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The Effect of Abdominal Massage on Gastric Residual Volume among Critically Ill Patients Receiving Enteral Feeding

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1.ABSTRACT

Background: Critically ill patients who receive enteral nutrition suffer from many gastric complications and gastric intolerance seems to be the most common gastrointestinal complications. Abdominal massage is a non-pharmacological technique easily applied by nurses to decrease gastric intolerance without side effects. **Aim:** the aim of this study was to investigate the effect of abdominal massage on gastric residual volume between critically ill patients receiving enteral feeding. **Method:** A quasi-experimental design was used to conduct this study in the medical intensive care unit of Kafrelshiekh University Hospital. A convenience sample of 110 patients was randomly divided into the massage group (n=55) and the control group (n=55). The massage group received the abdominal massage intervention and the control group received the routine care of the unit. Enteral nutrition follow up tool was used to collect data for this study. **Results:** The results revealed statistically significant differences between both groups regarding the implementation of abdominal massage *(P =0.001)*. **Conclusion:** Implementation of the abdominal massage is significantly effective in reducing the gastric residual volume among critically ill patients receiving enteral nutrition. **Recommendations:** Critical care nurses should incorporate the abdominal massage as a part of daily routine care in intensive care units to achieve good patient outcomes. To enhance the knowledge regarding how to care for critically ill patients receiving enteral feeding, further extensive studies are recommended.

Keywords: *Abdominal massage, Critically ill patients, Enteral nutrition, Gastric residual volume*

2.Introduction:

Patients with critical illness frequently exhibit a catabolic stress state and a systemic inflammatory response and therefore, one of the most important components in the care of critically ill patients is nutritional support **(Mehta et al., 2018)**. Additionally, enteral nutrition (EN) helps maintain strong connections between gut epithelial cells, guards against excessive permeability, stimulates blood flow, boosts the immunological activities of the gut, and enhances the mesenteric blood flow even in critically ill patients receiving vasopressors **(Korwin & Honiden, 2019)**.

During administration of EN, close monitoring is required to ensure adequacy of EN and to minimize its complications such as delayed gastric emptying and feeding intolerance which are considered the most common gastrointestinal (GI) complications during critical illness **(Momenfar, Abdi, Salari, Soroush, & Hemmatpour, 2018)**. It has been reported that gastric intolerance was common during EN and happened in nearly two-thirds (66%) of the critically ill patients receiving EN **(Yahyapoor et al., 2021)**.

Monitoring the gastric residual volume (GRV) for critically ill patients is the most commonly used method and is required to avoid the risk of GI dysfunctions such as decreased peristalsis, decreased bowel transit period, pulmonary aspiration, regurgitation, and ventilator-associated pneumonia (VAP) **(Gunner, Thomas & Daren, 2014)**. Critical care nurses (CCNs) are responsible for preventing these complications and improving GI function to provide nutrition at the right time by determining early EN, checking whether the patient has intolerance to the GI system, facilitating patients to get the right type of nutrition and checking the placement of the end of the naso gastric tube (NGT). Additionally, they should ascertain how many calories the patient needs and evaluate

whether or not their GRV is still large (Momenfar et al., 2018).

Additionally, the success of EN depends on CCNs' careful assessment, planning, safe and effective feeding, careful monitoring of patients' response, and application of alternative therapies such abdominal massage to prevent any complication connected to EN (Abdelhafez & AbdElnaeem, 2019; El-Feky & Ali, 2020).

In case of high GRV, the patient may not have a meal throughout that session, which may increase the risk of malnutrition, and the nurse should report to the doctor for any additional diagnostic testing (El-Feky & Ali, 2020; Wilson et al., 2016). Therefore, various methods have been suggested to increase the rate of gastric emptying and prevent or treat feeding intolerance, and abdominal massage one of these method (Momenfar et al., 2018).

