International Journal of Gerontology 17 (2023) 286–289
https://doi.org/10.6890/IJGE.202310_17(4).0014

International Journal of Gerontology

journal homepage: http://www.sgecm.org.tw/ijge/

Original Article

Determining Gastric Emptying Time by Using Ultrasound Associated with Preoperative Fasting Time in Elderly

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ARTICLE INFO

Accepted 31 July 2023

Keywords:
gastric emptying,
respiratory aspiration of gastric contents,
fasting,
breakfast

SUMMARY

Introduction: Gastric content aspiration is one of the most severe complications of general anesthesia. However, few studies have assessed gastric volume with ultrasound to determine the appropriate fasting time before surgery. This study aimed to determine gastric emptying time following the consumption of a traditional Turkish breakfast using ultrasound.
Materials and Method: Patients were asked to fast for 8 h before the first ultrasound; subsequently, the gastric emptying time was determined via serial gastric ultrasound examinations conducted by two experienced sonographers. Real-time ultrasonographic evaluations were performed every 1 hour. All ultrasound assessments were conducted with volunteers in the supine position and right lateral decubitus position, and a convex probe was used to visualize the epigastric area.
Results: Fourteen patients with a mean age of 71.71 ± 6.33 years were enrolled in the study, and the mean body mass index was 32.74 ± 9.14 kg/m^2. Gastric emptying time was 286.14 ± 33.96 min. The craniocaudal and anteroposterior diameters, as well as their antral cross-sectional areas, revealed statistical differences.
Conclusion: Our findings show that gastric emptying time determined by measuring antral cross-sectional area on ultrasound is less than 6 hours in subjects aged over 65 years.

1. Introduction

Preoperative fasting is defined as 6 h of fasting of light meals and 8 or more hours of fatty food according to the American Society of Anaesthesiologists (ASA) guidelines.[1] Although according to the recommendations of ASA preoperative fasting for 6 hours is required to avoid pulmonary aspiration, fasting time may vary among different age groups and conditions such as pediatrics, elderly, pregnancy, and obesity. Aspiration of gastric content is the most debated and important complication of general anesthesia. Especially in the elderly, impaired peristalsis by causing a delay of gastric emptying, comorbidities, and medication, lack of swallowing, and impaired cough reflexes, increase the risk of pulmonary aspiration.[2] Both solid and liquid emptying has been shown to be slower in older patients compared to younger ones.[3] So it is important to clarify the gastric status and gastric emptying time (GET) before surgery. Gastric ultrasound is a simple, reliable, and readily available technique for the determination of the residual gastric content and thus estimation of GET. Sugita et al. found GET as lower than 5 h after a normal Japanese breakfast by calculating gastric cross-sectional area (CSA) and gastric volume via using gastric ultrasound.[4,5]

Patients scheduled for surgery often have complaints of preoperative fasting. This study aimed to investigate GET in the Turkish population by serial measurement of antral CSA with gastric ultrasound.

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2. Methods

The Institutional Ethical Committee (Taksim Gaziosmanpaşa Training and Research Hospital Local Ethical Committee) approved this study (protocol no: 182-08.01.2020) and registered Clinical Trials (NCT04789785) on March 8, 2021. The research was conducted in accordance with the ethical principles of human investigations, as outlined by the Second Declaration of Helsinki.

14 volunteers were included in the study, inclusion criteria were being older than 65 years old and having no accompanying diseases that may potentially interfere with GET like diabetes, previous abdominal or oesophageal surgery, scleroderma, hypothyroidism, and narcotic medications. After obtaining written informed consent, participants were asked for 8 hours of fasting before the first ultrasound examination. Ultrasound assessments were performed every hour by two experienced sonographers and mean values of the two measurements were recorded for each variable.[6] These assay results are considered as fasting gastric volume. Measurements were done until reaching these fasting gastric volume results. In repeated measurements, the exact minute to reach the initial measurements was determined and calculated in minutes, considered as GET.

These assessments on volunteers were made both in the supine position and right lateral decubitus (RLD) from the epigastric area by using a convex probe. RLD measurements are preferred because of better visualization. After visualization of gastric antrum with respect to landmarks such as the abdominal aorta, superior mesenteric artery, and the left lobe of the liver; we measured craniocaudal

(CC) and anteroposterior (AP) antral diameters in the sagittal plane (Figure 1). Calculation of CSA was done using the following formula: Antral CSA = AP × CC × π/4. Gastric volume was also found by an equation that exists for adults: GV (ml) = 27.0 + 146 × CSA (cm^2) – 1.28 × age (year). Following the first ultrasound examinations, all volunteers had a standard Turkish breakfast at the same time, with the same content (Table 1). After breakfast, consecutive USG assessments were performed on each volunteer at 60-min intervals until the identification of initial fasting gastric volumes. Based on the identification of the CSA and calculation of gastric volume, the GET was estimated.

