Newborn self-regulation and mother comfort in kangaroo position versus sucrose during repeated heel punctures: randomized clinical trial

Autorregulação e conforto materno ao recém-nascido em posição canguru versus sacarose submetidos a punções de calcâneo: ensaio clínico randomizado

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ABSTRACT

BACKGROUND AND OBJECTIVES: Self-regulation is the ability to control mental functions, satisfying physical, social and emotional needs. The objective of this study was to compare self-regulatory actions in newborns submitted to kangaroo position or 25% sucrose for analgesia during two heel punctures in the first hours of life, and to describe the comfort actions offered by mothers to their infants in kangaroo position.

METHODS: Randomized equivalence clinical trial with newborns submitted to two heel punctures and their mothers. The kangaroo position group remained in contact with the mother for three minutes before, during and three minutes after the punctures. The sucrose group received 25% sucrose orally two minutes before the punctures and remained in a common crib, without manipulation. The self-regulation actions and maternal comfort were microanalytically analyzed in the two punctures (18 data collection phases). The percentages of self-regulation/comfort actions duration were compared between intragroup and between groups.

RESULTS: The sample consisted of 80 newborns (40 per group) and 40 mothers (kangaroo position group). Sucking fingers/fist/tongue was the only self-regulation action that statistically differed in the two punctures (p<0.001), being higher in the sucrose group. In the kangaroo position group, mothers offered comfort actions to the child at all stages of collection, especially rocking and caressing.

CONCLUSION: Self-regulation actions of the newborns were observed in all phases of collection in both groups, such as sucking and taking hand to mouth. In the kangaroo position group, there were maternal comfort actions, especially hugging and caressing.

Keywords: Emotional regulation, Kangaroo-mother, Neonatal pain, Pain Management.

RESUMO

JUSTIFICATIVA E OBJETIVOS: Autorregulação é a habilidade de controlar as funções mentais, satisfazendo necessidades físicas, sociais e emocionais. O objetivo deste estudo foi comparar ações de autorregulação em recém-nascidos submetidos à posição canguru ou a sacarose 25% para analgesia durante duas punções de calcâneo, nas primeiras horas de vida, e descrever as ações de conforto oferecidas pelas mães aos filhos na posição canguru.

MÉTODOS: Ensaio clínico de equivalência randomizado, com recém-nascidos submetidos a duas punções de calcâneo e suas mães. O grupo posição canguru permaneceu em contato materno por três minutos antes, durante e três minutos após as punções. O grupo sacarose recebeu sacarose oral 25% dois minutos antes das punções e permaneceu em berço comum, sem manipulação. As ações de autorregulação e conforto materno foram analisadas microanaliticamente nas duas punções (18 fases de coleta de dados). As porcentagens de duração das ações de autorregulação/conforto foram comparadas entre as fases intragrupo e entre grupos.

RESULTADOS: A amostra foi composta por 80 recém-nascidos (40 por grupo) e 40 mães (grupo posição canguru). Sugar dedos/punho/língua foi a única ação de autorregulação que diferiu estatisticamente nas duas punções (p<0,001), sendo maior no grupo sacarose. No grupo posição canguru, as mães ofereceram ações de conforto ao filho em todas as fases da coleta, especialmente embalar e acariciar.

CONCLUSÃO: Foram observadas ações de autorregulação dos recém-nascidos em todas as fases da coleta em ambos os grupos, como sugar e levar mão à boca. No grupo posição canguru, houve ações de conforto materno, especialmente abraçar e acariciar.

Descritores: Dor neonatal, Manejo da dor, Posição canguru, Regulação emocional.

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HIGHLIGHTS

- Neonatal autoregulation for acute pain in the first hours of life.
- Maternal comfort for newborns in acute pain.
- Microlith analysis of the images, enabling detailed comprehension of the observed phenomena.

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INTRODUCTION

Soon after birth, newborns (NB) are exposed to uncomfortable or painful procedures, such as heel puncture, which may occur repeatedly[1]. Painful procedure repetition may affect the pain response pattern, leading to behaviors such as hyperalgesia[2], allodynia, stimulus association learning, and anticipation of painful events[3]. Such behaviors may continue throughout life if left untreated[4]. Thus, pain must be properly assessed, prevented and treated, and the training of professionals in its evaluation and management is essential[5].

Among the various forms of prevention and treatment of neonatal pain in single painful procedures, oral sucrose and the kangaroo position, also called skin-to-skin contact, stand out[6]. However, studies are still needed to evaluate the effectiveness of the kangaroo position in repeated procedures.

Acute pain is a stressful event and as such, it can trigger NB actions to self-regulate. These actions may be the same as those the fetus already performs in utero (hand on face/mouth, or sucking, for example) or may be taught or induced by contact with parents/caregivers[7].

Self-regulation is an ability that all living beings need to develop; it is about controlling their mental functions, satisfying their physical, social and emotional needs[7], in order to obtain balance and well-being during and after stressful events. The ability to self-regulate matures with the growth and development of the children, especially with the acquisition of basic skills to be autonomous, being essential during stressful or painful events[7].