Abdominal massage is a noninvasive technique, inexpensive, and free from harmful side effects. It has numerous advantages because it can increase intestinal motility and parasympathetic activity, which causes GI tract response. It also changes intra-abdominal pressure (IAP), which accelerates peristalsis and has a mechanical and reactive effect on the intestines (Uysal, 2017).

From our clinical experience in ICUs, we observed that most critically ill patients who received EN have many complications related to GI dysfunction, such as constipation, diarrhea, vomiting, and increased GRV. Supporting this, the medical records of the general ICU at Assiut University hospital indicated that the incidence of GI dysfunction during the year of 2019 was 54%. About 11% of them had elevated GRV with 50% mortality (Mahran & Mohammed, 2021).

In 2019, a cross-sectional study including 245 patients was carried out over the course of 7 days in the three general ICUs of the Imam Reza Hospital in Mashhad, Iran. The findings showed that eating intolerance was present in 66% of the critically ill patients receiving EN based on the GRV and was linked to worsening nutritional status and clinical outcomes (Yahyapoor et al., 2021). Hence, we conducted this study to assess the effect of abdominal massage, which is a non-pharmacological method with minimal cost and no side effect on GRV among critically ill patients receiving EN.

2.1 Research Aim

This study aims to investigate the effect of abdominal massage on gastric residual volume among critically ill patients receiving enteral feeding.

2.2 Research hypothesis

Critically ill patients on EF who receive abdominal massage will have less GRV than patients who do not receive abdominal massage.

3Method

3.1Research Design

A quasi-experimental research design was used to conduct this study. The purpose of this design is to evaluate the impact of one variable on another or examine causal relationships (LoBiondo-Wood, Haber, &Titler, 2018).

3.2Setting

At Kafrelshiekh University Hospital, this study was carried out in the medical intensive care unit. There are two units in it. Each unit includes 7 beds and is well-equipped with the modern technology and manpower required for the treatment and care of critically ill patients. Patients with a variety of diagnoses, including neurological issues, GI problems, respiratory disorders, and renal abnormalities, are cared for in this section.

3.3Sample

A convenience sample of 110 critically ill adult unconscious patients aged between 20 and 60 years old of both genders who started EN within 24 hours of admission and were admitted to the previously mentioned setting during the study period. The studied patients were divided randomly into two groups: massage group and control group. Each group included 55 patients. The control group involved patients who received the feeding according to hospital's routine. While the abdominal massage group consisted of patients who were received abdominal

massage intervention and the routine care in ICU.

Patients who were under abdominal radiotherapy during the last 6 weeks, having abdominal surgery or with any contraindications for abdominal massage as diarrhea, abdominal burn or abdominal compartment syndrome were excluded. Patients who might be discharged or died during carrying out of the study were omitted.

3.4Sample size calculation

It was assumed that the average GRV in the massage group was 31.43 32.93 ml on the third day and that it was 50.26 47.04 ml in the control group when calculating the study sample size using the clin calc.com sample size calculator software **(Fareed & El-Sayed, 2017)**. The sample size was 49 in each group. We added 10.0% for better quality of data and drop out, so each group's sample size was 55 patients.

3.5Data Collection Tool

One tool used to collect data for this study "Enteral nutrition follow up tool". This tool consists of two parts: part I was developed by the primary investigator (PI) based upon appropriate literature **(Fareed& El-Sayad, 2017; Momenfar et al., 2018)**, and part II was adopted from **Elpasiony, Abdelkader, Abdelhamid, and Mohamed (2017)**.

Part I: Patients' Demographic Characteristics and Health Profile Data

This part was used to collect health data that can affect the participants' health status and causes lead to EN. Participants' health-related data such as their age, gender, date of admission, past medical history, diagnosis, current medications, length of time using a nasogastric tube, length of stay in the intensive care unit, and reasons for ICU discharge are covered.

Part II: Enteral Feeding Follow- Up Checklist

This part aimed to assess the effect of performing abdominal massage for the massage group. It included the type of feeding, amount of feeding content, amount of GRV, time of follow up, abdominal circumference measurement, number of vomiting episodes and frequency of defecation.

