

INTRODUCTION

Pulmonary aspiration of gastric content is a major anesthetic-related complication. Although current npo guidelines do not guarantee any specific outcome, verifying patient compliance is prudent. Point of care ultrasound can help differentiate an empty stomach from one with liquid/solid content. In 2011, "Bedside ultrasound assessment of gastric content" published by Dr. Perlas, described the sonographic characteristics of the gastric antrum. Based on ultrasound technique and calculations of gastric antrum cross-sectional area (CSA) (cm²), the paper described a quick and non-invasive way to qualitatively and quantitatively evaluate gastric content to then help assess risk of aspiration.

The early gastric emptying studies for clear liquids were done comparing water and apple juice with limited evidence on emptying times of orange juice. To help elucidate this dilemma, we helped design a study using gastric ultrasound to evaluate motility of orange juice, with and without pulp, through the stomach.

METHODS

The Institutional Review Board (IRB) approved this study, and after obtaining written informed consent, we recruited 32 subjects to participate. Their ages ranged from 22-42yrs, weighing 53-102kg, BMI <35kg/cm², 8 female, and 24 male. Five subjects had a history of Gastroesophageal reflux disease (GERD), but otherwise healthy.

After being npo overnight, we obtained a baseline gastric antrum CSA (in cm²) in the supine and right lateral decubitus position. Imaging techniques are described in the original article cited above. Immediately after, subjects drank 8 ounces of water. We then recorded gastric antrum CSA at each designated time interval until they were declared low risk for aspiration. Risk of aspiration was based on a risk stratification chart by Perlas, which correlated gastric antral CSA to predicted gastric volume (ml). The subjects repeated the study with orange juice with and without pulp on two separate days.

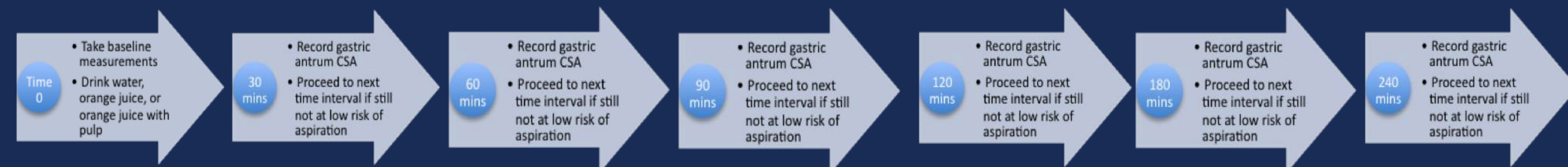


Figure 1: Timeline of gastric ultrasound measurements

RESULTS

Assessment of aspiration risk based on Gastric emptying times of water, orange juice, and orange juice based on gastric antrum cross sectional area (CSA) (cm²)

Baseline gastric antrum cross-sectional area (CSA) (cm ²)	Supine		Right lateral decubitus				
	Average	3.06	4.23				
	Range	1.36-7.02	1.08-10.0				
Cumulative number and percentage of subjects considered low risk of aspiration at each time interval	Time interval	Water		Orange juice		Orange juice with pulp	
	30 mins	12/32	37.50%	0	0%	0/32	0%
	60 mins	25/32	78.12%	8/32	25%	0/32	0%
	90 mins	32/32	100.00%	16/32	50%	5/32	15.6%
	120 mins			31/32	96.8%	9/32	28.1%
	180 mins			32/32	100%	30/32	93.8%
240 mins					32/32	100%	

For all 32 healthy subjects, we were able to successfully locate the gastric antrum in the supine and lateral decubitus position using ultrasound technique referenced above. Gastric emptying times are summarized in Table 1. The average baseline gastric antrum CSA in the supine and right lateral decubitus position was 3.06cm² (ranged 1.36 – 7.02 cm²) and 4.23 cm² (ranged 1.08 – 10 cm²), respectively for ages 22-42yrs, otherwise healthy. After ingestion of water, 100% of the subjects were considered low risk of aspiration at 90mins. With orange juice, 96.8% were considered low risk at 120mins and 100% were low risk at 180mins. After orange juice with pulp, only 28.1% of the subjects were considered low risk at 120mins, 93.8% were low risk at 180mins, and all of the were low risk at 240mins.



Figure 2: Ultrasound image of the gastric antrum in right lateral decubitus position immediately after ingesting 8-ounces of water. The trace function (seen by dotted line) is used to calculate gastric antrum cross-sectional area.



