Effect of Successive Abdominal Massage on Feeding Intolerance and Daily Weight Gain among Preterm Neonates: A Randomized Controlled Trial

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Abstract

Background: Functional immaturity of the gastrointestinal tract in preterm neonate can cause several problems. It leads to feeding intolerance which may lead to suboptimal nutrition and subsequent adverse outcomes including reduced brain growth, decreased weight gain, and cognitive delays. **Aim:** this study aimed to investigate the effect of successive abdominal massage on feeding intolerance and daily weight increase among preterm neonates. **Research design:** Randomized controlled trial. **Sample:** A convenience sample of 40 preterm neonates was included. The total sample was randomly divided into two groups (Control and Study) using simple random technique. **Setting:** The study was carried out at Neonatal Intensive Care Unit (NICU) affiliated to Mansoura University Children's Hospital (MUCH). **Tools:** two tools were used to collect the required data namely, Preterm Neonates' Characteristics and Medical Data Structured Questionnaire Sheet and Preterm Neonates' Follow-up Sheet. **Results:** A highly statistically significant difference was found between control and massage groups related to all feeding intolerance measurements and for daily weight increase. **Conclusion:** Successive abdominal massage is a safe and cost-effective method to be applied on preterm neonates. It has the potential to decrease the gastric residual volume (GRV), frequency of vomiting episodes, abdominal distension and increase frequency of defecation and daily weight gain in preterm neonates. **Recommendation:** Nurses should apply abdominal massage three times a day as an intervention helping prevent gastric residual volume excess and abdominal distension in intermittently enterally fed preterm.

Keywords: Daily Weight Gain, Feeding Intolerance, Preterm Neonates, Successive Abdominal Massage

Introduction

Premature birth is one of the foremost vital direct causes of infant mortality and the second leading reason behind infant's mortality after pneumonia. Every year, a million out of the fifteen million premature infants die within the 1st year of life because of the complications of premature birth. In recent years, essential enhancements have been created in the care provide to those infants; however, immaturity continues to be a significant cause of infant morbidity and mortality in developing countries [1, 2]. The problem that usually happens in premature infants is the immaturity of the digestive system. Physiologically, intestinal motility is regular at 27–30 weeks of gestation and progresses to a different mature pattern at 33–34 weeks; therefore neonates < 37 weeks mature are in danger of developing severe gastrointestinal problems [3, 4].

Many premature infants are transferred to Neonatal Intensive Care

Units (NICUs) after birth and fed by oral or nasal tubes. Because of immaturity, they lack the adequate coordination between sucking, swallowing, and also breathing. This increases risk of aspiration and require them to be fed by tube. Nutritional issues are one of the factors leading to prolonged hospitalization of preterm infants in the NICU. Incomplete development of the gastrointestinal system in preterm infants prolongs gastric emptying time and slows defecation, eventually leading to symptoms such as constipation, bloating, and increased residual gastric volume (GRV) [5]. An excessive GRV will increase the hazard of gastrointestinal complications, which include necrotizing enterocolitis (NEC). It is a situation in which there will be insufficient oxygen supply (ischemic) to the gut, which causes accumulation of fuel line and infection withinside the gut [6]

Feeding tolerance is verified through the ability of low birth weight (LBW) infants to safely ingest and digest the recommended enteral feeding without difficulties or complications or by gastrointestinal dysfunction, aspiration, and infection [7]. Feeding intolerance is usually based on the assessment of gastric residual volume (GRV), color and aspect, and accompanying clinical manifestations such as vomiting, abdominal distension, blood in stools, apnea with bradycardia, and failure to gain weight over a long-time range [3]. Feeding intolerance is the neonate's inability to maintain enteral nutrition which is characterized by one or more

symptoms of increased gastric residue, abdominal distension, and vomiting [8]. Criteria for the increase in gastric residue are characterized by the presence of green or red residues and or the amount of residue of 5 ml/kg or > 50% of the previous drinking. In contrast abdominal distension is characterized by an increase in acute abdominal circumference ≥2 cm from the previous examination. In addition, vomiting with a frequency ≥3x/day is another symptom of feeding intolerance [9]. Vomiting is the most severe complication associated with enteral feeding, increasing the risk of aspiration and pneumonia. Therefore, it is crucial to correctly know and assess the warning signs of the possible complications of enteral feeding [10].

