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The Impact of Early Discharged of Stable Preterm Neonates with Home Gavage Feeding; A Case Control Study

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Abstract

Background: Premature neonates are hospitalized until they can get full mouth feeding and this often leads to increasing the hospitalization period. This study compared two neonatal care policies: early discharge of stable preterm infants with home gavage feeding and discharge when they reached to full oral feeding.

Materials and Methods: By a case-control study, all stable premature neonates admitted in Alzahra teaching hospital, Tabriz, Iran, who were not able to feed orally, were divided into two groups. Study group included 48 neonates who achieved full oral feeding through oro- gastric tube and were discharged for outpatient follow-up. Control group included 50 neonates with the same feeding conditions who remained hospitalized and fed up by their mothers. Within one month, early clinical criteria were compared between both groups.

Results: The mean gestational age for the control group was (30.6 ± 2.5 weeks), study group was (30.2 ± 1.8 weeks) and average admission weights for control and study groups were 1409.0 ± 363.6gr and 1352.7 ± 272.3gr, respectively. Infants at the early discharge program, spent less time to reach the full oral feeding (13 days vs. 16 days) than the control group (p = 0.025), and had lower risk of sepsis and feeding intolerance compared to those in the control group and their difference for feeding intolerance was significant (p= 0.03).

Conclusion: This study showed that after an appropriate education for parents the early discharge of stable preterm neonates with home gavage feeding not only revealed a positive impact on their feeding and sucking improvement but also did not show any complication or negative impact on their growth parameters.

Key Words: Early discharge, Iran, Neonate, Tube feeding.

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1- INTRODUCTION

One of the main goals of neonatal care team is to provide an appropriate nutritional support so that all neonatal growth, development and weight gain indices are similar to those naturally provided for intra uterine growth of fetus (1,2). Previously, neonatal weight index was considered as an essential criterion for early discharge of hospitalized neonates, but recent studies showed that this criterion has lost its importance and other criteria such as physiological stability, satisfactory feeding, the ability of parents to care their babies at home and convenient access to the medical centers are now more important (3). Enteral method is recommended as the first priority of feeding due to its lower incidence of infection, better weight gain, and lower mortality rate (4).

Premature neonates, who are born before 34 weeks of gestational age as well as some term infants, do not have a proper sucking ability or are not able to coordinate between sucking, swallowing and breathing reflexes and therefore do not have the ability to feed orally and their first nutritional option must be applied via gavage (5). Premature neonates are hospitalized for nutritional purposes until they can get their entire dietary requirements via mouth feeding and this often leads to longer hospitalization period of infants in neonatal wards (6-7). Long-term hospitalization of neonates can lead to a shortage of hospital beds, increasing of health care costs, risk of hospital infections and sentimental problems for parents. Some premature babies, during their hospital stay, may have physiological stability but they still need special care for feeding by gavage, which can be provided domiciliary after an appropriate training to their parents (8). Several studies have reported the feasibility and safety of early discharge of premature babies before achieving the predetermined weight so that the infants are physiologically stable and able to feed by mouth (9-10). In this study, we compared two policies of early discharge of stable preterm infants with home gavage feeding and stable preterm infants when they reached to full oral feeding but still hospitalized.

2- MATERIALS AND METHODS

2-1. Method

The current project was a case – control study and for this purpose all stable premature neonates admitted in Alzahra teaching hospital, Tabriz, Iran, between August and October 2016 who were not able to feed orally, were divided into two groups. Study group included 48 neonates who achieved full oral feeding through oro- gastric tube and were discharged for outpatient follow-up. Control group included 50 neonates with the same feeding conditions who remained hospitalized and fed up by their mothers. Inclusion, exclusion and discharge criteria for stable preterm neonates are mentioned in **Table.1**. Proper implementation of the trainings was given under the special supervision for mothers of study's preterm neonates for following educations in two-hour sessions for 3 days, according to the following program (**Appendix.1**):

Appendix.1: The training programs for mothers of preterm neonates.

