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The Effect of Enteral Feeding Tubes' Insertion Sites and Preterm Infants' Positions on Aspirated Gastric Residuals.

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***Abstract**: Preterm infants born before 37 weeks are not mature enough to coordinate sucking, breathing and swallowing. As they get stronger, they can start to get milk through a tube goes into the stomach through the nose or mouths.Infant body position after feeding has been considered an important factor affecting gastric emptying. Our study aims to assess the effect of enteral feeding tubes' insertion sites and preterm infants' position on feeding tolerance. This quasi-experimental design was conducted in the neonatal intensive care unit at Bilques Central Hospital between May 2016 &January 2017. A convenient sample of 98 simple preterm infants were divided randomly into control and experimental groups. The results of this study revealed that there was a positive relation between age on initiation of minimal enteral feeding and duration to reach full enteral feeding. Number of non-significant aspirated gastric residuals were more in preterm infants in the control group than those in the experimental group with a positive relation between amount of aspirated gastric residuals and gestational age for infants in the experimental group. Hence, assigning preterm infant in the right side position could reduce feeding intolerance regardless of the tube insertion site.*

***Keywords:** Enteral Feeding, Feeding Tolerance.*

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I. Introduction

Prematurity is a term for the broad category of neonates born at less than 37 weeks gestation. Preterm birth is the leading cause of neonatal mortality and the most common reason for antenatal hospitalization [1]. Although the estimated date of confinement (EDC) is 40 weeks gestation, the World Health Organization (WHO), 2010 broadened the range of full term to include 37-42 weeks gestation **[2].** The rates of prematurity are rising around the world. About 15 million babies born preterm every year according to **WHO, 2014[3]**, 60% occur in Africa and South Asia . According to United States Department of Health and Human Services (US DHHS), 2014, it is estimated that incidence of preterm birth in United States is about 11.4 % in 2013; while in Africa it is about 11.9%. Additionally, it is estimate that preterm delivery in Egypt is less than 10 % in the general population year in the same year. **[4].**

Preterm infants are more likely to have immature gastrointestinal system leaving them predisposing to complications such as necrotizing enterocolitis (NEC) this potentially serious complication, in which the cells lining the bowel wall are injured and can occur in preterm babies after they start feeding. Necrotizing enterocolitis in preterm infants (NEC) is an example for feeding problem whichis an acquired gastrointestinal disease that manly affects preterm infants **[5].**

The presentation of NEC varies widely. Symptoms of NEC may be sudden and profound or insidious and subtle. Additionally, disease presentation varies depending on the stage of disease. Therefore, NEC is best defined a long continuum from suspected cases to infants with advanced disease. Signs and symptoms of NEC during early onset are often nonspecific and may resemble symptoms of sepsis such as apnea, temperature instability and lethargy **.** Other nonspecific signs of NEC may include feeding intolerance, sepsis or GI bleeding, all of which may be caused by stress or other conditions of prematurity [5].

Newborn infants born before 37 weeks often have problems feeding from a bottle or a breast. This is because they are not yet mature enough to coordinate sucking, breathing and swallowing, other illness can also interfere with newborn's ability to feed by mouth some of these include breathing problems, low oxygen saturation levels, circulatory problems and blood infection. As preterm infants get stronger, they can start to get milk or formula through a tube that goes into the stomach through the nose or mouths this is called gavage feeding[6].

The advantage of intragastric feeding is that it utilizes the digestive capacity of the stomach, can be performed intermittently and hence requires less supervision. Furthermore, a fat digestion in newborn depends mostly on lingual lipase, which is most active in an acid medium, intragastric feeding would theoretically allow better fat digestion and absorption[7]**.**

The primary advantage of NG-tube is that it is temporarily and relatively non-invasive to place. Although NG- tubes may be more stable and less prone to displacement, local irritation and vagal stimulation**.** However, several studies have suggested that, the use of indwelling nasogastric tube results in respiratory compromise in VLBW preterm infants. Morever, there are certain conditions in which orogastric tubes could be used including infants requiring respiratory support, infants showing only signs of respiratory distress, infants with choanal atresia, cleft lip and palate, and extremely low birth weight infants< 1000 gm at birth, while on the other hand NG tubes can be used for all other infants [8]**.**. The introduction of enteral feeding is usually delayed in preterm infants due to the fear of poor tolerance in the presence of multi-system dysfunction, immaturity of the gastrointestinal tract and the risk of necrotizing enterocolitis[9]**.**