Thus, self-regulation of the NB and maternal comfort during painful procedures may be a form of support and treatment of neonatal pain. This research chose to study the self-regulation behavior of the NB and the comfort offered by their mothers (kangaroo position) during two repeated heel punctures, because no studies that observed this interaction in neonatal pain situations when using the kangaroo position and sucrose as pain relief interventions were identified.

The kangaroo position allows the intimate contact between mother and child, facilitating the interaction of this binomial[8]. Thus, in the kangaroo position, the NB can rely not only on its own actions to self-regulate, but also with maternal actions that promote comfort, such as talking, rocking, kissing, caressing or offering non-nutritive sucking[9].

Sucrose was used as a positive control because it is the standard treatment for neonatal analgesia in the hospital where the data was collected[10]. It is a sweetened solution that, when orally administered, stimulates the taste receptors of the tongue papillae, activating the release of endorphins by the hypothalamus[11], in addition to promoting self-regulatory actions, such as sucking the tongue.

Thus, the objectives of this study were to compare the self-regulation responses between NB submitted to the kangaroo position or to the administration of 25% sucrose in the treatment of pain resulting from two heel punctures in the first hours of life, as well as to describe the comfort actions offered by mothers to NB in kangaroo position during the painful procedure.

METHODS

A randomized controlled equivalence clinical trial, conducted from June to December 2013, in the rooming-in units house of a public university hospital in the state of São Paulo, Brazil, which was guided by CONSORT[12] standards.

This study is part of a larger research project in which neonatal pain was broadly assessed using facial mimicry, measurement of heart rate, crying, self-regulatory actions of the NB, and comfort actions offered by mothers during the painful procedure. In the present study, the results referring to maternal self-regulation and comfort are presented.

The use of 25% sucrose (positive control/standard treatment) and the kangaroo position (new treatment) as therapeutic treatments for acute pain in infants who had undergone two heel punctures was evaluated.

In the hospital used as field, 25% sucrose is used only for neonatal analgesia, produced in its own compounding pharmacy and administered according to an institutional protocol[10]; and the kangaroo position is used for mother-child contact soon after birth (early skin-to-skin contact) in the neonatal units.

The study population included 80 NB with gestational age ≥ 36 weeks, who required at least two heel punctures during the hospitalization period, which were allocated into two groups: 40 in the kangaroo position group and 40 in the 25% sucrose group.

The NB were selected by the researchers at the time of their admission to the rooming-in unit. Thus, all NB born in the hospital during the data collection period were evaluated for inclusion and exclusion criteria. Also, the inclusion and exclusion criteria for mothers was assessed. All binomials who met the inclusion criteria and did not have exclusion criteria was invited to participate in the study. After the mothers signed the Free and Informed Consent Term (FICT), was proceeded the randomization by opening the envelope containing the treatment for pain relief (Kangaroo Position or Sucrose) to be received by the NB.

The sample was calculated using the Statistical Package for Social Sciences® (SPSS) software, version 21, based on data from a pilot study with 10 NB (five in each group), in which two identical data collections were considered. This study adopted a standard deviation of the facial mimicry duration (measured by Newborn Facial Coding System - NFCS) and the ratio between the number of comparison subjects was equal to one (Equivalence Clinical Trial), resulting in 40 NB per group (probability sample), effect size 0.145; alpha 0.5, power 0.95 and significance (p) 0.05. Perform the sample calculation taking into account the NFCS was the chosen option because it is a validated scale to assess acute neonatal pain[8], which is the main outcome of the study that generated this article.

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

NB classified as small for gestational age, those with congenital or neurological abnormalities, those clinically diagnosed with asphyxia or trauma during birth, and those with difficulty swallowing were excluded. Also were excluded cases of opioid use by the NB or mother before or after birth, mothers who used illicit drugs during pregnancy, those who had a twin sister participating in the study, as well as mothers who were unavailable to perform the kangaroo position and cases of admission to the rooming-in unit with more than 12 hours of life.

Simple randomization to the treatment groups was performed by a statistician, using the software R: Development Core Team® (2012), and a random sequence of 100 binomials was created, allocated in opaque and sealed envelopes, which were opened after the mother signed the Free and Informed Consent Term (FICT). Figure 1 shows the participants of this study.

NB data collection occurred between three and 18 hours after childbirth, in rooming-in unit with their mothers and other binomials in a room.

Data were collected in the same way in both heel punctures, each being divided into nine phases (baseline, treatment, antisepsis, T0, T15, T30, T60, T120 and T180 - seconds), totaling 18 phases of data collection (nine in the first and nine in the second heel puncture; described in table 1).

In the period between the heel punctures, NB were kept in the rooming-in unit with their mothers, were breastfed, diaper changes were performed, and they received other painful procedures as needed.

