EDITORIAL

The Seventh Organ—Gastrointestinal Tract: Neglect at Your Own Peril!

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Charak Samhita, an ancient Hindu medical text, written in 4th to 2nd century BCE, is a testimony, that the Ayurveda practitioners understood the importance of the process of digestion quite well.[1] Ayurveda goes beyond caloric intake and contains detailed description of classification general properties of food, and dietary regulations.[2]

In comparison, the anatomists and physicians of medieval age seemed to think that stomach was an unclean organ and was therefore separated by nature with diaphragm to protect the important organs and the site of reason and of the mind.[3] Some descriptions from this period seem exotic from today's perspective. "*The stomach has the liver below it like a fire underneath a cauldron; and thus the stomach is like a kettle of food, the gall-bladder its cook, and the liver is the fire*".[4]

The gut manages between 8 and 10 L of fluid and vast amounts of electrolytes [sodium (800 mEq), chlorides (700 mEq), and potassium (100 mmol)] every day. This contains nearly 3.5 to 4.0 L of secretions containing innumerable important enzymes and factors.[5]

Critical care literature is full of organ support therapies directed at managing respiratory failure, shock, renal, hepatic, and central nervous system dysfunction. The realization that gut dysfunction can initiate, propagate, and amplify critical illness and worsen the patient outcomes is relatively new in the critical care literature. The search for term "Gut dysfunction in Critically ill" in PubMed yields only 276 citations.

Mutlu et al. described the complex interactions between mechanical ventilation and gut dysfunction.[6] Due to concomitant presence of gut dysfunction and critical illness, it is difficult to pinpoint mechanical ventilation as a sole cause of gut dysfunction. However, mechanical ventilation can certainly worsen gut function primarily by reducing the splanchnic circulation by decreasing mean arterial pressure and increasing resistance of the gut vasculature. Furthermore, the gut is at a distinct disadvantage due to its lack of inability to autoregulate the blood flow and possibility of persistent splanchnic vasoconstriction, even when global hemodynamics are optimized. The hematocrit of blood in gut vessels is barely 10%, owing to dilution caused by absorption of nutrients and fluid from intestinal lumen and finally the tips of gut villi still remain vulnerable to hypoxia due to shunting of blood. This affects all parts of gut leading to multiple complications, such as stress ulcers, gastroparesis, feed intolerance, paralytic ileus, and diarrhea, not forgetting the worsening of hepatic and pancreatic function. In a multicenter prospective study of 337 patients from 40 ICUs, presence of 3 more GI symptoms on day 1 of ICU stay was associated with increased 28-day mortality (62.5 vs 28.9 %, $p = 0.001$).[7] Innumerable problems with gut function may be seen in the critically ill patients, which escape the radar of the intensivists, unless they are the presenting problems, such as acute pancreatitis or fulminant hepatic failure. Acute mesenteric ischemia, a problem seen mainly in the elderly, is seen in 0.1% of all hospital admissions in the USA.[8] This is not often seen in countries with lower life expectancy and is liable to be missed easily, since it may resolve spontaneously. However, low index of suspicion will worsen the outcomes in these patients. In a narrative review, Reintam Blaser et al. stated that gastrointestinal symptoms and signs were common in critically ill patients.[9] Diffuse or localized pain though common in acute abdominal emergencies, this may be difficult to elicit in sedated or obtunded patients. Other common problems at presentation or during ICU stay may be vomiting, diarrhea, abdominal distension, high gastric volumes, and upper and lower gastrointestinal bleeding. Many underlying pathologies causing these signs and symptoms may lead to delayed enteral feeding, feeding intolerance, increased ICU length of stay and costs, and increased mortality (Table 1).

The Working Group on Abdominal Problems of the European Society of Intensive Care Medicine standardized the terminology, definitions, and management.[10]

Piton and Capellier reviewed the biomarkers of enterocyte damage and dysfunction leading to failure of barrier function of the gut leading to bacterial translocation and worsening of patient outcomes in ICU. Citrulline, an amino acid produced by small bowel enterocytes. Reduced plasma levels of citrulline indicate reduced

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mass of enterocytes, suggesting possible intestinal failure. Intestinal fatty acid-binding protein (I-FABP) is present in cytosol of mature enterocytes and is not normally seen in plasma or urine. Elevated levels of I-FABP in either plasma or urine, thus indicate necrosis of enterocytes.[11] A recent review by Longhitano et al. details the use of biomarkers in altered gastrointestinal function in patients with septic shock.[12]

