

# Gastric ultrasound for perioperative prandial status

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## Abstract

Gastric ultrasound is a valuable tool for real-time assessment of gastric content at the bedside, reducing the risk of pulmonary aspiration. A good understanding of the gastric sonoanatomy and techniques for image acquisition will allow the clinician to utilize ultrasound to assess gastric content and volume via qualitative and quantitative assessment to risk stratify their patient prior to the surgery. We describe the core principles of gastric ultrasound and its practical implications on patient safety during the perioperative period.

*Keywords:* gastric ultrasound, perioperative ultrasound, point-of-care ultrasound, risk stratification, pulmonary aspiration

## Introduction

The use of perioperative ultrasound by anaesthesiologists has significantly increased in recent years. Initially, it was primarily utilized by cardiovascular anaesthesiologists for transoesophageal echocardiography. Its application has expanded to include ultrasound-guided regional anaesthesia and vascular access.<sup>1</sup> Gastric ultrasound has particularly captured the attention of anaesthesiologists as a valuable tool for real-time assessment of gastric volume at the bedside, reducing the risk of pulmonary aspiration.<sup>2,3</sup> This brief communication describes the core

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principles of gastric ultrasound and its practical implications on patient safety during the perioperative period

## Basic principles of gastric ultrasound assessment

### Gross anatomy of the stomach

There are three main regions in the stomach: the cardia, fundus, and pylorus (Fig. 1).

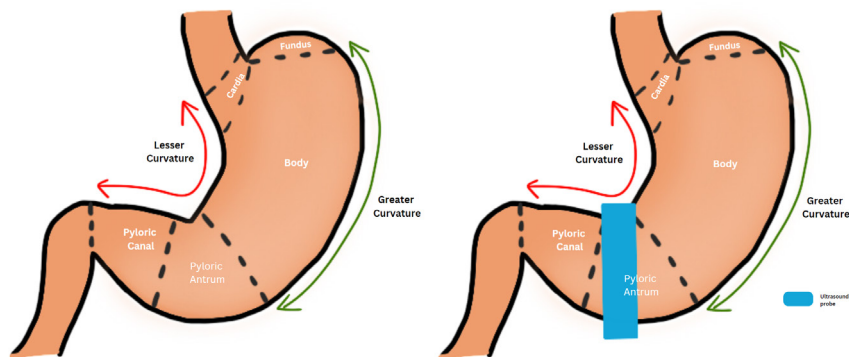


Fig. 1. The gross anatomy of the stomach and its main region (left); blue rectangle box indicating the structure that is visualized by the ultrasound (right).

### Indications

Patients with uncertain prandial status, and known or suspected delayed gastric emptying.

### Probe selection

Low-frequency curved array transducer (1-5 Mhz); high frequency probe can be used in leaner/paediatric population.

### Position of patient

Supine and right lateral decubitus position (Figs. 2 and 3); semirecumbent is an alternative if unable to turn lateral.

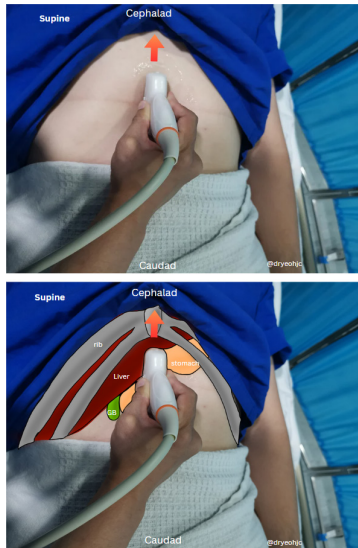


Fig. 2. Probe position at the epigastrum region in a supine position.<sup>4</sup>

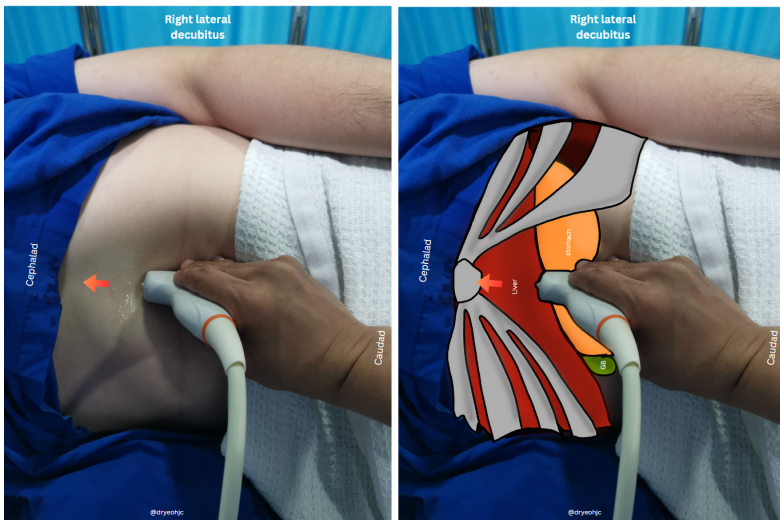


Fig. 3. Probe position at the epigastrum region in a right lateral decubitus position.