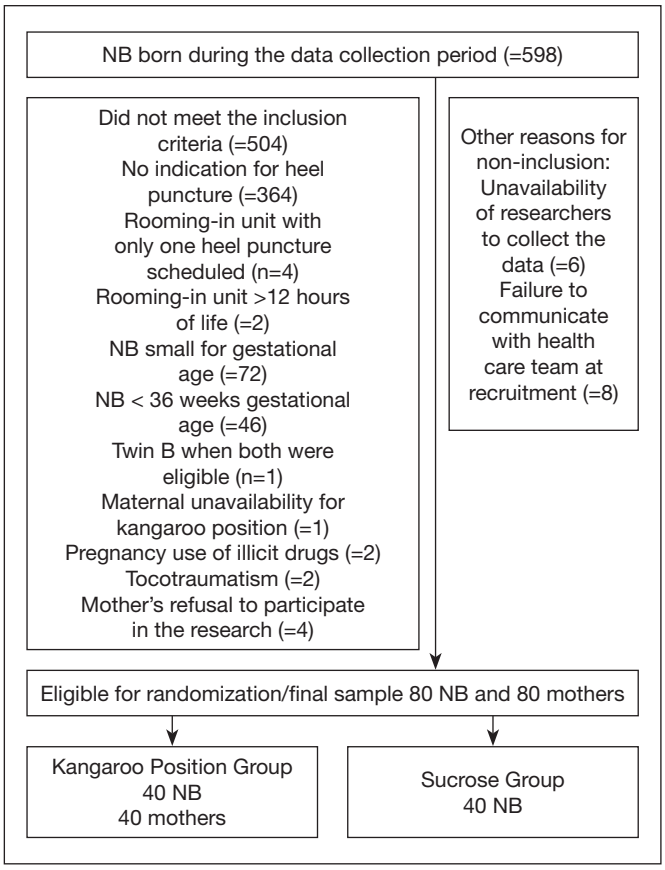

Figure 1. Study participants.

Table 1. Description of the duration and procedures performed in the phases of data collection.

Phases	Baseline	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** NB remained in a regular crib, wearing only a diaper. Two cardiac electrodes were installed below the nipples, which were connected to Polar RS800® equipment to assess heart rate*. A camera (SONY-Digital® Handycam, Hybrid Hard Disk Drive model) was placed on a tripod to record the NB actions of self-regulation and maternal comfort (kangaroo position group). **Data Collection** NB were filmed without intervention.	**Sucrose group treatment** NB receive 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[10]; they were positioned in dorsal decubitus and remained unmanipulated until the end of T180 phase. **Sucrose group data collection** Data was collected from the last minute after sucrose administration continuously until the end of each data collection. **Kangaroo position group treatment** NB were positioned upright on their mother's chest, wearing only a diaper and with their heads sideways[8], remaining in this position for three minutes before, during, and three minutes after the painful procedure[14]. **Kangaroo position group data collection** Collected data from the last minute of the kangaroo position before the painful procedure. Mothers could act freely with the baby, as long as they maintained the kangaroo position. Images of maternal self-regulation and comfort actions were recorded continuously.	Antisepsis was performed with cotton and 70% alcohol. The images of maternal self-regulation and comfort actions (kangaroo position group) were recorded continuously.	The moment of the heel puncture, performed with a Pro Uno Accu-Chek® lancet by the same trained nurse.	T15-T180: recovery after painful procedure. Data was collected continuously, without intervention from the researchers. After the end of data collection from the first heel puncture, the camera was turned off, the cardiac monitor was disconnected, and the NB remained in the rooming-in unit with their mothers. The painful procedures (type of procedure and analgesia received) that the NB received in the interval between the two data collections were recorded. At the end of the data collection from the second heel puncture, the cardiac leads were removed and the NB continued in the rooming-in unit with their mothers.				

*Heart rate data will be presented in another article.

MEASURED VARIABLES

Sample characterization

The NB were characterized with regard to the following variables: gender, birth weight, gestational age, type of delivery, drugs used at delivery, skin-to-skin contact in the birth room, invasive procedures prior to the start of data collection and those performed in the interval between the two collections (type of procedure and analgesia used). The kangaroo position group mothers were classified by age and marital status.

Neonatal comfort behaviors

Through the images obtained, the self-regulation actions performed by the NB and the maternal comfort actions offered by their mothers (kangaroo position group) were observed. The images were coded continuously, second by second, according to the method of systematic microanalytical observation[7].

The presence or absence of the following self-regulatory actions performed by NB was observed[7,9,15]:

• move the hands to the mouth: bring one or both hands to the mouth or perioral region.

• finger, hand/fist or tongue sucking: suction on fingers, hand/fist or tongue.

• search reflex: there is a slight movement of the head, opening of the mouth and protrusion of the tongue in an attempt to grasp something.

• attention to voices and maternal face: paying attention to the mother's vocalizations and/or face. This action was observed only in the kangaroo position group, because only the infants in this group could interact with their mothers.

Both the sucrose group and the kangaroo position group NB were positioned with their hands free and close to their faces to perform the actions mentioned, if they wished. The comfort actions offered by the mother to the NB were coded only in the kangaroo position group. In the sucrose group, as the objective was to evaluate the effect of sucrose alone, mothers were asked not to interact with their infants during data collection.

