0021-7557/06/82-06/475
Jornal de Pediatria

doi:10.2223/JPED.1565

Relationship between positioning of premature infants in Kangaroo Mother Care and early neuromotor development

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Abstract

Objective: To evaluate the relationship between prone and lateral positioning of preterm infants in Kangaroo Mother Care and early neuromotor development.

Methods: Eighty preterm infants born at Instituto Materno-Infantil de Pernambuco, Brazil, admitted to the Kangaroo Mother Care Unit between July and October 2004 were divided into two groups. Forty infants was placed in prone position (PP), while the remaining 40 children were kept in lateral decubitus (LD). On admission and at discharge from the Kangaroo Mother Care Unit, all infants underwent a biomechanical and a neurobehavioral assessment (Dubowitz exam). Statistical analyses were performed using Epi-Info 6.4, with calculation of 95% confidence intervals and significance established at $p < 0.05$.

Results: The groups were homogeneous prior to the intervention. Infants placed in LD showed a more flexed posture, and also adopted a more twisted trunk posture. The LD group improved in 13 out of 16 items assessed by the Dubowitz exam, while the group assigned to PP improved in only five items.

Conclusion: Placement of infants in LD had a favorable impact on early neuromotor development in our sample. However, additional longitudinal studies are needed to better clarify this relationship.

J Pediatr (Rio J). 2006;82(6):475-80: Premature, Kangaroo Mother Care, positioning, neuromotor development.

Introduction

Technological developments have improved neonatal care and reduced morbidity and mortality rates among premature newborns. Nevertheless, these children require special attention and additional support.[1] Newborns are considered preterm when delivered at less than 37 weeks (259 days) of gestational age (GA). Low birth weight – defined as a birth weight less than 2,500 g – is in itself one of the leading causes of childhood mortality.[2]

In 1979, Héctor Martínez and Edgar Rey Sanabria, from the Institute for Maternal and Child Health at Hospital San Juan de Dios, in Bogota, Colombia, proposed a significant change that redefined the concept of care for prematurely born and underweight infants – employing a more humanistic approach, they developed the Kangaroo Mother Care (KMC) program.[3]

The KMC program aims at reducing incubator time for preterm infants by placing the child on the mother's chest in the kangaroo position (skin-to-skin contact between mother and baby), promoting exclusive breastfeeding and establishing a follow-up program for the child. In addition, two body positions are described for KMC: prone position (PP) or lateral decubitus (LD), the first one being most frequently adopted and promoted.[3]

Halpern et al.[4] state that preterm infants and children with birth weight under 2,000 g show a higher incidence of developmental delay. Not only do developmental outcomes for these children depend on the clinical signs they present, but also on the kind of medical assistance

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Manuscript received May 09 2006, accepted for publication Aug 16 2006.

Suggested citation: Barradas J, Fonseca A, Guimarães CL, Lima GM. Relationship between positioning of premature infants in Kangaroo Mother Care and early neuromotor development. J Pediatr (Rio J). 2006;82:475-80.

they receive. Information concerning the relationship between KMC and developmental delay is still scarce; nevertheless, according to the technical handbook of the KMC program, premature newborns who undergo this process receive sensorial and vestibular stimulation, which in turn would help their neuropsychomotor development.

In term infants, a flexor-dominant posture of the extremities is observed. This physiological flexor tone results from central nervous system maturation during fetal life. Conversely, preterm babies are relatively hypotonic since they have not yet attained the neurological maturity needed to develop a flexor posture, nor have they experienced the advantage of long-term positioning in the intrauterine environment.[5]

In search of postural stability or external support in the extrauterine environment, premature infants initially present a cervical hyperextension that will block the development of mobility and co-contraction in this area. This abnormal postural stabilization may sequentially affect the shoulder, pelvis and hips, leading to a developmental motor delay in preterm children.[5]

The premature transition to the extrauterine environment imposes a challenge to preterms, who need to maintain stability in a sensory-rich environment. Therefore, creating a stable atmosphere is a crucial step in promoting the normal development of these children.[6] According to Als et al.,[7] developmentally oriented caregiving during the neonatal period positively affects the child's neuromotor development.

Thus, the early intervention proposed by KMC is extremely important for preterms; however, there are few studies indicating the best body positioning for these children. The present study aims at identifying neurological and psychomotor implications associated with the placement of premature infants in PP and LD, and also at evaluating the posture adopted by children when placed in either position.

Methods

The study sample was composed of preterm newborns delivered at Instituto Materno-Infantil de Pernambuco (IMIP), Brazil. The study was carried out at the Kangaroo Mother Unit (KMU) of the same hospital. Inclusion criteria were the following: corrected GA between 32 and 40 weeks at the time of admission to the KMU and infant-related inclusion criteria established by the KMC technical handbook[8] – clinical stability, total enteral nutrition (breast, gastric tube, or cup), and minimum weight of 1,250 g.