3.6Validity and Reliability

The validity of the tool was tested by five specialists from Critical Care Nursing and Medicine fields. All experts reviewed the data collection tool for clarity, relevancy and applicability. Using Cronbach's Alpha, the tool's reliability was tested, and the result was 0.752, indicating the tool's reliability.

3.7Pilot Study

A pilot study involving 11 patients was conducted before starting data collection process to assess the objectivity and applicability of the data collection tool. Those patients were excluded from the studied groups.

3.8Ethical Considerations

Ethical approval was gained from the Research Ethics Committee (REC) of the Faculty of Nursing – Mansoura University. Hospital's director gave permission for carrying out the study after the aim of the study aim had been discussed. Written informed consent was obtained from the participants' next of kin after providing them with all the details about the study, including aim, procedure, benefits, and risks. The relatives were informed that the participation in the study was voluntary and that they had the right to accept or refuse to allow the patients to take part in the study. Moreover, they were assured that the patient's personal data would be kept confidential. They were informed that they had the right to withdraw the patients from the study at any stage and that this would not affect their treatment or care.

3.9Data Collection Process

The data were assembled by the PI between June 2020 and April 2021. Permission was obtained from the study setting to conduct this investigation after explaining the nature of the study. Once the patient's next of kin approved of their participation in the study, the data gathering procedure was begun.

Intervention

For both groups

All patients had primary assessment to ensure they were free from the exclusion criteria. The recruited patients were divided into two equal groups at random. The control group and the abdominal massage group. The PI used a 50 ml syringe to inject 20 ml of air in the NGT while listening by a stethoscope at the epigastric region to determine the correct position of the tube. To assess the GRV, the PI aspirated the gastric content from the NGT by the 50 ml syringe before feeding. If gastric content was not aspirated, the aspiration process had been repeated to ensure that the stomach is empty.

For the abdominal massage group

Patients in this group received 15 minutes of abdominal massage intervention twice a day for three consecutive days before feeding while the patient in supine position with the head of the bed elevated at 30 - 45 degrees in four consecutive steps. Primarily, the PI rubbed her hands with a lubricant oil (lavender oil) to facilitate the massaging process.

In the first step, the PI performed Light Stroking Effleurage. It is a form of circular stroking massage over the abdomen. The second step is Effleurage on colon. Effleurage from descending colon, then transverse to descending, then ascending to transverse to descending colon. In the third step, the PI had performed Petrissage /kneading by moving the tissues away from the underlying organs and in the last step. Vibration had been done in a high frequency with finger pads **(McClurg et al., 2016; Zhong, Wang, Wan, & Lei, 2019)**.

According to the unit policy, patients in the chosen ICU were gavaged every four hours and fed in the same manner. The stomach content was aspirated once the NGT placement had been confirmed, and the GRV was calculated. This quantity was then gavaged into the stomach along with another amount of food, bringing the total volume of feeding administered to each patient to 400 cc. A 15-minute abdominal massage was given at ten in the morning. The second stage of abdominal massage was done after two hours, and the GRV was then evaluated one hour after the second massage, at one in the afternoon.

For the control group

The patients received the routine care of EN as assessment of tube placed correctly and assessment of GRV.

Outcome Evaluation

The number of vomiting episodes, GRV, frequency of defecation and abdominal circumference were assessed in the massage group and control group.

3.10 Data Analysis

The collected data were coded, computed and statistically analyzed using Statistical Package of Social Sciences (SPSS), version 22. Data were presented as frequency and percentages (qualitative variables) and mean ± SD (quantitative continuous variables). Chi square (x^2) was used for comparison of categorical variables, and was replaced by Fisher exact test (FET) or Mont Carlo Exact test if the expected value of any cell was less than 5. Student's t test was used for comparison of continuous quantitative variables (two groups). The difference was considered significant at $P \leq 0.05$.