Thus, was observed the presence or absence of the following comfort actions offered by the mother in the kangaroo position group to comfort the NB, adapted from the medical literature[9]:

• talk: mother presents verbal and non-verbal vocalization (cooing, e.g. "*Oh, oh, oh...*", "*woo... woo...* ", "*hmm...*" or hissing "*shh... shh...*").

• rocking: mom rocks NB.

• kiss: mother kisses NB.

• caress: mother touches the NB in a soft or firm way, stroking or patting. The movement can be light and long or firm and short, repetitive or not.

• hug: mother hugs the baby so that he/she is enveloped by their embrace.

• offering non-nutritive sucking to NB: mother offers her finger for NB to suck or helps/stimulates to suck him/her own finger or hand.

Statistical analysis

In order to verify homogeneity between the groups, behavioral and demographic neonatal variables (gender, birth weight, duration of labor, gestational age, type of birth, medications used at birth, skin-to-skin contact in the birth room), comparisons between the sucrose and kangaroo position groups were performed using the Chi-squared Test or Fisher's Exact Test for categorical variables, the T-Test for independent samples, and the Mann-Whitney Test for continuous variables.

The duration percentage of the self-regulation actions and maternal comfort in the first and second data collection was calculated, using the formula: [duration of action/total duration time of the phases x 100][9].

The duration percentages of the NB self-regulation actions and comfort actions offered by the mother were compared from the collection phases in each group using Freedman's Test (intra-group comparisons); for the comparison between groups, Mann-Whitney's Test was used (between-group comparisons).

Throughout the study, a 5% significance level was adopted. The statistical analyses were performed in the SPSS® program.

RESULTS

During the data collection period, 598 NB were born in the data collection hospital. Of these, 80 were recruited to participate in the research and randomized between the groups.

In the kangaroo position group, one NB was excluded from part of phase T180 analysis in the first heel puncture, and in the sucrose group, one RN was excluded from part of phase T180 analysis in the second heel puncture. Both exclusions occurred because the recording of images ended before the completion of 60 seconds of this phase; in other words, there was no data available for the 60 seconds of this phase, but the available data were analyzed. The groups were homogeneous, with no significant differences between the demographic variables, as shown in table 2.

Table 2. Neonatal characteristics of participants in the kangaroo position and sucrose groups.

Groups	Kangaroo (n=40) n (%)	Sucrose (n=40) n (%)	P-value
Gender			0.65
Female	21 (52.5%)	19 (47.5%)	
Male	19 (47.5%)	21 (52.5%)	
Average birth weight	3.713±566g	3.746±491g	0.77
Average duration of labour	355	491	0.34
Gestational Age			
> 37 weeks	37 (92.5%)	39 (97.5%)	0.88
< 37 weeks	03 (7.5%)	01 (2.5%)	
Type of labour			
Vaginal	16 (40.0%)	15 (37.5%)	0.81
Cesarean section	24 (60.0%)	25 (62.5%)	
Drugs used in labour			
Bupivacaine	34 (85.0%)	35 (87.5%)	
Sulfentanil	36 (91.0%)	38 (94.4%)	
Morphine	21 (51.4%)	22 (55.6%)	
Skin-to-skin contact in the birth room	15 (37.5%)	12 (30.0%)	0.24

n: absolute frequency; % = relative frequency; SD = standard deviation.

The mothers participating in the kangaroo position group had a mean age of 30±5 years), 34 (85%) were married or in a stable union, and six (15%) were single.

The kangaroo position and sucrose groups did not show significant differences (p=1.00) in the number of punctures received, whether first or second heel puncture.

Before data collection began, all NB received two muscle punctures (vitamin K and hepatitis B vaccine); 62.5% in the kangaroo position group and 57.5% in the sucrose group received airway aspiration at birth; and 52.5% in the kangaroo position group and 42.5% in the sucrose group underwent two heel punctures.

However, there was no significant difference regarding the amount of any of the painful procedures: airway aspiration (p=0.64), heel punctures (p=0.40) and intramuscular punctures.

In the interval between heel punctures, five (6.2%) NB were submitted to painful procedures, three (7.5%) 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.

It is noteworthy that the NB did not receive any type of analgesia for the painful procedures they underwent before the start of data collection or in the interval between the first and second heel puncture.

Self-regulation of the newborn during the painful procedure

The sucrose group showed longer duration of self-regulation actions such as finger/wrist/tongue sucking than the kangaroo position group (p<0.05), in the phases: treatment, antisepsis and T30 in the two heel punctures; T15 in the first heel puncture; and T0 in the second heel puncture (Table 3).

Bringing the hand to the mouth was the action that showed the highest average percentage of duration in both groups, however there were no significant differences between the groups in any of the phases of data collection.

Table 3. Distribution and comparison (p) of the mean percentage and standard deviation of the self-regulation actions duration grouped in each phase in the kangaroo position and sucrose groups, in the first and second heel puncture.

