

The Effects of Pre-feeding Oral Stimulations and Non-nutritive Sucking on Physical Growth and Independent Oral Feeding of Preterm Infants

Nasrin Khalessi¹, Sepideh Nazi¹, Mamak Shariat², Maryam Saboteh³, Zahra Farahani^{2*}

1. Aliasghar Hospital, Iran University of Medical Sciences, Tehran, Iran

2. Maternal Fetal and Neonatal Research Center, Tehran University of Medical Sciences, Tehran, Iran

3. Akbarabadi Hospital, Iran University of Medical Sciences, Tehran, Iran

ABSTRACT

Background: Breastfeeding failures and oral feeding problems in preterm infants result in long-term health complications. In this study, therefore, we aimed to evaluate the effect of oral stimulation along with non-nutritive sucking (NNS) on independent oral feeding initiation and weight gain in preterm infants.

Methods: This prospective randomized clinical trial was carried out at Aliasghar Hospital in Tehran, Iran, 2014. A total of 50 26-32 weeks gestational age hospitalized infants, who were fed through tubes, were recruited in the study. The newborns were randomized into A, B and C groups. In the A and B groups, the neonates were stimulated through oral stimulation as well as non-nutritive sucking for 5 or 10 days, while in the group C, no especial intervention was performed. Infants' mean daily weight gain, the number of days until initiation of oral feeding, oral feeding progression, the number of days until reaching full oral feeding and date of discharge were recorded. The obtained data were analyzed and compared in the three groups using SPSS version 16.0.

Results: Of all the participants, 25 cases (55.55%) were male. Mean gestational age at birth and mean birth weight were 28.64±1.93 weeks and 1337.11±185.07 grams, respectively. In the group A, newborns' weight at reaching four and eight oral feedings per day and their weights at discharge were significantly higher than the other two groups (P=0.016, 0.001 and 0.001, respectively). Mean daily weight gain in the group A was higher (84.2850 g) than the other groups (69.5814 vs. 64.2677 g). However, ANOVA results showed that this difference was not significant (P=0.108). Moreover, independent samples t-test indicated that this difference between groups A and C was significant (P=0.049).

Conclusion: In clinically stable preterm neonates, oral stimulation and should be implemented to increase their weight; however, further studies are required to address this issue.

Keywords: Non-nutritive sucking, Oral feeding, Oral stimulation, Preterm infants

Introduction

About 13 million preterm infants are annually born worldwide (1). Breastfeeding failure and oral feeding problems in preterm infants often cause long hospital stays, maternal stress and long-term health problems. Administration of enteral and parenteral nutrition cause lack of gastrointestinal tract stimulation. In addition, providing adequate and safe nutrition with underdeveloped cardiovascular, respiratory, gastrointestinal and central nervous systems is a great challenge for neonatologists (2-4).

The coordination of sucking, swallowing and breathing does not develop before 32-34 weeks gestational age (5, 6). Increased maturation and coordination of sucking, swallowing and digestion, as well as improvement of initiation and duration

of the nutritive sucking (during gavage feeding or transition from gavage to breast/bottle feeding) were observed in preterm neonates with implementing non-nutritive sucking (NNS) opportunities (5, 7, 8).

Other studies have also shown the benefits of oral stimulation through NNS before or during oral feeding in medically stable preterm infants (2). Bache et al. have indicated that at least 10 days of oral stimulation program combined with NNS in the full gavage feeding period can facilitate oral feeding progress and improve rates of breastfeeding among preterm infants and might decrease the length of hospital stay (5). Fucile et al. demonstrated that with oral stimulation program, oral feeding achieved significant results

* Corresponding author: Zahra Farahani, 2nd Floor, Maternal Fetal and Neonatal Research Center, Vali-e-Asr Hospital, Imam Khomeini Hospital, BagherKhan Ave., Tehran, Iran. Tel: (+9821) 66591316-61192357; E-mail: fetuspapyrus@gmail.com

in the intervention group, as compare to the control group (11 vs. 18 days) (2).

NNS in its simplest form has been applied as a method for effective early feeding. However, some studies have not accounted for the effect of NNS on growth, energy intake, intestinal transit time, age at full oral feeding and behavioral state (3, 7). Moreover, there is little information regarding the effects of oral stimulation on preterm infants' growth.

Since no studies have been performed on this issue in Iran, we aimed to evaluate the effect of oral stimulation combined with NNS on preterm infants' initiation and achievement of independent oral feeding and weight gain. Such investigations can promote neonatal outcome, decrease the length of newborns' hospital stay and may significantly reduce the economic burden on the health system.