- Direct instructions of neonate feeding through oro-gastric tube gavage feeding,
- The ways to verify proper positioning of the oro-gastric tube ,
- Gavage feeding intolerance symptoms,
- The ways to control body temperature,
- Signs of hazards in newborns, and
- The ways to use a pulse oximeter.

Table-1: In/Exclusion/Discharge criteria for stable preterm neonates in early discharge study.

Criteria	Explanation
Inclusion	Physiological stability,
	No oral feeding skill attainment,
	Feeding through oro -gastric tube due to sucking oral feeding failure,
	Lack of apnea events,
	Lack of oxygen-dependency,
	Living in cities where neonatal units are existed,
	No contraindication to enteral feeding,
	Parental consent.
Exclusion	Existence of a congenital cardiac disorder, neural tube or gastrointestinal anomalies,
	Oxygen-dependency and chronic lung disease,
	Lack of ability of parents to care for baby,
	History of necrotizing enterocolitis,
	Any enteral feeding contraindications,
	Intraventricular hemorrhage grades III, IV or other intracranial hemorrhage,
	Chromosomal anomalies or craniofacial malformation, nervous system anomalies,
	Cyanotic congenital heart disease,
	Not ready for oral feedings as determined by the health care team.
Discharge	Physiological stability,
	Full gavage feeding at rate 150 – 170 ml/kg/day (breast milk + fortifier/formula powder milk),
	Lack of apnea events or apnea medication for a week,
	Proper defecation/urination,
	Lack of oxygen-dependency,
	Normal thermoregulation in open bed,
	Not receiving intravenous drug medication,
	Living in cities with at least one hospital possessing a neonatal unit,
	Having a discharge weight of at least 1500 grams,
	Daily weight gain of at least 20 grams,
	Gestational age of at least 34 weeks,
	Completion of parents training for feeding and care of newborn under supervising of responsible nurse, neonatologist,
	Finger probe Pulse oximeter prehension,
	Parental consent and readiness.

Neonates with similar conditions to the study group who their parents did not tend to discharge them or were not able to care for their babies at home were remained hospitalized as control group and were fed by their mothers or staff. Neonates were visited at home 24-48 hours after discharge and daily by trained neonatal home care team in term of assessing the quality of neonatal care by parents or any probable danger sign according to preterm neonate's follow-up checklist and were followed periodically by outpatient clinics. Neonates of both groups were followed until full-oral feeding achievement and oro-gastric tube removal, and were assessed in terms of weight gain, apnea, feeding intolerance, nasal ulcers, sepsis, full-feed time, the frequency of random oro –gastric tube displacement, the number of readmissions, O2 saturation below 90% frequency of readmission. Discharged neonates in the study group accessed to the relevant care and treatment throughout the day.

2-2. Newborns feeding instructions

Nutritional requirements (100 -120 kcal, 175 ml/kg/day) of neonates who did not have feeding contraindication and were not able to perform a proper sucking, were firstly performed via oro – gastric tube either by mother/donor breast milk or formula (in case of unavailability of the breast milk). The amount of given milk was 20 ml/kg/day, at the start, and was increased by 20 ml/kg/day in case of feeding tolerance until completion of 175 ml/kg/day. By reaching milk gavage to feeding tolerance volume of 100 ml/kg/day, fortifier was also added to the breast milk and gradually extended to 1 g / 100 ml of milk. At the gestational age of at least 31 weeks, the ability of neonates was evaluated for oral feeding via observing a proper sucking for 20 minutes and existence of gag reflex, lack of respiratory distress or apnea, oxygen desaturation and bradycardia.

