

## Effect of Right Position During and After Feeding on Gastric Residual Volume and Regurgitation Episodes Among Preterm Infants

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### ABSTRACT

**Background:** Gastric residual and regurgitation are common problems in preterm infants. Body position affects the gastric emptying rate and feeding regimen manipulation have been shown to affect the episodes of regurgitation. **Aim:** to investigate the effect of right position during and after on gastric residual volume and regurgitation episodes among preterm infants. **Method:** a quasi-experimental design was utilized. A convenient sample of 90 preterm infants on gavage feeding was randomly allocated into three groups (30 supine position, 30 right 1 position after feeding time and 30 right 2 position during and after feeding time). The study was conducted at Neonatal Intensive Care Unit (NICU) of El Manial and Pediatric University Hospital, Cairo University Hospitals. The following tool utilized to collect the required data: preterm infant's characteristics sheet and record for gastric residual volume, regurgitation episodes and feeding. **Results:** More than half of the preterm infants in supine and half of them in right1 and right 2 groups were males. There is no statistically significant difference in the mean gestational age of preterm infants in supine, right 1 and right 2 groups. The mean gastric residual for preterm infants in right 2 position is the least volume than in right 1 and supine positions. **Conclusion:** A highly statistically significant difference was found in the mean of gastric residual volume in supine, right 1 and right 2 positions at different feeding time. No significant difference was detected in occurrence of regurgitation between the three positions while the least occurrence of regurgitation in right 2 position when compared to other positions. **Recommendation:** The current study recommended that preterm infants could be placed in right side during and after gavage feeding.

**Key words:** Preterm infants, Right and supine positions, Time of gavage feeding, Gastric residual volume, Regurgitation episodes.

### Introduction

Worldwide the incidence of preterm infants born before 37 weeks of gestations was 15 million per year (Purisch & Gyamfi-Bannerman, 2017). Preterm infants have poor sucking and swallowing abilities, immature digestive systems, insufficient gastrointestinal motility, and low gastrointestinal mucosal barrier function and they are prone to feeding intolerance such as regurgitation, vomiting, abdominal distension and gastric retention during feeding (Cui, Shi, Gao, Xue, and Fu,

2019; Morgan and Boyle, 2017). Guo, (2015) and Tudehope, Fewtrell, Kashyap, Udaeta (2013) stated that most of critically ill preterm infants are likely to experience delayed gastric emptying, intolerance of enteral feeding, pulmonary aspiration, infections and mortality all of which affect growth, all of which are contributing to delayed growth and hospital discharge (Gianni, et al., 2016).

Preterm infants exhibits reduced digestive and absorptive capacities, prolonged gastric emptying times compared

with the term neonate due to the anatomic and functional limitations of nervous and digestive system (Poquet & Wooster, 2016). Consequently, the development of the preterm infants is affected the feeding process due to an impaired suck swallow mechanism (Gallardo, Contreras & Keith, 2017). So preterm infants must be fed by gavage until achievement adequate oral feeding skills (Lau, 2016). Evaluating prefeed gastric residuals is considered routine care (Parker., etal. 2019). Preterm infants require necessity of assessment to the nutrition condition that is based on measuring gastric residual amount from the last feed when the next feed begins so proper enteral nutrition in preterm infants decreases mortality rate and spread of infection and improves weight gain (Kolnik and Billimoria, 2020).

Gastric emptying depends on a variety of factors such as type and volume of milk, physical condition and preterm infants' position as the proper position is one of the nurses' main tasks, and doing it perfectly needs more reliable evidences and clues (Gallardo, Contreras & Keith, 2017). Inability to digest enteral feedings presented as gastric residual volumes greater than 50% of previous feeding, abdominal distension or emesis (Mohamed and Ahmed, 2018). Therefore, Yayan, Kucukoglu, Dag and Boyra (2018) recommended that gastric residual is used as a significant source of data to decide whether to continue, increase, or end nutrition, and only a limited number of studies have been published on position and regurgitation.