2.1. Statistical analysis

In order to examine the correlation among gastric volume, fasting time, and measured GET, Spearman's correlation coefficient and linear regression analysis have been performed. A paired test has been used when comparing the GV after breakfast and before lunch.

SPSS statistical software package (SPSS, version 17.0 for Windows) was used for statistical analysis. The homogeneity of the distribution of parameters was controlled by the Kolmogorov–Smirnov test. Parametric tests were applied to the data of normal distribution and non-parametric tests were applied to the data of questionably normal distribution. In addition to Posthoc Bonferroni correction, the Repeated Measures ANOVA test was used in the comparison of AP and CC diameters and antral CSA measurements. The results have given as mean ± standard deviation. A p-value < 0.05 was considered statistically significant.

3. Results

A total of 14 patients with a mean age of 71.71 ± 6.33 years old were enrolled in the study and the mean body mass index was 32.74 ± 9.14. GET was found to be 286.14 ± 33.96 min. as shown in Table 2.

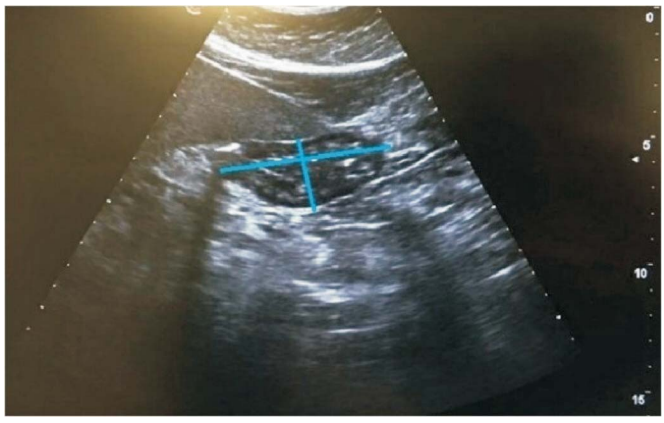

Figure 1. Image of antral cross-sectional area including the thickness of the gastric wall. Anteroposterior and craniocaudal diameters are shown.

Table 1
Contents of traditional Turkish breakfast.

1 egg: 155.1 kcal
A cup of tea: 1 kcal
A slice cheese: 402.5 kcal
A slice of bread: 264.6 kcal
Some olives (8): 115 kcal
A glass of milk (Optional): 42.3 kcal
4 pieces of cucumber: 14 kcal
4 pieces of tomatoes: 17.7 kcal
2 spoons of marmalade: 28 kcal

There was a significant difference in CSA among measurements. The magnitude of the values recorded in the 6th hour of CSA was significantly smaller than the 1st hour in posthoc analysis (4.2329 ± 0.7972 cm^2 vs. 10.0715 ± 2.37 cm^2, p < 0.001) (Figure 2). AP and CC diameters of the antrum at the 6th hour were also shorter than those measured at the 1st hour (Table 3).

Correlation and linear regression results are shown in Figure 3.

Table 2
Mean age, body mass index, and gastric emptying time values are shown in the table. Gastric emptying time has been found by real-time ultrasonography.

	n = 14
Age (years)	71.71 ± 6.33
Body mass index	32.74 ± 9.14
Gastric emptying time (min.)	286.14 ± 33.96

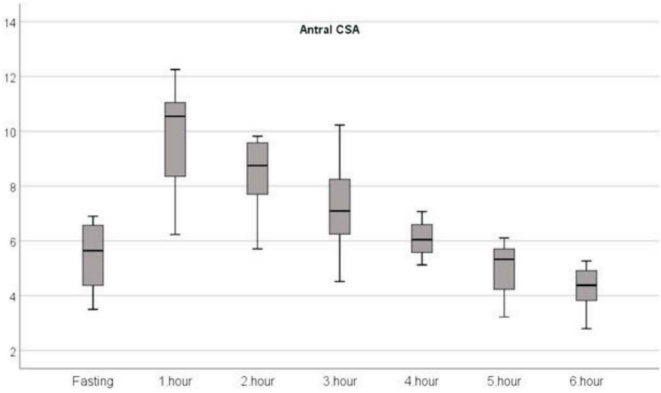

Figure 2. Antral cross-sectional area difference among 6 measurements done hourly.

Table 3
Measurements of anteroposterior, craniocaudal diameters and antral cross-sectional area calculation values by using ultrasound.

