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Point-of-care gastrointestinal and urinary tract sonography in daily evaluation of gastrointestinal dysfunction in critically ill patients (GUTS Protocol)

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Abstract

There is currently a lack of universally accepted criteria for gastrointestinal (GI) failure or dysfunction in critical care. Moreover, the clinical assessment of intestinal function is notoriously difficult and thus often goes unrecognized, contributing to poor outcomes. A recent grading system has been proposed to define acute gastrointestinal injury (AGI) in conjunction with other organ function scores (e.g., SOFA). Ultrasonography has become widely accepted as a diagnostic tool for GI problems and pathology. We propose a sonographic examination of the abdomen, using the GUTS protocol (gastrointestinal and urinary tract sonography) in critically ill patients as part of the point-of-care ultrasound evaluation in patients with AGI.

This article reviews possible applications of ultrasonography that may be relevant to monitor the GI function in critically ill patients.

The GI ultrasound protocol (GUTS) focuses on four gastrointestinal endpoints: gastrointestinal diameter, mucosal thickness, peristalsis, and blood flow. Moreover, it is possible to examine the urinary tract and kidney function.

Real-time ultrasound with the GUTS protocol is a simple, inexpensive, bedside imaging technique that can provide anatomical and functional information of the GI tract. Further studies are needed to investigate the utility of GUTS with other parameters, such as GI biomarkers, AGI class, and clinical outcomes.

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Key words: gastrointestinal dysfunction, point-of-care ultrasound, POCUS, GUTS, gastrointestinal and urinary tract sonography, acute gastrointestinal injury

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There is currently a lack of universally accepted criteria for gastrointestinal (GI) failure or dysfunction in critical care. Furthermore, the clinical assessment of intestinal function is notoriously difficult and thus often goes unrecognized, contributing to poor outcomes [1, 2]. Several biomarkers for GI function have been proposed. Three such biomarkers include intestinal fatty acid binding protein (I-FABP), liver fatty acid binding protein (L-FABP), and plasma citrulline [3]. However, their clinical use is still unclear, and treatment strategies are currently based on experience rather than evidence. Delayed gastric emptying (GE) was reported in 50% to 80% of critically ill patients, especially those with diabetes [3]. The prevalence of abnormal small bowel motility in ICU patients is less well known [3].

The European Consensus Definition of acute gastrointestinal injury (AGI) suggests a graded severity score [4]:

- AGI grade I represents a self-limiting condition with increased risk of developing GI dysfunction or failure;
- AGI grade II (GI dysfunction) represents a condition requiring interventions to restore GI function;
- AGI grade III (GI failure) represents a condition when GI function cannot be restored with interventions;
- AGI grade IV represents a dramatically manifesting GI failure, which is immediately life threatening (e.g. abdominal compartment syndrome with organ dysfunction) [4].

Ultrasonography (US) is a widely accepted diagnostic tool for gastrointestinal disease. Bedside point-of-care US (POCUS) is increasingly used to facilitate accurate diagnosis, monitor fluid status, and guide emergency and critical care procedures [5–7]. Gastrointestinal function can be assessed with US, thus providing anatomical and functional information through evaluation of the lumen, wall and surrounding structures of the stomach and bowel. However, it may be best used in combination with the evaluation of functional processes such as peristalsis and blood flow, providing important information about food passage and perfusion [8]. Such an approach may lead to an improved practical management approach for adult ICU-patients with AGI through better visualization of bowel pathology and associated changes in real time ("live anatomy") [8]. We propose a sonography protocol as part of POCUS evaluation of the GI and urinary tract in critically ill patients with four main examination endpoints: diameter, mucosal thickness, peristalsis, and blood flow. The mnemonic GUTS (the Gastrointestinal and Urinary Tract Sonography protocol) is derived from this approach.

GENERAL SONOGRAPHY OF THE GASTROINTESTINAL TRACT

For a complete examination, both low and high-resolution probes are needed with 5 or 7 MHz transducers.

