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## Determination and comparison of stomach residual volume at two alternate gavage ways with gravity and injection force in premature infants



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Mahnaz Jabraeili,<sup>1</sup> Malihe Assadollahi,<sup>2</sup> Mohammad Baqer Hosseini,<sup>3</sup>  
Mohammad Asghari Jafarabadi,<sup>4</sup> Samaneh Sadat Sajassi<sup>5\*</sup>

### ABSTRACT

**Background:** Prematurity is one of the most important problems of recent years, and the number of premature infants is increasing every year. Babies who are born prematurely due to defects in the coordination of swallowing, sucking and breathing require mouth tube or nasogastric intubation feeding. Because bolus gavage feeding is more appropriate physiologically and improves the secretion of gastric hormones is more common in neonatal intensive care units.

**Objective:** The primary objective of the study is a comparison of two alternate gavage ways with force gravity and injection with syringe in

premature infants and find existence difference and compared with the results of the research have been performed yet.

**Methods:** In this study, gastric residual volume indicators collecting method are used. The study used a questionnaire to collect data to measure indicators of the following tools. Results: Results showed that both alternate gravity and injection (push) ways, complications of gavage (vomiting, aspiration, abdominal distention and necrotizing enterocolitis) had not been seen.

**Conclusions:** Based on the results of both currently study of methods in preterm infants feeding have same effectiveness and safety.

**Keywords:** Gavage with syringes injection, Gavage with using force gravity, premature infants, volume stomach remained

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<sup>1</sup>Educator, Department of Pediatric Nursing, School of Nursing and Midwifery, Tabriz University of Medical Sciences, Tabriz, Iran.

<sup>2</sup>MSc of Pediatrics Nursing, - Faculty Member of Nursing & Midwifery School, Tabriz University of Medical Sciences, Tabriz, Iran.

<sup>3</sup>MD. Pediatric Health Research Center of Tabriz, Tabriz, Iran.

<sup>4</sup>Assistant Professor of Biostatistics, Department of Statistics and Epidemiology, Faculty of Health, Tabriz University of Medical Sciences, Tabriz, Iran.

<sup>5</sup>MSc Student of Neonatal Intensive Care Unit Nursing, Department of Pediatric Nursing and Student Research Committee, School of Nursing and Midwifery, Tabriz University of Medical Sciences, Tabriz, Iran.

\*Correspondence to: Samaneh Sadat Sajassi, MSc Student of Neonatal Intensive Care Unit Nursing, Department of Pediatric Nursing and Student Research Committee, School of Nursing and Midwifery, Tabriz University of Medical Sciences, Tabriz, Iran. [sajassi8085@gmail.com](mailto:sajassi8085@gmail.com)

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### INTRODUCTION

Prematurity is a major health problem in the world, in 2005 more than 500,000 babies were born prematurely.<sup>1</sup> In the classification of premature infants, infants weigh that less than 2500 grams considered as a baby with low birth weight and birth weight less than 1,500 grams considered as infants with very low birth weight and baby with weight less than 1000 grams considered as extremely very low.<sup>2,3</sup> Gastroesophageal reflux diseases (GERD) is one of the common symptoms of very low birth weight. GERD symptom does not classify as a symptom of vomiting or nausea which in vomiting or nausea is one of the symptoms of feeding intolerance.<sup>4,5</sup>

Prematurity increases the clinical affectation intensity in most of the neonatal disorders. Members premature performance, complications treatment and certain diseases that lead to the preterm labor that involved in the mortality and LBW preterm infants morbidity and these babies need extra attention that includes 1-temperature control and monitoring of heart rate and breathing, 2-oxygen therapy and 3- particular attention to feeding details.<sup>4</sup> At preterm infants feeding, the purpose was the highest growth and minimal intestinal damage after birth.<sup>5</sup> Research has shown proper nutrition start can improve intestinal lactase activity in preterm

infants and accelerate gastrointestinal function and prevention of necrotizing enterocolitis that 6 to 10 percent of very low weight birth is involved.<sup>6,7,8</sup> Also, adequate nutrition management in neonates is one of the long-term goals in preterm infants that cause reduction the incidence of cerebral palsy and psychomotor system development.<sup>9</sup>