		1st Heel puncture			2nd Heel puncture		
Phases	Action	Kangaroo $\bar{x}$ (SD)	Sucrose $\bar{x}$ (SD)	P-value	Kangaroo $\bar{x}$ (SD)	Sucrose $\bar{x}$ (SD)	P-value
Basal	Hand Mouth	22.82 (32.45)	43.25 (44.19)	0.65	23.06 (39.18)	32.89 (43.27)	0.64
	Suck	14.19 (18.29)	12.06 (19.09)	0.39	10.9 (18.56)	8.76 (15.54)	0.87
	Search	2.13 (6.75)	1.39 (5.93)	0.38	1.33 (6.73)	1.51 (4.96)	0.27
Treatment	Hand Mouth	44.33 (49.29)	48.21 (44.43)	0.48	46.50 (49.71)	42.17 (44.06)	0.93
	Suck	12.96 (29.42)	27.92 (33.21)	0.008*	1.51 (3.58)	7.04 (7.87)	<0.001*
	Search	0.21 (1.32)	1.88 (6.96)	0.16	0.17 (1.05)	0.42 (2.64)	0.98
	Face	0.88 (3.52)	-	-	0.42 (1.84)	-	-
Antisepsis	Hand Mouth	39.45 (45.49)	43.64 (44.21)	0.35	42.65 (47.68)	43.39 (45.00)	0.65
	Suck	8.13 (20.84)	21.20 (29.08)	0.009*	4.21 (11.19)	14.98 (18.66)	<0.001*
	Search	4.11 (12.04)	2.20 (8.29)	0.45	0.83 (3.71)	0.80 (5.03)	0.58
	Face	1.40 (6.88)	-	-	0.46 (2.87)	-	-
T0	Hand Mouth	41.17 (49.20)	42.33 (44.95)	0.77	45.67 (49.95)	42.00 (47.1)	0.56
	Suck	4.83 (15.25)	11.83 (28.50)	0.22	2.17 (8.18)	15.5 (28.1)	0.02 *
	Search	0.33 (2.11)	0 (0)	0.31	0 (0)	1.00 (4.67)	0.15
	Face	0 (0)	-	-	4.83 (18.79)	-	-
T15	Hand Mouth	44.83 (49.91)	47.67 (45.08)	0.87	46.83 (50.04)	38.33 (44.27)	0.32
	Suck	2.50 (12.78)	22.33 (33.51)	0.001*	5.33 (17.88)	9.17 (21.06)	0.32
	Search	2.5 (15.81)	0.00 (0.00)	0.31	0.00 (0.00)	0.00 (0.00)	1.00
	Face	0.50 (3.16)	-	-	0.00 (0.00)	-	-
T30	Hand Mouth	50.83 (54.95)	44.5 (45.91)	0.72	49.5 (50.23)	43.00 (47.81)	0.73
	Suck	6.58 (19.96)	22.67 (31.23)	0.001*	1.42 (6.36)	6.42 (14.13)	0.01*
	Search	1.75 (7.73)	0.42 (2.64)	0.54	3.17 (15.89)	1.92 (8.86)	0.98
	Face	0.60 (3.74)	-	-	0.25 (1.58)	-	-
T60	Hand Mouth	48.00 (50.19)	43.13 (45.14)	0.93	49.33 (49.41)	46.04 (48.08)	0.72
	Suck	9.00 (25.17)	10.42 (18.84)	0.29	6.75 (17.11)	7.88 (15.83)	0.51
	Search	1.25 (7.91)	0.00 (0.00)	0.31	2.29 (11.33)	0.00 (0.00)	0.15
	Face	1.33 (6.80)	-	-	0.00 (0.00)	-	-

Continue...

Table 3. Distribution and comparison (p) of the mean percentage and standard deviation of the self-regulation actions duration grouped in each phase in the kangaroo position and sucrose groups, in the first and second heel puncture – continuation

Phases	Action	1st Heel puncture			2nd Heel puncture		
		Kangaroo $\bar{x}$ (SD)	Sucrose $\bar{x}$ (SD)	P-value	Kangaroo $\bar{x}$ (SD)	Sucrose $\bar{x}$ (SD)	P-value
T120	Hand Mouth	45.33 (50.12)	47.38 (47.28)	0.74	40.25 (47.43)	39.00 (46.25)	0.87
	Suck	7.63 (21.29)	11.75 (22.03)	0.19	3.71 (12.53)	8.88 (20.94)	0.30
	Search	1.08 (4.49)	0.00 (0.00)	0.79	0.33 (2.11)	0.25 (1.58)	0.98
	Face	0.29 (1.84)	-	-	0.00 (0.00)	-	-
T180	Hand Mouth	43.12 (49.71)	39.75 (44.78)	0.92	41.05 (48.06)	32.91 (45.69)	0.27
	Suck	2.22 (6.25)	9.83 (27.77)	0.79	6.08 (16.45)	10.56 (22.21)	0.46
	Search	1.03 (5.64)	0.00 (0.00)	0.14	0.33 (2.11)	0.00 (0.00)	0.32
	Face	1.75 (6.80)	-	-	0.26 (1.66)	-	-

$\bar{x}$: Average duration percentage; SD = standard deviation; Hand Mouth = bring hand to mouth; Search = search reflex; Suck = finger/fist/tongue sucking; Face = attention to mother's voice/face

In the intragroup comparison, that is, in the comparisons between the phases of the collections in the first and second heel puncture, in the kangaroo position group, NB showed a significant increase in the percentage of duration of the self-regulation actions throughout the data collections: bringing hands to the mouth (p=0.01), sucking fingers, fist and tongue (p<0.001) and the search reflex (p=0.04), except for attention to the face and mother's voice (p=0.512).