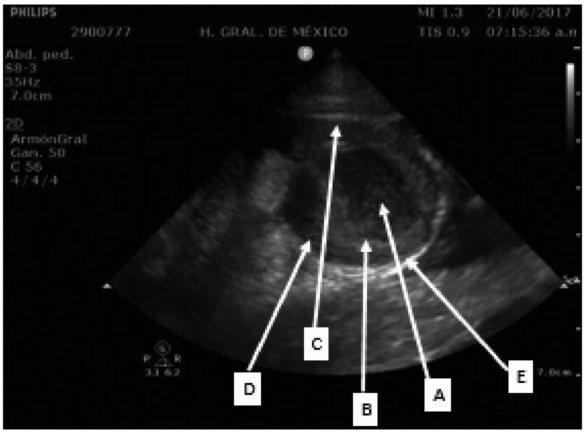

Figure 1. POCUS of the GI tract helps to identify 5 layers. **A** — a hyperechogenic inner layer — represents the border between the digestive fluid and mucosa; **B** — a hypoechogenic layer — a thin layer that represents mucosa, lamina propria, and lamina muscularis; **C** — a hyperechogenic layer — represents submucosa; **D** — a hypoechogenic layer — represents the muscular layer, the thickness of which depends on the segment of the digestive tract being examined; **E** — an outer hyperechogenic layer — represents the border between the peridigestive fat and serous layer [11]

Abdominal compression should be performed using the US probe, in the same way as when performing palpation with the fingertips [9]. POCUS of the GI tract helps one to identify five layers (Fig. 1), visualized only when the intestinal walls are normal [10, 11, 31, 38].

- A hyperechogenic inner layer — represents the border between the digestive fluid and mucosa [11];
- A hypoechogenic layer — a thin layer that represents mucosa, lamina propria, and lamina muscularis [11];
- A hyperechogenic layer — represents submucosa [11];
- A hypoechogenic layer — represents the muscular layer, the thickness of which depends on the segment of the digestive tract being examined [11];
- An outer hyperechogenic layer — represents the border between the peri-digestive fat and serous layer [11].

DOPPLER TECHNIQUES

Doppler US is used to assess the signal from visceral vessels that supply the GI tract, as well as smaller vessels within the intestinal wall. This technique cannot assess capillary flow. Doppler US mode helps one perform an analysis of superior and inferior mesenteric in-flow using pulsed Doppler scanning and provides several quantifiable parameters such as pulsatility index (5.3 ± 2.7), resistance index (1.1 ± 0.1), systolic (8.4 mm ± 3.5) and diastolic (3.2 mm ± 0.7) velocities, and blood flow volume (305 mL min^{-1} ± 168) [12–14]. For optimal assessment of GI vessels, it is suggested to position the probe over the sample area at a distance of 2–3 cm distal to the origin of the vessel (performed in a longitudinal plane as it runs parallel to the aorta), and in