Khatony, Abdi, Karimi, Aghaei and Brojeni (2019) concluded that body position is a factor that affects gastric residuals, the best position to decrease gastric residual volume in preterm infants after gavage was right-lateral. Lau and

Smith (2011) showed that gastric residual volume one hour after feeding in right-lateral position is less than that in left-lateral and prone positions. However, Hussein (2012) reported that right-lateral and supine positions were not effective in gastric residual volume one hour after the meal in 35 infants of NICU. Therefore, preterm infants have less often and smaller gastric residuals when nursed in a right lateral position (Sangers, et al., 2013).

Regurgitation episodes refers to the reverse movement of gastric contents into the mouth, it was extremely common in preterm infants and occur multiple times every day due to reflex relaxation of the lower esophageal sphincter (Eichenwald, 2018). When regurgitation occurs it is recommended to sit upright or raise the head of the preterm during the feeding and for at least 60 minutes after feeding (McGill-Vargas & Ilg, 2018). Symptoms such as vomiting, poor weight gain, intolerance and irritability have been attributable to regurgitation in preterm infants (Dermyshi, Mackie, Kigozi, Schoonakker & Dorling, 2018).

Dermyshi, etal. (2018) concluded that supine position predisposes to a greater degree of regurgitation than the prone position, gastric emptying was delayed in the left lateral and supine positions, the percentage of regurgitation is lower in left side and prone position with statistical difference compared with supine and right lateral position. There are different measures to control regurgitation including little manipulation, place the preterm infant in the right lateral position, elevating the head, feeding smaller volumes more frequently and using thickened formula for preterm infants (Eichenwald, 2018). Moreover, body position influences the regurgitation in preterm infants and regurgitation is particularly frequent and is

probably largely physiological and usually resolving spontaneously and may become pathological when dehydration and respiratory disease occur (Baird, Harker & Karmes, 2015; Hockenberry & Wilson, 2015).

### **Significance of the study:**

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Nutrition cares are the main measures to save preterm infants and proper positioning is one of the key measures that is done by nurses (Khatony , Abdi, Karimi , Aghaei & Brojeni, 2019). Ameri, Rostami, Baniasadi, Aboli and Ghorbani (2018) recommended that health care professionals could help the preterm infants by performing the appropriate positioning after feeding to provide efficient feeding and to prevent maximum gastric residuals volume as right position. Nurses working in NICU need to be educated on how body position affects gastric residual, the risks and benefits of different positions and time as well as the best intervention strategies for preterm infants feeding. Guo (2015) stated that maintaining a semi-recumbent right position is a strategy to improve gastric emptying and prevent regurgitations and not measuring gastric residual could result in preterm infants' harm as pulmonary aspiration.

Tube feeding can induce increased regurgitation in preterm infants as resulting from a reduction in swallow frequency, swallow propagation, and adaptive peristaltic reflexes (Dodrill, 2011). Position of the preterm affect gastric emptying and regurgitation episodes so proper position is one of the nurses' main tasks and doing it perfectly needs more reliable evidences and clues (Khatony et al., 2019).\_Right side position during the feeding significantly affect the preterm infants in transitioning from gavage to full volume oral feeding and foster improved feeding outcomes (Bradley.

Guarrera-Bowlby, Jadcherla, McManus, Mital & Ward, 2015). Dawson et al, (2013) suggested that consistent and appropriate positioning provide more regulated heart and respiratory rate and oxygen saturation in the semi-upright position. Finally, the most dangerous consequence of regurgitation is aspiration and sudden infant death syndrome to prevent and reduce the frequency of regurgitation the nurse should adhere to the correct technique when feeding the preterm infants, and put the preterm on upright position in order to remove air from the stomach and enhance digestion (Setruk, et al., 2020).

### **Definition of terms:**

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Gastric residual: is the retained gastric content from the previous feeding that was measured by aspirate gastric content before the next feeding.

Regurgitation episodes: is the occurrence of reverse movement of gastric contents into the mouth during one hour after feeding.

### **Aim of the Study**

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The aim of the current study was to investigate the effect of right position during and after feeding time on gastric residual volume and regurgitation episodes among preterm infants.