Method

Subjects

This prospective randomized clinical trial was carried out in the neonatal intensive care unit (NICU) of Aliasghar Hospital, a tertiary referral center and a teaching hospital affiliated to Iran University of Medical Sciences in Tehran, Iran, 2014. Our study was approved by the Institutional Review Board of Iran University of Medical Sciences according Helsinki declaration. Informed consent was obtained from neonates' parents before conducting the study.

The gathered data were kept confidential and no extra cost was reimbursed to our subjects.

Fifty NICU hospitalized neonates with 26-32 weeks gestational age, who were fed through tubes, were recruited in the study. All the subjects had similar baseline characteristics with respect to gestational age, birth weight and gender.

Newborns with medical complications such as bronchopulmonary dysplasia, intraventricular hemorrhage, infection, sepsis, gastroesophageal reflux or necrotizing enterocolitis were excluded. Newborns were randomized into A, B and C groups using a stratified blocked randomization method, with a block size of 4. In the groups A and B, neonates were stimulated with oral stimulation program along with NNS, while in group C the neonates only received the routine nursing care.

Interventions

Pre-feeding oral stimulation and NNS, established by Fucile (2), were performed by a nurse wearing gloves. At the first 12 minutes, the infants' cheeks, lips, gums and tongue were

stroked and during the final three minutes NNS through sucking on a pacifier was performed.

In the group A, pre-feeding oral stimulation and NNS (once a day) were done by a trained nurse within 10 consecutive days. In the group B, the intervention consisted of performing pre-feeding oral stimulation and NNS twice a day within five consecutive days. The group C received neither oral stimulation nor NNS before or during gavage feeding. All the infants' demographic and medical information were recorded in some checklists.

In the physiologically stable newborns, the respective intervention of each group was started before or during gavage feeding, and was immediately stopped with infants' skin discoloration, episodes of oxygen desaturation, apnea or bradycardia.

The initiation and progress of one, four and eight successful oral feedings per day or reaching full PO (by mouth) feeding were ordered by attending physicians who were blinded about the groups. Newborns' weight was also measured on a daily basis by a blinded nurse.

Infants' mean daily weight gain (weight change during hospital stay), postmenstrual age (PMA: gestational age plus the time elapsed after birth), the number of days until oral feeding initiation, oral feeding progression, the number of days until reaching full oral feeding and date of discharge were recorded. Finally, the gathered data were compared in the three groups to evaluate the effect of oral stimulation along with NNS on weight gain and independent oral feeding of preterm infants. Some variables such as PMA to achieve once, four and eight full oral feeding as well as length of hospital stay were also considered.

Statistical analysis

The obtained data were analyzed performing multivariate analysis, independent samples t-test, ANOVA and Chi-square tests, using SPSS version 16.0. Data were presented as mean±standard deviation and n% for the continuous and categorical variables, respectively. With the power of 90% the sample size was calculated to be 45. P-values less than 0.05 were considered statistically significant.

Results

Five out of the 50 recruited cases were ineligible due to congenital malformations, genetic problems, intraventricular hemorrhage and sepsis. Of all the subjects, 25 cases (55.55%) were

male. Mean gestational age at birth and mean birth weight were 28.64±1.93 weeks and 1337.11±185.07 grams, respectively. A total of 15 preterm infants were randomly assigned to each of the three groups. There were no significant differences between the subjects regarding demographic information such as gestational age at birth, birth weight and gender ($P>0.05$) (Table 1). The mean PMA of the subjects at introducing to oral feeding and one, four, eight oral feedings per day, as well as at discharge were 33.36, 33.88, 34.93, 36.14 and 36.68 weeks, respectively.

Mean infants' weight at reaching four and eight times oral feedings per day and at discharge in group A was significantly higher than the other groups ($P=0.016$, 0.001 and 0.001 , respectively).

Mean daily weight gain in group A was higher (84.2850 g) than groups B and C (69.5814 and 64.2677 g), but ANOVA indicated that this difference was not statistically significant ($P=0.108$). Additionally, independent samples t-

test results reflected a significant difference between groups A and C ($P=0.049$, confidence interval (CI): -39.32- -0.711).

No significant difference was observed among the three groups regarding length of hospital stay ($P=0.248$), but multivariate analysis and pairwise comparisons showed that the infants in group B had shorter length of hospital stay (7.17 days), as compared to the group A ($P=0.041$, CI: 0.418-18.99).

There were no significant differences among the groups concerning PMA at day of introducing to oral feeding, one, four and eight oral feedings per day, full oral feeding and discharge ($P>0.05$). The days of life to reach one, four and eight oral feedings per day or full PO feeding were not significantly different among the groups ($P>0.05$). No significant differences were also observed in subjects' minimum weights during hospital stay (1208.33±174, 1218.00±162, 1178.00±191 g, $P=0.812$). Detailed data are shown in Table 2.