4. Results

Table 1 shows the participants' socio-demographic characteristics. The results revealed that 63.3% of the massage group and 61.8% of the control group were in the age group between 51-60 years old with the mean age of 51.18 ±10.06 and 51.16 ±9.54 years, respectively. About half of the participants in both groups were males (50.9%). Additionally, 40% of the massage group and 36.4% of the control group were smokers. Regarding the sociodemographic characteristics, there were no statistically significant differences between the two groups *(P>0.05)*.

Table 2 depicts the participants' health-relevant data. It showed that neurological problems were the most common cause of ICU admission among 54.5% of the massage and 63.6% of the control group followed by respiratory disorders (23.6% and 29.1%

respectively). The most common past medical history in the massage group (49.1%) and the control group (56.4%) was hypertension followed by diabetes mellitus (34.5% & 45.5% respectively). The majority of the massage group (80%) and the control group (76.4%) had GCS of 3-4. Regarding health relevant data, there were no statistically significant differences found between the two groups *(P > 0.05).*

Table 3 compares the mean of feeding volume, GRV and abdominal circumference between the studied groups. A statistical significant difference was noted in the feeding volume between the two groups in the first session of the first day *(P=0.029).* However, no statistically significant differences were noted between the two groups on the second and the third day of the study. It was noted that the mean of GRV was lower in the massage group than in the control group with statistically significant differences in the second session of the first day *(P=0.040)*, and on the second and third days (*P<0.001*). The results also illustrated the mean of the abdominal circumference was lower in the massage group than in the control group with statistically significant differences between the two groups in the three days of the study.

Table 1 *Socio-demographic Characteristics of the Studied Groups*

Variables	Massage Group		Control Group		Significant Test	
	n (55)	%	n (55)	%	χ^2	P value
Age (years)						
• 20-30	3	5.5	2	3.6		
• 31-40	5	9.1	9	16.4	1.539	0.713
• 41-50	12	21.8	10	18.2		
• 51-60	35	63.6	34	61.8		
Mean ± SD	51.18 ± 10.06		51.16 ± 9.54		t = 0.010	0.992
Gender						
• Male	28	50.9	28	50.9		
• Female	27	49.1	27	49.1		
Smoking						
• Yes	22	40.0	20	36.4	0.154	0.695
• No	33	60.0	35	63.6		

Data are expressed as number (n) and Frequency (%), SD: Standard Deviation , χ2: Chi Square Statistically significant at $p \leq 0.05$, t: student t test

Table 2 *Participants' Health Relevant Data*

Variables	Massage Group		Control Group		Significant Test	
	n (55)	%	n (55)	%	χ^2 / FET	P value/MEP
Causes of ICU Admission						
Respiratory disorders	13	23.6	16	29.1	0.425	0.516
Cardiac disorders	6	10.9	8	14.5	0.327	0.567
Renal disorders	7	12.7	7	12.7	-----	------
GIT disorders	2	3.6	1	1.8	FET	1.00
Neurological disorders	30	54.5	35	63.6	0.940	0.322
Sepsis	10	18.2	8	14.5	0.266	0.606
Trauma	6	10.9	2	3.6	2.157	MEP 0.142
Drug over dose	0	0.0	1	1.8	FET	1.00
Others	9	16.4	8	14.5	0.070	0.792
Past Medical History						
None	12	21.8	8	14.5	0.978	0.323
Hepatic disorders	3	5.5	4	7.3	FET	1.00
DM	19	34.5	25	45.5	1.364	0.243
Hypertension	27	49.1	31	56.4	0.584	0.445
Cardiac disorders	8	14.5	7	12.7	0.077	0.781

Neurological	12	21.8	9	16.4	0.530	0.467
Surgery	3	5.5	1	1.8	FET	0.618
Others	10	18.2	13	23.6	0.495	0.482
GCS						
3-4	44	80.0	42	76.4		
5-6	7	12.7	9	16.4	0.301	0.862
7-8	4	7.3	4	7.3		
Mean ± SD	3.67 ± 1.40		3.73 ± 1.25		t = 0.215	