### **Materials and Methods**

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#### **Research hypotheses**

1. Preterm infants who were in right position during and after feeding time had lower mean gastric residual volume than those who did not.
2. Preterm infants who were in right position during and after feeding time had lower regurgitation episodes than those who did not.

## Design

The study used a quazi experimental design to investigate the effect of right position during and after feeding time on gastric residual volume and regurgitation episodes among preterm infants.

## Setting

The study was conducted at NICU of El Manial University Hospital and Pediatric University Hospital which affiliated to Cairo University Hospitals.

## Sample

A convenient sample of the preterm infants hospitalized in NICU who were fed through gavage and randomly assigned to control group and study group. The control group who was in supine position after feeding according to hospital care and were collected first, then the researcher collect the two intervention groups (the first intervention was right one group position after feeding time and the second intervention was right two group position during and after feeding time). To determine a sample size, a power analysis was conducted using 0.05 as the level of significance, 0.95 as the power and effect size of 0.25. The minimum required sample size obtained was 90 preterm infants.

**Inclusion criteria:** the preterm infants <37 weeks of gestational age and were fed by gavage with 3 hours interval of feeding schedule, stable physiological parameters and fed expressed breast milk or formula milk.

**Exclusion criteria:** the preterm infants had intraventricular hemorrhage, sepsis, congenital malformations and digestive problems as vomiting and bilious stained gastric aspirate, intolerance of feeding, seizures and receive digestive medications.

## Tools for data collection

The following tools utilized to collect the required data: 1- Preterm infant's personal characteristics which developed by the researcher after reviewing the related literature. It included 7 questions related to the preterm infant's gender, gestational age, birth weight, current weight, age, mode of delivery and diagnosis. All questions were in the form of closed ended question and the answer to each question was in the form of choose one of the alternatives. 2- Gastric residual volume record, which used as a tool to measure in right one, right two and supine positions amount of gastric residual volume (GRV) retained in the stomach before giving the next feeding, it measured by aspirating with a syringe from a nasogastric/orogastric tube. The amount of GRV which aspirated recorded in the recording sheet included time of feeding, milk type and amount also record the observation of regurgitation episodes with each position and record its frequency if present or not.

## Pilot study

A pilot study was carried out on 9 preterm infants to evaluate the content and test the feasibility of tools. The result of pilot study confirmed that the study was feasible. The sample of the pilot study was included in the total sample size.

## Tool validity

Assessment sheet reviewed by 3 experts in the field of high-risk neonates and pediatric nursing to test content validity and according to their review few modifications were carried out in the content of the assessment sheet.

## Ethical considerations

The researcher obtained written informed consent from the parent after inform all parents about the aim, tools and

duration of the study and explain to them the benefits of the study. Parents were assured about confidentiality of the data which gathered from their preterm infants during the study. The researcher informed the parents about their right to withdraw from the study at any time without any effect on the care provided for their preterm infants.

### Procedure

Before conducting the study an official permission was obtained from the director of the NICU at El Manial and Pediatric University Hospitals, after clear explanation about the aim, tool, duration and expected outcomes of the study. Preterm infants who met the inclusion criteria were randomly assigned into both intervention and control groups, firstly the researcher fill the preterm infants' personal characteristics from the medical and nursing sheet of the preterm infants, at the morning shift at 9 am. Firstly the researcher collect the requiring data from the control group who left to routine care in the unit (not receive the intervention) where positioned supine after feeding for one hour and assess if regurgitation episodes occur or not for one hour after feeding then the gastric residual was aspirated using syringe 5 ml before the next gavage feeding and recorded in the GRV record. Then the researcher collect the second group of the preterm infants (intervention group one; right one) who were positioned in right lateral with head of bed elevated 45 degree after feeding time for one hour and finally the researcher collect the intervention group two (right two) of the preterm infants who were positioned in right lateral two with head of bed elevated 45 degree during and after feeding time for one hour using a rolled sterile linen to support the preterm infants in the right position, the same previous measures done in the supine group

were recorded in the right one and right two groups.

