/peds.2012-0010