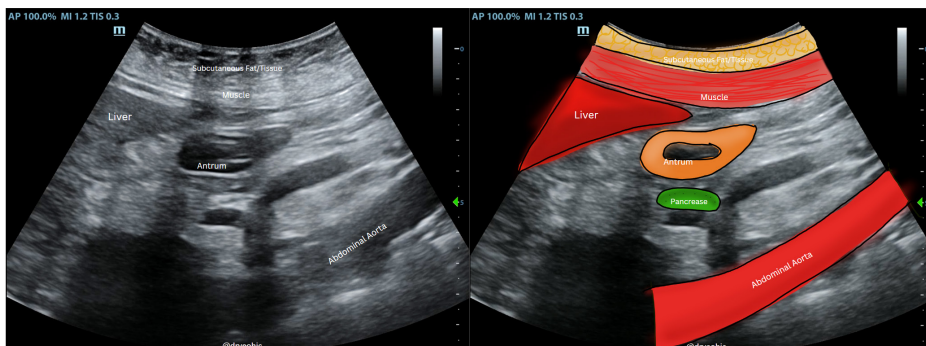


Fig. 4. Sonoanatomy to be identified during gastric ultrasound.

### Transducer position

In the sagittal plane at the epigastrium region, perpendicular to the skin (Figs. 2 and 3). Tilt/slide/rotate the probe to best obtain a true cross-sectional view of the antrum (the smallest possible cross-sectional view for the measurement of the gastric volume).<sup>3</sup>

### Anatomy to identify

A portion of the liver, long axis of the abdominal aorta or sometimes the inferior vena cava, pancreas (posterior to the antrum), and short axis of gastric antrum (easiest to obtain) as per Figure 4.

## Qualitative assessment with gastric ultrasound (Table 1 and 2)

Table 1. Qualitative/visual assessment<sup>2</sup>

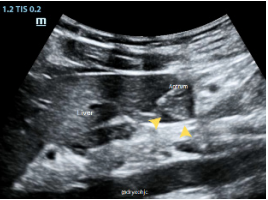
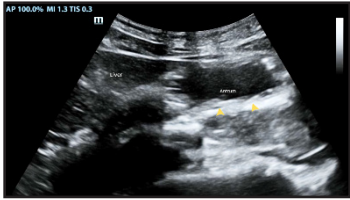
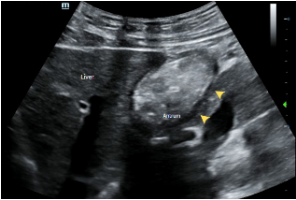
	Empty	Clear fluid	Milk or suspensions	Solid
<b>Antral</b>	Flat, collapsed, or circular (resembling a bull's eye)	Circular, well filled lumen	Circular, well filled lumen	Circular, well filled lumen
<b>Antral wall</b>	Thick wall with prominent muscularis propriae	Thin wall	Thin wall	Thin wall
<b>Content</b>	None Grade 0, or small	Hypoechoic	Hyperechoic	Hyperechoic, heterogenous (mixture with air in gastric)
<b>Peristalsis</b>	No peristaltic movement	Present	Present	Present
<b>Ultrasound anatomy</b>	 <p>[Figure A] Sonographic image of an empty stomach. Note the antrum is collapsed with no visible content</p>	 <p>[Figure B] Sonographic image of the gastric antrum with hypoechoic/anechoic content.</p>	 <p>[Figure C] Sonographic image of gastric antrum with solid content</p>	

Table 2. Grading score for gastric content

Grade	Features
Grade 0	The antrum appeared <b>flattened and empty</b> in both supine and right lateral decubitus position
Grade 1	Fluid can be demonstrated in the antrum <b>only</b> in the right lateral position
Grade 2	Fluid is demonstrated in the antrum <b>in both</b> supine and right lateral positions

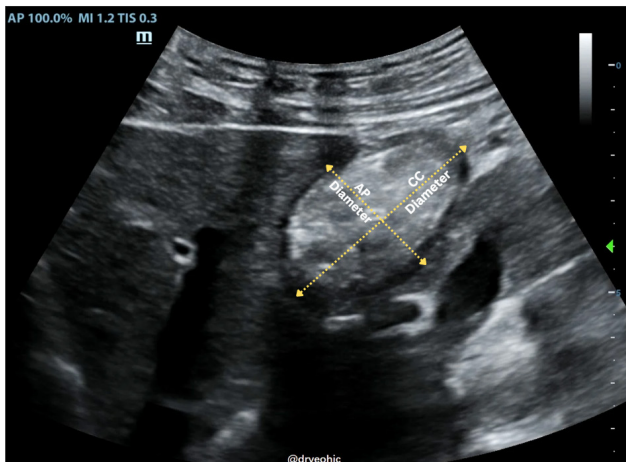


Fig. 5. Anterior-posterior (AP) diameter and cranio-caudal (CC) diameter is required for cross-sectional area (CSA) measurement.

