Clinical Application of Point-of-Care Ultrasound Gastric Examination in the Management of an ASA Class 3E Patient: A Case Report

Christian Ross Falyar, DNAP, CRNA
Louis Kantzavelos, MD

A 79-year-old ASA class 3 patient scheduled for outpatient testing secondary to prostate cancer, was found to have a previously unknown 10-cm abdominal aortic aneurysm (AAA) causing acute renal insufficiency and hydronephrosis, requiring prompt surgical intervention. The patient was instructed to return to the hospital for further evaluation of the AAA and emergent ureteral stent placement. During the pre-anesthetic examination, the patient revealed he had eaten a small amount of food before returning to the hospital, placing him at increased risk of pulmonary aspiration. Traditional fasting times would have warranted either a delay in starting the case or performing it under general anesthesia with an endotracheal tube, both at increased risk to the patient. Instead, a point-of-care ultrasound gastric study was performed at the bedside to assess for gastric contents, which revealed the stomach was empty. The case proceeded under monitored anesthesia care without incident. A metallic stent was successfully employed, correcting the hydronephrosis and allowing for further evaluation and treatment of the AAA.

Keywords: Antrum, fasting times, gastric ultrasound, POCUS, pulmonary aspiration.

The aspiration of gastric contents is a serious anesthetic complication that can result in severe morbidity or mortality. Traditionally, preoperative fasting times have been used to determine aspiration risk and when it is safe to proceed with surgery. However, these guidelines apply to healthy patients undergoing elective procedures and do not address emergent cases or patients with multiple comorbidities. Point-of-care ultrasound (POCUS) examination enables the provider to bring portable ultrasound imaging to the patient's bedside and perform a study in real-time. Although anesthesia providers routinely use ultrasonography perioperatively, POCUS affords far greater capabilities than ultrasonography using regional anesthesia or central venous access. Gastric ultrasound imaging, an emerging POCUS examination, has been demonstrated to successfully confirm the presence or absence of gastric contents. This allows the anesthetist to deliver the best possible anesthetic while reducing the potential for aspiration and other complications. The following case study demonstrates how gastric ultrasonography was used to optimize the anesthetic plan for an ASA class 3E patient with a previously undiagnosed abdominal aortic aneurysm (AAA) requiring a cystoscopy with stent placement for treatment of acute renal obstruction.

Case Summary
A 123-kg (body mass index [BMI] = 37.7 kg/m²), 79-year-old male with a history of coronary artery disease, hypertension, hyperlipidemia, type 2 diabetes mellitus, previous history of smoking, and chronic kidney disease, was scheduled for a computed tomography (CT) urogram following a recent diagnosis of prostate cancer. The outpatient examination was completed without incident, and the patient was discharged home. The radiologist reading the study discovered a previously undiagnosed 10-cm AAA causing deterioration in renal function, either from mass effect or inflammation, resulting in hydronephrosis. He notified the attending urologist, who instructed the patient to return to the hospital for further evaluation by a vascular surgeon. After examining the patient, the surgeon requested placement of a double-J or metallic ureteral stent to correct the acute renal dysfunction before he could even consider possible repair. An emergent cystoscopy with placement of a metal ureteral stent to relieve the obstruction was scheduled. The patient informed the staff he had eaten crackers and cheese following the CT, 2 to 3 hours earlier.

The dilemma was whether to wait for 8 hours from the time of the patient's last meal or proceed with the surgery. Delaying the case meant delaying surgical intervention. Given that acute renal insufficiency was developing because of the obstruction, the plan was to proceed with surgery. Also concerning was the fact that spontaneous rupture in an AAA greater than 7 cm occurs in one-third of these patients, and mortality following rupture is greater than 85%. The urologist believed that if the ureter could be easily identified, he could place...
the stent with minimal stimulation under monitored anesthesia care. The patient's recent food intake, BMI, and multiple comorbidities placed him at high risk of aspiration. Additionally, a potential difficult intubation could lead to cardiovascular instability, not desirable in a patient with a large AAA.