Infants presenting any of the following conditions were excluded from the study: periventricular hemorrhage grades III or IV, moderate or severe hypoxia, Apgar < 7 at 5 minutes, and birth weight < 1,000 g.

The study was carried out between July and October 2004, and included all children admitted at the KMU who met the criteria described above.

Infants admitted to the study were divided into two groups. In one, children were placed in prone position (PP), while the other group was positioned in lateral decubitus (LD), as shown in Figures 1 and 2. The babies were placed in the position assigned to the group both in the kangaroo binder and in the crib. Children were randomly allocated to one of the two groups.

Figure 1 - Newborn placed in prone position; net cloth kangaroo binder allows full posture assessment

Figure 2 - Newborn placed in lateral decubitus; net cloth kangaroo binder allows full posture assessment

On the day of admission to the KMU, children in both groups underwent a biomechanical evaluation and neurobehavioral assessment using the Dubowitz method. The biomechanical examination aimed at analyzing the posture adopted by the infant when placed in the kangaroo binder in PP or LD. In order to facilitate visualization, IMP-standard kangaroo binders were made with transparent cloth (net cloth). Anteroposterior and lateral photographs were taken.

A measurement of trunk twisting was performed in all infants, adapting a technique normally used to assess thoracolumbar flexion in adult patients.[9] This adaptation, developed by the authors, was named degree of twisting. The seventh cervical vertebra (C7) and the disc between L4 and L5 were taken as reference points.

Measurements were performed with a metric tape. The infant was initially placed in the supine position (SP) in the cradle, where the first measurement was taken. The child was then placed in the kangaroo binder in PP or LD, according to the group, and a second measurement was recorded. The first value, in SP, was subtracted from the second, in the kangaroo binder, providing the degree of twisting – that is, how much trunk twisting the child would get when placed in the kangaroo binder in PP or LD.

Still on the first day of admission, Dubowitz neurobehavioral assessment was performed. The objective of this assessment was to ensure a fast and systematic evaluation of both full term and preterm newborns. One of the advantages of this instrument is that it requires minimal training or experience.[5] The test is composed of 32 items: two items cover habituation, 15 movement and tone, six reflex, and nine neurobehavioral traits. Only items in the movement and tone section were used, since they were more directly related to the goals of the study. At discharge, the assessment was once again performed.

Investigated variables included posture when placed on PP or LD in the kangaroo binder; degree of twisting; GA; weight; Apgar at 1 and 5 minutes; time spent in the KMU; and results of Dubowitz movement and tone assessment.

The materials employed included a metric tape, a digital camera, the biochemical evaluation spreadsheet and the Dubowitz neurobehavioral examination. Statistical analyses were performed using Epi-Info 6.4; 95% confidence intervals were calculated. The results were considered significant if $p < 0.05$.

A preliminary draft of the protocol was sent to the Research Ethics Committee at IMIP on April 4, 2004, and was approved on May 10. In accordance with resolution 196/96 of the National Health Council, during data collection, the goals and methods of the study were explained to all participating mothers, who then signed an informed consent authorizing the inclusion of their children in the study, as well as picture-taking.

Results

A total of 92 infants were included in the study; however, 12 did not meet the inclusion criteria or had undergone the Dubowitz exam at discharge. Thus, the final sample size was 80 infants, 40 allocated to group PP and 40 to group LD.

Means for GA (in days), weight (in grams), Apgar at 1 and 5 minutes, and time spent at the KMU are summarized in Table 1.

The variables above were used to determine if there were any significant group differences before intervention, using Student's t test. Results indicated no statistically significant differences between the two groups (PP and LD), i.e., they were homogeneous prior to the intervention.

Biomechanical analysis

Biomechanical analysis of infants in the kangaroo binder revealed different postures adopted in each positioning, PP and LD. Infants placed in PP presented

Table 1 - Descriptive analysis of groups PP and LD

PP	Mean	SD	LD	Mean	SD
GA	239.85	13.688	GA	235.88	11.686
Weight	1,742.56	347.462	Weight	1,606.38	338.227
Apgar 1	7.27	1.797	Apgar 1	6.79	2.154
Apgar 5	8.78	0.62	Apgar 5	8.54	1.636
TS-KMU	7.88	4.462	TS-KMU	8.85	3.919

GA = gestational age; LD = lateral decubitus; PP = prone position; SD = standard deviation; TS-KMU = time spent in Kangaroo mother unit.

cervical extension and rotation; shoulder extension and abduction; scapular adduction; and hip flexion and abduction. In LD, children showed cervical flexion; shoulder flexion and adduction; scapular abduction; and hip flexion and adduction. Flexed elbows and knees were observed in both groups. In addition, infants in PP placed their hands at midline, which was not observed in LD. Concerning trunk flexion, the PP and LD groups were statistically different, with a mean degree of twisting of 0.584 cm in the PP group and 2.056 cm in the LD group.

