# Analgesic effect of kangaroo position method versus sucrose during heel punctures in newborn: randomized clinical trial

*Efeitos analgésicos da posição canguru versus sacarose durante punções de calcâneo em recém-nascidos: ensaio clínico randomizado*

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DOI 10.5935/2595-0118.20220060-en

## ABSTRACT

**BACKGROUND AND OBJECTIVES**: 25% sucrose and kangaroo position are effective for neonatal analgesia in single procedures and sucrose is also effective in repeated procedures. Behavioral and physiological responses and adverse effect on newborns submitted to kangaroo position or 25% sucrose for analgesia were compared in two heel punctures applied during the first hours of life.

**METHODS**: Randomized clinical trial with 80 newborns and 40 mothers. Data were collected during two heel punctures. The kangaroo position was performed for three minutes before, during and three minutes after the punctures. Oral 25% sucrose (0.5 mL/kg) was administered two minutes before the punctures and the newborns were kept in a crib. Each data collection was divided into nine phases. The facial action, crying and heart rate data were analyzed using descriptive and comparative analyses. Facial actions, assessed by the Newborn Facial Coding System scale, was used to test the hypothesis. The frequency of gastric side effects was calculated. Ethical aspects were preserved.

**RESULTS**: Facial actions did not differ (p>0.05) between groups in the two data collections. There were no relevant changes in heart rate between and within groups. The newborns in the kangaroo group cried more than in the sucrose group (p<0.05) in the second collection. In the administration of sucrose, more side effects were observed in the first (p=0.02) and second collection (p=0.007).

**CONCLUSION**: The kangaroo position is as effective as the administration of 25% sucrose to relieve pain resulting from two repeated heel punctures.

**Keywords**: Crying, Heart rate, Kangaroo-mother care method, Newborn, Pain, Sucrose.

## RESUMO

**JUSTIFICATIVA E OBJETIVOS**: Sacarose a 25% e posição canguru são efetivos para analgesia neonatal em procedimentos únicos e a sacarose também é efetiva em procedimentos repetidos. Comparou-se as respostas comportamentais e fisiológicas e o efeito adverso entre recém-nascidos submetidos a posição canguru ou sacarose a 25% na analgesia em duas punções de calcâneo, aplicadas durante as primeiras horas de vida.

**MÉTODOS**: Ensaio clínico randomizado com 80 recém-nascidos e 40 mães. Os dados foram coletados durante duas punções de calcâneo. A posição canguru foi realizada por três minutos antes, durante e três minutos após as punções. A sacarose a 25% oral (0,5 mL/kg) foi administrada dois minutos antes das punções e os recém-nascidos permaneceram em berço. Cada coleta de dados foi dividida em nove fases. Os dados da mímica facial, choro e frequência cardíaca foram analisados por meio de análises descritivas e comparativas. A mímica facial, avaliada pela escala *Newborn Facial Coding System*, foi utilizada para testar a hipótese. A frequência dos efeitos colaterais gástricos foi calculada. Os aspectos éticos foram preservados.

**RESULTADOS**: A mímica facial não diferiu (p>0,05) entre os grupos nas duas coletas de dados. Não houve alterações relevantes na frequência cardíaca entre e intragrupos. Os recém-nascidos do grupo canguru choraram mais que no grupo sacarose (p<0,05) na segunda coleta. Na administração de sacarose, foram observados mais efeitos adversos, na primeira (p=0,02) e segunda coleta (p=0,007).

**CONCLUSÃO**: A posição canguru é tão eficaz quanto a administração de sacarose a 25% para aliviar a dor decorrente de duas punções de calcâneo repetidas.

**Descritores**: Dor, Choro, Frequência cardíaca. Método canguru, Recém-nascido, Sacarose.

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Submitted on April 07, 2022.
Accepted for publication on November 14, 2022.
Conflict of interest: none – Sponsoring sources: *Fundação de Amparo à Pesquisa do Estado de São Paulo* (São Paulo State Research Support Foundation), PhD Scholarship in the country.

**HIGHLIGHTS**

- Neonatal analgesia in repeated procedures.
- Neonatal analgesia on the first day of life.
- Microlithic analysis of the data, enabling detailed comprehension of the observed phenomenon.

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## INTRODUCTION

The first hours of life of the newborn (NB) mark the period of adaptation to extra-uterine life, with the stabilization of physiological functions. During this period, the NB is exposed to repeated painful procedures that can generate short-term consequences, such as changes in physiological parameters, crying, motor activity, and facial action[1]. Furthermore, it is believed that the first experience of tissue injury can be as painful as subsequent experiences[2] and painful procedure repetition in the same region of the body, as with heel puncture, can lead to long-term complications such as hyperalgesia and allodynia[3]. Such complications can negatively influence NB recovery and impact their quality of life. Thus, pain control in the neonatal period, besides being a human right[4], brings benefits for the child's development. In this sense, oral sucrose and the kangaroo position have been used to promote analgesia in newborns undergoing painful procedures[5].