The sample of the study consisted of 90 preterm infants received gavage feeding by the assigned nurse according to the feeding schedule at the unit and the duration of each gavage feeding between 15-20 minutes in three hours interval and the researcher measure GRV and assess regurgitation episodes for each preterm infant once. Data were collected over a period from the beginning of November 2019 to the end of March 2020.

### Statistical analysis

Data was analyzed using SPSS Statistical Package for Social Sciences version 24, quantitative data tabulated and summarized using mean  $\pm$  standard deviation (SD). Qualitative data were presented in frequency and percent. Data was computerized and analyzed using appropriate descriptive and inferential statistical tests. Chi-square crosstabulation test was used to examine the relation between qualitative variables. One way ANOVA test was used to compare means scores. P-value  $< 0.05$  was considered significant.

### Results

**Preterm infant's personal characteristics:** Table (1) reveals that the mean gestational age of the preterm infants in supine, right 1 and right 2 groups were (33.900 $\pm$ 2.368, 32.800 $\pm$ 2.325 & 32.700 $\pm$ 2.588 weeks respectively). Regarding the mean birth weight of preterm infants in supine, right 1 and right 2 groups were (1339.67 $\pm$ 201.66, 1545.53 $\pm$ 266.01 & 1446.37 $\pm$ 296.71grams respectively). The mean age of the preterm infants in supine, right 1 and right 2 groups were (7.87 $\pm$ 3.627, 12.07 $\pm$ 7.041 & 15.27 $\pm$ 9.906 days respectively). There is a statistically

significant difference regarding birth weight between three groups ( $F= 4.783$  at  $p=0.011^*$ ), and highly statistically significant differences found regarding current weight and age of the preterm infants ( $F= 6.916$  at  $p=0.002^*$  &  $F= 7.706$  at  $p=0.001^*$  respectively) while no significant difference was found in gestational age between three groups ( $F= 2.252$  at  $p=0.111$ ).

Figure (1) illustrated that the highest percentage of the preterm infants were diagnosed on admission with RDS in supine, right 1 and right 2 groups (63.3%, 76.7% & 76.7% respectively).

Table (2) reveals that more than half (60%) of the preterm infants were male in the supine position group and half (50%) of them in the right 1 and right 2 groups were male. The highest percentage of the preterm infants were delivered by cesarean section in supine, right 1 and right 2 group (73.3%, 63.3% & 80.0% respectively). Regarding type of milk the highest percentage have formula milk in supine, right 1 and right 2 group (73.3%, 83.3% & 83.3% respectively) with no statistical significant differences regarding gender, mood of delivery and type of milk between three groups ( $\chi^2= 0.804^a$  at  $p=0.669$ ,  $\chi^2= 2.105^a$

at  $p=0.349$  &  $\chi^2= 3.250^a$  at  $p=0.517$  respectively).