The physical growth of preterm infants is of paramount significance. Weight is viewed as the most significant and specific indicator for the growth of preterm neonates. It is the main criterion for hospital discharge, and numerous interventions have been designed to maximize the weight gain of preterm infants. Feeding intolerance prevention strategies are diverse and vary substantially between institutions. One of the interventions is massage therapy [11]. Massage is the mechanical manipulation of soft tissues through rhythmic pressure to improve health and well-being. Generally, massage involves passive touch. Research studies have shown that massage has several benefits for infants, including changing sleep patterns, weight gain, and improving gastrointestinal function and

development. It also led to weight gain, and shorter hospital stays in preterm neonates. Daily 15-minute massage of preterm infants for five days resulted in increased vagal activity and gastric motility. Increased vagal activity can lead to increased food intake due to increased gastric motility and higher hormone levels associated with food absorption [5,10]. Successive Abdominal massage is a valuable way to relax neonates' abdominal muscles as much as possible, which could effectively relieve their gastrointestinal discomfort. It could not only promote the early growth and development of preterm infants but also significantly increase their gastrin and insulin levels, thus improving the digestion and absorption of their nutrients. During an abdominal massage, on the other hand, therapeutic signals could be transmitted directly to the brain through skin contact and pressure, stimulating the vagus nerve and thus promoting intestinal peristalsis [12, 13]. Abdominal massage is an inexpensive nursing therapeutic method that can stimulate parasympathetic activity and evoke a more effective digestive system response by accelerating peristalsis, reducing abdominal distension, accelerating intestinal emptying time, increasing defecation frequency, and reducing bowel frequency every day[14 ,15]. Hence, it is consistently associated with an increase in vagal activity and gastric motility, leading to weight gain [16 ,17.]

Nursing assessment for early detection of food intolerance symptoms has not yet been addressed. Neonatal caregivers must understand the potential physical changes they may see when the preterm infant experiences a nutritional intolerance. Currently, there are no nursing assessment standards or guidelines that focus on the symptoms of food intolerance. However, there is a remarkable agreement in the literature regarding the symptoms commonly associated with food intolerance and operational definitions. These components are necessary to develop a standard of care that aims to encourage prudent reporting of early signs/symptoms of feeding intolerance to healthcare providers, which can improve neonatal outcomes [18, 19]. However, little research showed the connection between intervention of abdominal massage and feeding intolerance in premature neonate. Hopefully, the present study could do that.

Significance of the study

Preterm neonates have an increased susceptibility to feeding intolerance which is one of the most significant causes of growth failure. The inability to sustain enteral feedings also contributes to extended periods of parenteral nutrition, which often requires central venous access, thereby increasing the risk of infection. Establishing and tolerating adequate enteral nutrition is difficult due to the immaturity of the gastrointestinal system; however, it is important for neonates' normal growth, infection resistance, and long-term cognitive and neurologic development. Therefore, it is crucial for neonatology nurses to detect this problem as early as possible and

provide proper nursing interventions to improve newborn outcome.

Aim

The aim of this study was to investigate the effect of successive abdominal massage on feeding intolerance and daily weight gain among preterm neonates.

Operational Definitions

In this study:

Successive abdominal massage is a group of consecutive interventions which included paddling massage technique, I Love U stroke, sun and moon massage technique, fulling massage technique and knees up maneuver [12, 13].

Research Hypothesis

-Preterm neonates who receive successive abdominal massage exhibit less feeding intolerance than those who don't.

- Preterm neonates who receive successive abdominal massage exhibit more daily weight increase than those who don't.

Method

Research design

Randomized controlled trial: control and study group were used to meet the aim of the study.

Sample

A convenience sample of 40 premature neonates was divided into two equal groups namely study and control. Neonates were randomly assigned to each group by simple random sample technique using coin (King was used for study group and Writing for control group). The study group received successive abdominal massage for 15 minutes half an hour before feeding. Researcher applied massage twice a day and over five consecutive days. The control group received only routine unit care regarding enteral feeding including preparation and administration but without any abdominal massage.