Oral sucrose has proven effective for neonatal analgesia in single procedures (heel puncture and intramuscular injection) in full-term and premature newborns, and no serious side events have been documented with its use[6]. Although effective in these repeated procedures, further studies are needed to verify its effectiveness and adverse effects[6,7], especially when doses are administered over a short interval of time.

The kangaroo position, also known as "skin-to-skin contact" or "kangaroo care", has proven effective and safe for neonatal pain relief in single procedures (intramuscular injection and heel puncture). However, there are still no studies on its effectiveness in repeated procedures[8]. Furthermore, studies in premature newborns have shown that kangaroo position was as effective as sucrose in single procedures[9,10].

In the present study, the term "kangaroo position" is used to refer to the intervention described above, because this is the position defined and adopted by the Kangaroo Cara method[11]. Thus, this study aimed to compare behavioral and physiological responses and adverse effects between infants undergoing kangaroo position or 25% sucrose administration in the treatment of pain from two repeated heel punctures in the first hours of life. The hypothesis that kangaroo position is as effective as oral administration of 25% sucrose to relieve pain in infants exposed to two repeated heel punctures was tested.

## METHODS

This is a randomized controlled equivalence clinical trial conducted in the rooming-in unit of a public university hospital in São Paulo state, Brazil, which was guided by the standards of Consolidated Standards of Reporting Trials (CONSORT)[12] and Template for Intervention Description and Replication (TIDieR) Checklist and Guide[13]. Randomization to the treatment groups was performed by a statistician using the software R: Development Core Team® (2012), and a random sequence of 100 units was created, which were allocated, individually, in opaque, sealed envelopes, which were opened after the mother signed the Free and Informed Consent Term (FICT).

The use of 25% sucrose (positive control) and kangaroo position (new treatment) as therapeutic treatments for acute pain in NB who underwent two heel punctures was evaluated. Although the compared treatments were different in nature, the chosen option was to test 25% sucrose with a new treatment (kangaroo position) because it is the standard treatment for neonatal analgesia in the hospital/field of data collection. 25% sucrose was produced at the institution's compounding pharmacy and administered according to the institutional protocol[13]. Kangaroo position is used in this hospital for mother-child contact right after birth and in neonatal units, and is not regularly used during painful procedures.

This study population consisted of NB with gestational age ≥ 36 weeks who required at least two heel punctures during the hospitalization period, which were allocated into two groups.

The sample was calculated using the Statistical Package for the Social Sciences® (SPSS) software, version 21, based on a pilot study with 10 NB (five in each group), in which two identical data collections were considered. A standard deviation of the facial action duration (measured by Newborn Facial Coding System - NFCS) and a ratio between the number of comparison subjects equal to one (equivalence clinical trial) was adopted, resulting in 40 NB per group, with an effect size of 0.145, alpha of 0.5, power of 0.95, and significance (p) of 0.05.

Inclusion criteria for NB were gestational age ≥ 36 weeks, born at the data collection field hospital, at least two repeated and successive heel punctures (three hours apart), Apgar score ≥ 7 at the 5th minute of birth, and were clinically stable with a heart rate between 93-154 bpm[12] at the time of recruitment. All mothers included in this study were clinically stable and able to perform kangaroo position during data collection.

classified as small for gestational age, those with congenital or neurological abnormalities, clinical diagnosis of asphyxia or trauma during birth, difficulty swallowing, use of opioids by NB or mother before or after birth, mothers who used illicit drugs during pregnancy, who had a twin brother participating in the study, mothers who were unavailable to perform kangaroo position, and cases of admission to the rooming-in unit with more than 12 hours of life were not included. Figure 1 shows the study participants flowchart.

Data collection occurred when the infants were between three and 18 hours old and were with their mothers in the rooms of the hospital's rooming-in unit, together with other binomials. Data were collected in the same way in both collections, each one being divided into nine phases, described in table 1. In the period between data collections, the NB remained in the rooming-in unit with their mothers, were breastfed, had their diapers changed, and other painful procedures were given to them as needed.

## MEASURED VARIABLES

**Sample characterization**

NB were characterized regarding the following variables: gender, weight, 5th minute Apgar score, gestational age, type of delivery,