NB in the sucrose group showed significant increase in the percentage of self-regulatory actions duration throughout data collection phases: sucking fingers, fist and tongue (p<0.001) and search reflex (p=0.01); bringing hands to mouth showed no significant changes in the intragroup analyses (p=0.85).

Comfort actions offered by mother to newborn

Table 4 shows the results of comfort actions performed by mothers in the kangaroo position group in all phases of data collection. The actions with the highest average percentage of duration were hugging (average percentage ranging from 25.20 to 45.00) and caressing (average percentage ranging from 7.10 to 30.35, majority above 22%) in all phases of the first and second data collection.

Non-nutritive sucking was offered by the mothers only in the second heel puncture and for a short time in the antisepsis, treatment (2.50%) and T60 (0.20) phases. Kissing was also an infrequent action, reaching a maximum average percentage of 3.00 in the T15 phase of the second puncture.

The average percentage of the talking act ranged from 0.53 to 12.3; while the rocking act ranged from 4.33 to 13.71.

In the analysis of all data collection phases, talking to the NB showed significant intragroup change, being more present in the T0 phase (p=0.046), that is, at the time of the heel puncture mothers talked more with their infants.

However, when comparing maternal actions between the two heel punctures, it was found that none of them showed a statistically significant difference: hugging (p=0.060), caressing (p=0.426), talking (p=0.549), rocking (p=0.426), kissing (p=0.492), and offering non-nutritive suction (p=0.269).

Table 4. Distribution of the mean percentage and standard deviation of the duration of comfort actions performed by mothers in the kangaroo position group according to the phases of data collection.

Phases	Action	1st Heel puncture $\bar{x}$ (SD)	2nd Heel puncture $\bar{x}$ (SD)
Treatment	Talking	4.30 (14.62)	2.71 (10.44)
	Rocking	8.85 (26.02)	13.71 (30.56)
	Kissing	0.38 (1.21)	0.67 (2.35)
	Caressing	22.73 (32.19)	22.50 (35.47)
	Hugging	44.10 (48.89)	26.67 (42.18)
	Non-nutritive Suction	0 (0)	2.50 (15.81)
Antisepsis	Talking	4.60 (14.24)	1.73 (5.76)
	Rocking	11.53 (28.35)	8.20 (23.45)
	Kissing	0.70 (2.73)	0.83 (4.32)
	Caressing	17.10 (28.51)	22.48 (35.61)
	Hugging	39.75 (46.03)	26.18 (39.64)
	Non-nutritive Suction	0.00 (0.00)	2.50 (15.81)
T0	Talking	3.33 (9.21)	8.18 (21.20)
	Rocking	12.33 (30.81)	4.33 (17.87)
	Kissing	0.68 (4.27)	0 (0)
	Caressing	22.69 (34.71)	29.85 (39.29)
	Hugging	42.00 (49.57)	33.83 (46.22)
	Non-nutritive Suction	0 (0)	0 (0)
T15	Talking	8.17 (16.98)	12.53 (27.65)
	Rocking	12.50 (33.49)	6.68 (22.26)
	Kissing	0.83 (3.76)	3.00 (13.34)
	Caressing	25.50 (37.16)	30.35 (38.98)
	Hugging	45.17 (49.21)	34.33 (46.84)
	Non-nutritive Suction	0 (0)	0 (0)

Continue...

Table 4. Distribution of the mean percentage and standard deviation of the duration of comfort actions performed by mothers in the kangaroo position group according to the phases of data collection – continuation

Phases	Action	1st Heel puncture $\bar{x}$ (SD)	2nd Heel puncture $\bar{x}$ (SD)
T30	Talking	4.50 (16.60)	3.93 (16.23)
	Rocking	12.50 (30.37)	4.93 (21.74)
	Kissing	0.50 (2.67)	0.25 (1.58)
	Caressing	28.25 (33.80)	25.40 (34.94)
	Hugging	45.00 (47.51)	32.75 (47.28)
	Non-nutritive Suction	0 (0)	0 (0)
T60	Talking	2.00 (6.09)	1.58 (4.29)
	Rocking	9.29 (26.03)	10.18 (23.07)
	Kissing	2.63 (15.80)	0.68 (2.59)
	Caressing	29.42 (37.35)	20.50 (31.55)
	Hugging	35.33 (46.21)	25.20 (41.67)
	Non-nutritive Suction	0 (0)	0.20 (1.26)
T120	Talking	1.13 (5.00)	0.53 (2.87)
	Rocking	9.54 (23.90)	6.90 (19.23)
	Kissing	0 (0)	0.18 (1.11)
	Caressing	24.67 (33.82)	22.95 (33.89)
	Hugging	31.08 (44.38)	31.65 (45.17)
	Non-nutritive Suction	0 (0)	0 (0)
T180	Talking	0.68 (3.08)	1.28 (4.37)
	Rocking	6.07 (20.06)	5.48 (19.56)
	Kissing	0.13 (0.80)	0.38 (1.75)
	Caressing	22.52 (35.95)	26.18 (37.92)
	Hugging	33.85 (45.50)	26.33 (43.23)
	Non-nutritive Suction	0 (0)	0.25 (1.58)

$\bar{x}$: Average duration percentage; SD = standard deviation.