On the other hand, feeding by gavage reduces risks of maternal nutrition and infection risks.<sup>10</sup> Feeding premature infants in the different method have particular importance to avoid the aspiration, baby fatigue and regurgitation then, the way of each premature infants nutrition should be determined, separately.<sup>4,11,12</sup> In fact, oral feeding in newborns with respiratory distress, hypoxia, circulatory failure, excessive discharge, retch, sepsis, weakening the central nervous system, severe prematurity or symptoms of serious illness should not be initiated or should be stopped. These infants need for fluids and electrolytes intravenous feeding or gavage feeding to supply energy.<sup>1,2</sup> Gavage tube feeding through the nose or mouth stomach is the most common method used in Neonatal intensive care units because these people are receiving food through the digestive system causing intestinal trophic factors and development of the gastrointestinal tract and save energy.<sup>4,13</sup>

Gavage performed on babies in different ways, including continuous and intermittent bolus gavage, including by force of gravity and injection with a syringe.<sup>14</sup> When the feeding tube is used, before each feeding, gastric contents must be aspirated if only small amounts of air or mucus are obtained, feeding with the same prior diet planning done, if all or much of it aspirated, feeding rate must be reduced or discontinued. Brigit,<sup>5</sup> Silvia<sup>15</sup> and colleagues performed a study to determine the proper nutrition tolerated by the infants. They reported symptoms of feeding intolerance and high gastric residual volume, vomiting, abdominal distention, bloody stools, apnea, bradycardia, and hypotension and lack of temperature stability. In fact, the average volume of residual gastric evaluation is one of the most common methods for identification of tolerance or intolerance in feeding by preterm infants.<sup>16</sup>

Gastric residual volume increase represents Infant feeding intolerance that the first stage necrotizing enterocolitis can see that is one of the causes of death of infants with low birth weight.<sup>17</sup> Change cardiovascular (bradycardia and apnea) are other symptoms that may associate with other symptoms of feeding intolerance in infants.<sup>18</sup> So choosing the most suitable method to baby gavage is one of the intervention that a nurse can prevent the complications of feeding intolerance, necrotizing and aspiration.<sup>5,15,19,20</sup> Due to intermittent gavage complications, intermittent gavage is now more common in NICU centers, and it is important to know which alternate gavage methods that have fewer side effects.<sup>14</sup>

Intermittent gavage is in two ways, one is by gravitational force, and another one through injection is carried out slowly and gradually into the baby's stomach.<sup>14</sup> Since infant feeding is the research priorities in infants area, it is essential to minimize complications in infants. Thus, we perform a study to determine and compare the volume of the remaining gastric in alternate gavage (injected with a syringe and gravity) on premature infants with comparison and determination of gavage complications such as aspiration, abdominal distention, vomiting and necrotizing enterocolitis continue to investigate for this purpose.

## THEORETICAL BASIC

**Consequences:** The outcome or impact of an activity or an event.

**Premature infants:** Infants were born less than 37 weeks from the first day of the last menstrual period said preterm.<sup>13</sup> In this study, premature newborn infants who were between 28 and

34 weeks of gestation and had a birth weight below 2500 grams.

Early consequences: The consequences of such early impact in this study is an index such gastric residual volume.

**Gastric residual volume:** Stomach contents with a syringe before each feeding time can be determined by aspirating.<sup>21,22</sup> In this study, if the substance of the stomach which is intake by syringe, thirty percent received over the past two to three hours is considered a high gastric residual volume and any remaining amount of chart paper are recorded in cc.

**Intermittent gavage:** Gavage feeding is given in every two to three hours with calculating the amount of energy required based the needs of children alternately.<sup>13</sup> In this study, intermittent gavage is in every two to three hours in two ways (gravity force and injection with a syringe). The gravity force method with the syringe can be used as the funnel and by the gravity of milk within 15-10 minutes goes to the stomach and in the injection with a syringe for 30-15 minutes can be injected into the newborn infant's stomach.