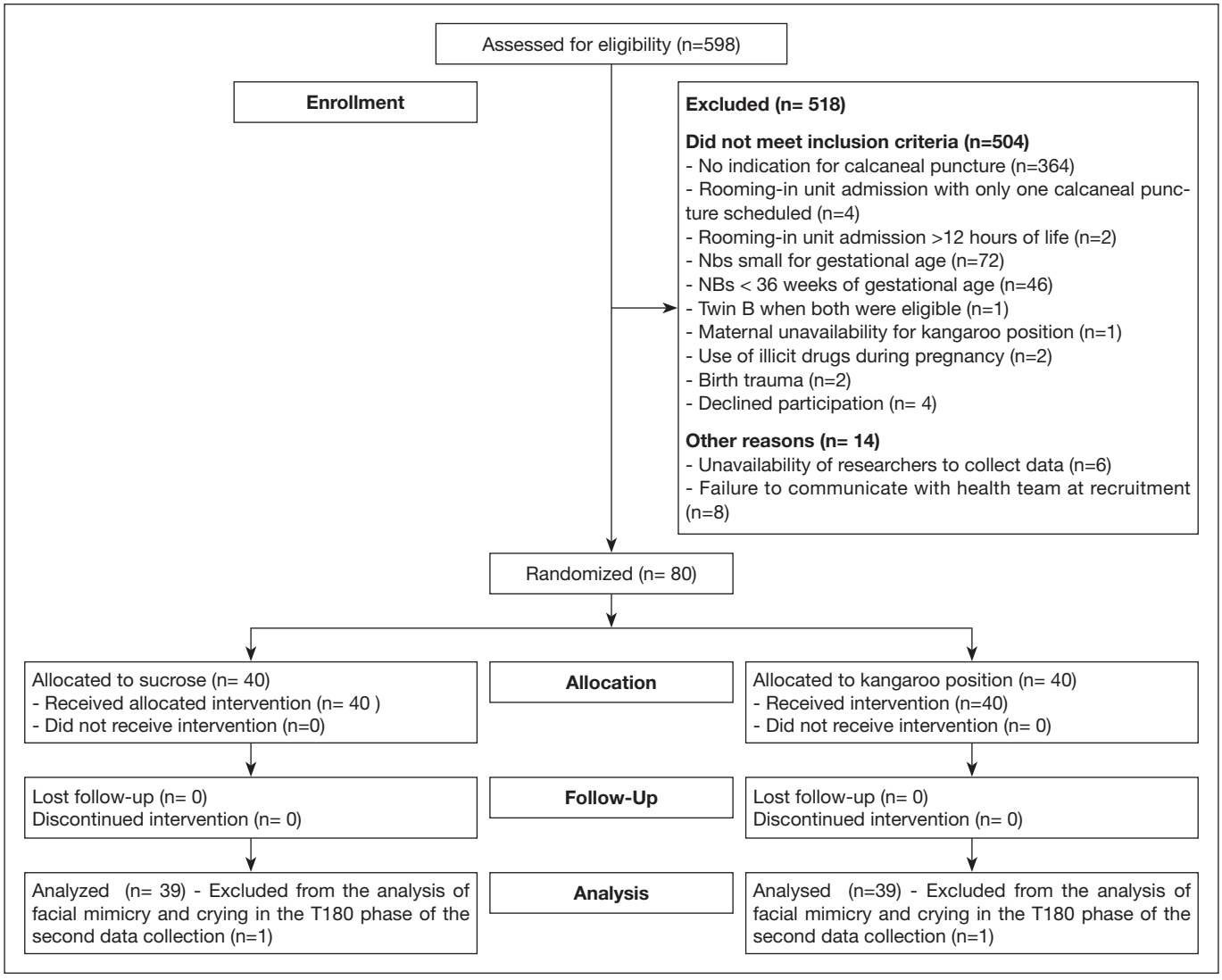


**Figure 1**. Flowchart of the newborns and mothers participating in this study.

duration of labor, drugs used at delivery, invasive procedures since birth, drugs since birth, feeding, hours of life at the time of collection, side effects (nausea, regurgitation, and vomiting). These variables were collected in the NB chart, except for adverse effects and hours of life at the time of data collection, which were collected in both collections.

**Facial actions**

The facial action was used to test the equivalence hypothesis and was analyzed using the NFCS, which has five facial actions that include: protruding forehead, pinched eyes, deep nasolabial groove, horizontal mouth, and tense tongue. However, there is evidence that the evaluation of three of these actions is sufficient to capture the face of pain in the NB[15].

Thus, the present study considered three of these actions (bulging forehead, pinched eyes, and deepened nasolabial groove) that are more easily observed during kangaroo position and that have already been evaluated in previous studies without compromising the results[16].

The following is a description of each of these actions[15]: 1. bulging forehead - bulging or the appearance of vertical furrows between the eyebrows as a result of the lowering and drawing together of the eyebrows; 2. pinched eyes - tight closing and/or bulging of the eyelids; 3. deepened nasolabial groove - elevation and deepening of the nasolabial groove, i.e., the line that forms between the nasal wings to the lips.

**Crying**

Crying was assessed by sizing the total duration and quality based on the classification used by Warnock[16]: 1. loud cry/whining - cry is diffuse/amplified/strong, diffused and with open mouth; 2. weak/exhausted cry - cry is hoarse, very tired, may sound weak, feeble, and the baby's sounds seem exhausted.

**Heart rate**

Heart rate was assessed continuously during all collection phases and stored every second in a database in the software of the Polar RS800® (USA) device.

