ISSN 2706-6819 Vol.5, Issue 5: 63-66, DOI: 10.25236/IJFM.2023.050511

Current status of post-traumatic injury with acute gastrointestinal injury and progress in diagnosis and treatment

Weijie Cheng, Yi Hu*

The Fifth Affiliated Hospital of Xinjiang Medical University, Urumqi, Xinjiang, 830000, China
**Corresponding author: 506081575@qq.com*

Abstract: *Hypertriglyceridemia is the third most common cause of acute pancreatitis worldwide, and in China, it is the second leading cause. It mainly affects patients with underlying lipoprotein metabolism disorders and comorbidities like diabetes mellitus, alcohol abuse, or drug use. Pancreatitis caused by hypertriglyceridemia has similar clinical manifestations to acute pancreatitis caused by other factors but has a longer course and more complications, increasing the likelihood of organ failure. Treatment involves aggressive fluid resuscitation, pain control, and nutritional support, similar to acute pancreatitis from other causes. Timely recognition of hypertriglyceridemia is crucial for proper management, preventing recurrence, and long-term disease management.*

Keywords: *trauma, acute gastrointestinal injury, serum markers, scoring system*

1. Introduction

Trauma is defined by the World Health Organization as physical or psychological harm resulting from violence, accidents, or suicide. [1] Trauma is a leading cause of death and disability, particularly in men, with changing incidence and causes such as traffic accidents, suicide, and violent crime.[2]Severe trauma can involve multiple body systems and lead to organ dysfunction, infection, and MODS, including SIRS and ARDS.[3]

AGI is a common complication in trauma patients and predicts a poor prognosis, playing a crucial role in studying multi-organ dysfunction. [4] Intestinal microbiota maintains intestinal homeostasis via beneficial interactions. [5]AGI in critical illness causes nutrient malabsorption due to impaired intestinal barrier, dynamics, and gastric emptying.[6]

The intestinal microbiota is linked to host health, but disruption can cause harmful flora multiplication and dysbiosis. Immune activation can trigger inflammation, disrupting gut microbe-host alliance, and even MODS and death.[7] Critical care patients need GI protection, as AGI can worsen the systemic inflammatory response.[8] The traditional approach relying on symptoms was inadequate. The ESICM standardized grading of gastrointestinal function in 2012 improved the assessment of AGI in critically ill patients. [9]

2. Acute gastrointestinal injury classification

AGI is a combination of gastrointestinal dysfunction and impairment due to multiple causes in critically ill patients, which can severely affect the prognosis and survival of patients.[10]

AGI grade I: Partial impairment of GI function, manifested by GI symptoms associated with known causes.

AGI grade II: The gastrointestinal tract does not adequately digest and absorb to meet the body's nutritional and fluid needs, but it has not yet affected the systemic condition.

AGI grade III: GI function was lost, GI function was not restored despite interventions, and systemic status did not improve.

AGI grade IV: AGI has progressed to an immediate and immediately life-threatening condition with worsening MODS and shock.

ISSN 2706-6819 Vol.5, Issue 5: 63-66, DOI: 10.25236/IJFM.2023.050511

3. Current status of post-traumatic injury with acute gastrointestinal injury

Dong Zhang's study showed that critically ill patients with AGI had higher mortality risk, especially those with severe AGI.[11]In a study of 550 ICU patients by Bangchuan Hu, 470 were diagnosed with AGI. AGI grading correlated positively with morbidity and mortality at 28 and 60 days: 24.5% grade I, 49.4% grade II, 20.6% grade III, and 5.5% grade IV. [12]

The complex and multifactorial mechanisms behind AGI after trauma include stress-induced inflammation, mechanical ventilation, prolonged fasting or parenteral nutrition, and the use of opioid analgesics. These factors can lead to mucosal damage, impaired intestinal barrier function, bacterial transfer, infection, and changes in the intestinal microbiota and epithelium, ultimately contributing to the development of AGI in trauma patients.[13]

4. Markers of acute gastrointestinal injury

Detecting markers of gastrointestinal function is crucial in patients with AGI, as clinical assessment is difficult. New markers like intestinal mucosal barrier indicators and plasma metabolites have higher sensitivity and specificity. Common markers include lactate, intestinal fatty acid-binding protein, and D-lactate, among others.