## BACKGROUND

In the clinical trial study by Schanler et al.<sup>21</sup> in Texas, the goal of feeding strategy on premature infants between 26 and 30 weeks was breastfed. Preliminary results on height, weight, head circumference, absorbing organic matter were considered in two continuous gavage, and intermittent flows and food intolerance in infants by measuring gastric residual volume factor, vomiting and abdominal distension as secondary outcomes were studied. The results showed that the absorption of organic materials, height, head circumference, the oral intake was not different between the two intermittent and continuous flows groups but in intermittent gavage, food intolerance and growth has improved in infants. A study, as alternate feeding methods versus continuous gavage in infants, was conducted in 1996 by Sylvester et al.<sup>23</sup> The aim of this study was to compare outcomes such as gastrointestinal tolerance and absorption of nutrients in infants less than 1500 grams between the two groups of infants receiving bolus and intermittent gavage. In this study, 92 infants between 750 grams to 1500 grams and 27 to 34 weeks gestational age were randomly divided into two 40, and 42 members groups and the group was divided to 750 to 999, 1000 to 1250 and 1250 until 1499 grams. The results showed that the absorption of nutrients and feeding tolerance between permanent and intermittent gavage, there is no difference. According to the study, Shulman et al. in the preterm babies with the relative health

of the gastrointestinal, intermittent feeding have been reported beneficial, but significant differences between the two groups in the occurrence of intermittent and continuous apnea and bradycardia were not seen.<sup>24</sup> Also, in the time to achieve full oral nutrition and weight gain in preterm infants, the difference between continuous and intermittent gavage have not seen.

## RESEARCH METHODS

The population in this study includes 97 premature newborn babies who were born in Al-Zahra hospital in Tabriz between 28 and 34 weeks gestation and weighed less than 2500 grams and needed to feed the stomach nasal cannula. The research environment was Al-Zahra hospital in Tabriz. The samples in this study were infants admitted in Al-Zahra hospital NICU and had criteria to participate in this study, and their parents had written informed consent. To determine the volume of samples, basic information including mean and standard deviation, remains volume variable of study size. Gabriel et al.<sup>12</sup> with considering 95% confidence, 80% statistical power, the two-tailed test with considering a 30% change in the main variable the minimum sample size was calculated for each group of 48 cases, including 20 percent loss, the sample size increased to 55 cases in each group.

In this study, gastric residual volume indicators collecting method are used. The study used a questionnaire to collect data to measure indicators of the following tools. These tools were used to evaluate gastric residual volume before gavage that with a five cc syringe slowly pulled the baby's stomach and if it was more than 30% of the infants earlier gavage.

It is a sign of massive gastric residual volume and in the form of data collection was recorded in cc, and this study was done every two to three hours before gavage, during the 48 hours. If milk does not digest by the baby and if in that turn gavage was not done then in the checklist as a gavage intolerance in that turn is recorded. This study is an interventional study from two groups of a clinical trial that population was divided into two groups. The first group is intermittent gravity-fed infants treated with red oral gastric tube No. 4 F and milk were poured into the pipe mouth which was attached to a syringe, and the syringe was used as a funnel.

With a clear height of the baby which is about 20 cm and it was allowed to tap on the baby stomach with the force of gravity, and this type of intermittent gavage for 10 to 15 minutes were completed. In the second group which intermittent gavage feeding was by injecting with syringes, the same number of the tube was used, and milk

poured into the syringe and was injected to stomach with the piston pressure into the stomach during 30 minutes. Actually, with injecting low milk into the stomach, gavages were stopped and re-start after a period until the infants required volume enters his half of stomach in an hour of slowly milk infusion.

Measurement of indicators was during 24 hours and was 8 to 12 times, and in the event of any sign of life-threatening, gavage was stopped according to babies experts and sample was removed from the study. To study gastric residual volume, before starting gavage, the baby's stomach was pulled with a 5 cc of syringe slowly, and this volume was recorded in cc format and charted. Completing the questionnaires by the researcher and check list by relative nurses was done without notice to research objectives. During 48 hours of study, any side effects such as vomiting, abdominal distention, aspiration, neonatal necrotizing enterocolitis were recorded. Vomiting of infants viewing (Revert given milk), aspiration with signs of suffocation (Choking) and distress, distention abdomen with abdominal circumference basis measurement in the first gavage and case of suspension of distention.

It was measured again, and if 2 cm increase than first time were seen, distention was considered, and necrotizing enterocolitis via distention (skin sleek) and death was marked with the loss of vital signs and list was filled with "Yes" and "No" in the check list form. Eventually, to analyze the data, SPSS statistical analysis software (version 13) was used and was done at the 0.05 significance level.