**Table 1.** Description of the duration and procedures performed in each of data collection's nine phases.

| Phases | Basal | Treatment | Antisepsis | T0 | T15 | T30 | T60 | T120 | T180 |
|---|---|---|---|---|---|---|---|---|---|
| Duration | 3 minutes | 1 minute | 33-82 sec. | 15 sec. | 15 sec. | 30 sec. | 60 sec. | 60 sec. | 60 sec. |
| Description of procedures performed in each phase. | Preparation<br>NB remained in a regular crib, wearing only a diaper.<br>Two cardiac electrodes were placed under the nipples, which were connected to Polar RS800® equipment to assess heart rate.<br>A tripod camera was placed to record facial action and crying.<br><br>Data Collection<br>NB were filmed without intervention.<br>Heart rate was collected continuously from baseline to T180 phase. | Preparation of sucrose<br>NB received a dose of 25% sucrose (0.5 mL/kg - maximum 2 mL) orally, with a syringe on the anterior part of the tongue, two minutes before the procedure[14]. They were positioned in dorsal decubitus and remained unmanipulated until the end of data collection.<br>Sucrose data collection<br>Data were collected from the last minute after sucrose administration.<br><br>Kangaroo position preparation<br>NB were positioned upright on their mother's chest, wearing only a diaper and with their heads sideways11. They remained in the kangaroo position for three minutes before the painful procedure[14], maintaining it until the end of data collection.<br><br>Data collection in the kangaroo position<br>Data were collected from the last minute before the painful procedure. | Antisepsis was performed with cotton and 70% alcohol.<br><br>The images of facial actions and crying were recorded continuously. | The moment of heel puncture, performed with a lancet Pro Uno Accu-Chek® lancet (United States) by the same trained nurse. | T15-T180: recovery after the painful procedure.<br><br>Data is collected continuously, without intervention from the researchers.<br><br>After the end of each data collection, the camera was turned off, the heart monitor was disconnected, and the NB remained in the rooming-in unit with their mothers.<br><br>The painful procedures (type of procedure and analgesia received) that the NB received in the interval between the two data collections were recorded.<br><br>At the end of the second data collection, the cardiac leads were removed and the NB continued to be housed together with their mothers. | | | | |

Tachycardia was considered to be a heart rate greater than 154 bpm, according to the classification of the European Society of Cardiology[17].

**Image coding and analysis**

Data regarding facial mimicry and crying were filmed using a digital camera (SONY-Digital Handycam, model Hybrid Hard Disk Drive® (Japan) and coded continuously, second by second, in a microanalytic manner, in the two data collections. In addition, the percentage of occurrence of facial actions (behavior duration/phase duration X 100) was analyzed. The coders received training and used a coding sheet in which they analyzed the facial actions second by second, separately.

Inter-observer reliability was checked with 20% of the study sample (16 NB) using the GSEQ® program (version 5.0), obtaining Kappa coefficients equal to or greater than 0.80 for all coders. Next, the coding was continued and the data were processed by double entry in an Excel spreadsheet and transported to the Statistical Package for Social Sciences (SPSS), version 21, for descriptive and comparative analysis.

The project was approved by the ethics committee of the hospital/study site (CAAE: 17228713.5.0000.5393), and registered in *Registro Brasileiro de Ensaios Clínicos* (Brazilian Registry of Clinical Trials), available at http://www.ensaiosclinicos.gov.br/rg/RBR-7nynr7/.

**Statistical analysis**

The homogeneity between groups was verified for the behavioral and characterization variables of the sample, and the comparison was made using the Chi-squared or Fisher's Exact test for categorical variables, and the t-test for independent samples (or Mann-Whitney) for continuous variables.

For the analysis of facial mimicry, was chose to group the three actions that were evaluated. To group the actions in the GSEQ 5.1 program, was followed Warnock's[16] recommendation; thus, the three facial actions were grouped into one action called "action", which best captured the facial expression of NB. The "or" function in the GSEQ 5.1 program to group the facial actions was used. Thus, the action variable measures the presence of at least one of three facial actions that express pain[16].

The behavioral variables (NFCS and crying) were analyzed for each second, calculating the average percentages of duration[16]. Since no normality was found in the behavior of these variables (verified by the Kolmogorov-Smirnov and Shapiro-Wilk tests), they were treated non-parametrically, using Friedman's test for comparison between the phases of data collection (intragroup) and the Mann-Whitney test in each phase of data collection between the groups. The heart rate data were transferred to Excel program, the mean values and standard deviation were calculated, and finally, transported to SPSS®, version 21. Throughout the study, a 5% significance level was adopted.

## RESULTS

The study included 80 NB, 40 in the sucrose group (control) and 40 in the kangaroo position group (intervention). However,

there were image losses in the T180 phase at the end of the 2nd data collection, leading to the exclusion of two NB (one from each group) from the analyses referring to this phase. As images from the camera were lost in the T180 phase, it was not possible to analyze these images. In table 2, it was found that both groups did not differ in their neonatal and maternal characteristics (type of delivery, duration of labor, and use of drugs).

As for feeding, in both groups, most NB (82.5%) were on exclusive breastfeeding and the rest were receiving breast milk from the milk bank or artificial milk (in the unavailability of human milk). There was no significant difference regarding the amount of painful procedures performed before the start of data collection: orotracheal intubation (p=0.99); airway aspiration (p=0.64); heel (p=0.40), venous (p=0.99), arterial (p=0.99) and intramuscular (p=1.00) punctures. All NB received ocular silver nitrate instillation, intramuscular vitamin K, and hepatitis B vaccine in the delivery room.

Regarding the use of pain relief methods in procedures performed prior to data collection, only one NB in the sucrose group received combined rolling with sucrose for pain relief during an arterial puncture.