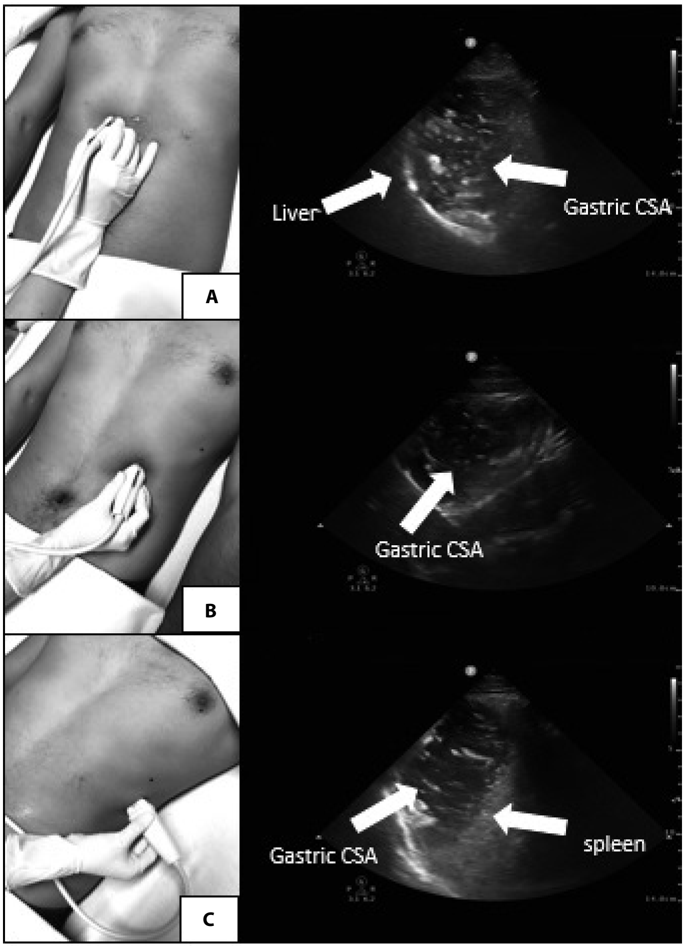

Figure 2. Gastric ultrasound windows of a healthy volunteer with a full meal: **A** —epigastric; **B** — subcostal; **C** —transsplenic

a proximal direction to any side branches [14–16]. The probe should be tilted to an angle of < 60° and a high pass filter of 100–200 kHz used to eliminate low frequencies related to vessel wall movement [17, 18].

GASTRIC ULTRASOUND

Dysfunctional gastric emptying in critically ill patients can contribute to complications during procedures related to airway management and can result in unsuccessful enteral feeding, and an increased risk of aspiration [19]. Animal experiments have shown a link between the severity of pulmonary damage and the volume of gastric fluid aspirated [20]. A 6-hour fasting period (2 hours for clear fluid) has been recommended for patients undergoing elective surgery to reduce the risk of aspiration during anaesthesia [21]. In the ICU, gastric emptying is frequently altered and influenced by several factors including age, diagnosis on admission [22], underlying disease processes [23], therapeutic interventions, medications [24, 25], electrolyte and metabolic disturbances, and mechanical ventilation [26].

The measure of the antral cross-sectional area (CSA) by US is feasible in most critically ill patients. Several studies suggest that the distal parts of the stomach (antrum and body) are better evaluated in a semi-sitting position [27–32].

PROCEDURE

Abdominal US should be performed with standard settings, and a curvilinear, low-frequency transducer (2–5 MHz) for the GUTS protocol. This provides the necessary penetration to identify relevant anatomical landmarks [32]. Normal gastric wall thickness is 4–6 mm and has the distinct five layers as described above (Fig. 2) [11, 27–32, 38]. This is often referred to as the "gut" signature.

The three following sonogram windows are used to assess the gastric antrum:

- Epigastric: The probe is placed sagittally over the epigastric area and rotated clockwise to visualize the gastric antrum, under the left hepatic lobe (LHL), superior mesenteric vein (SMV), and above the inferior vena cava (IVC) (Fig. 2A).
- Subcostal: The probe is placed sagittally at 45 degrees at the left subcostal area, then rotated clockwise to visualize

the gastric body, superior to IVC and SMV, and a transversal image of the LHL (Fig. 2B).

Trans-splenic: The probe is placed in the mid-axillary line and at the left subcostal margin to visualize the gastric fundus beside the splenic hilum (Fig. 2C).

The epigastric window remains the most validated position. It assesses the longitudinal (D1) and anteroposterior (D2) diameters of a single section of gastric antral CSA using the abdominal aorta and the left lobe of the liver as landmarks, in order to consistently maintain the same standardized scanning level (Fig. 1A, B) [33].

Koenig *et al.* [35] published a study to qualitatively assess the gastric contents of patients requiring urgent endotracheal intubation with a rapid (< 2 min) left upper-quadrant US examination helping to identify patients with a full stomach (mean gastric volume of 553 ± 290 mL) [35]. Kruisselbrink described "near perfect" intra- and inter-observer reliability (correlation coefficient > 0.8) with maximum bias within a 13% limit [36]. Bouvet found a significant positive relationship between antral CSA and aspirated gastric fluid volumes [37]. The cut-off value of antral CSA predicting the risk for aspiration was considered to be 340 mL with 91% sensitivity and 71% specificity. The author found an area under the receiver operating curve of 0.9. Gastric US can also identify other pathologies such as gastric tumours (carcinomas and, rarely, teratomas), hypertrophic pyloric stenosis, and even bezoars related to enteral nutrition.