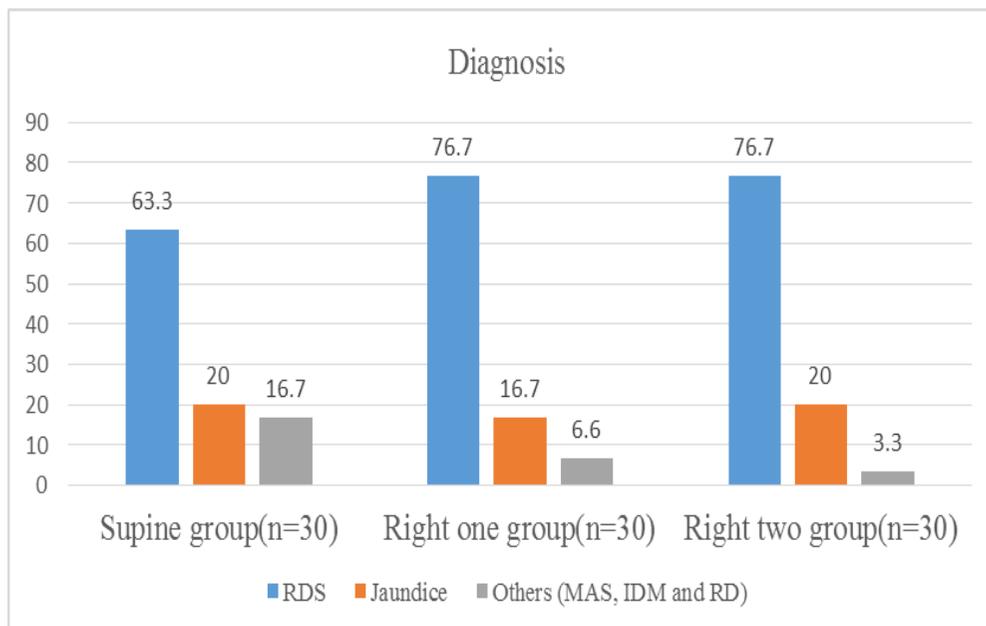
**Recording data for gastric residual volume, milk amount and regurgitation episodes:** Table (3) indicates that the mean differences in gastric residual volume for preterm infants in supine, right 1 and right 2 position groups at different feeding time were ( $2.85\pm 2.50$ ,  $0.80\pm 1.21$  &  $0.60\pm 1.10$  ml respectively) with a highly statistically significant difference ( $F=15.563$  at  $p=0.000^{**}$ ). As regard to the mean differences in milk amount in the current feeding for preterm infants in supine, right 1 and right 2 position groups at different feeding time were ( $24.33\pm 9.279$ ,  $23.90\pm 7.959$  &  $24.30\pm 9.495$ ml respectively) there was no statistically significant difference ( $F=0.022$  at  $p=0.978$ ).

Figure (2) illustrates that the highest percentage of preterm infants have not regurgitation episodes for them after feeding in supine, right 1 and right 2 position groups (66.7%, 80.0% & 86.7% respectively), although there is no statistically significant difference in occurrence of regurgitation episodes between the three positions ( $\chi^2=3.600^a$  at  $P=0.165$ ).

**Table 1:** Preterm infant's characteristics in percentage distribution (n= 90).

Items	Supine (n=30)	Right 1 (n=30)	Right 2 (n=30)	F	P
<b>Gestational age (wks)</b>	33.900 ± 2.368	32.800 ± 2.325	32.700 ± 2.588	2.252	0.111
<b>Birth weight (gm)</b>	1339.67± 201.66	1545.53± 266.01	1446.37± 296.71	4.783	0.011*
<b>Current weigh (gm)</b>	1423.67± 188.96	1658.50± 278.06	1635.03± 323.52	6.916	0.002*
<b>Age (day)</b>	7.87 ± 3.627	12.07 ± 7.041	15.27 ± 9.906	7.706	0.001*

**Figure (1)** Percentage distribution of preterm infants according to their diagnosis in supine, right 1 and right 2 position groups ( n=90).



RDS: Respiratory Distress Syndrome, IDM: Infant of Diabetic Mother, RD: Respiratory Distress MAS: Meconium Aspiration Syndrome.

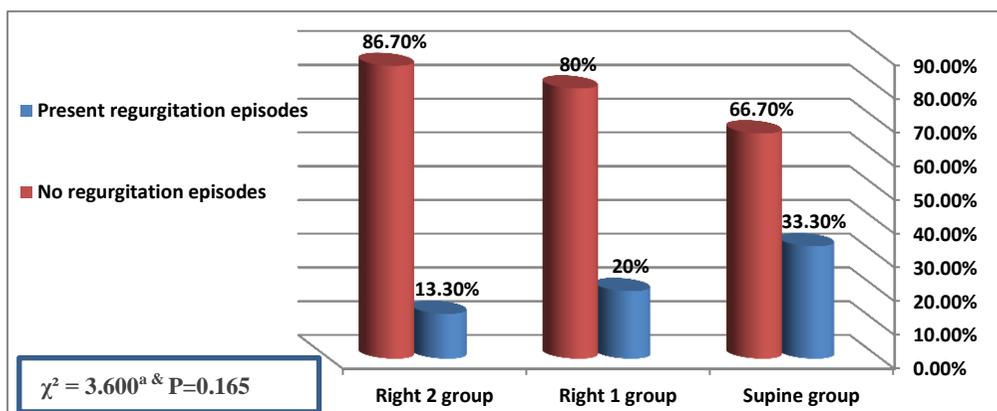
**Table 2:** Preterm infant's characteristics and type of milk in percentage distribution (n= 90).