Five (6.2%) of the 80 NB were submitted to painful procedures between data collection, three (7.5%) of them in the kangaroo position group and two (5.0%) in the sucrose group. In the kangaroo position group, one NB was submitted to venipuncture, one to arterial puncture and another to aspiration of the upper airways. In the sucrose group, one NB received a venipuncture and another was submitted to gastric lavage. None of these NB received analgesia during these procedures.

The assessment of neonatal pain through the duration of facial action (mean percentage) showed that, when comparing the groups, there was no statistical difference (p>0.05) in any phase of data collection (Table 3). Intragroup comparisons (analysis of data from all phases in the same group) were statistically significant in the sucrose group (p<0.001) and in the kangaroo position group (p<0.001).

The analysis of crying, by means of its total duration and quality (high and weak crying duration), shows that there was no statistically significant difference between the groups regarding crying duration and quality (high and weak) at any stage of the first data collection. Differently, in the second data collection, the mean percentage of total cry duration was significantly higher in the kangaroo position group (p>0.05) in all phases of the procedure, except at baseline, compared to the sucrose group. Furthermore, in this second collection, there was no significant difference between the groups regarding the average percentage of both loud and weak crying of the infants in any phase of the procedure (Table 4).

The intragroup comparison showed that there were significant changes in the percentage of total crying in both treatment

**Table 2.** Neonatal and maternal characteristics of the kangaroo position and sucrose groups of study participants in a rooming-in unit.

| Groups | Kangaroo (n=40) | Sucrose (n=40) | p-value |
|---|---|---|---|
| Gender [n(%)] | | | |
| Female | 21 (52.5%) | 19 (47.5%) | 0.65* |
| Male | 19 (47.5%) | 21 (52.5%) | |
| Average weight (g) | 3.713 g | 3.746 g | 0.77** |
| Gestational age [n(%)] | | | |
| > 37 weeks | 37 (92.5%) | 39 (97.5%) | 0.34* |
| < 37 weeks | 03 (7.5%) | 01 (2.5%) | |
| Type of delivery [n(%)] | | | |
| Vaginal | 16 (40.0%) | 15 (37.5%) | 0.81* |
| Cesarean section | 24 (60.0%) | 25 (62.5%) | |
| Labor duration (minutes) | 355 | 491 | 0.34** |
| Drugs used in childbirth [n(%)] | | | |
| Bupivacaine | 34 (85.0%) | 35 (87.5%) | 0.99** |
| Sufentanil | 36 (91.0%) | 38 (94.4%) | |
| Morphine | 21 (51.4%) | 22 (55.6%) | |

*Fisher's Exact Test ** Chi Squared Test

**Table 3.** Mean percentage and standard of the NB's facial actions duration grouped at each collection phase in the kangaroo and sucrose groups at the first and second blood collection in a rooming-in unit.

| | 1st data collection | | | | | 2nd data collection | | | | |
|---|---|---|---|---|---|---|---|---|---|---|
| Groups | Kangaroo | | Sucrose | | p-value* | Kangaroo | | Sucrose | | p-value* |
| Phase | $\bar{x}$ | SD | $\bar{x}$ | SD | | $\bar{x}$ | SD | $\bar{x}$ | SD | |
| Baseline | 6.60 | 12.64 | 7.70 | 18.74 | 0.44 | 8.53 | 6.53 | 1.28 | 23.27 | 0.58 |
| Treatment | 6.03 | 17.85 | 3.53 | 6.41 | 0.18 | 9.00 | 17.11 | 6.43 | 16.77 | 0.53 |
| Antisepsis | 7.38 | 17.50 | 6.58 | 13.58 | 0.50 | 14.68 | 1.23 | 9.00 | 18.09 | 0.58 |
| T0 | 18.58 | 27.72 | 14.10 | 2.41 | 0.80 | 25.28 | 26.70 | 13.80 | 15.70 | 0.80 |
| T15 | 26.80 | 34.28 | 28.50 | 34.13 | 0.67 | 42.15 | 38.21 | 28.15 | 31.17 | 0.12 |
| T30 | 11.43 | 21.83 | 8.48 | 14.45 | 0.76 | 16.60 | 26.66 | 9.93 | 17.8 | 0.60 |
| T60 | 12.63 | 28.10 | 10.18 | 22.43 | 0.37 | 15.53 | 29.0 | 7.65 | 17.18 | 0.39 |
| T120 | 3.60 | 10.00 | 6.23 | 14.41 | 0.16 | 12.38 | 20.87 | 8.50 | 16.95 | 0.43 |
| T180 | 3.79 | 8.62 | 11.80 | 22.00 | 0.18 | 9.80 | 20.34 | 3.33 | 6.43 | 0.24 |

$\bar{x}$: mean percentage of the facial action duration; SD: standard deviation. *Mann-Whitney test

**Table 4.** Average percentage of total duration and quality of crying of newborns in the kangaroo position and sucrose groups, in the different phases of the first and second data collection in a rooming-in unit.