When the ability of neonates for oral feeding was confirmed by neonatologist, one of the feeding promises was performed orally either from mother's breast or by syringe (syringe or dropper infant feeding guidelines) within 20 minutes and the ability of neonate for oral feeding tolerance was monitored simultaneously. In the next feeding promises, if the baby tolerated, the numbers of gavage feeding were decreased and were substituted by oral feeding gradually. This our hospital protocol was continued until a gestational age of at least 34 weeks in which the neonate could receive all feeding promises orally and home care evaluation team member removes the tube. In this study, the interval between feeding promises was considered as about 2-3 hours.

2-3. Definitions

2-3-1. Oro – gastric tube feeding

A common method of feeding for premature neonates with lack of sucking or coordinating between swallowing, sucking and breathing via insertion of a soft plastic tube F4-F6 through the mouth into the stomach (The length of the distance between the nasal bridge and the ear to middle of xyphoid and umbilicus).

2-3-2. Early discharge

Discharge of clinically stable infants with a gestational age of at least 34 weeks and a weight of 1,500 grams without oral medication needs that are unable for full oral feeding (3).

2-3-3. Stable neonates

Neonates with a gestational age of at least 34 weeks, who are able to tolerate the full feed volume through an oro -gastric tube without apnea, hypothermia, hyperbilirubinemia, organ failure, drug instructions with hemodynamic stability from 5 days before discharge and at least 20 - 30 grams daily weight gain (3).

2-3-4. Re-admission

It means re-hospitalization during the period of home gavage feeding.

2-3-5. Feeding intolerance

A nutritional condition of neonates associated with the existence of vomiting, severe abdominal distention (>15% of the baseline abdominal girth), a gastric residual >30% of the feed volume given over the previous 3 hours on at least 2 occasions during a 24-hour period (4)

2-3-6. Chronic lung disease

It means persistent oxygen dependency up to 28 days of life**.**

2-4. Statistics

The statistical analysis was performed using SPSS software version 20.0 (SPSS Inc., Chicago, IL, USA), and descriptive values were shown as the mean ± standard deviation (SD) via tables and diagrams appropriately. Student's t-test was used to analyze differences between the mean variables of two independent groups. For all statistical tests, the significant level was considered as $P \leq 0.05$. If the frequency

numbers of certain variables were less than five, the results reported upon the Fisher's exact test. For comparison of the categorical variables, Chi-square was used.

2-5. Ethics considerations

This study was in accordance with Declaration of *Helsinki - Ethical Principles* for Medical Research. The possible hazards of participation in the study were explained to the parents prior to entering into the study and informed consent was obtained from the parents of all neonates. The Ethics Committee of Tabriz University of Medical Sciences approved the study design, with approval number of.REC.1395.827.

3- RESULTS

During the study period, 98 neonates (study group: 48 and control group: 50) were enrolled (**Figure.1**). The control group included 31 (62%) girls and 19 (38%) boys, study group, 28 (58%) girls and 20 (42%) boys. The mean gestational age of all neonates was 30.4 ± 2.2 weeks and the mean gestational age for the control and study groups was 30.6 ± 2.5 and 30.2 ± 1.8 weeks, respectively without any significant difference between the two groups (p= 0.260).

The mean birth weight for all participants at the start of study was 1381.4 ± 321.7 grams and the mean admission weight for the control and study groups was 1409.0 ± 363.6 and 1352.7 ± 272.3 grams, respectively without any significant difference between the two groups (p= 0.389). In addition, the details of other studied markers, such as height and head circumference, either at the start or end of study compared between two groups are indicated in **Table.2**. Based on the results, the difference between mean weight of neonates at the start and end of study either for control or study groups was significant (p= 0.000 and p= 0.001, respectively). There was no significant difference between the study and control groups for weight (p = 0.748), at the end of study period (**Table.2**). Comparing the final figures of other growth markers such as mean height and mean head circumference between two groups did not show any significance difference (45.0 ± 2.8 vs. 43.6 ± 3.4cm; p=0.09 and 33.2 ± 2.2 vs. 33.4 ± 3.4cm; p= 0.301, respectively) (**Table.3**).