Data are expressed as number (n) and Frequency (%), SD: Standard Deviation, $\chi 2$: Chi Square, FET :Fisher Exact Test, ICU: Intensive Care Unit, GIT: Gastro Intestinal Tract, DM: Diabetes Mellitus, GCS: Glasgow Coma Scale, Statistically significant at $p \leq 0.05$, t : student t test, Each subject may have more than one response. Therefore, each subject has separate $\chi 2$ and *p value*

Table 3 *Comparing the Mean of Feeding Volume, GRV and Abdominal Circumference Between the Studied Groups in Three Consecutive Days*

Variable	Massage Group n 55	Control Group n 55		
Feeding Volume	Mean ± SD	Mean ± SD	**Significant test**	**P value**
1st Day session 1	295.45 ± 90.41	327.27 ± 55.96	t = 2.219	**0.029**
session 2	380.00 ± 44.72	381.82 ± 38.92	t = 0.227	0.821
2nd Day session 1	291.82 ± 90.45	320.00 ± 55.78	t = 1.972	0.051
session 2	378.18 ± 45.91	378.18 ± 41.68	-------	-------
3rd Day session 1	288.18 ± 89.75	314.54 ± 55.84	t = 1.850	0.067
session 2	380.00 ± 44.71	372.73 ± 44.95	t = 0.851	0.397
GRV				
1st Day session 1	99.45 ± 41.24	104.64 ± 28.36	t = 0.678	0.444
session 2	97.27 ± 39.50	111.45 ± 31.65	t = 2.078	**0.040**
2nd Day session 1	66.54 ± 31.10	103.55 ± 22.99	t = 7.095	**< 0.001**
session 2	58.82 ± 31.02	113.45 ± 30.84	t = 9.265	**< 0.001**
3rd Day session 1	36.64 ± 29.04	104.55 ± 23.65	t = 13.643	**< 0.001**
session 2	27.09 ± 28.65	115.82 ± 27.80	t = 16.428	**< 0.001**
Abd. Circumference				
1st Day session 1	104.44 ± 10.63	109.58 ± 9.13	t = 2.724	**0.008**
session 2	104.33 ± 10.62	109.67 ± 9.15	t = 2.829	**0.006**
2nd Day session 1	103.07 ± 10.25	109.65 ± 9.40	t = 3.497	**0.001**
session 2	102.82 ± 10.59	110.08 ± 9.42	t = 3.803	**< 0.001**
3rd Day session 1	102.22 ± 10.47	110.35 ± 9.65	t = 4.120	**< 0.001**
session 2	102.13 ± 10.51	110.36 ± 9.75	t = 4.261	**< 0.001**

Data are expressed as number (n) and Frequency (%), SD: Standard Deviation, GRV:
Gastric Residual Volume, Abd: Abdominal, Statistically Significant at $P \leq 0.05$, t: student t test

5. Discussion

esults of the present study demonstrated that the biggest proportion of patients in the two groups were in the age category of fifty to sixty years old and the percentage of males to females among both groups was the same. These outcomes correspond with the findings of a study carried out by **El-Feky and Ali (2020)** who assessed the impact of abdominal massage on GRV among critically ill patients at Cairo University Hospitals and found that the mean age of the studied group was 54.37 ±

9.41 and the control group was 55.43 ± 10.54, and slightly more than half of the participants were females. On the other hand, these findings disagree with another study which found that the mean age in the study group was 42.97 ± 23.08 and in the control group was 40.94 ± 19.44 (**Dehghan, Poor, Mehdipoor, & Ahmadinejad, 2018**).

The current study denoted that neurological problems were the most common causes of ICU admission, followed by respiratory problems. These findings are in harmony with **Elpasiony et al. (2017)** study which investigated the impact of abdominal massage on VAP among patients with EF. The authors reported neurological problems as the most common cause of ICU admission in both groups. Additionally, **Aldugiem et al. (2021)** found that respiratory diseases were the most common causes of ICU admission in the studied group. The current study findings showed that the biggest proportion of the massage group and the control group had a history of hypertension followed by DM. These findings are consistent with other investigations which found that DM was the most common co-morbidity in the studied sample (**Aldugiem et al., 2021; El-Feky, & Ali, 2020**).