SMALL AND LARGE BOWEL ULTRASOUND

For a complete bowel examination, both low and high-resolution probes are needed, the latter using a frequency above 5 MHz for measuring bowel wall thickness. The scan starts by placing the probe over the right iliac fossa to identify the terminal ileum. The probe is moved cranially and caudally to scan overlapping sectors and applying sufficient pressure to identify the dorsal wall of the abdominal cavity [38].

BOWEL WALL THICKNESS

The most common finding is the wall thickness of normal small and large intestine being < 2 mm when distended [39, 40]. The exceptions to this are the duodenal bulb and rectum, which are less than 3 and 4mm, respectively [39].

BOWEL DIAMETER AND INTRALUMINAL CONTENTS

The diameter of the bowel and its contents may vary according to site, fasting/feeding state, and bowel function. Normal bowel loops show a maximal diameter of 25 mm for small bowel and 50 mm for the colon [4]. These values are used as cut-offs for intestinal bowel obstruction, other pathological conditions such as intestinal infectious and inflammatory diseases, and abnormalities that affect bowel peristalsis [38]. Intraluminal content of the gut appears as a thin hyperechoic line on a longitudinal section, representing the interface between the two mucosae that face each other when empty [38]. Gaseous content produces comet tail artefacts (as seen in lung ultrasound) that can hide the bowel wall distal to the probe [39]. In this case, only the most superficial wall can be properly studied. When evaluating intraluminal content, liquid content appears anechogenic. Both the superficial and distal walls can be visualised as well as the internal profile of the mucosa [38]. When liquids are mixed with a solid or gaseous component, they appear as a corpuscular mass, and the sonographic image will consist of spots of different sizes and echogenicity. When peristalsis is slow, it is possible to distinguish different layers in the intraluminal content [38]. Solid matter may be appreciated with a stone-like aspect or as a dark solid mass with posterior shadowing. This is usually observed in the colon [38].

BOWEL WALL VASCULARITY

Colour or power Doppler sonography is used to estimate perfusion abnormalities and may show hyperaemia. The spectral analysis of Doppler signals of arteries supplying the GI tract (truncus celiacus, superior and inferior mesenteric arteries) and the vessels draining the intestine, can be used to estimate bowel perfusion. Colour Doppler can usually assess the perfusion in vessels 1 mm in width, with blood flows up to 1 mm/sec. Colour Doppler allows for the assessment of mural flow, the absence of which is a sign of ischaemia. Unfortunately, this finding is only reported in 20–50% of the patients with a proven diagnosis of ischemic colitis [42, 43].

PERISTALSIS

Assessment of bowel peristalsis is difficult and subjective but may provide useful information in several intestinal diseases. Increased small bowel peristalsis has been described in coeliac disease and acute mechanic bowel obstruction. This is in contrast to a dynamic ileus that is characterized by an absence of peristaltic movements [44, 45]. Dilated loops of bowel are essentially static, and the bowel contents do not move. Four different peristaltic movements are described:

- Absent peristalsis; no peristaltic movement, which can be partial (obstruction, ileus) or complete (ESM video1) — available in on-line version;
- Present ineffective peristalsis; peristaltic movement can be seen, while intestinal content does not move forward, but rather sways (pendulum-peristalsis) (ESM video 2) — available in on-line version;
- Present effective peristalsis; peristaltic movement is propulsive, and bowel content is pushed forward (ESM video 3) — available in on-line version;
- Augmented peristalsis; this can be described as partial (obstruction, ileus) or total (bacterial overgrowth) (ESM video 4) — available in on-line version [46].