Infants were compared for different side effects during the study period and the results showed that 33 out of 50 neonates (66%) in the control group and 35 out of 48 neonates (73%) in the study group did not have any complication. The only significant difference between the study and control groups for complications was seen for feeding intolerance (4/48 vs. 10/50; p= 0.03) that showed neonates at home tolerated the feeding better than the hospitalized infants (**Table.4**).

In the study group, 48 neonates discharged but only 10 infants required one or more readmissions after early discharge from hospital indicating a significant difference between those readmitted and those without readmission (0.003) (**Table.2**).

Readmission was due to complications (**Table.4**), but feeding intolerance in two neonates did not require hospitalization by modifying the feeding method and icter in one neonate that was controlled via phototherapy at home. The cause of sepsis in the study group was due to staphylococcus aurous and in the control group was due to gram-negative basils (Klebsiella). No infant death occurred during the study

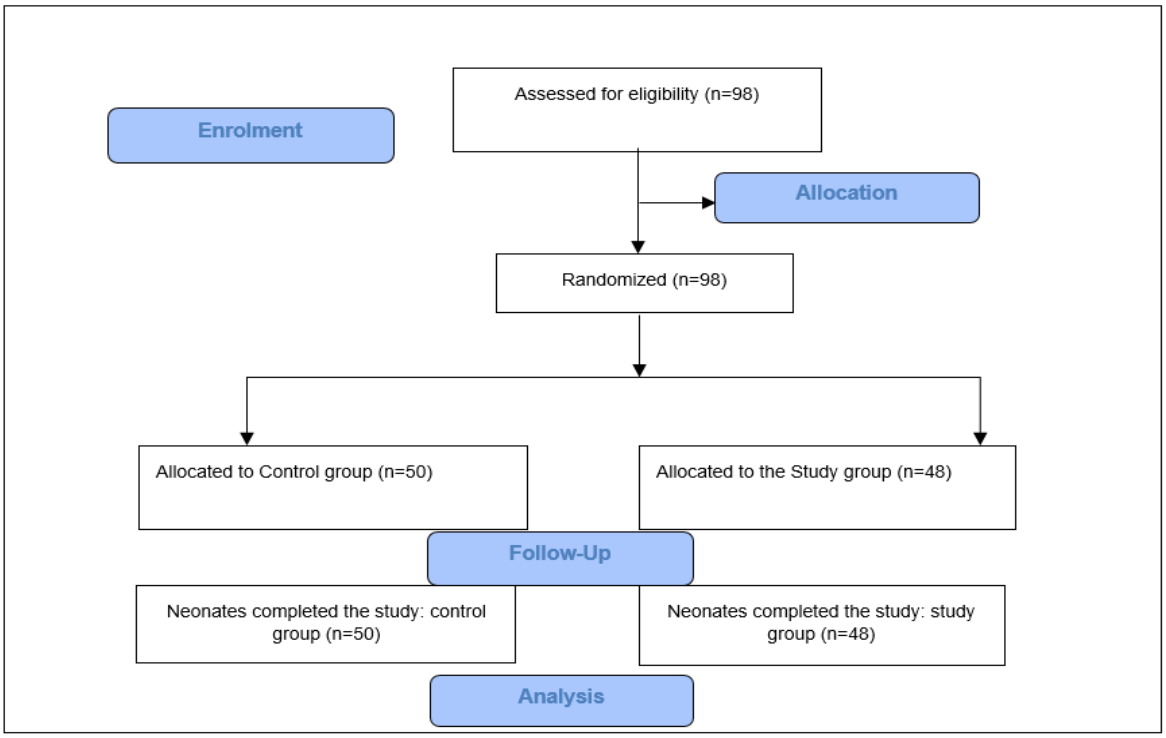

Fig.1: Flowchart of neonate's enrolment in different groups.

Table-2: Comparison of the mean and standard deviation of different growth indices among neonates in the study and control groups.