According toegyptian neonatal care protocol for hospital physicians, enteral feeding for preterm infants should be started in the first 3 days of life with the objective of reaching full enteral feeding in the first 2-3 weeks of life. Morever, minimal enteral nutrition should be started after ensuring hemodynamic stability in preterm neonates [10]**.** In the Neonatal Intensive Care Units (NICU), preterm infants can be placed in different positions which an impact on have various aspects of the child's survival and development.Infant body position after feeding has also been considered as an important factor affecting gastric emptying. Positioning the preterm infant is a primary nursing task. It is an important topic not only for its effect on feeding, but also, on sleep and respiration for preterm infants [11]**.**

The majority of previous studies have been focused on gastric emptying. Clarifying the effect of positioning on gastric residuals would contribute to avoiding the presence of maximum gastric residuals in preterm infants, while may lead to temporary cessation of feedings and may result in prolongation of the length of stay [12]**.**Improvements of gastric residuals are observed in prone and left lateral positions; whereas supine and right lateral positioning seem to play a worsening effect. However, due to the established risk of sudden infant death syndrome (SIDS) linked to prone positioning, this measure is limited to hospitalized babies and should not be applied in symptomatic infants discharged without cardiorespiratory monitoring[13]**.**

Evidence support that developmental care has a positive effect on preterm infants in the NICU. Appropriate positioning such as turning when feeding, not only facilitate feeding tolerance but also contribute to the stability of preterm infants' neuromotor system and promotes self-regulation. Health care professionals should understand the importance of timing in changing the position of preterm infants in order to optimize their physiological development[12]**.**

II. MaterialAnd Methods

This quasi-experimental study was carried out on preterm infants of Neonatal Intensive Care Unit department of Bilques Central Hospital ,Dakahlia, Egypt. From May 2016 to January 2017. A total of 98 preterm subjects (both control and experimental) were included in this study.

Study Design:A quasi- experimental research design.

Study Location: The study was conducted in the neonatal intensive care unit at Bilques Central Hospital**,** Dakahlia, Egypt.

Study Duration: From May 2016 to January 2017**.**

Sample Size: 98 preterm infants.

Sample size calculation: The sample size was estimated on the basis of a single proportion design. The target population from which we randomly selected our sample was considered 980. It is assumed that the confidence interval of 10% and confidencelevel of 95%. The sample size actually obtained for this study was 98 patients for both groups. We planned to include 26 in the control group and 72 in the experimental group.

Subjects& selection method:

A sample of convenience of (98) preterm infants were recruited in this study**.** This sample was divided randomly into two groups: (72) in the experimental group and (26) in the control group. Morever, the infants in the experimental group was divided randomly according to site of insertion into two subgroups; (36) in the nasogastric subgroup and (36) in the orogastric subgroup, not only that but also, each subgroup was divided according to preterms' body position during intervention into three subsubgroups; (12) in supine, (12) in prone ,

and (12) in right side position

Inclusion criteria:

a. Simple preterm infant.
b. Gestational age between 28-36 weeks of gestation.
c. Asymptomatic for gastro esophageal reflux, necrotizing enterocolitis (NEC) or other gastrointestinal diseases.
d. Medically stable preterm as indicated by their vital signs while starting the intervention.

Exclusion criteria:

Preterm infants were excluded if they had;

a) Major congenital anomalies.
b) Gastrointestinal abnormalities.
c) Hypoxic ischemic encephalopathy (HIE) as indicated by persistent low Apgar score after birth.
d) Neonatal sepsis.

Procedure Methodology:

The field work was carried out through a period of 9 months that started from 1 May 2016 to 31 January 2017, throughout this period the researcher was a member of the unit staff in Bilques Central Hospital. The researcher was available every day from 8:30 a.mtill 9:30 pm throughout the period of data collection. The pilot study took 4 weeks to be fulfilled and the implementation of the intervention lasted for the rest of the 9 months.

The researcher was available for 7 days/week throughout 9 months from 8:30 a.mtill 9:30 p.m (for13 hours/day) to observe and provide intervention. Random assignment to the experimental and control groups was done for preterm infants who only just met the inclusion criteria. They were medically stable and had been either admitted or transferred to intermediate or ordinary care room before the start of the intervention.