Item	Supine (n=30) (%)	Right 1 (n=30) (%)	Right 2 (n=30) (%)	$\chi^2$	P
<b>Gender</b>					
- Male	18 (60.0%)	15 (50.0%)	15 (50.0%)	0.804 <sup>a</sup>	0.669
- Female	12 (40.0%)	15 (50.0%)	15 (50.0%)		
<b>Mood of delivery</b>					
- NVD	8 (26.7%)	11 (36.7%)	6 (20.0%)	2.105 <sup>a</sup>	0.349
- CS	22 (73.3%)	19 (63.3%)	24 (80.0%)		
<b>Type of milk</b>					
- Breast milk	6 (20.0%)	5 (16.7%)	3 (10.0%)	3.250 <sup>a</sup>	0.517
- Formula milk	22 (73.3%)	25 (83.3%)	25 (83.3%)		
- Mixed	2 (6.7%)	0(0%)	2(6.7%)		

NVD: Normal Vaginal Delivery CS: Cesarean Section

**Table 3:** Mean differences in gastric residual and milk volume of preterm infants between supine, right 1 and right 2 position groups (n= 30).

Item	Supine (n= 30)	Right 1 (n= 30)	Right2 (n= 30)	F	P
Gastric residual volume (ml)	2.85±2.50	0.80±1.21	0.60±1.10	15.563	0.000**
Milk amount (ml)	24.33±9.279	23.90±7.959	24.30±9.495	0.022	0.978

**Figure (2):** Frequency distribution of occurrence of regurgitation episodes among preterm infants in supine, right 1 and right 2 position groups (n= 30).

## Discussion

It is noticed that gastric residual volume is influenced by lying position of the preterm infants, diameter of feeding tube, gastric localization of the tube, warmth and viscosity of the milk intake. Increase in GRV and change in its character due to delay in gastric emptying and decreased intestinal motor activity because of immaturity (Akar & Turgut, 2020). An emerging evidence from recent study by Dorling, et al. (2020) concluded that routine GRV measurement is part of standard practice in neonatal units.

The current study data found that no significant difference was found in

gestational age between preterm infants at supine, right 1 and right 2 groups ( $F= 2.252$  at  $p=0.111$ ) and there were no statistical significant differences regarding gender, mood of delivery, type and amount of milk between three groups. As similar to the study of Ameri, et al. (2018) who reported that there were not a significant difference between type of milk and other demographic characteristics as birth weight and gestational age for preterm infants at different position after feeding.

The current study data found that the mean differences in gastric residual volume for preterm infants in supine, right 1 and right 2 position groups were (2.85±2.50, 0.80±1.21 & 0.60±1.10ml respectively) with

a highly statistically significant difference ( $F=15.563$  at  $p=0.000^{**}$ ), gastric residual volume for preterm infants were higher in supine than right 1 and right 2 positions. The study results were supported by a prospective study by Sangers, et al. (2013) to investigate the effect of body position on gastric residuals in 147 preterm infants with a gestational age of 28–36 weeks and mean birth weight 1630 grams and found that amounts of gastric residuals were higher during left position than right position and supine position and preterm infants have less often and smaller gastric residuals when nursed in a right position. On the same line, an experimental study was conducted in Eastern Turkey by Yayan, Kucukoglu, Dag & Boyra (2018) found that the right lateral position showed the lowest mean gastric residue level, followed by the prone, supine, and left lateral positions respectively. The right lateral position was not found to be significantly different from the supine and prone positions in terms of gastric residue. However, significant differences were found between the right lateral and left lateral positions and between the left lateral and prone positions.