4.1 Citrulline

Citrulline is a non-protein amino acid, an intermediate metabolite of the "urea-ornithine cycle", which is synthesized in the small intestinal mucosa using glutamine as a precursor substance. [14]The role of guanosine as a biomarker has been studied in patients with short bowel syndrome, chronic small bowel lesions, intestinal graft-versus-host disease, and acute intestinal failure, showing promising results. [15]

It has been shown that in patients with short bowel syndrome, plasma guanine concentrations correlate with residual small bowel length. [16] Citrulline was associated with the severity and extent of villous atrophy in patients with normal small bowel length and patients with villous atrophy associated with small bowel disease. [17]Studies have confirmed that in patients at risk of small bowel dysfunction due to SIRS and hypovolemia, clinical bowel dysfunction is associated with biological evidence of intestinal epithelial cell necrosis; [18]

Low plasma citrulline is associated with small bowel ischemia, loss of intestinal barrier function, and acute renal failure in SIRS.[19]A study showed that serum citrulline correlated with the severity of gastrointestinal failure in critically ill patients and that the use of citrulline improved the diagnostic efficacy of identifying critically ill patients with gastrointestinal failure. [20]Plasma citrulline reflects enterocyte mass, length, and absorptive capacity. It's a promising marker for assessing small intestinal function due to its continuous measurement and reflection of functional enterocyte quality in acute conditions. [21]

4.2 Intestinal fatty acid binding protein, I-FABP

I-FABP is a low molecular weight protein that is released by enterocytes into the circulatory system after intestinal ischemia occurs and has been shown to be a sensitive marker of intestinal epithelial injury. [22]The level of I-FABP is reported to reflect the physiological turnover rate of enterocytes, and its elevation indicates damage to the intestinal epithelium. [23]

A study showed that in 576 (AGI) patients in the ICU, serum IFABP levels were significantly higher in patients across AGI grades compared to healthy controls, with progressively higher IFABP levels with increasing AGI classification, suggesting a strong relationship between the severity of AGI and the level of I-FABP.[24] Gaël Piton et al. showed that I-FABP may help intensivists to identify patients presenting with intestinal injury, at risk of bacterial translocation and systemic inflammatory response syndrome, as well as patients with reduced enterocyte function and at risk of malabsorption. [25]

I-FABP has been of great interest and is widely used as a marker of ischemia. Studies have shown that I-FABP levels are elevated in various conditions of impaired intestinal function. These conditions include trauma with or without abdominal lesions, after performing major but non-abdominal surgery, cardiac arrest, cardiac arrest, sepsis, acute mesenteric occlusive and non-occlusive ischemic phenotypes, etc. [26]

ISSN 2706-6819 Vol.5, Issue 5: 63-66, DOI: 10.25236/IJFM.2023.050511

5. Acute gastrointestinal injury emergency care score

5.1 GIDS (Gastrointestinal Dysfunction Score)

The GIDS is a new scoring system to assess the severity of AGI in critically ill patients. Developed in 2021 by Blaser et al., it includes variables like citrulline, I-FABP concentrations, and abdominal signs. When added to the total SOFA score, GIDS improved the predictive power of the score and was an independent correlate of 28- and 90-day mortality. [27]

The study involved 276 ICU patients from two hospitals who were monitored for GI and abdominal symptoms for the first 7 days of admission. AGI grading and DIGS scoring were conducted for 7 consecutive days, with follow-up for 28 days. GIDS effectively quantified GI dysfunction in critically ill patients and was closely related to disease severity, prognosis, and 28-day mortality.[28]

There is a trend for GIDS to be the primary score for patients with AGI, [29]but the current study sample is small and more multicenter prospective studies with large samples are needed to demonstrate this.

5.2 SOFA (Sequential Organ Failure Assessment)

SOFA is a tool that assesses the severity of a patient's condition by evaluating the organ function in multiple systems. Studies have combined SOFA with other scores, such as GIDS, to comprehensively assess AGI. A study by Sun Jiakui found SOFA to be a risk factor for AGI grade II or above.[30]Another study reported a progressive increase in sequential organ failure score (SOFA) with increasing AGI classification.[24]

A study by Jin Teng reported that SOFA scores in patients with gastrointestinal impairment were correlated with serum levels of citrulline, D-lactate, and LPS based on correlation analysis. This suggests that SOFA scores can, to some extent, be used in conjunction with these indicators to reflect the degree of illness in patients with AGI, which can be helpful in the treatment of patients.[20]The study by Dong Zhang reported that patients in the secondary group were older and had higher SOFA scores compared to patients with primary AGI, and that SOFA scores independently predicted the odds of 28-day mortality in patients with AGI.[31]