Figure 3: Ultrasound image of the gastric antrum in right lateral decubitus position immediately after ingesting 8-ounces of orange juice without pulp

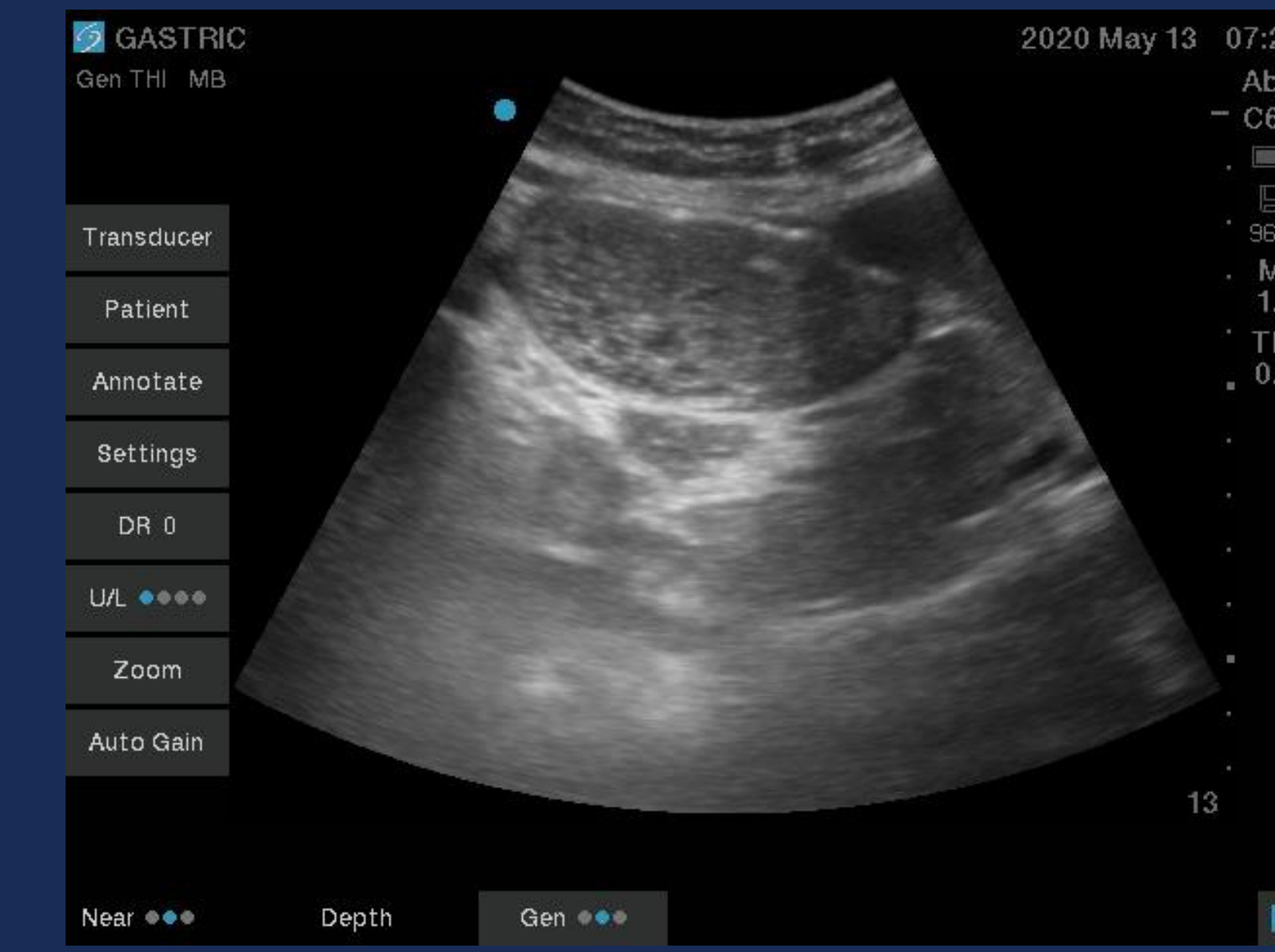


Figure 4: Ultrasound image of the gastric antrum in right lateral decubitus position immediately after ingesting 8-ounces of orange juice with pulp

DISCUSSION

The preliminary results provided some clarification about gastric emptying times of orange juice since >95% of patients were considered low risk at 2 hours. Qualitatively, orange juice in the antrum correlated with a clear liquid that was initially described on ultrasound as punctate hyperechoic areas within the hypoechoic fluid. Orange juice with pulp was more heterogenous with larger hyperechoic areas and certainly took longer to empty.

Limitations to the study include the expertise of the physician performing the gastric ultrasound and the reliability of using gastric ultrasound to calculate risk of aspiration. Certain pathology such as severe GERD, Diabetes, end-stage renal disease may also affect gastric emptying. Interpreting the quality of the gastric content on ultrasound can also vary based on physician technique, patient position, and content of ingestion and can mislead decision-making. Perhaps with more qualitative and qualitative data accounting for patient variables, we can add orange juice without pulp to clear liquids, allowing patients to drink it up to two hours prior to their procedure.

REFERENCES

Perlas A, Mitsakakis N, Liu L, Cino M, Haldipur N, Davis L, Cubillos J, Chan V. Validation of a mathematical model for ultrasound assessment of gastric volume by gastroscopic examination. *Anesthesia and Analgesia* 2013 February

Perlas A, Van de Putte P, Van Houwe P, Chan VWS. An I-AIM framework for point-of-care gastric ultrasound. *British Journal of Anesthesia* 2015 May e-pub ahead of print DOI: 10.1093/bja/aev113 (PA)

Practice Guidelines for Preoperative Fasting and the Use of Pharmacologic Agents to Reduce the Risk of Pulmonary Aspiration: Application to Healthy Patients Undergoing Elective Procedures: An Updated Report by the American Society of Anesthesiologists Committee on Standards and Practice Parameters. *Anesthesiology* 2011