On admission of preterm infant, the researcher divided them randomly into two groups:

I-Control group: infants in this group received routine care according to unit policy

II- Experimental group: it included 6subsubgroups

1. Nasogastric tube insertion site with right side position.
2. Nasogastric tube insertion site with supine position.
3. Nasogastric tube insertion site with prone position.
4. Orogastric tube insertion site with right side position.
5. Orogastric tube insertion site with supine position.
6. Orogastric tube insertion site with prone position.

(N.B): Preterm infants in the experimental group had a definitive tube insertion site and assigned to a definitive position according to his subsubgroup only for one hour postfeeding then his position was changed according to unit policy for positioning schedule. Preterm infants assigned to this intervention from admission till discharge or being excluded from the study if had one or more of exclusion criteria.

On admission the researcher used medical record sheets in order to collect the sociodemographic data of the preterm infant which included; name, gender, residence, APGAR score on one and five minutes, study group, medical diagnosis, birth date, gestational age in weeks, infant weight and age on beginning of the intervention, type of milk used in feeding, preterm infant on age on initiating of minimal enteral feeding and amount of minimal enteral feeding. Additionally, the researcher measured physical measurements which included; weight, length, head and chest circumference, these measurements had measured only on admission and on discharge except weight that had been measured three times a week (Tuesday, Thursday and Sunday) to monitor preterm infants' weight gain throughout the time of intervention. Also, abdominal girth was measured immediately before feeding and 30 minutes after each feeding time.

Also, physiological measurements of preterm infants which included ; body temperature , with its normal value between 36.6-37.3° c, the heart rate with its normal value between 100≤170b/m, respiratory rate, with its normal value between 40-70 c/m, and oxygen saturation with its normal value between 85%≥100%. These measurements was taken 10 minutes pre and post feeding time.

Feeding amount was recorded every 6 hours before feeding for both groups at 6 a.m , 12 p.m& 6p.m, while aspirated gastric residual was measured at 9 a.m , 3 p.m& 9p.m every day along time of intervention. Also, assessment of early signs of feeding intolerance which included; vomiting, aspirated gastric residuals more than 25% of previous feeding, increasing of abdominal girth more than 2 cm more than prefeeding measured one, diarrhea, apnea for more than 20 seconds and temperature instability, also, late feeding intolerance signs are recorded which includes greenish vomiting, and bloody stool

Also, the total days of hospitalization were also estimated (the difference between the day of inclusion in intervention till the day of discharge), also, preterm infant's age while reaching to full oral feeding is calculated, time preterm infant spent from initiation of minimal enteral feeding till reaching to full oral feeding. Additionally, the difference between the birth day and day of inclusion was estimated. Not only has that but also, mean weight gain was calculated

III. Results

It is revealed from this table that slightly more than half of the subjects (51%) were male, the vast majority of them (86.7%) diagnosed with respiratory distress syndrome on admission, the current study revealed that two fifth of the study subjects (40.8%) admitted to the NICU in the first day of life. Additionally, one fifth of the neonates (19.4%) initiated minimal enteral feeding in the first 48hours of life.

Table (1): Characteristics of the Studied subjects (n=98).

Item	Group				Total (n=98)		Test of significance
	Experimental (n=72)		Control (n=26)				
	No	%	No	%	No	%	
Sex							
-Male	33	45.8			50	51.0	$X^{2=}$ 922
-Female	39	54.2	17	65.4	48	49.0	P=0.087
			9	34.6			
Diagnosis							
-RDS	63	87.5	22	84.6	85	86.7	$X^{2=}0.181^{*}$
-Sepsis	5	6.9	2	7.7	7	7.1	P=0.916
-Others	4	5.6	2	7.7	6	6.2	
Gestational age							
-From28-32 weeks	37	51.4	14	53.8	51	52.0	$X^{2=}0.046$
-From33-36 weeks	35	48.6	12	46.2	47		P=0.830
					48.0		
Postnatal age on admission to the NICU							
-First day of life	29	40.3	11	42.3	40	40.8	X^{2}=2.995*
-2-3 days of life	32	44.4	11	42.3	43	43.9	P=0.392
-4-7 day of life	11	15.3	3	11.5	14	14.3	
-2nd week of life	0	0.0	1	3.8	1	1.0	
Type of milk used for feeding							FET
-Breast milk	1	1.4	1	3.8	2	2	P=0.462
-Preterm formula	71	98.6	25	96.2	96	98	
Inclusion age:							
-1st48 hours of birth	12	16.7	7	26.9	19	19.4	X^{2}=1.733
-2-4 days of life	24	33.3	6	23.1	30	30.6	P=0.630
-4-7 days of life	21	29.2	8	30.8	29	29.6	
-2nd week of life	15	20.8	5	19.2	20	20.4	