## RESULTS

110 infants were entered into the study, but due to doctor's orders to oral intake or lack of parental, we consent to continue research or baby transferring to the other treatment group. Some infants were excluded from the study. Finally, 48 children in the gravity force gavage group and 49 infants in the treated with the syringe group were studied. The results showed that the mean age of babies based on the weeks of pregnancy; in the group injected with a syringe week  $2.16 \pm 31.26$  weeks and  $1.52 \pm 31.11$  weeks in the group gravity. The two groups regarding mean gestational age at birth were not significantly different ( $P = 0.850$ ). In the group treated by syringe, 28 cases (57.14%) were male, and 21 cases (42.86%) were female, and also in the group treated with gravity, 27 cases (57.45%) were males and 20 (42.55%) cases were female. The two groups were not significantly different regarding gender ( $P = 0.960$ ).

### 6.1 statistical t-test

To compare quantitative and qualitative variables between the two groups, t- independent test independent was used respectively. The results are shown in Table 1 and case of non-normal distribution of data, the equivalent non-parametric tests were used.

Table 1 shows that in comparing the studied babies personal information, two groups regarding age, gastric residual volume at the first and second day, weight, abdominal circumference, Apgar score at birth does not have significant difference and they were same groups.

### 6.2 Investigator Principal Index test

Table 2 and 3 Show that there was no significant difference between the two groups in vomiting frequencies. Also, results in Table 4 suggest that the observed side effects in both groups were rare complications.

As Table 5 Show between gastric residual volume in two alternate gavage with gravity and injection, there is no significant difference in premature infants.

As Table 6 Show that gastric residual volume between the two intermittent gavages with gravity and injection, there is no significant difference in premature infants.

**Table 1 Comparison of babies personal information (quantitative) at two case study groups**

Variable	POSH Group	Gravity Group	Test parameters
	Mean ± Sd	Mean ± Sd	
In terms of infant gestational age *	16/2 ± 26/31	52/1 ± 33/3	P = 0/85 t = -0/17
* Apgar during 1-minute birth.	22/1 ± 75/7	51/1 ± 43/7	P = 1/11 t = 0/23
* Apgar during 5-minute birth.	91/0 ± 97/8	54/7 ± 87/9	P = 0/41 t = -0/81
Infant birth weight	08/411 ± 51/1665	51/327 ± 79/1571	P = 0/70 t = -0/38
Infant birth weight at study time*	35/416 ± 51/1665	04/374 ± 79/1571	P = 0/58 t = 0/55
Baby belly circumference *	76/1 ± 88/25	00/2 ± 76/25	P = 0/75 t = 0/31
moxg *	85/0 ± 12/4	88/0 ± 66/4	P = 0/30 t = -1/06
Gastric residual volume at the first day *	09/25 ± 41/43	11/41 ± 00/48	P = 0/50 t = -0/66
* Gastric residual volume at the second day	40/47 ± 65/73	88/46 ± 26/66	P = 0/44 t = 0/77

**Table 2 Comparison between frequency and Percent distribution related to vomiting at study in Separation of Study groups**

Variable		Group two hours POSH N =	Group three hours POSH N =	Group two hours gravity N =	Group three hours gravity	Test
		The number (percentage)	The number (percentage)	The number (percentage)	Number (percent )	
es1	0	(7/95) 22	(2/96) 25	(90) 18	(9/92) 26	P = 08/0
	1	(0) 0	(8/3) 1	(0) 0	(0) 0	
	2	(0) 0	(0) 0	(5) 1	(0) 0	
	3	(0) 0	(0) 0	(0) 0	(1/7) 2	
	8	(0) 0	(0) 0	(5) 1	(0) 0	
Es 2	0	(7/95) 22	(100) 26	(95) 19	(100) 28	P = 34/0
	11	(3/4) 1	(0) 0	(5) 1	(0) 0	
D1	0	(7/95) 22	(100) 26	(100) 20	(100) 28	P = 44/0
	8	(3/4) 1	(0) 0	(0) 0	(0) 0	

**Table 3** Comparison between frequency and Percent distribution related to vomiting at study in Separation of Study groups