| | | 1st Data collection | | | | | 2nd Data collection | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|
| | Crying | Kangaroo | | Sucrose | | p-value* | Kangaroo | | Sucrose | | p-value* |
| | | $\bar{x}$ | SD | $\bar{x}$ | SD | | $\bar{x}$ | SD | $\bar{x}$ | SD | |
| Baseline | Total | 1.79 | 6.42 | 4.63 | 16.13 | 0.67 | 2.38 | 8.78 | 4.28 | 12.19 | 0.71 |
| | High | 1.45 | 6.00 | 4.65 | 16.12 | 0.32 | 1.93 | 6.59 | 4.20 | 12.22 | 0.32 |
| | Weak | 0.33 | 2.69 | 0 | 0 | 0.32 | 0.48 | 3.00 | 0 | 0 | 0.90 |
| Treatment | Total | 1.58 | 10.01 | 0 | 0 | 0.32 | 3.18 | 11.22 | 1.67 | 10.54 | 0.04* |
| | High | 1.58 | 9.96 | 0 | 0 | 1.00 | 3.18 | 10.40 | 0 | 0 | 1.00 |
| | Weak | 0 | 0 | 0 | 0 | 1.00 | 0 | 0 | 0 | 0 | 1.00 |
| Antisepsis | Total | 2.50 | 15.81 | 0.93 | 5.86 | 0.99 | 3.18 | 11.22 | 1.67 | 10.54 | 0.02* |
| | High | 2.50 | 15.81 | 0.93 | 7.27 | 1.00 | 4.85 | 15.05 | 0 | 0 | 1.00 |
| | Weak | 0 | 0 | 0 | 0 | 1.00 | 0 | 0 | 0 | 0 | 1.00 |
| T0 | Total | 10.00 | 22.39 | 3.33 | 16.12 | 0.09 | 14.00 | 26.79 | 0.83 | 4.32 | 0.04* |
| | High | 9.20 | 22.17 | 3.33 | 16.11 | 0.32 | 13.33 | 26.79 | 0.85 | 4.38 | 0.32 |
| | Weak | 0.83 | 5.22 | 0 | 0 | 1.00 | 0.68 | 4.27 | 0 | 0 | 0.32 |
| T15 | Total | 7.33 | 21.13 | 6 | 18.35 | 0.74 | 14.00 | 10.00 | 4.32 | 26.67 | 0.03* |
| | High | 5.65 | 18.78 | 5.18 | 17.89 | 0.49 | 10.97 | 25.13 | 4.32 | 10.15 | 0.32 |
| | Weak | 1.67 | 10.54 | 0 | 0 | 0.32 | 3.02 | 8.38 | 0 | 0 | 0.32 |
| T30 | Total | 7.58 | 24.42 | 1.92 | 7.47 | 0.62 | 7.25 | 22.08 | 0 | 0 | 0.02* |
| | High | 5.50 | 21.15 | 1.90 | 7.43 | 0.32 | 7.25 | 22.07 | 0 | 0 | 1.00 |
| | Weak | 2.08 | 13.12 | 0 | 0 | 0.94 | 0 | 0 | 0 | 0 | 1.00 |
| T60 | Total | 4.71 | 18.97 | 0.83 | 5.27 | 0.17 | 5.71 | 18.25 | 0 | 0 | 0.02* |
| | High | 4.58 | 18.17 | 0.83 | 5.22 | 0.32 | 5.70 | 18.25 | 0 | 0 | 1.00 |
| | Weak | 0.13 | 0.79 | 0 | 0 | 0.52 | 0 | 0 | 0 | 0 | 1.00 |
| T120 | Total | 5.55 | 20.15 | 1.29 | 6.74 | 0.38 | 4.25 | 12.35 | 0 | 0 | 0.01* |
| | High | 5.55 | 20.16 | 1.30 | 6.79 | 1.00 | 3.98 | 12.33 | 0 | 0 | 0.32 |
| | Weak | 0 | 0 | 0 | 0 | 1.00 | 0.30 | 1.90 | 0 | 0 | 0.32 |
| T180 | Total | 2.95 | 14.15 | 2.65 | 13.07 | 0.98 | 6.04 | 17.44 | 0 | 0 | 0.02* |
| | High | 2.93 | 20.73 | 2.58 | 12.85 | 1.00 | 4.57 | 12.78 | 0 | 0 | 1.00 |
| | Weak | 0 | 0 | 0 | 0 | 1.00 | 1.50 | 9.48 | 0 | 0 | 1.00 |

$\bar{x}$: percentage mean; SD: standard deviation; * p<0.05 (Mann-Whitney test)

groups (kangaroo position p=0.001 and sucrose p=0.001) and in loud crying (kangaroo position p=0.01 and sucrose p<0.001), predominantly at T0 and T15. On the other hand, there was no difference (p=0.45) in the average percentage of weak crying between the data collection phases in the kangaroo position group.

No NB presented altered heart rate during data collection in both groups. In the comparison between the groups, both in the first and second heel puncture, there was no statistically significant difference in heart rate, except in the treatment phase of the second heel puncture (p=0.04) (Table 5).

The intra-group analysis over the two data collections showed that the infants in both groups had significant changes in heart rate, with p=0.001 in the kangaroo position group and p<0.001 in the sucrose group.