Point of care ultrasound (POCUS) is increasingly being in ICUs. e-FAST is now an established part of assessment and management patients with abdominal and thoracic trauma. Ultrasonography has also been used to aid the placement of the naso/orogastric tube along with placement of endotracheal tube. Similarly, it was found to be useful in assessing gastric residual volume and peristalsis.[13,14] Perez-Calatayud et al. proposed the gastrointestinal and urinary tract sonography (GUTS) protocol for the evaluation of gastrointestinal dysfunction in critically ill patients. They suggested that POCUS should be used to gain anatomical and functional information about the gastrointestinal injury, as defined by the European Consensus Definition of acute gastrointestinal injury (AGI), by looking at the four parameters like diameter, mucosal thickness, peristalsis, and blood flow (using Doppler).[15] Subsequently, Gao et al. used POCUS daily for 1 week in 116 critically ill patients to assess the intestinal thickness, diameter, folds, and peristalsis and stratification of the intestinal wall and calculate the acute gastrointestinal injury ultrasonography (AGIUS) and the GUTS score. They concluded that trans-abdominal USG could be used for evaluating gastrointestinal injury in the critically ill patients.[14]

Sequential organ failure assessment (SOFA) score is commonly used for evaluating progression of the organ dysfunction of six organ systems. It is time we started paying the gastrointestinal tract its due; and find a way to integrate its assessment as the seventh and equally important organ. This approach will certainly improve outcomes of our critically ill patients.

References

1. Sutherland WD. Charaka samhita. Ind Med Gaz 1919;54(2):41–50.
2. http://www.carakasamhitaonline.com/mediawiki-1.32.1/index.php?title=Ahara_vidhi#Terminologies/last accessed on 30th September 2020.
3. http://www.carakasamhitaonline.com/mediawiki-1.32.1/index.php?title=Ahara_vidhi#Terminologies/last. accessed on 30th September 2020.
4. https://web.stanford.edu/class/history13/earlysciencelab/body/stomachpages/stomachcolonintestines.html/last accessed 30th September 2020.
5. Kiela PR, Ghishan FK. Physiology of intestinal absorption and secretion. Best Pract Res Clin Gastroenterol 2016;30(2):145–159. DOI: 10.1016/j.bpg.2016.02.007.
6. Mutlu GM, Mutlu EA, Factor P. GI complications in patients receiving mechanical ventilation. Chest 2001;119(4):1222–1241. DOI: 10.1378/chest.119.4.1222.
7. Reintam Blaser A, Poeze M, Malbrain ML, Björck M, Oudemans-van Straaten HM, Starkopf J, et al. Gastrointestinal symptoms during the first week of intensive care are associated with poor outcome: a prospective multicentre study. Intensive Care Med 2013;39(5):899–909. DOI: 10.1007/s00134-013-2831-1.
8. From Chat V Dang https://emedicine.medscape.com/article/189146-overview#a2. Updated: Mar 26, 2020/last accessed 30th September 2020.
9. Reintam Blaser A, Starkopf J, Malbrain ML. Abdominal signs and symptoms in intensive care patients. Anaesthesiol Intensive Ther 2015;47(4):379–387. DOI: 10.5603/AIT.a2015.0022.
10. Reintam Blaser A, Malbrain ML, Starkopf J, Fruhwald S, Jakob SM, De Waele J, et al. Gastrointestinal function in intensive care patients: terminology, definitions and management. Recommendations of the ESICM working group on abdominal problems. Intensive Care Med 2012;38(3):384–394. DOI: 10.1007/s00134-011-2459-y.
11. Piton G, Capellier G. Biomarkers of gut barrier failure in the ICU. Curr Opin Crit Care 2016;22(2):152–160. DOI: 10.1097/MCC.0000000000000283.

Table 1: Gastrointestinal complications in critically ill patients

Complications	*Incidence (%)*	*Risk factors*
SRMD (on endoscopy)[6]	74	MV >48 hours
	100	TBI, coagulopathy, corticosteroids
Upper GI bleeding[16–18]	0.1	
	25	
Delayed gastric emptying[19,20]	50	Sedation, opioids, TBI, hypoxia, hypercapnia, hyperglycemia
	80	
Paralytic ileus[21,22]	25 50	Sepsis, peritonitis, pancreatitis, opioids, hypoxia, hypokalemia, hypercapnia, hyperglycemia, hypothermia
Diarrhea[23,24]	11.9–23.1	Infective (*C. difficile*, norovirus, etc.)
	5.3 (6.5 infective)	Laxatives, enemas, feed intolerance
Constipation[6,25]	15 (Mutlu) 51.9	MV, opioids, sedation, neuromuscular blocking agents, enteral nutrition, vaso-pressors
	83	
IAH (ACS)[26,27]	50.5 (8.2) 30–49	Retroperitoneal hemorrhage, penetrating and blunt abdominal injury, massive ascites, pancreatitis, liver transplant, circumferential burns
	(1.6–6.1)	