Inclusion Criteria:

Preterm neonates with:

1. Gestational age ranged from 28 -36 weeks.

2. Birth weight ranged from 1000 to less than 2500 gram.

3. Gavage feeding by nasal or orogastric tube.

Exclusion Criteria:

Preterm neonates who had:

1. Any contraindication to abdominal massage such as intestinal obstruction.

2. Major congenital malformation as congenital heart disease and gastrointestinal anomalies.

3. Neurological problems as hypoxic injury.

4. Respiratory failure with ventilator support.

5. Necrotizing enterocolitis (NEC).

6. Suspected or confirmed sepsis.

7. Any abdominal surgery.

Sample size calculation

According to Taherdoost H (2017) [20], the minimum required sample size for each of study and control group by considering dropouts by adding 10% is 20 preterm neonates. It is calculated by using ClinCalc Statistical Software (21) based on 85% power, 5% alpha error rate. It is considered that hypothetical mean of Gastric residual volume (GRV) of the study group before applying the message is 2.4, and their standard deviation is 1.14, while the hypothetical mean of GRV of the control group is 0.8, and their

standard deviation is 0.1. In addition to, the ratio of sample size in study to control group is 1/1.

Setting

The study was carried out at Neonatal Intensive Care Unit (NICU) affiliated to Mansoura University Children's Hospital (MUCH) over a three-month period beginning in February 2022 and ending in April 2022.

Tools of data collection

Two tools were used to collect the required data for this study:-

Tool 1: Preterm Neonates' Characteristics and Medical Data Structured Questionnaire Sheet

It was developed by the researchers after reviewing the related literature [2,5]. It included two parts as follows:

Part A: Preterm neonates' characteristics which involved gender, gestational age, birth weight and age at the beginning of the study.

Part B: Preterm neonates' medical data which included diagnosis, weight, time of starting enteral feeding, type of feeding milk, time to reach full enteral feeding and feeding withholds.

Tool II: Preterm Neonates' Follow-up Sheet

It was developed by the researchers after reviewing the related literature (14 ,15) to measure newborn parameters related to feeding intolerance. It included two parts as follows:

Part A: Measurements of studied neonates feeding intolerance criteria which included abdominal circumference, abdominal distention, number and amount of vomiting episodes, gastric residual volume and frequency of defecation.

Part B: Daily weight of preterm neonates' record which included recording down daily weight of neonate in grams.

Data Collection Procedure

Ethical considerations

This study was approved by ethical committee at Faculty of Nursing, Mansoura University. Agreement was taken from the Board of Neonatal Intensive Care Unit affiliated to Mansoura University Children's Hospital (MUCH) to carry out the study after describing the study's aim and content of the study. After explaining the study's purpose to the director of the unit, an official permission was obtained. Consent was obtained from the parents of the preterm neonate in the study and control groups after clarification of the study's aim, how to apply the study and ensuring them about the confidentiality of the data collected and their right to withdraw their neonates from the study at any time.

Validity and Reliability

Tools of the present study were reviewed by a panel of 3 experts in the neonatology and pediatric nursing to test its content validity and their notes and modifications were made before data collection. The reliability of the questionnaire was determined using Cronbach's alpha test; it was 0.75.

Pilot Study

A pilot study was carried out on 10% of the total sample size (4 neonates). No modifications were done. So, neonates who participated in the pilot study were included in the study.

Intervention / Procedure

1.Administrative approval was obtained from the head manager of

Mansoura University Children Hospital and the head of the Neonatal Intensive Care Unit before implementation of the study.

2.Preterm neonates' characteristics was obtained from medical record and neonates' mother using part A of Tool I for all neonates in the two groups.

3.Relevant medical history was gathered from the neonates' medical records using part B of Tool I for all neonates in the two groups.

4.Data collection was done five days per week from 8.00 AM to 2.00 PM.

Successive Abdominal Massage Procedure:

5. Abdominal massage was applied to the study group subjects for 15 minutes, 2 times daily, one hour before the subject was fed starting in the 5-day study period.