Dubowitz neonatal neurobehavioral assessment

Data obtained on the day of admission to the KMU were compared to those collected at discharge, for both groups. In the PP group, only five out of the 16 items evaluated by the Dubowitz examination were statistically different ($p < 0.05$) when comparing admission and discharge results. In group DL, 13 out of the 16 items showed statistically significant difference ($p < 0.05$). The items in which change was observed between admission and discharge are described in Table 2.

Discussion

Biomechanical analysis

Results of the biomechanical analysis demonstrate that children placed on LD present a more flexed posture and a higher degree of trunk twisting. These are two extremely important factors, especially in preterm newborns, in whom a physiological flexion-deficit is observed due to the reduced time spent in the intrauterine environment.[1] Placing infants in lateral decubitus seems to help them reassume their intrauterine position.

The DL group showed a higher degree of trunk twisting. In trunk twisting, the body's major muscle groups are positioned so as to favor motor coordination.[10] Béziers also states that the quality of the upright position depends on the quality of trunk twisting, and that the act of twisting and untwisting guarantees harmony and anteroposterior balance for the child.

The twisted trunk posture adopted by infants in LD matches the physiological aspect of the spinal cord observed in fetal and neonatal life – a single anterior concave curve resulting from the flexed posture assumed by the fetus. Cervical and lumbar lordoses will develop only when the child assumes full cervical extension and bipedalism, respectively.[11,12] Babies in PP showed a trend towards extension, contrary to the direction of the physiological curvature. This fact may have significant implications on the biomechanical development of these children, but other studies are needed to confirm this observation.

According to Douret,[13] infants placed in PP present postural abnormalities such as scapular retraction, tendency towards an opisthotonos-like posture, flexed elbows, abducted shoulders and external rotation of the hips, in addition to orthopedic foot abnormalities. These findings correlate with the postural pattern adopted by children in the PP group in our work, as evidenced by the biomechanical evaluation. Therefore, posture could be influencing installation of the pattern described by Douret at a later time.[13]

Table 2 - Dubowitz exam items showing significant improvement in groups PP and LD

LD		**PP**	
Test	**p**	**Test**	**p**
Posture	0.000	Arm traction	0.009
Arm recoil	0.000	Leg traction	0.007
Arm traction	0.000	Head control (ant.)[†]	0.01
Leg recoil	0.0001	Ventral suspension	0.04
Leg traction	0.000	Head raising in PP	0.019
Popliteal angle	0.000		
Head control (post.)[†]	0.000		
Head control (ant.)[†]	0.000		
Head lag	0.000		
Ventral suspension	0.000		
Head raising in PP	0.000		
Arm release in PP	0.000		
Spontaneous movements	0.000		

LD = lateral decubitus; PP = prone position.
[†] post. = posterior; ant. = anterior.

Dubowitz neonatal neurobehavioral assessment

Results of the Dubowitz examination demonstrated a superior performance of the LD group, with better development of an overall flexor tone, as observed in newborns delivered at term. The posture adopted by children in LD while bound to the mother or lying in the cradle allowed for flexion of upper and lower limbs, as well as trunk twisting, as described in the results of the biomechanical evaluation.

It is possible that PP did not contribute to the development of a flexor tone, which would be in accordance to the findings of Vaivre-Douret.[14] In that study, preterms were divided in two groups: a control group, in which neonates were placed only in PP, and a treatment group, including the prone and supine positions and lateral decubitus. When the groups were compared after the intervention, the main result was related to the postural evaluation: children in the control group showed an inability to position themselves in LD, due to extensor hypertonicity.

Postural stability is an important factor in the development of motor planning and coordination, being determined by flexor tone, which acts to compensate the normal progression of the extensor tone.[1] This stability then facilitates mobility, promoting motor experiences and stimulating learning and development.[15]

In regard to head control, LD children showed significant progress in both anterior and posterior head control. The PP group, however, showed significant improvement in anterior head control only.

The present results differ from those reported by Ratliff-Schaub et al.[16] Those authors divided a sample of newborns into three groups, each being assigned prone, supine or lateral positioning. Using the Bayley Scales of Infant Development, in which posterior head control is evaluated in the same way as in the Dubowitz examination (sitting position, head dropped forward), the authors suggest that cervical muscles become stronger in infants placed in PP, since this position would give them more opportunity for practice.