Table 1. Neonatal characteristics

	Group A, n=15	Group B, n=15	Group C, n=15	P-value
Gestational age at birth (weeks)	28.40±2.19	28.73±1.94	28.80±1.74	.838
Birth weight (g)	1304±192	1296±199	1410±148	.175
Gender (male/female)	6/9	9/6	10/5	.31

Table 2. Oral feeding progression between the three groups

	Group A n=15	Group B n=15	Group C n=15	P-value
Weight at introduction to oral feeding (g)	1677±57	1678±58	1692±61	.746
Weight at once oral feeding (g)	1788±58	1757±56	1765±75	.390
Weight at 4 oral feeding (g)	2040±89	1940±83	1945±127	.016*
Weight at 8 oral feeding (g)	2327±159	2134±97	2170±165	.001*
Weight at full oral feeding (g)	1254±153	1252±154	1309±123	.48
Weight at discharge (g)	2438±165	2226±105	2286±168	.001*
Days of life at introduction to oral feeding	34.40±10.03	34.27±10.15	34.67±11.14	.994
Days of life at once oral feeding	38.27±10.07	37±10.26	38.27±11.20	.93
Days of life at 4 oral feeding	46.33 ±10.23	42.93±10.64	45.60±11.56	.667
Days of life at 8 oral feeding	56.27 ±11.13	49.60±11.35	54±12.76	.299
Days of life at full oral feeding	12.60±3.73	12.53±2.99	12.80±3.74	.977
Days of life at discharge	59.87±11.27	52.60±11.65	57.73±13.15	.248
PMA* at introducing to oral feeding (Weeks)	33.20±1.72	33.26±1.55	33.64±1.24	.685
PMA at once oral feeding (Weeks)	33.88±1.50	33.65±1.47	34.10±1.19	.678
PMA at 4 oral feeding (Weeks)	34.98±1.71	34.52±1.60	35.30±1.32	.395
PMA at 8 oral feeding (Weeks)	36.44±1.72	35.43±1.63	36.55±1.55	.132
PMA at full oral feeding (Weeks)	30.12±2.05	30.42±1.81	30.54±1.59	.811
PMA at discharge (Weeks)	36.98±1.64	35.93±1.62	37.13±1.66	.105
Mean daily weight gain	84.28±26.96	69.58±24.37	64.26±27.16	.108

PMA: Postmenstrual age (gestational age plus the time elapsed after birth)

Discussion

Since nutritional problems are one of the major difficulties preterm neonates experience after birth, evaluation of the factors associated with initiation of independent oral feeding would be beneficial. Many studies have indicated that oral stimulation improves oral feeding progress and influences neonatal morbidities and outcomes (4, 9).

This study is an example of successful oral stimulation with NNS in preterm infants. Although the sample size used in our study was small, it raises some points which warrant further study. Our results demonstrated the significant effect of long oral stimulation and NNS (10 days) on babies' weight gain in group A, at reaching four and eight oral feedings per day and at discharge. In line with our results, Bernbaum et al. demonstrated a significant higher weight gain in the intervention group. NNS could cause a rapid weight gain in 30 premature infants by lowering intestinal transit time (10). Gaebler et al. also revealed that the subjects in the intervention group, who received pre-feeding perioral and intraoral stimulation, had more breastfeeding which in turn, resulted in greater weight gain (11). On the other hand, the study done by Pinelli et al. did not show positive effects of NNS on energy intake, intestinal transit time and weight gain (7).

Our results demonstrated that mean daily weight gain in the group A, with 10 days of NNS, was higher, as compare to the control group (no intervention group). This finding is confirmed by the study of Field et al., who showed a higher daily weight gain in preterm neonates admitted to NICU with non-nutritive sucking during tube feedings (12).

Based on our results, there were no significant differences in all participants' mean weights at introducing oral feeding. This result is consistent with the results of Tian-chan (4).

Our intervention did not have a significant effect on the length of hospital stay in the three groups. While infants in the group A had higher weights at discharge, they could not be discharged earlier than the cases in the control group. It is believed that discharge from hospital is correlated with some other important factors such as independent oral feeding status. These findings were in agreement with the results of Bache et al. study (5). On the other hand, Coker-Bolt et al. indicated that infants with oral stimulation program were discharged from hospital seven days earlier than the infants in the control group (9). Rocha et al. also demonstrated that neonates in the intervention group achieved independent oral feeding sooner and were hospitalized for a

shorter period than the subjects in control group ($P < 0.05$) (13).