Regarding adverse effects, differences were observed between the groups only in the occurrence of nausea, being more frequent in the sucrose group - first collection (p=0.02) and second collection (p=0.007).

In the first collection, one (2.5%) NB in the kangaroo position group had nausea during the baseline phase and vomiting after establishing the kangaroo position. In the sucrose group, eight NB (20%) had nausea at baseline, and this effect continued after sucrose administration until the end of data collection in four NB (10%; p=0.03).

In the second data collection, in the kangaroo position group, one (2.5%) NB presented nausea after establishing the kangaroo position. In the sucrose group, nine (22.5%) NB had nausea, two (5%) regurgitation, and one (2.5%) vomiting. These effects occurred predominantly after sucrose administration (17.5%, seven NB; p=0.06).

**Table 5.** Mean heart rate (bpm) of infants in the two data collection phases in a rooming-in unit unit.

| | 1st Data Collection | | | | | 2nd Data Collection | | | | |
|---|---|---|---|---|---|---|---|---|---|---|
| | Kangaroo | | Sucrose | | p-value* | Kangaroo | | Sucrose | | p-value* |
| | $\bar{x}$ | SD | $\bar{x}$ | SD | | $\bar{x}$ | SD | $\bar{x}$ | SD | |
| Basal | 122.90 | 10.10 | 124.80 | 10.20 | 0.54 | 126.10 | 9.70 | 127.40 | 11.10 | 0.96 |
| Treatment | 126.80 | 9.00 | 130.90 | 10.70 | 0.12 | 127.60 | 9.10 | 134.50 | 14.00 | 0.04* |
| Antisepsis | 126.10 | 8.60 | 128.30 | 9.70 | 0.33 | 127.50 | 11.00 | 132.20 | 13.30 | 0.11 |
| T0 | 128.50 | 8.90 | 129.40 | 10.20 | 0.76 | 128.50 | 9.90 | 133.00 | 14.40 | 0.40 |
| T15 | 128.50 | 10.40 | 132.20 | 11.60 | 0.11 | 129.70 | 10.80 | 132.90 | 12.50 | 0.27 |
| T30 | 127.60 | 9.70 | 128.10 | 9.90 | 0.99 | 127.60 | 11.60 | 129.90 | 12.80 | 0.48 |
| T60 | 126.90 | 9.20 | 125.10 | 10.10 | 0.33 | 128.20 | 10.80 | 127.90 | 11.70 | 0.93 |
| T120 | 126.10 | 12.00 | 124.30 | 10.50 | 0.39 | 127.90 | 10.50 | 130.10 | 12.10 | 0.47 |
| T180 | 126.20 | 11.50 | 123.80 | 10.10 | 0.33 | 128.70 | 11.30 | 127.30 | 9.40 | 0.57 |

$\bar{x}$: mean heart rate; SD: standard deviation; *p<0.05, Chi-squared test

## DISCUSSION

Regarding facial actions, it was observed that there was no statistical difference (p>0.05) between the groups in the percentage of facial action duration at the first or second data collection.

These data allow the statement that both kangaroo position (three minutes before, during, and three minutes after the procedure) and 25% oral sucrose (0.5 mL/kg, administered two minutes before the procedure) were equally effective in relieving neonatal pain from two heel punctures three hours apart.

On the other hand, there were significant differences in the percentage of crying duration in the second data collection, with higher values in kangaroo position group in the following phases: treatment (p=0.042), antisepsis (p=0.022), T0 (p=0.004), T15 (p=0.032), T30 (p=0.022), T60 (p=0.022), T120 (p=0.011) and T180 (p=0.022). Regarding crying quality, a predominance of loud crying was observed in kangaroo position group, at the second collection, in the same phases mentioned above: treatment (p=0.042), antisepsis (p=0.022), T0 (p=0.017), T15 (p=0.017), T30 (p=0.022), T60 (p=0.022), T120 (p=0.022) and T180 (p=0.044).

Thus, it was observed that sucrose proved more effective in reducing crying in the second puncture. In this sense, it should be noted that, as the kangaroo position predisposes the NB to breastfeeding, for it to be more effective it may be important to allow breastfeeding on demand during the procedure, so the NB would possibly be comfortable and cry less before the painful procedure. Thus, this study suggest researches that test the kangaroo position in association with breastfeeding on demand during repeated painful procedures in order to test its effectiveness compared to sucrose.

The calming effects of sucrose may last longer than the analgesic effects, according to a study that evaluated reduced behavioral stress responses during a subsequent handling procedure performed up to one hour later[18]. Thus, it is important to emphasize that this solution should be used with caution, since it is not known for sure what consequences its use may have, and evidence-based protocols for its use are needed[19].

In both groups, the NB' heart rate remained within normal parameters (93 - 154 bpm) in all phases of data collection. Statistically significant differences were observed between the groups, only in the treatment phase of the second data collection (p=0.04), with a higher heart rate in the sucrose group compared to the kangaroo position.

The NB heart rate stability may be related to both the effective analgesia of both treatments, as well as the intensity of painful stimulus caused by heel puncture. Other authors[7] also verified the maintenance of heart rate during repeated heel punctures after sucrose administration in hospitalized NB.

