

Gastric ultrasonography in the setting of gastric distention and bowel obstruction : to place or not to place a nasogastric tube? A case report

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Abstract : Pulmonary aspiration remains a potential complication of airway management in general anesthesia. The risk is greater in emergency cases, with higher morbidity and mortality rates. Although rapid sequence induction and intubation is common practice for securing a patient's airway, a distended stomach due to delayed or impaired gastric emptying puts the patient at risk for pulmonary aspiration of gastric contents. In the present case report, we illustrate how bedside gastric ultrasonography can help to manage a patient with a distended stomach and aid in the decision whether a gastric decompression prior to induction of anesthesia and tracheal intubation should be performed.

Keywords : delayed gastric emptying ; gastric ultrasonography ; nasogastric tube ; point-of-care ultrasonography ; pulmonary aspiration; pulmonary complications

INTRODUCTION

Pulmonary aspiration is a known complication of airway management in general anesthesia. The risk is higher in emergency abdominal surgery, likely due to a full stomach or underlying conditions that would result in delayed gastric emptying (1). In cases of gastric distention, decompression is often achieved with placement of a nasogastric tube (NGT). However, placement of an NGT is commonly a source of discomfort for the patient, can be traumatic, and may potentially interfere with lower esophageal tone; thus, it is done on a selective basis (2).

Gastric point-of-care ultrasonography (POCUS) is a simple tool for providing bedside assessment of gastric contents and volume (3). This noninvasive assessment has been used to identify patients with a full stomach in elective and emergency cases (4). We propose that gastric POCUS may help to identify a patient with gastric distention, and a high risk of aspiration, and help guide an airway management plan beyond rapid sequence induction (RSI) and endotracheal intubation alone.

CASE REPORT

A 92-year-old woman presented to the emergency department with abdominal pain. The previous 3 days, she had not eaten and had been experiencing constipation, poor appetite, dehydration, and nausea. Abdominal computed tomography revealed an incarcerated inguinal hernia with dilated bowel loops. After intravenous hydration and treatment of nausea with intravenous ondansetron, she was brought to the pre-surgical area in preparation for an urgent inguinal hernia and small bowel obstruction repair. During the pre-anesthetic evaluation, a small amount of blood was noted in her nares, found to be due to unsuccessful attempts by emergency department staff to place an NGT.

Despite lack of oral intake for almost 3 days, the patient was considered at increased risk for pulmonary aspiration of gastric contents with induction of general anesthesia (GA), and RSI with endotracheal intubation was planned. Before proceeding to the operating room, we scanned her stomach with an abdominal curvilinear ultrasound probe (2-5 MHz) (X-Porte System by FUJIFILM SonoSite Inc. Bothell, WA 98021USA) to assess gastric contents and distension with the standardized approach described by Perlas and colleagues (5, 6). The patient was initially examined in the supine position and the stomach imaged in the sagittal plane. The stomach appeared distended but the image and additional landmarks were difficult to interpret due to acoustic shadowing from dilated loops of bowel (Fig. 1). With the patient placed in right lateral decubitus position (RLD), the antrum

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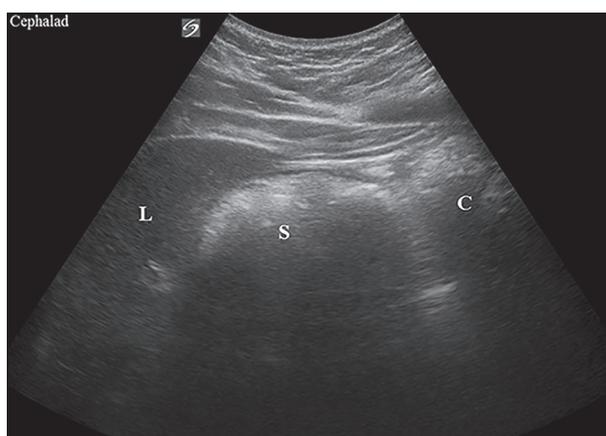


Fig. 1. — A distended stomach imaged in the supine position.