Table 1. GI dysfunctions that could be monitored with ultrasound in critically ill patients

Gastroparesis with high gastric residuals or reflux,
Paralysis of the lower GI tract
Visible blood in gastric content or stool.
Feeding intolerance is present if at least via enteral route.
Bowel dilatation
Bowel ischemia,
Bowel Obstruction
GI bleeding leading to hemorrhagic shock,
Ogilvie's syndrome
Ascitis
Bowel bacterial overgrowth
Toxic megacolon
Intraabdominal perfusion
Ileum

NONINVASIVE GASTROINTESTINAL MONITORING

While controversy still exists about optimal gastric volume and further research is required to examine its use in the critically ill patient, some of the GI dysfunctions in critically ill patients that can be monitored with ultrasound are summarized in Table 1. For the experienced user, GI ultrasound allows for the identification of pathology in the intestinal tract: small or large bowel intussusception, inflammatory bowel disease, necrotizing enterocolitis, Meckel's diverticulum, appendicitis, diverticulitis or duplication cysts.

GASTROINTESTINAL AND URINARY TRACT SONOGRAPHY PROTOCOL (GUTS) (FIG. 3)

On admission, Focused Assessment with Sonography for Trauma (FAST) and GUTS protocol should be performed for the diagnosis of GI emergencies. After initial treatment and stabilization, the application of a daily GUTS protocol at the bedside can help clinicians assess the evolution of GI function. Normal findings were described above. Classification of pathological findings are listed below.

AGI GRADE I:

According to the definition and clinical findings proposed by the ESICM Working Group on Abdominal Problems [4], patients with AGI grade I have gastric ultrasound findings showing an antral CSA with a predicted volume < 300 mL [37], and absent or ineffective (intestinal content sways) peristalsis. Blood flow is present at all times, with some hyperaemia on the Doppler ultrasound. The small bowel diameter is less than 20 mm, and the diameter of the colon is less than 50mm. Mucosal thickness is normal and < 5 mm.

Other possible ultrasound findings are the presence of ascites in FAST, and a renal Doppler flow showing a resistive index of less than 0.7. Resistive index (RI) can be calculated as follows:

$$RI = \frac{\text{(peak systolic flow — diastolic flow)}}{\text{Diastolic flow in the renal arteries}}$$

AGI GRADE II:

Gastric ultrasound shows an antral CSA of > 300 mL [37] or > 500 mL in gastroparesis, peristalsis is absent or ineffective, while augmented peristalsis can be seen in the presence of bacterial overgrowth. Blood flow is present at all time, hyperaemia may be present, a small bowel diameter > 20 mm, but < 30 mm, and a colonic diameter < 60 mm. Mucosal thickness is usually < 5 mm. Other ultrasound findings are the same as in AGI grade I.

AGI GRADE III:

Gastric ultrasound demonstrates an antral CSA of > 300 mL [37] or > 500 mL in gastroparesis, peristalsis is absent, intestinal content varies, and blood flow is absent or severely diminished**.** The small bowel diameter is > 30 mm, and the colonic diameter is > 60 mm (toxic megacolon should be suspected when the diameter of the colon is more than 60–65 mm). Mucosal thickness is classically > 5 mm. Other ultrasound findings are an RI > 0.7 on renal Doppler and diaphragmatic excursions < 1.5 cm in spontaneous breathing ventilation (diaphragm excursion is abolished in controlled ventilation). Ascites may be present.

AGI GRADE IV:

Sonographic findings are the same as in AGI Grade III, with absent blood flow**.** Other ultrasound findings are a renal Doppler RI > 1 indicating a severe compromise of renal blood flow, the presence of acute kidney failure (AKI), and diaphragmatic excursions < 1.5 cm in spontaneously breathing ventilation. Significant ascites may be present. The ESICM Working Group on Abdominal Problems included GI bleeding leading to haemorrhagic shock as a Grade IV AGI (ESM video 5 shows a massive GI bleed).

COMPLEMENTARY EVALUATION

Daily evaluation of the GI tract in critically ill patients should include a sonographic Doppler evaluation of the renal, liver, splenic arteries and portal vein, as part of an intraabdominal perfusion examination.