6. Abdominal massage was then applied for 15 minutes one hour before feeding within the 5-day study period.

7. Successive abdominal massage was applied in a clockwise direction over the intestines on the abdominal wall. It was applied with moderate pressure to the areas of the preterm neonates' abdomen:

- Preterm neonate was placed directly in front of researcher in supine position with head elevated 30°- 45°.

- A little amount of moisturizing oil (Johnson baby moisturizing oil) was put in researcher's hands. Hands were rubbed together to warm oil before starting massage.

- Paddling massage technique: for this technique, researcher holded her hand so the pinkie finger's edge can move like a paddle across the preterm's abdomen. Researcher started at the base of the rib cage, stroked downwards with one hand and then the other in a paddle-wheel-like motion

-I Love U" stroke as follows: Researcher traced the letter I down the premature neonate's left side. Next, traced an inverted L, stroked across the abdomen along the base of the ribs from the right side to the left side and then downward. Researcher traced an inverted U, stroked from down the premature neonate's right side upward and around the umbilicus and finally down the left side.

- Sun and moon massage technique: Researcher looked at preterm neonate's abdomen as if it was a clock (with 12 o'clock at the top and 6 o'clock at the bottom) and began at 6 o'clock by using the left hand. Then, researcher gently pressed and slided her hand in a clockwise motion around the baby's bowel. After that, researcher's right hand began at 12 o'clock, gently pressed and slided her hand in a clockwise motion in a half moon shape until reaching 6 o'clock. Researcher was always creating clockwise motion when the left hand began, the right hand followed.

- Researcher massaged the preterm neonate's abdomen with her fingertips in a circular clockwise motion.

-Fulling massage technique: Researcher layed her two thumbs flat across preterm neonate's abdomen. Then, researcher gently pressed in, slided the thumbs away from each other. The "fulling" sequence was done in this order:

- Two strokes just above the navel.

- One stroke on each side moving out

from the navel.

- Two strokes just below the navel.

- Knees Up: Researcher held the preterm neonate's knees and feet together and gently pressed the knees up toward the abdomen. Then, researcher rotated the premature neonate's hips around to the right.

- When the preterm neonate was in any distress during the intervention, the procedure was discontinued, and neonate was examined by a neonatologist. Signs of distress included tachycardia, tachypnea and oxygen desaturation.

For the study and control groups using Tool II:

8. The gastric residual volume (GRV) measurement is checked daily during study period before each feeding administration. Gastric residual volume measurement was made by aspirating with a 5 ml syringe before each feeding. Positioning of the gastric tube was checked before measurement. During the GRV measurement, the syringe piston was withdrawn slowly. When the stomach contents are no longer aspirated, the measurement was repeated to verify whether the stomach is empty.

9. During preterm neonate gavage feeding, the flow rate of milk was created by gravity using the suspension technique without applying the pressure to the injector.

10. The abdominal circumference was measured and recorded with a measuring tape 30 minutes after gavage feeding.

11. The preterm neonate's abdomen was observed and palpated 30 minutes after gavage to assess the presence of distention.

12. Premature neonate's body weight (grams) was measured and recorded daily at morning during study period.

13. For any related defecation and vomiting, the researcher observed and recorded the times of and frequency per day during study period.

14. The control group received the usual care only with no massage techniques applied.

15. Comparison between the two groups was done using the appropriate statistical tests.

16. Statistical analysis:

The collected data were coded and entered to the statistical package of social sciences (SPSS) version 24. After complete entry, data were explored for detecting any error, then, it was analyzed by the same program for presenting frequency tables with percentages. Qualitative data was presented as number and percent. The study data were tested for normality by Kolmogorov-Smirnov test. The abnormally distributed variables were described as median & range as appropriate. Friedman test was utilized for comparison between more than two related groups. Wilcoxon signed-rank test was conducted to test the differences between 1st and 5th day of the abdominal message for the two study groups variables. The Chi-Square was used to check the homogeneity of both study groups. All tests were performed at a level of significance (P-value) equal or less than 0.05 was statistically significant.

