Case Report

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Gastric Emptying of Oral Nutritional Supplements Assessed by Ultrasound

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Abstract

Fasting has been the standard of many medical procedures such as upper endoscopic procedure, surgery, bronchoscopy and abdominal ultrasound imaging. Generally, the fasting recommendations follow The Canadian Anesthetist's Society (CAS) and American Society of Anesthesiologists (ASA) guidelines. In that recommendation, patients only received clear liquid which contains simple carbohydrate or water two to six hours prior to surgery. After three hours of meal body has to provide nutritions for itself by gluconeogenesis. In addition to nutritional issues, gastric irritation and dehydration occur as well. All these conditions can have adverse effects on the patients pre and post-surgical outcomes.

Oral nutritional supplements (ONS) contain complete nutrient is a standard formula which could be given as an option to the patients undergoing surgery or endoscopic procedures. In a preoperative period, besides providing adequate nutrients, ONS also improves patient satisfaction.

We present a case of gastric emptying of 200 ml ONS assessed by ultrasound. The ONS when tracked by the ultrasound resulted in passing through the stomach within two hours. We suggest that 200 ml ONS can be given to patients two hours prior to medical and surgical procedures.

Key words: Enteral nutrition, gastric emptying time.

Introduction

In the setting of medical procedure, such as in upper endoscopic procedure, (1) surgery, (2,3) bronchoscopy (4) and abdominal ultrasound imaging, (5) pre-operative fasting has been used to prevent aspiration and other feeding related complications during the procedure. Pre-operative fasting on the other hand can result in hunger, thirst, tiredness, weakness, and inability to concentrate, (6) nausea and vomiting, (7) metabolic consequences (8) and lack of patient satisfaction. (9)

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Based on current guideline by CAS and ASA, two to six hours prior to any medical or surgical, patients be allowed to drink only clear liquids (water, fruit juice without pulp, carbonated beverages, clear tea or black coffee). (2,3) In patients receiving only simple carbohydrate without protein supply, the body will utilize the endogenous protein after few hours, which is more pronounced after the prolong fasting, as in surgical patients who may be fasting for seventeen to twenty hours or more.

Oral nutritional supplements (ONS) given orally, could be used as an option prior to medical procedure as it has complete nutritional content and the small particles leave the stomach rapidly. The content of ONS is standard complete nutrient (macronutrient and micronutrient), 1 kcal/ml with low lipid (20%), high protein (18%) and carbohydrate (62%) in 200 ml.

Case report

We hereby describe a case of 42 year-old female whose gastric emptying time was studied by measuring gastric content serially after the patient was given 200 ml ONS prior to the ultrasound assessment. Patient was healthy, without any gastointestinal problem or any stress related to any medical procedure.

Method

The examination started at 9 am with an empty stomach. Patient received full meal on the night prior to the procedure. Two hours prior to the scheduled procedure time, patient received 200 ml of ONS (**Table 1**). The meal schedule was arranged following fasting guidelines form ASA 1999 (**Table 2**). Based on the guidelines, the first assessment was considered as the baseline of empty stomach. We used 2D ultrasound to assess the gastric emptying and volume. Reliability and validity of ultrasound has been documented in the literature. (10,11)

Gilja suggested the use of 2D ultrasound for gastric emptying assessment and a 3D one for volume estimation. (10,11) In our case, we used 2D ultrasound for gastric emptying assessment, but not a 3D for volume estimation. We compare the gastric emptying after drinking ONS with the baseline gastric images. We calculated the volume using $\pi r^2 L$ formula, assuming that stomach was in a cylindrical form.

The ultrasound was performed on a patient in semi-recumbent position. The ultrasound transducer was positioned in the epigastrium by the left subcostal margin; imaging of stomach was done in longitudinal and transversal views. Baseline (time zero) was prior to drinking 200 ml of ONS. The assessment was repeated every 30 minutes, until the stomach was considered to be empty again or back to baseline image on ultrasound. The same ultrasound imaging and calculation method was used during each subsequent assessment.