*Montcarlo exact test
FET=fisher exact test

Table (2): despite median length of hospital stay for preterm infants in the control group were more than that for preterm infants in the experimental group , there were no significant difference between both groups,while median duration of observation for those preterm infants in the control group was more that for preterm infants in the experimental group .

Table (2): Median, Mean and Standard Deviation of the Included Neonates According to their Characteristics:

Item	Group		Test of significance
	Experimental	Control	
Length of hospital stay (days)			
X^{-}±SD	17.20±10.61	15.88±5. 73	Z=0.250
Median	14.5	17.0	P=0.803
Duration of observation (days)			
X^{-}±SD	15.71±9.20	14.15±4.45	Z=0.339
Median	13.5	14.5	P=0.735
Chronological age (days) X^{-}±SD	4.54±2.57	6.27±5.79	Z=0.518 P=0.604

Median	4.0	5.0	
Starting weight (gms) $\bar{X}$±SD	1590.3±325.73	1633.8±255.65	Z=0.910 P=0.363
Median	1567.5	1625.0	

Table (3): showed that infants in the control group had more episodes of aspirated gastric residual than infants in the experimental group while infants with supine position in the experimental group regardlessnthe insertion site had more episodes of aspirated gastric residual compared to infants with right side or prone position. Additionally, table (3) revealed that median duration to reach full enteral feeding for infants in the control group was more than that of infants in the experimental group.

Table (3): Median, Mean and Standard Deviation of clinical indicators among Control and each Subsubgroup of the Experimental Group:

Item	**Control (n=26) $\bar{X}$ ± SD**	**Experimental (n=72)**					
		Nasogastric			**Orogatric**		
		Right side (n=12) $\bar{X}$ ± SD	**Supine (n=12) $\bar{X}$ ± SD**	**Prone (n=12) $\bar{X}$ ± SD**	**Right side (n=12) $\bar{X}$ ± SD**	**Supine (n=12) $\bar{X}$ ± SD**	**Prone (n=12) $\bar{X}$ ± SD**
number of non-significant aspirated gastric residuals	10.81± 3.28	7.33± 6.69	9.50± 8.33	7.83± **7.**13	8.5± 5.79	10.67± 4.98	8.25± 4.22
Median	11.0	5.5	7.0	5.5	6.5	10.0	6.5
Significance test		Z=3.198 **P=0.001***	Z=2.082 **P=0.037***	Z=2.602 **P=0.009***	Z=1.814 P=0.071	Z=0.237 P=0.813	Z=3.733 **P=0.000***
Duration to reach full enteral feeding $\bar{X}$ ± SD	13.92± 4.44	15.75± 10.42	13.50± 9.11	14.83± 9.52	17.58± 11.61	19.00± 8.17	12.92± 6.45
Median	14.5	14.5	9.5	12.0	13.5	13.0	11.0
Significance test		Z=0.205 P=0.838	Z=1.216 P=0.224	Z=0.710 P=0.478	Z=0.158 P=0.875	Z=2.091 **P=0.048***	Z=0.741 P=0.459
Age to reach full enteral feeding $\bar{X}$±SD	18.92±7.33	19.25± 11.55	17.50± 10.22	19.25± 10.60	21.67±15.03	21.67± 10.7	17.5± 7.89
Median	19.0	18.0	15.0	16.5	16.0	22.0	17.5
Significance test		Z=0.142 P=0.887	Z=0.867 P=0.386	Z=0.458 P=0.647	Z=0.331 P=0.741	Z=1.213 P=0.225	Z=0.331 P=0.740

Table (4): as regards the relation between amount of gastric residual and gestational age table (4) indicated that there was a positive relation between amount of aspirated gastric residual and gestational age for infants in the experimental group as P=0.003, while there was no relation for infants in the control group.