RENAL DOPPLER

The RI, pulse wave Doppler signal from segmental branches of the right renal artery, showed a slight but significant during intraabdominal hypertension. This suggests an increase of intrarenal pressure [47]. The RI reflects vascular resistances and increases in acute and chronic renal disease. This index is affected by IAH and may represent an early sign of renal impairment [47]. A recent meta-analysis suggested that RI may be a predictor of persistent AKI in critically ill patients with a pooled sensitivity and specificity of 0.83 (95%

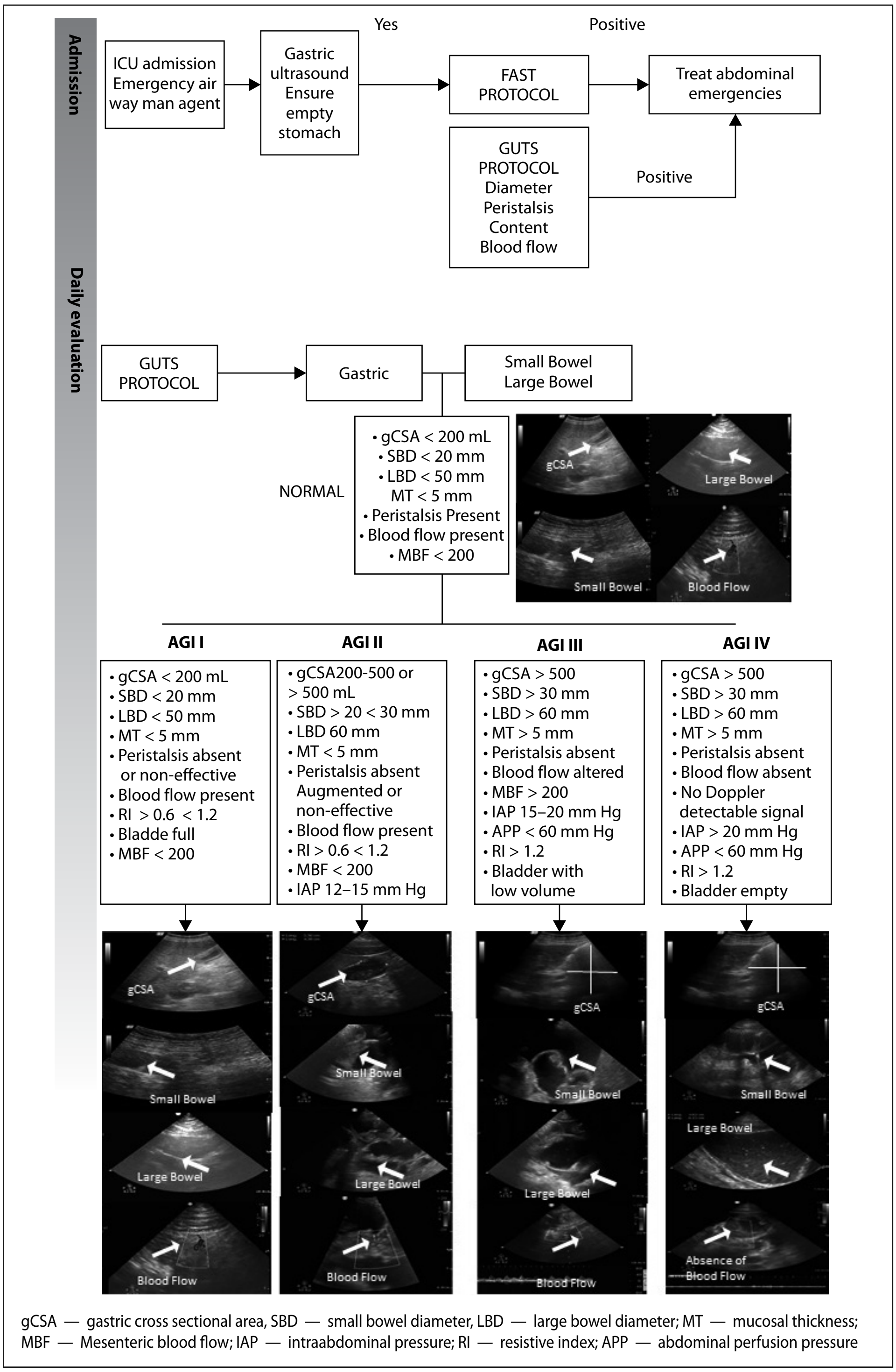

Figure 3. Point-of-care gastrointestinal and urinary tract sonography in daily evaluation of gastrointestinal dysfunction in critically ill patients (GUTS Protocol)

CI, 0.77–0.88) and 0.84 (95% CI, 0.79–0.88) and a positive and negative likelihood ratio of 4.9 (95% CI, 2.44–9.87) and 0.21 (95% CI, 0.11–0.41) [49]. However, renal RI could increase for many other reasons. It has been proposed as an early marker of renal dysfunction in sepsis, cardiac surgery, IAH, the need to use vasopressors, and should be taken into consideration during interpretation [47–50].