DISCUSSION

The NB manifested self-regulatory actions when exposed to acute pain in both groups. The predominant actions were sucking and bringing the hand to the mouth. The sucrose group showed longer duration of the sucking fingers/fist/tongue action at the time of acute pain (T0) and in the first 15 seconds after acute pain (T15) ($p<0.05$). The increase in the duration of self-regulation actions was observed throughout the phases of data collection in both groups. In the kangaroo position group, mothers performed all the comfort actions analyzed, predominantly hugging and caressing. Talking to the child was more present in the acute pain phase (T0) ($p=0.046$). However, there were no significant changes in the duration of comfort actions between the two punctures.

The increased NB self-regulatory actions observed in both groups throughout the 18 phases of data collection can be attributed to the increased self-regulate ability in the face of two heel punctures.

In the analyses between groups, it was observed that sucrose favored the percentage of duration of finger/fist/tongue sucking action more than the kangaroo position. This fact may be related to the sweet taste of sucrose and the consequent stimulus to sucking, especially on the tongue. The search reflex and sucking are primitive reflexes developed during gestation, which are related to feeding[16]. As the NB associates sucking with satiety and comfort provided by nutrition (satisfaction of a basic human need), sucking during a painful stimulus may favor self-regulation.

However, tongue/hand or fist sucking can become a harmful event, because if it occurs indiscriminately, it can contribute to the abnormal development of the dental arches[16]. Thus, further studies are needed to evaluate the long term consequences of repeated use of non-nutritive suction or sweetened solutions which stimulate sucking.

Another issue with sucrose is the dose and form of administration. Current studies indicate that lower doses of sucrose 24% (minimum 0.1 ml) are effective in promoting analgesia in neonates during single procedures. However, there is still no consensus about how to administer sucrose (e.g. syringe, dropper or associated with non-nutritive suction)[18].

Therefore, further studies are needed to evaluate autoregulation of the NB exposed to repeated acute pain using smaller doses of sucrose and other forms of administration, such as associated with non-nutritive suction.

Intragroup analyses showed that both kangaroo position and sucrose favored self-regulatory actions of search reflex and sucking fingers, fist, and tongue. However, in kangaroo position, NB also showed significant changes in the action of taking hands to mouth.

Although maternal comfort actions did not change during data collection, it was observed that mothers comforted their children during the two heel punctures, and these actions were more present at the time of acute pain (T0) and early recovery (T15 and T30). Thus, the results of this study indicate that the kangaroo position allows the NB to perform more actions of self-regulation.

The immediate effects of kangaroo position on neonatal analgesia can be attributed to a set of actions that provide the NB self-regulation, such as prone position, restraint, gentle touch, self-care, increased opportunity for sucking, encouragement of breastfeeding, involvement with parents in care, restraint, and lapping[8].

In the long term, the kangaroo position has also provided beneficial effects, especially for premature infants, such as reduced cognitive sequelae and motor coordination deficits[19].

This study considered it important that the binomial has previously performed the kangaroo position, freely and without being associated with painful procedures on the NB, in order to enable both mother and NB to get to know each other, strengthen the affective bond, and that the mother becomes more able to support her child in painful situations.

In this sense, evidence on humanization at birth indicate that the practice of skin-to-skin contact (kangaroo position) in the first minutes of life provides better NB adaptation to extra-uterine environment and the bond between the binomial[8]. Moreover, at birth, it is recommended to guide pregnant and parturient regar-

ding the procedures, avoid separation of the binomial, postpone routine neonatal procedures, minimize interventions and favor early skin-to-skin contact whenever possible, regardless the type of delivery[8,20].

However, the characterization of the sample shows low adherence to skin-to-skin contact in the childbirth room, which may be related to the high number of cesarean sections, in agreement with the results of another study[21].

Although surgical teams still have fear and difficulty in adhering to skin-to-skin contact soon after birth, there are studies showing that it is possible to maintain surgical asepsis along skin-to-skin contact between mother and child in the first half hour of life[22]. Thus, it becomes necessary to train the obstetric teams for the NB reception and to discuss possible ways to ensure that skin-to-skin contact will be established in cases of cesarean sections.

The present study also verified the lack of analgesia in the painful procedures that preceded data collection, and muscle puncture for hepatitis B vaccination was one of the procedures performed in all NB without analgesia. This procedure could have been postponed until it was possible to perform the kangaroo position or breastfeeding in the childbirth room, in order to provide adequate analgesia[23].