Conversely, the results obtained in the present study demonstrate greater improvement in head control among children placed in LD compared to PP. This was probably due not only to practice, but mainly to the stretching of extensor muscles, which is made easier when the child is placed in LD. As Bly states,[17] flexed posture promotes the stretching of extensor muscles, later favoring their contraction and the development of active extension. Active extension, in turn, favors the stretching of flexor muscles, facilitating the subsequent development of active flexion.

The present study suggests that placing preterm infants in LD results in significant benefits regarding neuromotor development. However, the absence of a long-term follow-up prevents a full judgment of the observed results. Therefore, other studies should be undertaken promoting a more extensive follow-up.

Nevertheless, this study was important in the sense of enlarging the current options for positioning preterm infants in KMC. New studies should be performed to confirm whether these results are valid when children are monitored for a longer interval, as well as when positioning is switched between PP and LD. Additional studies are needed to deepen the knowledge regarding infant positioning in the kangaroo binder.

This study was entirely based on information found on articles and books investigating the relationship between body positioning and motor development. However, none of these focused on the kangaroo position. This shows that additional work in necessary so ensure a more scientific basis for infant positioning in kangaroo care.

Finally, this study highlights the role of physical therapists in promoting the health of preterm infants. These professionals are prepared to offer a comprehensive perspective on biomechanical and neuropsychomotor issues, and to act as facilitators, favoring the development of these children.

References

1. Tecklin JS, Sheahan MS, Brockway NF. A criança de alto risco. In: Tecklin JS. Fisioterapia pediátrica. 3a ed. Porto Alegre: Artmed; 2002. p. 69-97.
2. Nascimento LF. Estudo transversal sobre fatores associados ao baixo peso ao nascer a partir de informações obtidas em sala de vacinação. Rev Bras Saude Mater Infant. 2003;3:37-42.
3. Prochnik M, Carvalho MR. Método mãe-canguru de atenção ao prematuro. Rio de Janeiro: BNDES social; 2001.
4. Halpern R, Giugliani ERJ, Victora CG, Barros FC, Horta BL. Fatores de risco para suspeita de atraso no desenvolvimento neuropsicomotor aos 12 meses de vida. J Pediatr (Rio J). 2000;76:421-8.
5. Sweeney JK, Swanson MW. Neonatos e bebês de risco: manejo em UTIN e acompanhamento. In: Umphered DA. Fisioterapia neurológica. 2 ed. São Paulo: Manole; 1994. p. 181-236.
6. Monterosso L, Kristjanson L, Cole J. Neuromotor development and the physiologic effects of positioning in very low birth weight infants. J Obstet Gynecol Neonatal Nurs. 2002;31:138-46.
7. Als H, Gilkerson L. The role of relationship-based developmentally supportive newborn intensive care in strengthening outcome of preterm infants. Semin Perinatol. 1997;21:178-89.
8. Brasil, Ministério da Saúde. Atenção humanizada ao recém-nascido de baixo-peso: método mãe canguru. Brasília: Ministério da Saúde; 2002.
9. Palmer ML, Epler ME. Fundamentos das técnicas de avaliação musculoesquelética. 2a ed. Rio de Janeiro: Guanabara Koogan; 2000.
10. Béziers M, Husinger Y. O bebê e a coordenação motora. 2a ed. São Paulo: Summus; 1994.
11. Sweeney JK, Gutierrez T. Musculoskeletal implications of preterm infant positioning in the NICU. J Perinat Neonatal Nurs. 2002;15:58-70.
12. Rash PJ. Cinesiologia e anatomia aplicada. 7a ed. Rio de Janeiro: Guanabara Koogan; 1991.

13. Douret L. Deleterious effects of the prone position in the full-term infant throughout the first year of life. Child Care Health Dev. 1993;19:167-84.
14. Vaivre-Douret L, Ennouri K, Jrad I, Garrec C, Papiernik E. Effect of positioning on the incidence of abnormalities of muscle tone in low-risk preterm infants. Eur J Paediatr Neurol. 1994;8:21-34.
15. Groot L. Posture and motility in preterm infants. Dev Med Child Neurol. 2000;42:65-8.
16. Ratliff-Schaub K, Hunt CE, Crowell D, Golub H, Smok-Pearsall S, Palmer P, et al. Relationship between infant sleep position and motor development in preterm infants. J Dev Behav Pediatr. 2001;22:293-9.
17. Bly L. Motor skill acquisition in the first year: an illustrated guide to normal development. San Antonio: Therapy Skill Builders; 1994.

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