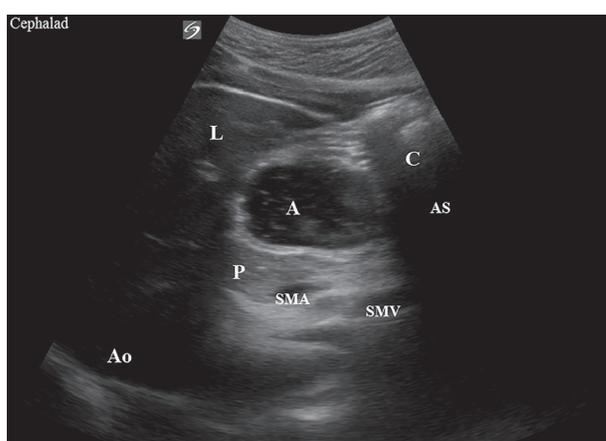


Fig. 2. — Clear fluid distending the gastric antrum imaged in the right lateral decubitus position.

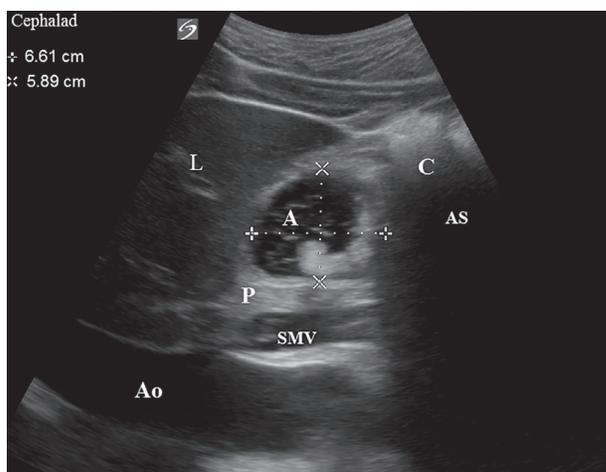


Fig. 3. Semi-solid contents in the gastric antrum and quantitative measurements.

CC = 6.61 cm; AP = 5.89 cm; Calculated CSA = 38.62 cm²; Calculated GV = 355.42 mL

Abbreviations: (L) liver, (A) gastric antrum, (Ao) Aorta, (AS) acoustic shadowing, (C) Colon, (P) pancreas, (S) stomach, (SMA) superior mesenteric artery, (SMV) superior mesenteric vein.

of the stomach and internal landmarks (such as the left lower lobe of the liver, the aorta, and pancreas) were imaged (Fig. 2).

The antrum appeared distended with thin walls and a heterogeneous content (clear fluid) (Fig. 2), mixed with thick or semisolid contents (Fig. 3). The antrum's cross sectional area (CSA) was measured and calculated ($CSA = \text{cephalad-caudad (CC)} * \text{anterior-posterior (AP)} * \pi / 4$), as described by Perlas and colleagues, and a validated mathematical model was used to estimate the total gastric fluid volume (GV) of 355 mL ($GV = 27.0 + 14.6 * CSA - 1.28 * \text{age}$) (7).

Attempts to dynamically scan the rest of the stomach were impeded by acoustic shadowing from the colon and dilated loops of bowel. Due to considerable gastric distention and presence of potentially semisolid contents as indicated by the ultrasound images, the patient was at high risk for pulmonary aspiration. We discussed this risk with the patient, and we decided to reattempt placement of an NGT prior to induction of GA.