Regarding GCS, the results of the current study revealed that the majority of participants were unconscious with a GCS category of 3–4. The deteriorated conscious level is one of the most important causes of starting EN to prevent malnutrition. Also, EN is always the first choice for patients with swallowing limitations and is considered the method of choice for nutritional support for critically ill patients (**Jamieson& Tadi, 2022**). These findings are in agreement with **Momenfar et al. (2018)** who reported that all participants had a GCS of less than 7. In contrast, **El-Feky and Ali (2020)** found that all participants in their study sample were with GCS greater than or equal to 8.

Concerning the current prescribed medications for the studied sample, the results showed that all patients in both groups were on antibiotics. In the same line, **Diab, Bahgat, Amin, and Weheda (2021)** reported that the majority of the massage and control groups, recently received antibiotic medication. This similarity may be explained by the fact that ICU patients frequently experience severe or life-threatening infections, and that the majority of infections there are bacterial or fungal in origin and require antimicrobial therapy for clinical resolution, making antibiotics the cornerstone of treatment (**Kollef et al., 2021**).

In respect to GRV, the current study finding revealed that the GRV was lower in the massage group than in the control group through the three days of follow-up. Additionally, there was a decrease in the GRV amount in the massage group and this decrease started from the first session of the second day. A highly significant difference between the massage group and control group regarding the GRV ($p<0.001$). These findings are in the same line with **Momenfar et al. (2018)** who investigated the effect of abdominal massage on the GRV in ICU patients. On the second and third day after the intervention in comparison to the first, they observed a considerable decline in the GRV.

The current study findings showed a significant reduction in the abdominal circumference in the massage group throughout the six sessions on the three days of the study. This is consistent with **Mohamed, Bakr, and Naguib, (2021)** study which reported a highly statistically significant difference regarding the abdominal circumference after abdominal massage than before for five days. Also, **Fareed and El-Sayad (2017)** concluded that the application of 15 minutes of abdominal massage for three days led to a significant difference among the studied sample regarding abdominal circumference. This is because the abdominal massage may decrease abdominal distention, and therefore, decrease abdominal circumference (**Çetinkaya, & Ovayolu, 2020**).

Regarding vomiting episodes, the current study findings illustrated that the majority of the massage group did not have episodes of vomiting on the second or third day of the study compared with the control group. On the same line, similar results were

reported by other investigators which found that the vomiting episodes was lower in the massage group than in the control group with a statistically significant difference between both groups **(Aldugiem et al., 2021; Fareed & El-Sayad, 2017)**.

Concerning the frequency of defecation per 24 hours during the three days of intervention, the current study found that the massage group had a higher frequency of defecation than the control group. The majority of the massage group passed stool once per day and some of them passed stool twice per day, while the majority of the control group did not pass stool and less than one quarter passed stool once per day. Abdominal massage promotes contractions of the large intestine, which moves fecal matter along the gut, speeds up the time it takes stool to move through the large intestines to the anus, softens the stool and makes it easier to pass out **(Dehghan et al., 2018)**.

6. Conclusion and Recommendations

The findings of the current study exposed that abdominal massage is a nursing practice that has an effective role in lowering GRV, increasing frequency of defecation, and reducing abdominal circumference in critically ill patients receiving EN. These findings underline the necessity for CCNs to incorporate abdominal massage within their standard of care for critically ill patients receiving EN.

7. Limitations of the current study

The sample was gathered from one hospital in a particular region of the Arab Republic of Egypt, which limits the generalizability of the findings. The communication with patients was limited because all the studied sample were unconscious.

8. Acknowledgment

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9. Statement of Competing Interests

The authors acknowledged no latent conflicts of interest regarding this study, authorship, and/or publication of this research.

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