Variable/group		Mean ± standard deviation	P-value
Gestational age (weeks)	Control	30.6 ± 2.5	0.260
	Study	30.2 ± 1.8	
	Total	30.4 ± 2.2	
Admission weight (gr)	Control	1409.0±363.6	0.389
	Study	1352.7±272.3	
	Total	1381.4 ± 321.7	
Admission length (cm)	Control	39.2 ± 3.3	0.129
	Study	40.4 ± 2.8	
	Total	39.6 ± 3.5	
Admission head circumference (cm)	Control	28.9 ± 2.2	0.070
	Study	29.6 ± 2.1	
	Total	29.2 ± 2.3	
Head end study(cm)	Control	33.4± 3.4	0.301
	Study	33.2± 2.2	
	Total	39.5 ± 6.0	
Length end study (cm)	Control	43.6± 3.4	0.09
	Study	45.0± 2.8	
	Total	44.1 ± 3.6	
Weight end study (gr)	Control	2750.4 ± 267.9	0.748
	Study	2625.8 ± 307.1	
	Total	2689.39 ± 1907.8	
Full oral feeding time (day)	Control	16.5 ± 6.6	0.025
	Study	13.3 ± 7.3	
	Total	14.9 ± 7.1	
Readmission (study group)	No admission (n)	38	0.003
	Readmission (n)	10	

Table-3: The comparison of the mean and standard deviation of three main growth indices among neonates at the start and end of the study within groups.

variables	Sub-group	Mean ± SD (start)	Mean ± SD (end)	Mean difference within group	P-value
Length (cm)	Control	39.2 ± 3.3	43.6 ± 3.4	4.4	0.000
	Study	40.4 ± 2.8	45.0 ± 2.8	4.3	0.000
Head C (cm)	Control	28.9 ± 2.2	33.4 ± 3.4	4.5	0.001
	Study	29.6 ± 2.1	33.2 ± 2.2	3.6	0.004
Weight (gr)	Control	1409 ± 363.6	2750.4 ± 267.9	1341.4	0.000
	Study	1352.7 ± 272.3	2625.8 ± 307.1	1273	0.001

SD: Standard deviation.

Table-4: The comparison between the frequency of different complications among study and control groups.

Group	Complication, number (%)							Total
	No complication	Icter	Sepsis	Feeding intolerance	Cyanosis	Apnea	Aspiration	
Control	33(66)	0(0)	3(6)	10(20)	2(4)	2(4)	0(0)	50
Study	35(72.9)	1(2)	1(2)	4(8.3)	3(6.2)	2(4.1)	2(4.1)	48
Total	68(69)	1(1)	4(4)	14(14.2)	5(5.1)	4(4)	2(2)	98
P-value	0.36	0.87	0.09	0.03	0.73	0.88	0.12	

SD: Standard deviation.

4- DISCUSSION

Different studies have indicated that avoiding unnecessary hospitalization and early discharge of stable preterm infants had a considerable impact on the growth acceleration, improving of breast- feeding and familial compatibility and a considerable reduction of health care costs. During hospital stay, some premature babies have a period of physiological stability, but still need special care such as gavage feeding to gradually getting the ability of oral feeding and this process increases the hospitalization period for these infants (5-6). By providing a short training for parents on how care and feed their babies by gavage, under the supervision of trained nurses and physicians, the hospital gavage feeding can be continued at home until the advent of baby's ability to oral feeding (7-8). Several studies have reported the feasibility and safety of early discharge of premature neonates who were physiologically stable with oral feeding and appropriate weight gain (9-10). However, adequate experience in the field of early discharge babies with feeding through oro– gastric tube at home is not available and only limited published studies are available. A study in Sach Children's Hospital in Stockholm investigated the consequences of early discharge of premature babies whose feeding was performed by oro- gastric tube regardless of their weights. One hundred admitted infants from January 1990 to May 1991 with hospital stay of more than 20 days were recruited in that study. Based on their results, once the neonates were stabilized physiologically, they rarely showed unexpected apnea events or other complications requiring immediate medical intervention. Only two children with gestational age of 30, and 29 weeks respectively, experienced cyanosis attacks and both were four weeks old at the time of apnea events and had responded to the tactile stimulation (11). Our study showed that complications were not observed in 33 out of 50 neonates in the control group and 35 out of 48 neonates in the study group with no significant differences between groups. Four out of 48 (8.3%) neonates among the study group and 10 out of 50 (20%) infants among the control group experienced the feeding intolerance with a