Variable	Group two hours post		Group three hours gravity		Test
		The number (percentage)		The number (percentage)	
e1	0	(8/78) 43	(8/95) 46		P = 0/48
	2	(2) 1	(0) 0		
	3	(0) 0	(1/2) 1		
	4	(0) 0	(1/2) 1		
	5	(2) 1	(0) 0		
	6	(2) 1	(0) 0		
	7	(2) 1	(0) 0		
	8	(2) 1	(0) 0		
	9	(2) 1	(0) 0		
E2	0	(19/93) 46	(9/97) 47		P = 1/00
	6	(2) 1	(0) 0		
	7	(2) 1	(0) 0		
	8	(2) 1	(0) 0		
	12	(0) 0	(2) 1		
Es1	0	(9/95) 47	(7/91) 44		P = 0/25
	1	(0) 0	(2) 1		
	2	(1/2) 1	(0) 0		
	3	(2/4) 2	(0) 0		
	8	(1/2) 1	(0) 0		
	9	(0) 0	(2) 1		
Es1	0	(98) 48	(9/97) 47		P = 1/00
	11	(2) 1	(1/2) 1		
De1	0	(98) 48	(100) 48		P = 00/1
	8	(2) 1	(0) 0		

**Table 4** comparison of gavage frequency in infants, injection with syringe (push) and gravity force in premature infants

P value	Gavage with gravity	Gavage with syringe	Group infant factor
P = 0.48	2 person	6 people	Vomiting on the first day
P = 1.000	1 person	3 people	Vomiting on the second day
P = 0.25	4 people	2 person	First aspiration day
P = 1.00	1 person	1 person	Second aspiration day
P = 1.00	3 people	3 people	Abdominal distention
P = 1.00	0 people	1 person	NEC

**Table 5** Determination and comparison of remaining stomach volume in two alternate gavages with gravity force and syringe injection in Premature infants

Statistical test	Three Gravity		POSH		Variable
		Mean ± SD		Mean ± SD	
T = -0/27 Df = 95 P = 0/78		12/8 ± 37/7		86/7 ± 92/6	The remaining volume of the stomach

**Table 6** Determination and comparison of remaining stomach volume at two alternate gavage with gavage periods in Premature infants

Statistical test	Gravity three hours	Gravity two-hour	POSH three hours	POSH two hours	Variable
	Mean $\pm$ SD	Mean $\pm$ SD	Mean $\pm$ SD	Mean $\pm$ SD	
f = 49/3 Df = 3 P = 01/0	38.9 $\pm$ 70/9	34/4 $\pm$ 10/4	61.9 $\pm$ 03/9	32/4 $\pm$ 55/4	The remaining volume of the stomach

## DISCUSSIONS AND CONCLUSIONS

Since all infants were well tolerated with both gavage methods and side effects of gavage were not seen, then, considering the results based the equality of both methods, one of the two approaches to feed the baby can be used. Then, associated with gastric residual volume which is a early complications of gavage, it can be said that Bridget et al.<sup>5</sup> had conducted a study based on search study method as tolerance of nutrition in preterm babies and care guide standard for nurses which was the systematic study of the various articles of feeding intolerance in infants with symptoms such as high gastric residual volume, abdominal distention, vomiting, bloody stools, apnea and bradycardia and necrotizing enterocolitis. They stated that in collecting data in the current study these marks were measured partly and there were no significant differences in complications between the two alternate gavages and this study is consistent with the study. In the clinical trial, Shay Shrchn in 2013 at a hospital in Taiwan as a result of prone and supine positions in gastric residual in preterm infants, a crossover time series study was conducted on 35 premature infants without digestive problems was surveyed and gastric residual volume in the supine position and after 3 hours was measured at prone position and results showed decreased gastric residual volume in the prone. Results of mentioned study do not match with the current study that measured gastric residual volume in supine position. A study by Simpson et al.<sup>25</sup> at NICU of Texas Hospital of 171 babies as feeding strategies for premature infants (clinical trials of gastrointestinal feeding starting and tube feeding) was performed. Infant ages were 26 to 30 weeks and were gavigated with breast milk which was strengthened by complementary and were in the two continuously and fed by gravity groups. Measurement outcomes was infant growth and tolerance of feeding which infant feeding tolerance was measured by gastric residual volume (by aspiration of gastric contents prior to each gavage), vomiting, abdominal distention were studied. The most important result was that the infant growth was higher in blows feeding but feeding tolerance was better in continues gavage which does not match with this study. In general, based on clinical

trial, comparing two push and gravity methods significant differences were not found in gastric residual volume. The side effects observed in both groups and complications were rare. Therefore, based on the results of both currently study of methods in preterm infants feeding have same effectiveness and safety.

## RESEARCH PROPOSALS

Along with the performed study, it proposed that comparison of early outcomes of two intermittent and injected with a syringe and gravity gavage methods have been in consideration of researchers in a wider range and longer time.

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