	AP	CC	Antral CSA
Fasting	2.87 ± 0.62 cm	2.63 ± 0.66 cm	5.9542 ± 2.03 cm^2
1.hour	3.73 ± 0.71 cm	3.44 ± 0.58 cm	10.0715 ± 2.37 cm^2
6.hour	2.48 ± 0.39 cm	2.18 ± 0.37 cm	4.2329 ± 0.7972 cm^2
P (ANOVA)	< 0.001	< 0.001	< 0.001

AP: anteroposterior, CC: craniocaudal, CSA: cross-sectional area.

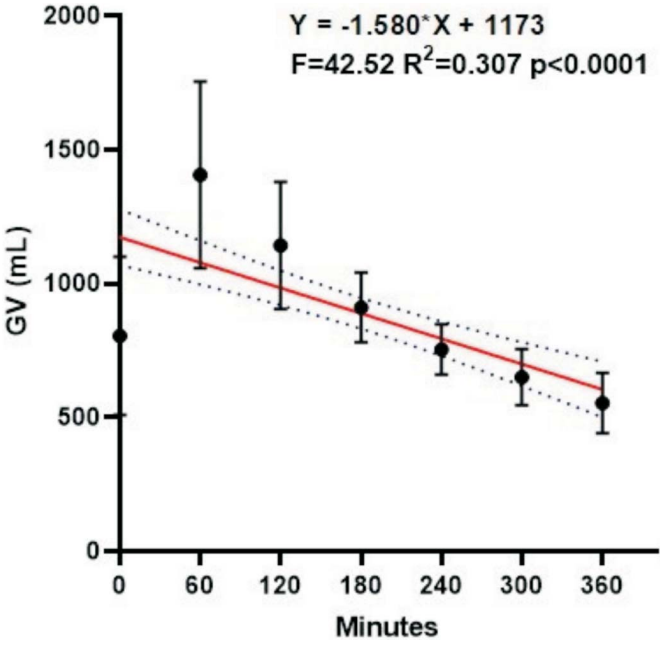

Figure 3. Correlation analysis of volunteers.

4. Discussion

Based on the calculation of the antral CSA with gastric ultrasound, our findings indicate that GET is 286.14 ± 33.96 min in elderlies following the consumption of a traditional Turkish breakfast.

Gastric ultrasound is a promising technique as a rapid, readily available, and bedside tool which recently have been used for determining the gastric volume and GET. Its validity has been evaluated in a variety of patient populations, including pregnant and non-pregnant adults, severely obese and pediatric patients.[7–9]

Previous data provided by the study of Sugita et al. indicate that fasting gastric volume is 53.1 ml and GET is 276.4 min.[5] The calculated GET in our study is so close to that reported by Sugita et al. and appears somewhat longer than that of the younger population reported previously. Beck et al. measured GET as below 4 h after breakfast by observing gastric CSA in preschool children and the observations indicated that CSA was inversely proportional with the fasting time.[10]

The first calculation of the gastric antrum area using ultrasound by Bolondi et al. in 1985 led to several types of research utilizing ultrasound in the estimation of the GET.[11] The findings of these studies demonstrated a high correlation between ultrasound and the gold standard technique, scintigraphy in the estimation of the GET.[13–15] Gastric ultrasound is being used widely, especially if the prandial status is unknown. Several data demonstrated that gastric ultrasound can be used to estimate gastric content in pregnant and non-pregnant adults, severely obese patients, and pediatric patients.[16–18]

There are several research with different age groups, but it is important to evaluate elderlies because gastric volume changes by age, as the mathematical formula for GET, contains age. In the study of Perlas et al. the CSA measured in the elderly was larger than that of the younger counterparts.[19] On the other hand, it is known that gastric emptying is significantly delayed in the elderly. Aging deteriorates a number of physiological functions in the gastrointestinal system as well. Impaired cognitive functions, comorbidities, drug utilization, and delayed gastric emptying in the elderly may result in pulmonary aspiration during general anesthesia.[20,21]

A recent meta-analysis of 49 studies including 1457 individuals from neonates to adults revealed that the type of nutrients is more significant than age in GET.[22] In our study, the content of the breakfast was the same in all participants but we found slower emptying time from previous studies including adults. In addition, we preferred traditional content from the diversity of food choices all over the world.

There are some limitations in this study: we don't have a younger control group, our patients don't have any comorbidities, and they are volunteers. Our patients were not preparing for surgery. The clinical situation may be different in surgical patients.

5. Conclusion

This is the first study done with an ultrasound evaluation of GET in the Turkish population after a traditional Turkish breakfast. Our study shows that GET is lower than 6 hours with various nutrients in the elderly. In conclusion, fasting time may be lower than the recommendations of ASA. However, further research is necessary to clarify the safe fasting time before surgery.

Declaration of conflicting interests

The author(s) declared no potential conflicts of interest with respect to the research, authorship, and/or publication of this article.

Funding

The author(s) received no financial support for the research, authorship, and/or publication of this article.

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