Results

Table 1 Illustrated that studied preterm neonate's characteristics and medical data. There were no statistically significant differences

between both massage and control group in terms of gender, gestational age, birth weight, age at the beginning of the study, time of start enteral feeding and type of milk feeding as evidenced by P. 0.525, 0.059, 0.607, 0.768, 0.342 and 0.587 respectively.

Table 2 Clarified comparison between the first and 5th day means of measurements changes about feeding intolerance for both control and massage groups of studied preterm neonates. Highly statistically significant differences were found between the means of the first day and 5th day related to feeding intolerance measurements of the massage group (P< 0.001) in which gastric residual volume (GRV) was decreased from (54.67 ± 8.2) in the first day to (43.49 ± 3.6) in the 5th day while vomiting frequency was decreased from (2.54 ± 0.2) in the first day to (0.09 ± 0.04) in the 5th day, abdominal circumference was decreased from (26.54 ± 1.5) in the first day to (22.32 ± 1.3) in the 5th day, and finally defecation frequency was increased from (0.54 ± 0.2) in the first day to (1.56 ± 0.3) in the 5th day. Conversely, no statistically significant differences were found between the means of the first day and 5th day of the control group related to gastric residual volume (GRV), abdominal circumference, and defecation frequency (P=0.914, P=0.527 & P=0.349) respectively except for vomiting frequency.

Fig 1 shows comparison between mean weight in grams of the control and massage groups on the 1st and 5th days of the study. For the control group, the mean weight on the 1st day was 1431.8 gm while on the 5th day was 1461 gm. For the massage group, the mean weight on the 1st day was 1350.7 gm while on the 5th day was 1564.5 gm.

Table 3 shows comparison between the mean measurements about feeding intolerance for the massage and control group. Highly statistically significant change (P=0.001) was found between control and massage groups related to all feeding intolerance measurements and for daily weight gain.

**Table 1. Characteristics and Medical Data of Studied Preterm Neonates**

Items	Massage Group (n=20)		Control Group (n=20)		*P-Value
	No.	%	No.	%	
Gender					
Boy	10	50	8	40	**0.525**
Girl	10	50	12	60	
Gestational age (weeks)					
28 - < 30	7	35	8	40	**0.059**
30 - < 32	3	15	8	40	
32 - < 34	5	25	4	20	
34 - ≤ 36	5	25	0	0	
Birth weight (gm)					
< 1.500	12	60	12	60	**0.607**
1.500 - < 2000	3	15	5	25	
2000 - ≤ 2.500	5	25	3	15	
Age (days) at the beginning of the study					
< 7	8	40	5	25	**0.768**
7- < 14	5	25	7	35	
14- < 21	3	15	3	15	
21- ≤ 28	4	20	5	25	
Time of start enteral feeding					
Before 5th day of birth	12	60	9	45	**0.342**
On 5th day of birth or after	8	40	11	55	
Type of milk feeding					
Expressed breast milk	2	10	4	20	**0.587**
Preterm formula milk	6	30	4	20	
Both	12	60	12	60	

* P-value of χ^2 = chi square

Table 2. Comparisons between 1ˢᵗ and 5ᵗʰ Day Means Of Measurements Changes About Feeding Intolerance For Massage And Control Groups

Parameters	Message group			Control group		
	1ˢᵗ day	5ᵗʰ day	*P-Value	1ˢᵗ day	5ᵗʰ day	*P-Value
Gastric Residual Volume (GRV)	54.67 ± 8.2	43.49 ± 3.6	**< 0.001	39.00 ± 11.6	41.36 ± 8.5	0.914
Abdominal Circumference	26.54 ± 1.5	22.32 ± 1.3	0.046	25.47 ± 5.6	26.58 ± 4.7	0.527
Vomiting Frequency	2.54 ± 0.2	0.09 ± 0.04	**< 0.011	0.97 ± 0.1	1.14 ± 0.2	0.046
Defecation Frequency	0.54 ± 0.2	1.56 ± 0.3	0.005	0.64 ± 0.1	0.70 ± 0.1	0.349