### Quantitative assessment with gastric ultrasound

Figure 5 shows the application of Perlas formula (widely adopted, simplified).<sup>5</sup>

- Gastric volume (ml) =  $27.0 + [14.6 \times \text{CSA}_{\text{right-lateral}} (\text{cm}^2)] - [1.28 \times \text{age (years)}]$
- CSA measurement:  $(\pi \times \text{CC} \times \text{AP}) / 4$ , serosa to serosa wall (Fig. 5).

### Risk stratification by gastric volume (Table 3)

Figure 6 shows the proposed clinical algorithm for gastric ultrasound and aspiration risk assessment via qualitative and quantitative measures.

Table 3. Risk stratification by gastric volume

Gastric volume (ml/kg)	Risk stratification
<1.5 ml/kg	Low risk
>1.5 ml/kg	High risk

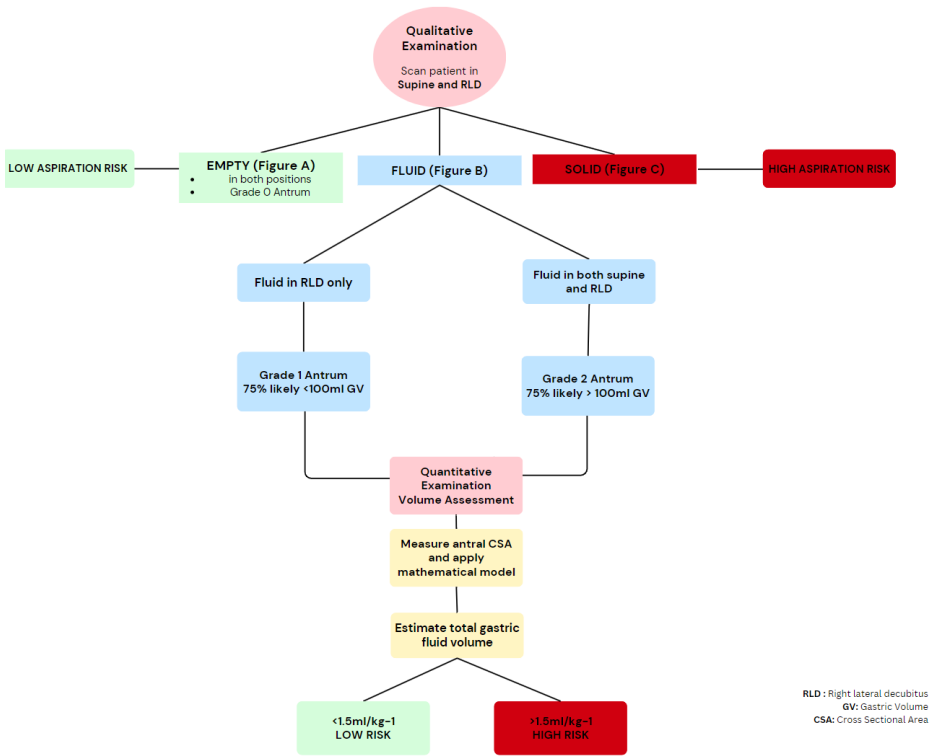


Fig. 6. Proposed clinical algorithm for risk stratification for pulmonary aspiration. Adapted from Van de Putte and Perlas.<sup>2</sup> CSA: cross-sectional area; GV: gastric volume; RLD: right lateral decubitus

### Clinical applications of gastric ultrasonography

Fasting for emergency surgery does not ensure an empty stomach.<sup>6</sup> Gastric ultrasound can serve as a useful tool alongside standard practices to enhance safety during anaesthesia with high levels of sensitivity (1.0), specificity (0.975), positive predictive value (0.976), and negative predictive value (1.0) when there is uncertainty about the fasting status.<sup>7</sup> When considering factors such as surgical urgency, medical conditions, and alternative anaesthetic techniques, gastric ultrasound has been shown to influence anaesthetic approaches significantly. With precise sonographic findings, anaesthesiologists are able to make informed decisions regarding surgery scheduling and anaesthesia management. They can choose to postpone or cancel a procedure if necessary, or proceed with the

appropriate technique.<sup>8</sup> This may involve employing rapid-sequence induction, tracheal intubation, or regional anaesthesia.<sup>3,8</sup>

## Conclusion

Gastric ultrasound assessment is an essential tool to determine prandial status in the perioperative period. The findings can be used to guide the decisions regarding scheduling and anaesthetic technique.

## Declarations

### Ethics approval and consent to participate

Not required, as this is a literature review.

### Competing interests

Dr. Shahridan Mohd Fathil serves as Deputy Chief Editor for Malaysian Journal of Anaesthesiology. He has not been involved in any part of the publication process prior to manuscript acceptance; peer review for this journal is double blind. The remaining authors have no competing interests to declare.

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