The patient was brought to the preoperative holding area for the anesthetic evaluation. The medical history, as previously stated, was documented. All pertinent laboratory and diagnostic tests were reviewed. The patient reported a family history of AAA, stating his father had suffered a fatal AAA rupture and his brother had undergone an endovascular aneurysm repair (EVAR) of an AAA. He also noted a history of coronary artery disease with a percutaneous stent placement in 2005, but denied taking anticoagulants.

Results of the physical examination revealed a mouth opening less than 3 fingerbreadths. The patient had full upper and lower dentures. The Mallampati score was 4. There was good neck flexion and extension, and a thyromental distance greater than 3 fingerbreadths. Breath sounds were clear bilaterally, and the heart rate and rhythm were normal, with no murmurs appreciated. The patient stated he ate crackers and cheese after the CT. He denied any history of gastric reflux disease or current indigestion.

Following the anesthetic evaluation, an ultrasound system (SonoSite S-Nerve, Fujifilm-SonoSite Inc) with a c60x/5-2MHz, low-frequency, curvilinear array transducer was placed in sagittal orientation at the patient's midline just inferior to the sternum in the supine position. The gastric antrum was identified dorsal to the rectus abdominis muscles, inferior to the liver, and anterior to the pancreas and superior mesenteric artery (Figure). The ultrasound image revealed that the antrum was empty. The transducer was then slid laterally in both directions to confirm the anatomic structures. The patient was then instructed to lie in the right lateral decubitus position, and the procedure was repeated, and the antrum was again noted to be empty. With the absence of gastric contents confirmed by ultrasonography, the plan was to perform the procedure under monitored anesthesia care. If the insertion of the cystoscope proved too stimulating for the patient, the procedure would be terminated immediately. General anesthesia would be induced and endotracheal intubation accomplished using portable video laryngoscopy (GlideScope, Verathon).

After consulting with the urologist, the patient was taken to the operating room and transferred to the cystoscopy table. He was preemptively placed in the sniffing position, and a video laryngoscope was placed at the bedside. Baseline vital signs were obtained, and the patient was placed on a regimen of 4 L/min nasally administered oxygen. He received an intravenous (IV) bolus of 25 μg of fentanyl, 50 mg of lidocaine, and 50 mg of propofol. An intravenous solution of propofol, 8 mg/mL; lidocaine, 2 mg/mL; and ketamine, 1 mg/mL, was started at 140 μg/kg/min. At the surgical timeout, the patient received an additional 25 μg of fentanyl IV. Spontaneous respirations were maintained throughout the procedure with an oxygen saturation measured by pulse oximetry (SpO2) greater than 95%. The electrocardiogram showed sinus rhythm with a rate of 80 to 85 bpm/min, and the blood pressure remained at or below baseline. The patient tolerated the procedure well without any major cardiovascular changes or signs of discomfort. On completion of the procedure, the propofol, lidocaine, and ketamine infusion was discontinued. Within minutes, the patient was awake and conversing with staff before transport to the postanesthesia care unit.

He was admitted to the hospital overnight for observation and to confirm resolution of the ureteral obstruction. In follow-up consultation, it was determined that the patient was not a candidate for an infrarenal EVAR because of the short and conical nature of the aneurysm. He was transferred to a facility where an EVAR using a suprarenal fenestrated graft could be employed.

**Discussion**

Pulmonary aspiration of gastric contents can result in substantial morbidity and mortality. The American Society of Anesthesiologists (ASA) developed practice guidelines for preoperative fasting times to help reduce the risk of aspiration during the perioperative period. Current ASA recommendations following the ingestion of solid food for a healthy patient having an elective procedure is 6 hours.1 However in the presented case, the emergent nature of the procedure and the patient's medical history of obesity and diabetes placed him at increased risk of pulmonary aspira-
tion secondary to delayed gastric emptying. Chen et al. noted that patients with chronic renal disease were also at increased risk of delayed gastric emptying after fasting 6 hours following a meal. Without the POCUS examination, it would not be possible to know whether gastric contents were in the stomach. If traditional fasting guidelines had been used, the case would have been delayed several hours or proceeded under general anesthesia with endotracheal intubation. Given the unknown circumstances surrounding the AAA, either scenario placed the patient at increased risk.