Since this was the first study to evaluate the effects of kangaroo position on repeated procedures, i.e., repeated measures were compared, it was necessary to evaluate intragroup behaviors in more detail. In relation to the average percentage of facial action, significant changes were observed in kangaroo position group (p<0.001, higher in all phases of the second data collection) and in sucrose group, (p<0.001, higher in the second data collection, in basal, treatment, antisepsis, T30 and T120 phases).

Significant changes were observed in the percentage of total crying (p=0.001) and loud crying (p=0.01) in the kangaroo position group (higher in all phases of the second data collection, except in phases T30 and T120). In the sucrose group, there were significant changes in total crying (p=0.001, higher in all phases of the first data collection, except in the treatment phase) and loud crying (p<0.001, higher in all phases of the first data collection, except in the treatment phase).

Both groups showed significant changes in heart rate p=0.001 in the kangaroo position group (higher in all phases of the second data collection, except in phases T0 and 130) and p<0.001 in the sucrose group (higher in all phases of the second data collection).

Although further studies are needed to evaluate the use of the kangaroo position in other repeated procedures, it is known that it can contribute to pain relief in several ways, such as: bonding between mother and child, breastfeeding, and stabilization of physiological parameters, capillary blood glucose levels, and maintenance of body temperature[11].

The kangaroo position is also a way to promote maternal and family autonomy in caring for the child in times of pain. However,

other authors point out that there is still a low participation of the family in caring for the NB child's pain[20]. It is believed that the association of the use of the kangaroo position and breastfeeding on demand may contribute to reducing crying in the phases of acute pain (T0 and 15), because breastfeeding has proven effective in relieving neonatal pain[21]. The presence of side effects such as nausea and vomiting was more frequent in the sucrose group in the first (p=0.02) and second collections (p=0.007). The nausea that occurred during baseline, especially before sucrose administration in the first data collection, may be associated with the birth process.

Although the adverse effects associated with the use of oral sucrose were not severe, the dose administered needs to be reviewed as an attempt to reduce such effects. Similarly, other authors point out the need for further studies to define the dose of sucrose to be administered when not associated with other pain relief methods[22]. The oral administration of 0.1 mL of 25% sucrose associated with non-nutritive sucking (pacifier) two minutes before heel puncture promoted neonatal pain relief in the first 30 and 60 seconds after the painful procedure in NB with 24 to 42 weeks of gestational age[22]. Thus, studies associating the use of sucrose with other non-pharmacological treatments are recommended in order to obtain effective analgesia with lower doses than those used in the present study in order to minimize adverse effects.

Studies with NB in the period of transition to extrauterine life may be difficult to interpret because, in addition to the physiological transformations, NB may be exposed to a bright and noisy environment, with different smells and temperature changes[23]. In practical terms, it is important to respect the NB's desire to breastfeed during the painful procedure and the assistance to the binomial that presents difficulty to initiate breastfeeding.

Although there is an increase in the nursing team's knowledge about pain and ways to treat neonatal pain[24] and a great advance in Health Education and in the promotion of care focused on the NB's development, taking into account the family participation, there is a need for a greater insertion of the families in the care of neonatal analgesia in the daily nursing care.

Thus, it is necessary to strengthen the educational technologies aimed at the health team, family, and community, in order to ensure correct neonatal analgesia with the evidence available today[25], collaborating with the dissemination of studies and improvement of nursing care to the NB.

For this, pain management must include not only pharmacological and non-pharmacological strategies, but also the engagement of both parents and professionals, taking into account their experiences, feelings, and wishes for the moment of the procedure itself, so that this strengthening in health education takes place[26].

Limitations of this study include the inability to blind the researcher and coders during data collection and image analysis due to the nature of the kangaroo position, the lack of a private room for data collection, exposing NB to environmental stimuli (ambient noise and movement of people), and data collections performed at night due to the technical difficulty of obtaining adequate images. The continuity of studies on neonatal analgesia involving sucrose and kangaroo position is paramount, especially in repeated procedures and in those that may be related to the longest period of pain and stress in NB.

Taking into consideration that the two interventions had the same efficacy on the main outcome (facial mimicry), it is believed that kangaroo position is more efficient because it does not involve material expenses like sucrose (production of the sucrose and syringe for administration). Thus, the kangaroo position or sucrose implementation is recommended for analgesia to NB exposed at two repeated blood draws. It is advisable to reserve the use of sucrose as analgesia for cases in which it is not possible to use the kangaroo position, because this method promotes the participation and autonomy of the mother/family in caring for the child and is free of costs and adverse effects.

## CONCLUSION

The results indicate that the kangaroo position, performed three minutes before, during and after heel puncture, and sucrose, administered orally two minutes before two blood draws (3-hour interval between them), were equally effective in promoting pain relief in neonates through observation of facial action. However, due to the adverse effects of sucrose, it is recommended that the kangaroo position be favored whenever possible.

## ACKNOWLEDGMENTS

To *Fundação de Amparo à Pesquisa do Estado de São Paulo* (São Paulo State Research Support Foundation) for funding the research (Case No. 2012/01938-0).

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