significant difference and based on this result, neonates at home tolerated the feeding better than hospitalized neonates. Aspiration was more observed in the study group but the difference was not significant and the incidence of jaundice, apnea and cyanosis attacks were relatively equal in both groups but the incidence of sepsis in the control group (3 infants) was more frequent than the study group (one neonate), although this difference was not significant. In another study on early discharge infants with gavage feeding, 88 neonates from 75 families were assessed (12). The mean length of hospitalization in the group of early discharge with home gavage feeding was almost nine days less than the control group. There was no significant difference in the breastfeeding volume, weight gain, parental consent, use of health services and readmission within 12 months after discharge in the study group compared to the control group. Neonates in the study group compared to the control group who spent the same hospitalization period, had a lower risk of clinical diseases.

Our study revealed that the growth indices such as mean weight, height and head circumference were increased, during the study period, relatively the same between both study and control groups and there was no significant difference between these groups at the end of study. During the study period, the mean hospital stay for all participated neonates was 26.3 ± 13.3 days. Based on these findings, all neonatal growth and weight gain indices were relatively the same for both hospital and home groups of neonates. One of the concerns about the early discharge of premature infants is possible complication or frequent readmission. Our study revealed that in the study group, 48 neonates were discharged but only 10 infants required readmission with a mean hospital stay of 4 days. After readmission, only one infant needed 9 days hospitalization and the maximum hospital stay for others was less than 5 days. Therefore, the long-term hospitalization of preterm neonates that can lead to a shortage of hospital beds, increasing of health care costs and risk of hospital infections could be avoided without the fear of life threaten complications or even growth problems. According to our findings, early discharge of physiologically stable preterm neonates with an appropriate training of their parents, not only did not increase the risk of complications and readmission, but also reduced the hospitalization period and relevant health costs. Although, some additional costs were needed for home visits by hospital personnel**,** during the study period, which should be considered during the cost estimations, but due to lack of similar experience we advised such precautionary care.

The presence of home visit team did not affect practically on the outcome and it would be removed if similar experiences were reported from other locations. Also, this is the first experience of early discharge of such neonates in the world and therefore, some mandatory requirements such as access to training centers, potential home assessment, and access to hospital nearby must be considered that would be needed to implement such practice safely in other locations. If more experiences from other locations with similar findings (least complications) were reported, some or all of these mandatory requirements might be removed. Our study indicated that nutrition and care of preterm neonates by their parents at home and in their family atmosphere could create a positive impact on the ability of their oral feeding without any negative impact on the growth indices. The strength of this study was neonatal follow up with neonatal home care team and weakness of this study was small sample size of participants. We suggest

more appropriate studies with higher sample sizes to confirm the findings of this work.

5- CONCLUSION

Our study showed that the policy of early discharge of physiologically stable neonates and home gavage feeding via appropriate parent's training compared to the policy of maintain such infants until attaining full sucking feed had a positive impact on the neonate's sucking improvement, reduction of hospital stay without negative impact on their growth criteria. However, the parents were carefully supervised and guided throughout by the study personnel. Infants at the early discharge program, with home gavage feeding, spent less time to reach the full oral feeding and oro-gastric tube removal than the control group significantly and did not show any complication or negative impact on their growth parameters.

6- CONFLICT OF INTEREST: None.

7- ACKNOWLEDGMENT

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