Table (4): Relation between Amount of Gastric Residual and Gestational Age:

Gestational age/week	**Group**		**Test of significance**
	Experimental	**Control**	
28-32 weeks $\bar{X}$±SD	9.97±**7.04**	11.00±**2.72**	Z=1.578 P=0.115
33-36 weeks $\bar{X}$±SD	6.29±**4.96**	10.58±**3.96**	Z=3.260 P=0.001
Median	5.0	10.0	
Significance test	Z=2.974 P=0.003	Z=0.233 P=0.816	

IV.Discussion

The establishment of safe oral feeding in preterm or low birth weight infants may be delayed because of poor co-ordination of sucking and swallowing, neurological immaturity and respiratory distress. Therefore, Enteral feeds may be delivered through a catheter (feeding tube) passed via the nose or via the mouth into the stomach · Body positioning can be considered an effective strategy to manage aspirated gastric residual in preterm infants [14, 15]. Regarding sociodemographiccharacteristic of the studied neonates the present study revealed that slightly more than half of the subjects were male. This result goes with a study conducted **Li,**

Tang&Xin-fen, 2016[16] about 'Application of prolonging small feeding volumes early in life to prevent NEC in very low birth weight preterm infants' who demonstrated that half of the studied subjects were males.

It is also obvious from the results that the vast majority of the study sample were diagnosed with respiratory distress syndrome on admission. This result goes in the same line with **Kim, Yoo, Jung &Byun, 2014**[17], in their study about 'The effect of inhaled albuterol in transient tachypnea of the newborn', in which the most of the subjects in the experimental and control groups were diagnosed with transient tachypnea of the newborn and respiratory distress syndrome. This result may be attributed to that more than 70% of neonates admitted to the study setting diagnosed with RDS on admission according to the setting statistics in 2016.

Additionally, the results revealed that median length of hospital stay for preterm infants in the experimental group was less than that of those infants in the control group, this result is in disagreement with **Krishnamurthy etal., 2010**[18] who conducted a study about 'Slow versus rapid enteral feeding advancemant in preterm newborn infants' in which median length of hospital stay for preterm infants in the experimental group was more than control group ,. Also, this result is in disagreement with **He, Chen, Li &Deng, 2017**[19] on their study about 'Gastric residual volume linked to gastric fluid PH in infants with very low birth weight' in which length of hospital stay for studied subjects in the control group was less than that for infants in the experimental group.

The results shows that infants with supine position in the experimental group with both nasogastric or orogastric tube insertion site had more episodes of aspirated gastric residual compared to infants with right side or prone position, , this result is in the same line with **Cohen etal., 2004**[20] who studied 'The effect of body positioning on gastric emptying and residuals' , the result supports that placement of the preterm infant in the prone or right lateral position following an enteral feeding results in the smallest gastric residuals.also this result is in agreement with **Chen, Ling, Gau, Kuo& Chen, 2013**[21] on their study about 'The effect of prone and supine positioning on gastric residuals in preterm infants', who found that gastric residuals were fevsignificantly lower in the prone than in supine position

.Moreover, the current study showed that gastric emptying and amount of aspirated gastric residuals decreases with increasing gestational age of the preterm infants, this result is in agreement with **Ramirez,Wong and Shulman, 2006**[22] who support the influence of gestational age on gastric emptying with the most immature infants exhibiting a slower rate , adding that gastric emptying has been found to be delayed in those extremely preterm infants, especially those confronting respiratory distress. This result may be explained in the context of researcher's point of view as with advancing gestational age of the preterm infant GIT system becomes more ready to digest food resulting in better gastric emptying.

IV. Conclusion

Based on the finding of the current study, it is concluded that, assigning the preterm infant with either nasogastric or orogastric tube insertion site in the right side position for one hour post feeding can reduce aspirated gastric residual and minimize the risk for feeding intolerance, not only that but also early initiation of minimal enteral feedings reduces the duration to reach full enteral feeding and minimizes the length of hospital stay.Therefore, it is important to provide information about enteral feeding and different insertion sites of enteral feeding tubes should be provided to medical staff in different ways to improve their performance and maintain optimal health care provided to neonates.

Limitation of the study:

- Limited number of stable preterm infants who were consistent with the inclusion criteria, with a majority being unstable
- Limited number of relevant local references.
- The researcher had to spend plenty of time in the unit.
- Limited cooperation from staff nurses in participating in the research

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