No difference was observed in the infants' age when the three groups began oral feeding (4). This result may have been affected by different factors such as development of the sucking ability. The mean PMA at the beginning of oral feeding in our study was 33.36 weeks, which is close to 33.60 weeks reported in Tian-chan et al. study (4).

Finally, we found that a fifteen-minute period of oral stimulation twice a day within five consecutive days, which was implemented in group B, did not significantly affect the infants' oral feeding behaviors.

Numerous studies have been done on NNS with different methods and durations in preterm infants, most of which have focused on the outcomes such as weight gain and behavioral state changes (14). The seven- and ten-day interventions using oral stimulation or NNS were reported by Hill et al. and Fucile et al., respectively (2, 5, 15). Quite in line with Fucile and Bache studies, we found that at least 10 days of pre-feeding oral stimulation program with NNS can benefit preterm infants (2, 5).

Limitations

This study included a small sample size and no evaluations were made on the infant's indicators of sucking efficiency such as sucking bursts, burst duration, amount of formula taken during feeding and the length of feeding, which might have provided valuable data. We also did not follow-up our subjects after discharge.

Conclusion

The main strengths of this study were the positive impact of oral stimulation and NNS on weight of healthy preterm infants. Based on our results, in clinically stable preterm neonates, oral stimulation and NNS should be implemented to increase their weight; however, further studies are required to address this issue

Acknowledgement

The authors wish to thank the faculties of aternal Fetal and Neonatal Research Center (TUMS) for their supports.

References

1. Liaw JJ, Yang L, Katherine Wang KW, Chen CM, Chang YC, Yin T. Non-nutritive sucking and facilitated tucking relieves preterm infant pain during heel-stick procedures: a prospective,

- randomized controlled crossover trial. *Int J Nurs Stud.* 2012; 49(3):300-9.
2. Fucile S, Gisel E, Lau C. Oral stimulation accelerates the transition from tube to oral feeding in preterm infants. *J Pediatr.* 2002; 141(2):230-6.
 3. Fanaro S. Feeding intolerance in the preterm infant. *Early Hum Dev.* 2013; 89 Suppl 2:S13-20.
 4. Lyu TC, Zhang YX, Hu XJ, Cao Y, Ren P, Wang YJ. The effect of an early oral stimulation program on oral feeding of preterm infants. *Inter J Nurs Sci.* 2014; 1(1):42-7.
 5. Bache M, Pizon E, Jacobs J, Vaillant M, Lecomte A. Effects of pre-feeding oral stimulation on oral feeding in preterm infants: a randomized clinical trial. *Early Hum Dev.* 2014; 90(3):125-9.
 6. Harding C, Frank L, Dungu C, Colton N. The use of nonnutritive sucking to facilitate oral feeding in a term infant: a single case study. *J Pediatr Nurs.* 2012; 27(6):700-6.
 7. Pinelli J, Symington A. Non-nutritive sucking for promoting physiologic stability and nutrition in preterm infants. *Cochrane Database Syst Rev.* 2005; (4):Cd001071.
 8. Harding C, Frank L, Van Someren V, Hilari K, Botting N. How does non-nutritive sucking support infant feeding? *Infant Behav Dev.* 2014; 37(4):457-64.
 9. Coker-Bolt P, Jarrard C, Woodard F, Merrill P. The effects of oral motor stimulation on feeding behaviors of infants born with univentricule anatomy. *J Pediatr Nurs.* 2013; 28(1):64-71.
 10. Bernbaum JC, Pereira GR, Watkins JB, Peckham GJ. Nonnutritive sucking during gavage feeding enhances growth and maturation in premature infants. *Pediatrics.* 1983; 71(1):41-5.
 11. Gaebler CP, Hanzlik JR. The effects of a prefeeding stimulation program on preterm infants. *Am J Occup Ther.* 1996; 50(3):184-92.
 12. Field T, Ignatoff E, Stringer S, Brennan J, Greenberg R, Widmayer S, et al. Nonnutritive sucking during tube feedings: effects on preterm neonates in an intensive care unit. *Pediatrics.* 1982; 70(3):381-4.
 13. Rocha AD, Moreira ME, Pimenta HP, Ramos JR, Lucena SL. A randomized study of the efficacy of sensory-motor-oral stimulation and non-nutritive sucking in very low birthweight infant. *Early Hum Dev.* 2007; 83(6):385-8.
 14. Greene Z, O'Donnell C, Walshe M. Oral stimulation techniques in preterm infants-International research challenges. *J Neonatal Nurs.* 2013; 19(4):168-74.
 15. Hill AS. The effects of nonnutritive sucking and oral support on the feeding efficiency of preterm infants. *Newborn Infant Nurs Rev.* 2005; 5(3):133-41.