Antral sonography in the paediatric patient: can transducer choice affect the view?

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Editor—In the adult literature, ultrasonography is becoming an established tool to assess gastric content and volume.1–3 A recent review suggests that gastric ultrasound could assist anaesthetists in individualizing aspiration risk at the bedside and more appropriately guide anaesthetic management.1 This non-invasive bedside tool could also help to identify children at risk of aspiration before interventions requiring deep sedation or anaesthesia, particularly when the prandial status is unknown.5

Adult studies typically use a curvilinear transducer (low frequency, 2–5 MHz) for ultrasound assessment of the antrum. Although the location of the antrum in children is more superficial, two paediatric studies assessing the potential use of antral sonography also used a curvilinear transducer.6,7 We hypothesized that a linear transducer (high frequency, 7–12 MHz) compared with a curvilinear transducer would provide a superior view of the antrum in the youngest patients of this paediatric cohort through improved spatial resolution and improved antral tissue layer differentiation, because the antrum is located more superficially. An ultrasound assessment of gastric antral area was completed in 72 fasted paediatric patients presenting for upper endoscopy. This paper reports on findings from a secondary analysis ascertained from a larger primary study with local ethics approval. Legal guardians, patients with the ability to understand the study, or both provided written informed consent for the completion of the ultrasound examination. Participant ages and weights ranged from 11 months to 17.9 yr (mean=10.9 yr) and from 8.4 to 91.0 kg (mean=38.5 kg), respectively.

Similar to recently published studies,3–4 patients were scanned in the right lateral decubitus position. The gastric antrum was identified in a sagittal to right parasagittal plane between the left lobe of the liver and the pancreas at the level of the abdominal aorta. Sonographic examination in each patient was performed using a Philips CX50 system (Philips Healthcare, Andover, MA, USA) with a curvilinear (low frequency, 2–5 MHz) and a linear transducer (high frequency, 7–12 MHz). The transducer providing the best view was determined at the time of the ultrasound examination based on a combination of objective and subjective criteria during this dynamic scan, including the following criteria:

(i) Ability to produce a complete view of the antral serosa while keeping vascular landmarks, such as the abdominal aorta, in view. A complete view of the antral serosa would allow measurement of gastric antral cross-sectional area, which in adults is used to estimate gastric fluid volume.

(ii) Overall image quality and differentiation of the multiple layers of the gastric antral area.

(iii) When gastric fluid was present, the clarity with which fluid movement could be seen within the antrum.

The best view of the antrum was achieved using a curvilinear transducer in 37 patients compared with 35 using a linear transducer (Table 1). A Mann–Whitney U-test was used to assess significant differences in age and weight between transducers that provided the best view of the antrum. Age was significantly greater (mean rank 46.5 vs 25.9, P<0.05) in patients for whom the best view was achieved using a curvilinear transducer (Table 1). A similar association was noted with patient weight (mean rank 47.4 vs 24.9, P<0.05; Table 1).

Current methodology used in adult studies suggests that a low-frequency curvilinear transducer provides superior assessment of the gastric antrum. In children, a better view of the gastric antral area was achieved with a high-frequency linear transducer in younger patients, while a low-frequency curvilinear transducer tended to perform better in older children (Table 1). The improved resolution and antral tissue differentiation offered by a linear transducer in the younger patients may be explained by the more superficial position of the antrum.

Table 1 Patient characteristics stratified by the ultrasound transducer that provided the best view of the gastric antrum. *Significant difference (P<0.05) in age (in years) between best views of the antrum achieved with a curvilinear or linear transducer. †Significant difference (P<0.05) in weight (in kilograms) between best views of the antrum achieved with a curvilinear or linear transducer

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<th>Patient characteristics</th>
<th>Ultrasound probe</th>
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<tr>
<td></td>
<td>Curvilinear</td>
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<td>Gender (n; male:female)</td>
<td>17:20</td>
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<tr>
<td>Age [years; mean (95% confidence interval)]</td>
<td>13.1* (11.7–14.6)</td>
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<tr>
<td>Weight [kg; mean (95% confidence interval)]</td>
<td>48.0† (41.8–54.1)</td>
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Declaration of interest
None declared.

References
4. Bouvet L, Miquel A, Chassard D, et al. Could a single standardized ultrasonographic measurement of antral area be of...
Structured approach to ultrasound-guided identification of the cricothyroid membrane: a randomized comparison with the palpation method in the morbidly obese


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Editor—Correct identification of the cricothyroid membrane is crucial in preparation for emergency airway management. However, the conventional method, inspection and palpation, has a low success rate,1 especially in women (24–35%).2 We have previously described a structured stepwise method for ultrasonographic identification of the cricothyroid membrane,3 4 in which it is not necessary to see or palpate any landmarks on the neck for successful identification. The method involves ultrasonographic identification of the trachea in the transverse plane, rotating the transducer to the longitudinal plane, and identifying the image of the anterior parts of the tracheal rings and the cricothyroid cartilage. Using its ability to cast a shadow on the ultrasound image, an i.v. needle is slid between the transducer and the skin, without penetrating the skin, until it is immediately cranial to the cricoid cartilage, thus indicating the cricothyroid membrane (Fig. 1).

We tested the effectiveness of the stepwise approach in the hand of airway-ultrasound naïve anaesthetists. After Ethics Committee approval, written consent, and trial registration, 35 anaesthetists, with a mean of 6 yr experience in clinical anaesthesia, completed a structured training programme consisting of an e-learning module, followed by a 20 min lecture, and 20 min hands-on training on live models. Subsequently, the anaesthetists’ ability to identify the cricothyroid membrane both with the palpation method and with ultrasonography was tested in a crossover randomized-sequence test on a morbidly obese female, height 166 cm, weight 125 kg, and BMI 45.3 kg m⁻².

Both attempts were timed and videotaped. The timing started when the finger or the ultrasound probe touched the skin of the neck. With both methods, the anaesthetist was instructed to place an i.v. needle (as a marker) transversely on the skin where he or she found the cricothyroid membrane to be. When the palpation attempt was completed, the examiner placed the ultrasound probe longitudinally on the trachea so that the exact location of the needle in relation to the cricothyroid membrane could be verified. The two attempts were judged independently both by the examiner on site and, subsequently, by another expert using only the video recording. The latter expert was blinded to the examiner’s judgement.

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Fig 1 Yellow shows the tissue–air border, the mucosal lining in the trachea. The distal part of the thyroid cartilage (purple) is seen. The cricothyroid membrane can be identified by sliding a needle (used only as a marker) underneath the ultrasonography transducer from the cranial end until it casts a shadow (red line) immediately cranial to the cricoid cartilage (turquoise). The green spot represents the reflection from the needle. Care is taken not to touch the patient with the sharp tip of the needle.