SRMD, stress-related mucosal damage; MV, mechanical ventilation; TBI, traumatic brain injury; IAH, intra-abdominal hypertension; ACS, abdominal compartment syndrome

12. Longhitano Y, Zanza C, Thangathurai D, Taurone S, Kozel D, Racca F, et al. Gut alterations in septic patients: a biochemical literature review. Rev Recent Clin Trials 2020. Online ahead of print 10.2174/1574887115666200811105251.
13. Sharma V, Gudivada D, Gueret R, Bailitz J. Ultrasound-assessed gastric antral area correlates with Aspirated tube feed volume in enterally fed critically ill patients. Nutr Clin Pract 2017;32(2):206–211. DOI: 10.1177/088453361668153.
14. Gao T, Cheng MH, Xi FC, Chen Y, Cao C, Su T, et al. Predictive value of transabdominal intestinal sonography in critically ill patients: a prospective observational study. Crit Care 2019;23(1):378. DOI: 10.1186/s13054-019-2645-9.
15. Perez-Calatayud AA, Carrillo-Esper R, Anica-Malagon ED, Briones-Garduño JC, Arch-Tirado E, Wise R, et al. Point-of-care gastrointestinal and urinary tract sonography in daily evaluation of gastrointestinal dysfunction in critically ill patients (GUTS protocol). Anaesthesiol Intensive Ther 2018;50(1):40–48. DOI: 10.5603/AIT.a2017.0073.
16. Cook DJ, Fuller HD, Guyatt GH, Marshall JC, Leasa D, Hall R, et al. Risk factors for gastrointestinal bleeding in critically ill patients. Canadian critical care trials group. N Engl J Med 1994;330(6):377–381. DOI: 10.1056/NEJM199402103300601.
17. Hastings PR, Skillman JJ, Bushnell LS, Silen W. Antacid titration in the prevention of acute gastrointestinal bleeding: a controlled, randomized trial in 100 critically ill patients. N Engl J Med 1978;298(19):1041–1045. DOI: 10.1056/NEJM197805112981901.
18. Heyland DK, Tougas G, King D, Cook DJ. Impaired gastric emptying in mechanically ventilated, critically ill patients. Intensive Care Med 1996;22(12):1339–1344. DOI: 10.1007/BF01709548.
19. Ott L, Young B, Phillips R, McClain C, Adams L, Dempsey R, et al. Altered gastric emptying in the head-injured patient: relationship to feeding intolerance. J Neurosurg 1991;74(5):738–742. DOI: 10.3171/jns.1991.74.5.0738.
20. Vazquez-Sandoval A, Ghamande S, Surani S. Critically ill patients and gut motility: are we addressing it? World J Gastrointest Pharmacol Ther 2017;8(3):174–179. DOI: 10.4292/wjgpt.v8.i3.174.
21. Adike A, Quigley EM. Gastrointestinal motility problems in critical care: a clinical perspective. J Dig Dis 2014;15(7):335–344. DOI: 10.1111/1751-2980.12147 Erratum In. J Dig Dis 2016;17(9):633.
22. Tirlapur N, Puthucheary ZA, Cooper JA, et al. Diarrhoea in the critically ill is common, associated with poor outcome, and rarely due to *Clostridium difficile*. Sci Rep 2016;6(1):24691. DOI: 10.1038/srep24691.
23. Murali M, Ly C, Tirlapur N, Montgomery HE, Cooper JA, Wilson AP. Diarrhoea in critical care is rarely infective in origin, associated with increased length of stay and higher mortality. J Intensive Care Soc 2020;21(1):72–78. DOI: 10.1177/1751143719843423.
24. Prat D, Messika J, Avenel A, Jacobs F, Fichet J, Lemeur M, et al. Constipation incidence and impact in medical critical care patients: importance of the definition criterion. Eur J Gastroenterol Hepatol 2016;28(3):290–296. DOI: 10.1097/MEG.0000000000000543.
25. van der Spoel JI, Schultz MJ, van der Voort PH, de Jonge E. Influence of severity of illness, medication and selective decontamination on defecation. Intensive Care Med 2006;32(6):875–880. DOI: 10.1007/s00134-006-0175-9.
26. Malbrain MLNG, Chiumello D, Pelosi P, Wilmer A, Brienza N, Malcangi V, et al. Prevalence of intra-abdominal hypertension in critically ill patients: a multicentre epidemiological study. Intensive Care Med 2004;30(5):822–829. DOI: 10.1007/s00134-004-2169-9.
27. Khot Z, Murphy PB, Sela N, Parry NG, Vogt K, Ball IM. Incidence of intra-abdominal hypertension and abdominal compartment syndrome: a systematic review. J Intensive Care Med 2019. 885066619892225 10.1177/0885066619892225.