Once in the operating room, topical nasal decongestion with oxymetazoline was administered. The NGT and nares were lubricated with 2% lidocaine jelly. The NGT was gently advanced to the stomach, and approximately 700 mL of bilious gastric liquid mixed with coagulated blood and dark semisolid contents was suctioned. After stomach decompression, the NGT was set to low intermittent wall suction, and we proceeded with GA/ RSI and endotracheal intubation with cricoid pressure. During direct laryngoscopy, the glottic opening was visualized to be clear of blood and gastric contents. With the surgery under way, a short section of the small bowel was found to be ischemic at the site of herniation and obstruction. Small bowel resection and repair of the hernia were completed without incident, and the patient's emergence from anesthesia and tracheal extubation were uneventful.

DISCUSSION

Pulmonary aspiration of gastric contents remains a major complication of GA and is associated with perioperative mortality (1). The urgent or emergent surgical population is often at risk for this complication, as these patients do not have adequate fasting time, and may have underlying pathology which delays or obstructs gastric emptying. RSI and endotracheal intubation with or without cricoid pressure is common practice in emergency airway management and in patients at risk of pulmonary aspiration. However, these techniques have several limitations. There is unclear consensus on the efficacy of cricoid pressure during

RSI and endotracheal intubation (8). Moreover, cricoid pressure is often improperly utilized (1), and has been described as a controversial technique that may impede laryngoscopy and visualization of the airway (9).

Historically, NGT decompression has been used in emergent abdominal surgery to decompress the stomach and potentially prevent pulmonary complications. However, this intervention can be a source of discomfort to the patient, carries potential complications, and should be used selectively (10). A noninvasive diagnostic tool, such as gastric POCUS, would in this case have been helpful to confirm clinical suspicion of gastric distention prior to the initial NGT placement attempts in the emergency department. Furthermore, the presence of semi-solid gastric contents in the ultrasound image in the pre-surgical area also raised suspicion of congealed blood further distending the stomach.

POCUS is an emerging technology in the perioperative setting and is utilized for comprehensive assessment of several organ systems, such as the patient's airway, lung, stomach, and heart (11). Gastric POCUS images are acquired either in the semi-recumbent or right lateral decubitus position, with a curvilinear 2-5 MHz abdominal probe placed in the sagittal or parasagittal plane below the xiphoid process (3, 12). Although both are valid approaches for visualizing the stomach, the right lateral decubitus position allows gastric contents to settle on the antrum, and air is displaced, reducing acoustic shadowing. The clinician needs to take into account that small amounts of gastric secretions are often present in the stomach even in the fasting state. A validated mathematical model was developed to calculate gastric volume based on the measured CSA of the antrum with the patient in the right decubitus position (7). As described in this case report, the calculated GV of 355 mL underestimated the aspirated GV of 700 mL. A potential explanation is that the quantitative assessment models (7, 12) were developed for the purpose of estimating the GV of clear liquids, and not when solid contents are present. Also, the calculated GV is based on a user-dependent measurement of the antrum's CSA. Therefore, if the measurements are taken at a distal section of the antrum due to technical difficulty (i.e. acoustic shadowing), the measured CSA and calculated GV will likely underestimate the actual volumes.

In our case report, gastric POCUS was a helpful tool for identifying gastric distention that warranted decompression via an NGT prior to induction of anesthesia. The characteristics of the gastric scan

were worrisome, not just due to the appearance of a full stomach, but also semisolid contents present at different cross sections of the antrum. Due to the limitations of a case report, it is unknown if the outcome would have changed if no stomach decompression had been done prior to RSI and endotracheal intubation. However, it is reasonable to assume that lower esophageal sphincter tone and cricoid pressure alone would not have been sufficient to prevent regurgitation of a distended stomach with 700 mL of bile and semisolid gastric contents.

CONCLUSION

With induction of GA, a distended stomach with larger than baseline secretions presents a risk of pulmonary aspiration, despite RSI and endotracheal intubation with or without cricoid pressure. We propose that gastric POCUS is a useful tool in identifying the nature and contents of a distended stomach and decompression of the stomach via an NGT prior to intubating may decrease the risk of aspiration.

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