BLADDER

The easiest way to scan the urinary bladder is by an external suprapubic abdominal approach with a convex 2.5–5 MHz probe. Bladder volume can be calculated by scanning the bladder transversely and longitudinally and using the following ellipsoid formula:

$$\text{Volume} = \text{height} \times \text{width} \times \text{depth} \times 0.5236$$

However, as the bladder is never totally spherical, operators should allow for some measurement error. When evaluating the urinary track as part of the GUTS protocol, the absence of bladder content may be an approach to the evaluation of oliguria for AKI related to IAP or ACS, and may also help identify any obstruction caused by urine catheter malfunction.

LIVER AND SPLEEN

Ultrasound of the liver is divided in general US views, which includes anatomic views of the liver, gallbladder, and biliary tree. This is important but beyond the scope of this paper. However, Doppler analysis of hepatic and spleen circulation and portal vein should be performed for the assessment of intra-abdominal organ perfusion. The main findings of liver vessel Doppler US are described in portal hypertension and liver compartment syndrome following subcapsular haematoma. Unfortunately, there are no studies on Doppler US evaluation in patients with IAH. Cavaliere published a physiological study in sixteen healthy volunteers with an IAH simulation model where he found the inferior vena cava was compressed and deformed, the portal vein also had a decreased diameter, but blood velocity did not change significantly either in the inferior vena cava, portal vein, right suprahepatic vein, or right external iliac vein [50]. He also reported a sensitivity of 65.6% and a specificity of 87.5% in the inferior vena cava section lower than 1 cm^{-2} m^{-2} to discriminate between the presence or absence of intra-abdominal hypertension. Finally, he found non-invasive ventilation did not affect vein sizes and velocities. Portal vein flow velocity has been reported to be from 14 to 16 cm sec^{-2}. A hepatic artery Doppler resistive index of < 0.78 and a splenic artery resistive index of < 0.63 should be considered normal [51]. While there is neither evidence nor any published research on this issue, any increase in RI or portal vein flow velocity should be considered an alteration in perfusion seen primarily in patients with AGI grade IV.

DISCUSSION

The proposal for assessment of GI function with POCUS at the bedside could equip physicians with the ability to recognise abnormal pathology and physiology in critically ill patients with GI dysfunction. The four main features of the intestine should be accurately identified, namely: the gastrointestinal diameter (and intraluminal content); mucosal wall (thickness echo pattern, vascularity); peristalsis and motility; and blood flow. Gastrointestinal ultrasound is a non-invasive, inexpensive, widely available and repeatable tool that can be used at the bedside and can help to identify patients that may need more invasive (and more expensive) procedures. However, as with all POCUS techniques there is a learning curve, and the observed findings will need expert interpretation in order to explain common ICU complications, such as Clostridium difficile infection, bacterial peritonitis etc. [38]. Incorporating GUTS into daily clinical evaluation of GI dysfunction will increase the accuracy of the technique in order to correlate the US findings with clinical severity of GI dysfunction. We believe that gastric content and volume assessment will become a new POCUS application and the standard of care. This could help one to determine the risk for aspiration, a technique that is already widely used in anaesthesia. [22, 23, 27–29, 33–37].