* P-value of χ^2 = chi square, **Statistically Significant at p ≤0.05
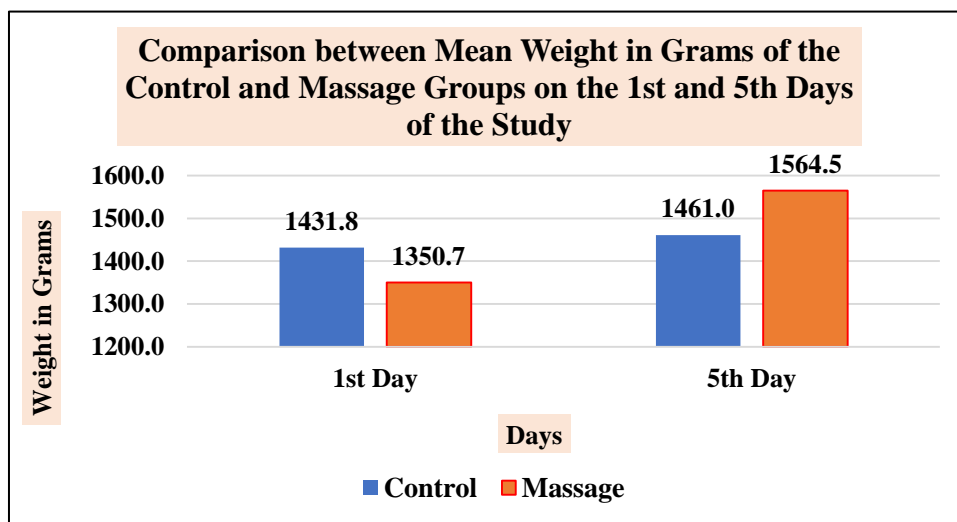
Figure (1). Comparison between Mean Weight in Grams of the Control and Massage Groups on the 1st and 5th Days of the Study

Table 3. Comparison between Means Measurements Related to Feeding Intolerance for Massage and Control Groups

Measurement parameters	Message group	Control group	*P-value
Gastric residual volume	6.54 ± 2.3	11.62 ± 1.8	**< 0.001
Abdominal circumference	1.84 ± 0.4	2.85 ± 0.3	**< 0.001
Vomiting frequency	0.49 ± 0.2	1.79 ± 0.1	**< 0.001
Defecation frequency	0.97 ± 0.3	0.11 ± 0.4	**= 0.001
Daily Body weight gain	137.25 ± 19.2	73.41 ± 23.5	**= 0.001

* P-value of χ^2 = chi square, **Statistically Significant at p ≤0.05

Disscussion

In the last decade, significant improvements have been made in the care provided to these infants; however, prematurity is still a significant cause of infant morbidity and mortality in developing countries. Preterm neonates have an increased susceptibility to feeding intolerance, one of the most significant contributors to their growth failure [7]. The present study aimed to investigate the effect of successive abdominal massage on feeding intolerance and daily weight gain among preterm neonates.

The findings of the present study showed that there were no statistically significant differences between both massage and control groups in terms of gender, gestational age, birth weight, age at the beginning of the study, time of start enteral feeding and type of milk feeding (table 1). These findings were approximately consistent with the study of Mohamed & Ahmed (2018) [8] who aimed to evaluate the efficacy of abdominal massage on feeding intolerance of preterm neonates and indicated that no statistically significant difference was found between the control and massage group of studied preterm neonates in terms of gestational age, birth weight, gender, and type of feeding.

As regards comparison between the first and 5th day means of measurements changes about feeding intolerance for both control and massage groups of studied preterm neonates. The present study results clarified that a highly statistically significant differences were found between the means of the first day and 5th day related to feeding intolerance measurements of the massage group in relation to gastric residual volume, vomiting frequency, abdominal circumference and defecation frequency. Conversely, no statistically significant differences were found between the means of the first day and 5th day of the control group related to gastric residual volume (GRV), abdominal circumference, and defecation frequency except for vomiting frequency (Table 2). One possible explanation for this result was that abdominal massage is efficient in preventing GRV excess and abdominal distension. Furthermore, the increased frequency of defecation has a direct relationship with the decreased abdominal circumference and gastric residual volume. In other words, as the frequency of defecation increases, the abdominal circumference and distension decrease. This justify is congruent with Ameri, et al. (2018) [16] who indicated that abdominal distention, emesis and gastric residuals are considered as indexes of feeding intolerance.