In accordance with Khatony et al. (2019) who found that mean gastric residual volume before gavage in supine position was higher than that in right lateral and prone positions with no significant difference was found in the three groups, further and deeper studies are needed. Hussein (2012) who studied the effects of right-lateral and semi-fowler's positions after feeding on gastric residual volume in infants in NICU and reported that there was no significant relationships between these two positions. Still, since the both positions were effective on decreasing the residual

volume, they are recommended after feeding infants. Moreover, the study supported by Kaur, Kaur and Saini (2018) who concluded that left lateral position was associated with higher but clinically non-significant pre-feed gastric residuals as compared to right lateral position.

Furthermore, the study results were contradicted with Ameri, Rostami, Baniyasi, Aboli and Ghorbani (2018) who reported that there were not observed a significant difference between gastric residual for preterm infants at different position after feeding. The current study contradicted with Sajadi, Akbari1, Alinejad, Khosravi (2019) who indicated the mean gastric residual volume in the prone position was significantly lower than that in the lateral position.

Therefore, from the researcher point of view right lateral position can be a suitable position during and after gavage feeding in preterm infants because it enhances the digestion when keeping the preterm infants in the anatomical structure of the gastrointestinal system by minimize the pressure on the stomach and prevent the preterm infants manipulation during and after gavage feeding.

The current study revealed that there is no statistically significant difference in occurrence of regurgitation episodes between the preterm infants in three positions ( $\chi^2=3.600^a$  at  $P=0.165$ ), while regurgitation episodes occur less frequently in right2 position than supine and right1 positions. Regurgitation occur in more than two-thirds of otherwise healthy infants, avoid supine positions is important to manage regurgitation (Lightdale & Gremse, 2013), these support the current

study data as few study was done in this issue.

The current study contradicted with a comparative study of three nursing positions on gastric residuals and regurgitation in preterm neonates by Kaur, Kaur and Saini (2018) who concluded that right lateral position was associated with significantly increased regurgitation episodes. In this respect, the current study was supported with Jung, et al. (2012) who concluded that there is a significantly less regurgitation and reflux in infants in the right and flat prone position compared with the flat supine position. Lightdale and Gremse (2013) stated that pediatricians must also be able to recognize and assess preterm infants with recurrent regurgitation and association of troublesome symptoms.

Positioning provides nurses with a noninvasive option to care for preterm infants with regurgitation and gastric reflux or have increased gastric aspirates and the right-side position is best for preterm infants to enhance digestion stems from theories of anatomy and physics which reflect less regurgitation episodes (Elser, 2012). Preterm infants who can have decreased gastric motility needing the right lateral position and also suffer from symptoms of gastric reflux requiring the left lateral position (Elser, 2012). Sleeping in a supine position could have some advantages in prevention of sudden infants death syndrome than in prone position but not used for minimizing regurgitation (Fister, Nolimal, Lenasi and Klemenc, 2020). According to Park, Pados and Thoyre (2018) found that right side lying position is beneficial for supporting physiologic stability during feeding.

From the researcher point of view preterm infants regurgitation is affected by weight, day of life, gestational age, frequency, type and amount of feeding, position and also by the ability of the preterm infants for milk digestion when keep the preterm infants in a right position during and after feeding without manipulation for preterm infants these minimize the risk of regurgitation.

It is obvious that the results of the study prove research hypotheses as there is a significant difference between supine position and right 1 position and right 2 position at different feeding time regarding to amount of gastric residual after feeding while no significant difference is found regarding regurgitation.

### **Conclusion**

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It can be concluded from the present study that there is a highly statistical significant difference between placing preterm infants after feeding in supine position compared to placing on right 1 position after feeding and in right 2 position during and after feeding time, while there was no statistically significant difference regarding occurrence of regurgitation episodes in the three position in spite of the least occurrence of regurgitation episodes occurred in the right 2 position during and after feeding time compared to the supine and right 1 positions.

### **Recommendations**

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The current study recommends that:

- 1- Preterm infants should be placed in right position during and after gavage feeding.

2- Further and deeper studies are needed in a large sample for generalization of the study.

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