Result

At the baseline, using cylinder formula calculation, patient's gastric volume was estimated to be <80 ml. Thirty minutes after drinking ONS, the gastric volume was calculated to be 157 ml. At 60 minutes the volume increased to 267 ml, then decreased again in 90 minutes to 125 ml. At 120 minutes ultrasound images showed content in the stomach to be similar to the first image with gastric volume (<80 ml) (**Figure 1**).

Discussion

Study about gastric emptying has been done for around 160 years. (12,13) Various techniques has been used to assess gastric emptying with their advantages and disadvantages; radiology, intubation-aspiration, radioisotope, ultrasound, absorption kinetics of orally-administered solutes (acetaminophen, ethanol, glucose), ferromagnetic tracer, epigastric impedance and tomography. The most frequently used methods are scintigraphy measurement and acetaminophen absorption technique, (12) while the gold standard is electronic barostat. (13) The weaknesses of those methods were that it was invasive. The non-invasive methods such as impedance, tomography and ultrasound are favorable for patients who are stress responsive, e.g. dyspepsia. (13) Among the non invasive methods, impedance, tomographies are much more expensive than ultrasound.

Ultrasound for gastric emptying assessment has been recommended because it's non-invasive, safe, possible to be repeatedly performed and valid. (10,11) Gilja suggests to use 2D ultrasound for gastric emptying assessment and the 3D one for volume estimation. (10,11) In this case we calculated the gastric volume by using the cylindrical formula. We compare the gastric emptying after drinking ONS with baseline image and also used $\pi r^2 L$ formula to estimate the gastric volume assuming that gastric vault was in a cylinder form.

Our case showed that ONS left stomach in 120 minutes. Compare to other food, ONS's rate of gastric emptying time is in between solid food and liquids. Liquid leaves stomach very fast, 95% of liquid is emptied within 1 hour. (14) Solid food is still detected in the stomach two hours after the meal. (15) Study by Søreide, et al (15) showed that after taking a slice of buttered toast with jam, a cup of coffee without milk or sugar and a glass of pulp-free orange juice, the stomach of three patients were considered empty after 180 minutes, six patients after 210 minutes and the remaining

after 240 minutes. (15) Burton, et al (16) presented the similar conclusion in their study. In their study, solid food (2 scrambled eggs+1 slice of bran bread+240 ml skim milk) was found in stomach >350 ml three hours after the initial meal. (16) Gastric emptying of solid food is longer than liquid. (17,18) Enteral nutrition, on the other hand, has tiny particle (<2 mm), which allows it to transit through stomach very rapidly.

We found that emptying of gastric content was non-linear. After taking ONS, the gastric volume of our patient decreased at 30 minutes interval, but increased again at 60 minutes, to be followed by decrease in gastric volume at 90 minutes interval. One possible hypothesis is that the difference in the osmolarity withdraws gastric juice. Other possible scenario may be the composition and drinking amount of ONS might result in different emptying time.

The absorption of food, in the small intestine also influences the rate of gastric emptying. Fat has the slowest gastric emptying when compared to carbohydrate and protein. The digestion and absorption of fat occurs in the lumen of intestine. Presence of fat in the intestine slows the gastric emptying. (17) Food rich in carbohydrate has faster gastric emptying rate compare to protein and lipid. (18) The ONS in our study contains 20% lipid, which is lowest lipid composition of balance diet. The lower lipid content transits through the stomach faster than nutrient with higher lipid content.

Conclusion

Oral nutritional supplements (ONS) could be given to patients in the setting of medical and surgical procedure that requires fasting. We suggest a possibility of giving 200 ml ONS contains of 20% lipid and 18% protein, 2 hours prior to the procedures, which can be a continuum source of nutrient. This approach can be beneficial for elective surgical or medical procedures. ONS could also be repeated in the event of delay in procedure. Further study with larger sample size, and different procedures is suggested to validate this hypothesis.

Table 1. Orally intake schedule.