In recent years, ultrasound systems have become more compact and portable, while retaining high-quality imaging. This has paved the way for POCUS studies, which can be performed and evaluated by the provider at the patient bedside. As early as 2004, the American Institute of Ultrasound in Medicine presented the notion that the “ultrasound stethoscope” was rapidly moving from theory to reality. Medical students at some institutions are now given handheld ultrasound systems to use during clinical rotations. Ramsingh et al. conducted a study in which second-year anesthesia residents at a large teaching medical center received POCUS training and used the technology to improve the clinical management of patients in the perioperative setting. At smaller hospitals, such as the one where this case study occurred, POCUS can be an invaluable tool because there is often no perioperative surgical home and many ancillary services are either not available or limited after normal “business” hours.

Perlas et al. were among the first to describe gastric ultrasound imaging as a practical noninvasive bedside study to determine gastric content and volume as a means to reduce the potential for aspiration in the perioperative period. Healthy volunteers were studied in 5 prandial states: fasting and after the ingestion of 250 mL of water, 500 mL of water, 500 mL of effervescent water, and a solid meal. They determined that the gastric antrum provided the most reliable information on gastric volume, particularly when the patients were in the right lateral decubitus position. On an ultrasound scan, the antrum is located inferior to the liver, and is anterior to the pancreas when one is imaging in a sagittal or parasagittal plane. The aorta and vena cava may be identified posterior to the pancreas, as well as the superior mesenteric artery. Results of recent studies report consistent success in identifying the stomach, especially the gastric antrum, even in the empty state. In a sagittal plane, it appears round to ovoid and has been compared with a target or “bull’s-eye pattern.” When the right lateral decubitus position is not possible, a study in the supine position can detect a distended stomach, but a negative result cannot exclude a full stomach.

A 3-point grading system was developed by Perlas et al. to correlate a predicted gastric volume to a qualitative ultrasound assessment of the antrum. Grade 0 describes an empty antrum in the supine and right lateral decubitus positions, suggesting no gastric contents are present. In a grade 1 image, the antrum appears empty in the supine position, and minimal fluid is detected only in the right lateral decubitus position. This corresponds to negligible fluid volumes (16 ± 36 mL). The antrum is visibly distended with fluid in both the supine and right lateral decubitus positions in grade 2. This finding correlates with significantly higher gastric volumes (180 ± 83 mL), beyond what is considered safe.

Arzola et al. described the ability to accurately identify fasting from nonfasting patients, as well as the difference between clear liquids and solids, with gastric ultrasound imaging. In a study conducted on 32 pregnant women (≥ 32 weeks’ gestational age), anesthesiologists trained in gastric ultrasonography determined whether the subjects were fasting or had ingested either clear liquids or solid food. The patients were randomly assigned, and the providers blinded to which group the subject belonged to. The correct diagnosis was made in nearly 88% of the cases.

The ability to identify gastric contents regardless of traditional fasting times allows the provider to optimize the anesthetic plan, in terms of both efficacy and safety. An empty antrum viewed in the supine and lateral positions implies a low aspiration risk determined through qualitative ultrasound assessment. Even in the presence of clear fluid, ultrasound assessment can determine if the volume present is consistent with baseline gastric secretions and negligible risk (up to 1.5 mL/kg) or if it is a higher volume that greatly increases the risk of aspiration.

Conclusion
Pulmonary aspiration of gastric contents is a complication that can result in substantial morbidity and mortality. Traditional fasting guidelines do not account for emergent cases or patients with multiple comorbidities. Examination with POCUS provides the provider with relevant clinical information and can be performed in real-time at the bedside. One such examination, gastric ultrasonography, has been shown to accurately assess for the presence or absence of gastric contents. This case study demonstrates how the incorporation of a POCUS gastric examination influenced the anesthetic plan without compromising patient safety.

REFERENCES


AUTHORS
Christian Ross Falyar, DNAP, CRNA, is a staff anesthetist at Great River Medical Center in Burlington, Iowa. Email: christian.falyar@gmail.com.

Louis Kantzavelos, MD, is a urologist at Great River Medical Center. Email: lkantzavelos@grhs.net.

DISCLOSURES
The authors have declared no financial relationships with any commercial entity related to the content of this article. The authors did not discuss off-label use within the article.