Perlas found the antral CSA grade correlates with gastric volume (gastric residual volume = 27.0 + 14.6 × right-lateral CSA — 1.28 × age). [31] Using this formula it is possible to non-invasively assess gastric volume at the bedside based on sonographic measurements of right lateral CSA. According to the author, this model predicts volumes from zero to 500mL and applies to non-pregnant adult patients with a body mass index (BMI) < 40 kg m^{-2} [31]. Both quantitative and qualitative gastric US can be used at the bedside. Others have found that the antral CSA has a positive correlation with gastric volume allowing a qualitative assessment of gastric volume with a clinically acceptable accuracy. [34] Although obtaining the antral CSA may be difficult in some critically ill patients, the technique is promising. Assessing gastric status could become a standard procedure in the critically ill, allowing safe emergency airway procedures and identifying patients at increased risk of gastric aspiration, or guiding appropriate medications when enteral feeding is not well tolerated [34]. The use of US to assess gastric contents by measuring antral CSA has already been studied in healthy volunteers. In the preoperative setting, it showed a very high degree of accuracy (98.5–100%).

To date, the use of the GUTS protocol to diagnose and treat GI dysfunction in critically ill patients has not been shown to change the outcome. However, we believe that this intervention could make a significant contribution to GI care protocols (Fig. 2) and help clinicians with accurate daily clinical decisions [46].

The GUTS protocol has limitations. Despite bedside availability, ease of use, repeatability, and non-invasiveness, there is a need for adequate training in order to use and interpret the ultrasound images correctly. The GUTS protocol cannot be considered to be disease specific. Therefore, it should always be interpreted in conjunction with clinical and laboratory data. Artefacts (interference of air-filled bowel) and patient constitution (obesity) contribute to its limitations. Evaluating GI function by US is operator dependent and subject to interpretative errors.

CONCLUSIONS

This paper summarizes the potential utility of ultrasonography for monitoring GI function and dysfunction in the critical care settings and may lead to appropriate therapeutic interventions. Real-time ultrasound with the GUTS protocol is a simple, inexpensive and portable imaging technique that can provide anatomical and functional GI information. Future research is needed to assess the ability of the GUTS protocol to identify patients with GI dysfunction according to the grade of AGI as suggested by the ESICM working group.

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Manu L.N.G. Malbrain is founding President of WSACS (The Abdominal Compartment Society) and current Treasurer, he is also member of the medical advisory Board of Pulsion Medical Systems (part of Maquet Getinge group) and consults for ConvaTec, Acelity, Spiegelberg and Holtech Medical. He is co-founder of the International Fluid Academy (IFA). This article is endorsed by the IFA. The mission statement of the IFA is to foster education, promote research on fluid management and hemodynamic monitoring, and thereby improve the survival of the critically ill by bringing together physicians, nurses, and others from throughout the world and from a variety of clinical disciplines. The IFA is integrated within the not-for-profit charitable organization iMERiT, International Medical Education and Research Initiative, under Belgian law. The IFA website (http://www.fluidacademy.org) is now an official SMACC affiliated site (Social Media and Critical Care) and its content is based on the philosophy of FOAM (Free Open Access Medical education — #FOAMed). The site recently received the HONcode quality label for medical education.

(https://www.healthonnet.org/HONcode/Conduct.html?HONConduct519739).

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ESM video 1. Absent peristalsis; we observe a small bowel loop with no peristaltic movement, secondary to ileus, essentially static, and the bowel contents do not move. We also observe ascites with dendrites. The large bowel has no peristaltic movement, and small bowel displays the same characteristics

ESM video 1.mp4 (on-line available)

ESM video 2. Present ineffective peristalsis; Peristaltic movement can be seen, while intestinal content does not move forward, but rather sways (pendulum-peristalsis)

ESM video 2.mp4 (on-line available)

ESM video 3. Present effective peristalsis; Peristaltic movement is propulsive and bowel content is pushed forward

ESM video 3 .mp4 (on-line available)

ESM video 4. Augmented peristalsis; it can be described as total (bacterial overgrowth) in the video we observe the presence of ascites with dendrites and an augmented peristalsis of the small bowel. Partial augmented peristalsis (obstruction, ileus), we observe the presence of augmented peristalsis and a loop of the small bowel with absent peristalsis secondary to intra-abdominal adherences

ESM video 4.mp4 (on-line available)

ESM video 5. The ESICM Working Group on Abdominal Problems included GI bleeding leading to haemorrhagic shock as a Grade IV AG, in this video we observe absent peristalsis with a propulsive intraluminal content corresponding to a massive GI bleeding

ESM video 5 .mp4 (on-line available)