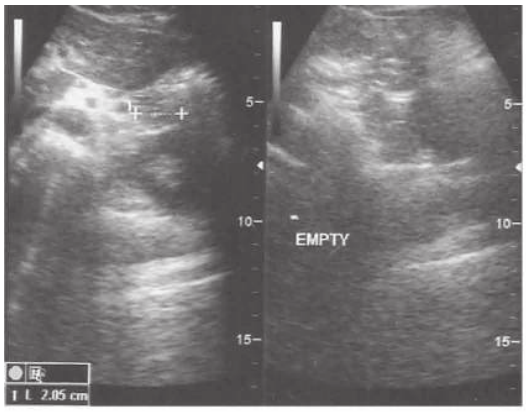
Time	Ingested material
A day before	Complete meal
07.00 am	200 ml tea with sugar
09.00 am	Ultrasound assessment

Table 2. American Society of Anesthesiologists fasting guidelines.

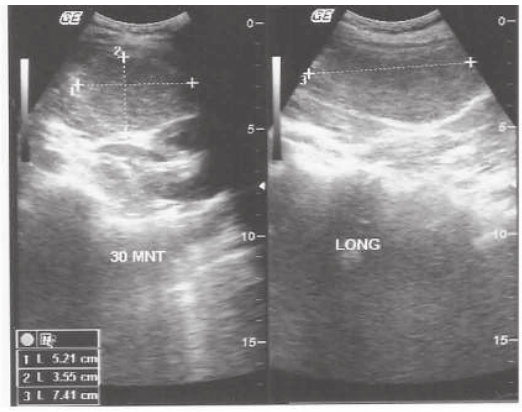
Ingested material	Minimum fast
Clear liquids[a]	2 hours
Non-human milk	6 hours
Light meal[b]	6 hours

Legend:
[a] Example: water, fruit juice without pulp, carbonated beverages, clear tea, black coffee.
[b] Example: dry toast and clear liquid.
Fried or fatty foods may prolong gastric emptying time. Both amount and type of food must be considered. The guidelines recommend no routine use of gastrointestinal stimulants, gastric acid secretion blockers or oral antacids.

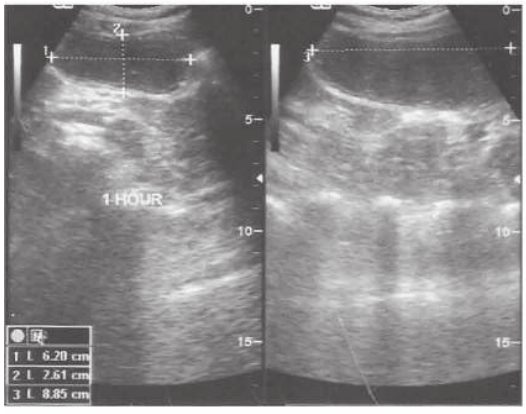
Figure 1. Ultrasound images of the stomach and volume calculation.



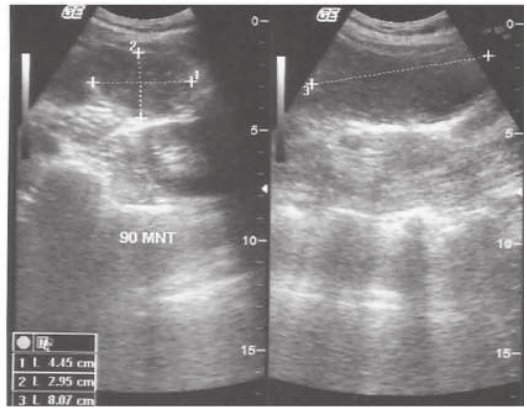
a. Empty stomach



b. 30 minutes after drinking ONS 157 ml



c. 60 minutes after drinking ONS 267 ml



d. 90 minutes after drinking ONS 125 ml

Legend:
120 minutes after drinking ONS stomach image was as same as the empty one (Figure 1a) (image was unprinted).

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