The NB in the kangaroo position group had the need to feed at the end of the recovery phase (T30-T180). Thus, the belief is that studies involving breastfeeding and kangaroo position may present better results regarding neonatal self-regulation and analgesia.

Breastfeeding has proven effective for neonatal analgesia in procedures such as vaccination[23]. However, if it is impossible to establish effective breastfeeding on the first day of life, the kangaroo position is suggested.

In this sense, the NB who remained on the mother's lap during painful procedures showed more hand sucking actions than those who suckled during the procedure. This shows that NB deprived of breastfeeding used hand sucking as a mechanism to self-regulate in the face of acute pain[18], similarly to what was observed in the present study.

In the kangaroo position group, the fact that the maternal face care action did not increase throughout the data collection phases can be attributed to the periods of inactivity of the RN in the first hours of life.

Regarding the comfort offered by mothers to NB, the fact that they were being filmed and that data collection was carried out in the postpartum period may have inhibited some mothers from expressing themselves. It should be noted that mothers were instructed to be free to act with their child as they felt like during data collection, as long as they remained in the kangaroo position.

There is still no consensus on whether maternal comfort actions decrease pain in the NB, and although maternal touch, rocking, hugging, stimulating breast sucking, cradling, talking, and eye contact have been widely studied[25], there are few studies that relate mother/child interaction in moments of acute pain.

The medical literature suggests that encouraging actions to comfort the child and maintaining privacy at the time of kangaroo position may facilitate the promotion of bonding between the binomial at the time of acute NB pain. Moreover, maternal postpartum fatigue may have affected their interaction with the NB. Maternal fatigue is a complex phenomenon that includes feelings of tiredness, physical exhaustion, and lack of motivation[26]. These symptoms can be mitigated by a care focused on the binomial, including the participation of parents and family members in supporting the mother's care (feeding, rest, hygiene) and NB (breastfeeding, hygiene, and painful procedures). Thus, by receiving adequate support and care, the mother can be more prepared to comfort the baby in the postpartum period.

Studies have shown that NB are dependent individuals to reach their physical, emotional, and social maturity; however, primitive reflexes and the strong desire to fight for survival make them resilient and seek ways to conquer everything they need to live[27]. In this sense, was observed that studies in the areas of medicine and psychology have made great advances in understanding the mechanisms of brain development and the influence of emotions in the lives of NB, their families, and the entire society that provides care to the NB. However, nurses need to continue appropriating this knowledge so that they can implement care aimed at the NB development based on the autonomy presented, especially by the mother-child binomial.

On the other hand, it is necessary to consider the difficulties, space limitations, trained professionals, and the time needed to implement measures for self-regulation/comfort of the NB, taking into account family support. Despite this, there is an increase in the interest and willingness of health professionals to offer care in a more humanized way[20].

There is also a growing appreciation of health education through various forms of technologies, always aiming to promote awareness of families for neonatal care, taking into account the challenges faced by the team in the work environment[25]. These initiatives need to be incorporated into the different health services in order to achieve humanized and atraumatic care.

The inability to mask the researcher and coders during data analysis due to the position adopted by NB in the kangaroo position group and the lack of a designated private room for data collection is a limitation of this study.

The analysis of the self-regulation/self-comfort actions during acute pain in NB associated with the proposed treatments (sucrose and kangaroo position) was the main strength of this study, which characterizes an innovation in knowledge about neonatal analgesia. The microlithic analysis of the data allowed the researchers to observe the exact moment when the actions of self-regulation/self-comfort started and ended, which shows the need to promote the self-regulation of neonatal pain at the moment when acute pain occurs.

In terms of implications for practice, this study recommends implementing the kangaroo position or sucrose as non-pharmacological methods for acute pain relief in NB for up to two repeated and successive heel punctures, prioritizing the kangaroo position whenever possible.

Health education for mothers/family members with a focus on teaching about baby pain responses and neonatal comfort actions can promote the provision of comfort at the time of acute NB pain.

This study suggests further research that can evaluate the use of kangaroo position as long-term analgesia, in order to assess

the NB behavioral adaptation in the face of repeated and varied painful stimuli, as well as its relationship with the pain threshold.

CONCLUSION

This study concluded that both the kangaroo position (three minutes before, during, and three minutes after the painful procedure) and sucrose administered two minutes before the painful procedure promote the self-regulation of NB submitted to acute pain, with a significant difference found only in the sucking of hand/fist/ tongue, favorable to sucrose group.

However, the kangaroo position enables the mother to promote comfort actions and the NB autonomy, besides facilitating breastfeeding right after the painful procedure, which can collaborate with the NB comfort and stability.

Thus, further studies are suggested, which may show the self-regulation/comfort behavior of the NB when submitted to other painful procedures and which may involve family members in promoting pain relief and neonatal regulation.

AUTHORS' CONTRIBUTIONS

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Statistical analysis, Funding acquisition, Data Collection, Conceptualization, Resource Management, Project Management, Research, Methodology, Writing - Preparation of the original, Writing - Review and Editing, Validation, Visualization

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