Similar with these results, Kaur, et al. (2015) [22] found that in the control group, the differences between the first day and last day of the study were not statistically significant for parameters of feeding intolerance. In line with the current study, Niemi (2017) [12] reported a significant increase in the frequency of defecation in the massage group. Moreover, these results in the same line with previous studies Shaeri, et al. (2017) [9], Al Balushi & Hanson (2019) [11] , Ghasemi, et al. (2019) [5], Mojaveri, et al. (2020) [6] and Jin, He, Zhang & Zhu (2020) [15]. All of those studies revealed that the means of the abdominal circumference, the frequency of vomiting episodes, and the gastric residual volume in the massage

group had decreased significantly after the intervention, as compared with those before the intervention, and the frequency of defecation had increased significantly. However, none of these variables changed significantly in the control group at the end of the study.

Furthermore, these findings were in agreement with more recent study conducted by Hendy, et al. (2022) [7] who studied the outcome of abdominal massage before gavage feeding on tolerated feeding for low birth weight infants demonstrated that there was a slight significant improvement in all items of feeding tolerance for the study group after abdominal massage, and there was also a slight significant difference between the study and control groups at the fourth day after abdominal massage related to all items of feeding tolerance such as frequency of defecation, frequency of vomiting/day and frequency of abdominal distention, abdominal circumference.

The finding of the current study revealed that there was statistically significant difference were found between the means of the first day and 5th day related to daily weight gain was increased from more 1300 gm in the first day to more than 1500 gm in the 5th day (Fig.1). Conversely, no statistically significant differences were found between the means of the first day and 5th day of the control group related daily weight gain (Figure 1).These findings were in agreement with Abed Elataief, Bahgat & Thabet (2017) [23] who indicated that premature infant who exposed to massage therapy experienced better weight gain compared to premature infant who received routine hospital care and also similar with Al Balushi & Hanson (2019)

who showed that weight increase in the experimental group due to massage more significant than control group who only received routine care. In addition, these findings were consistent with Ghasemi, et al. (2019) [5] who revealed that abdominal massage effectively enhances weight gain in the preterm infants . Moreover the results of the current study were in the same line with Jin, et al. (2020) [15] who proved that intervention with abdominal massage might promote weight gain and improve feeding tolerance.

Interestingly, finding of the current study revealed that highly statistically significant change was found between control and massage groups related to all feeding intolerance measurements and for daily weight gain (Table 3). This outcome is constant with Kim and Bang (2018) [16] who reported that enteral feeding improvement massage can assist in achieving earlier full enteral feeding. In addition these results are similar to those in the study performed by Ardiansyah, et al. (2021) [3] and Haghshenas, et al. (2020) [6] who revealed that the abdominal massage had a positive effect on the incidence of feeding intolerance in premature infants. Moreover, Mojaveri, et al. (2020) [6] reported that abdominal massage, which leads to less distension and GRV, is recommended before enteral feeding for very LBW infants. However, the results of this study are in contrast to the study by Fazli, et al. (2017) [24] who mentioned that abdominal massage was efficient only in the absence of vomiting.

Conclusion

Based on the results of the current study it can be concluded that Successive abdominal massage is a safe and cost-effective method to be applied on preterm neonates. It has the potential to decrease

the gastric residual volume, frequency of vomiting episodes, abdominal distension and increase frequency of defecation and daily weight gain in preterm neonates.

Recommendations

In accordance with the results of the study, it can be suggested that:

1. Nurses in neonatal intensive care unit should receive training program related to massage therapy to improve their practice regarding general condition two times of premature infants during hospitalization.

2. Nurses should apply abdominal massage three times a day as an intervention helping prevent GRV excess and abdominal distension in intermittently enterally fed preterm

3. More studies are needed to investigate the effect of abdominal massage on prevention of delayed gastric emptying in enterally fed preterm.

4. This study should be repeated, and a larger sample size is indicated in future research.

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