6. Problems and Prospects

The European Society of Critical Care defined a grading system for acute gastrointestinal injury (AGI) in 2012 for early diagnosis and treatment. However, to be a good organ function assessment tool, it must have features that correlate with prognosis and change in a single direction, with objectivity and reproducibility taken into account. Currently, AGI diagnosis and classification rely mostly on clinical signs and symptoms, and only elevated intra-abdominal pressure can be used as a quantitative criterion. However, this definition only reflects the digestive and absorptive functions of the gastrointestinal tract and fails to consider other functions, such as barrier and endocrine and immune functions. There is a lack of comprehensive tools or markers that reflect the full function of the gastrointestinal tract. Although laboratory indicators like citrulline reflect digestive, absorptive, and barrier functions, their sensitivity and specificity require further study. More in-depth laboratory studies are required to find markers with higher sensitivity and specificity, and more accurate scoring systems to provide an objective and accurate basis for the diagnosis and grading of AGI. Additionally, more research on the pathogenesis and risk factors associated with AGI is necessary to enhance the accuracy of diagnosis and grading.

References

[1] Harrison J E, Weber S, Jakob R, et al. ICD-11: an international classification of diseases for the twenty-first century [J]. BMC Med Inform Decis Mak, 2021, 21(Suppl 6): 206.
[2] Hadanny A, Efrati S. Treatment of persistent post-concussion syndrome due to mild traumatic brain injury: current status and future directions[J]. Expert Review of Neurotherapeutics, 2016:875-887.
[3] Pfeifer R, Pape H C. [Diagnostics and treatment strategies for multiple trauma patients] [J]. Chirurg, 2016, 87(2): 165-73; quiz 74-5.
[4] Kiang J G, Olabisi A O. Radiation: a poly-traumatic hit leading to multi-organ injury [J]. Cell Biosci, 2019, 9: 25.
[5] Kaiko G E, Stappenbeck T S. Host-microbe interactions shaping the gastrointestinal environment [J].

ISSN 2706-6819 Vol.5, Issue 5: 63-66, DOI: 10.25236/IJFM.2023.050511

Trends Immunol, 2014, 35(11): 538-48.
[6] Viteri F E, Schneider R E. Gastrointestinal alterations in protein-calorie malnutrition [J]. Med Clin North Am, 1974, 58(6): 1487-505.
[7] Haak B W, Wiersinga W J. The role of the gut microbiota in sepsis [J]. Lancet Gastroenterol Hepatol, 2017, 2(2): 135-43.
[8] Chen H, Zhang H, Li W, et al. Acute gastrointestinal injury in the intensive care unit: a retrospective study [J]. Ther Clin Risk Manag, 2015, 11: 1523-9.
[9] Reintam Blaser A, Malbrain M L, Starkopf J, et al. Gastrointestinal function in intensive care patients: terminology, definitions and management. Recommendations of the ESICM Working Group on Abdominal Problems [J]. Intensive Care Med, 2012, 38(3): 384-94.
[10] Zhang D, Li N, Dong L, et al. Evaluation of clinical application of ESICM acute gastrointestinal injury grading system: a single-center observational study [J]. Chin Med J (Engl), 2014, 127(10): 1833-6.
[11] Zhang D, Li Y, Ding L, et al. Prevalence and outcome of acute gastrointestinal injury in critically ill patients: A systematic review and meta-analysis [J]. Medicine (Baltimore), 2018, 97(43): e12970.
[12] Hu B, Sun R, Wu A, et al. Severity of acute gastrointestinal injury grade is a predictor of all-cause mortality in critically ill patients: a multicenter, prospective, observational study [J]. Crit Care, 2017, 21(1): 188.
[13] Chelakkot C, Ghim J, Ryu S H. Mechanisms regulating intestinal barrier integrity and its pathological implications [J]. Exp Mol Med, 2018, 50(8): 1-9.
[14] Palencia J Y P, Saraiva A, Abreu M L T, et al. Effectiveness of citrulline and N-carbamoyl glutamate as arginine precursors on reproductive performance in mammals: A systematic review [J]. PLoS One, 2018, 13(12): e0209569.
[15] Derikx J P, Matthijsen R A, De Bruïne A P, et al. A new model to study intestinal ischemia-reperfusion damage in man [J]. J Surg Res, 2011, 166(2): 222-6.
[16] Crenn P, Coudray-Lucas C, Thuillier F, et al. Postabsorptive plasma citrulline concentration is a marker of absorptive enterocyte mass and intestinal failure in humans [J]. Gastroenterology, 2000, 119(6): 1496-505.
[17] Crenn P, Vahedi K, Lavergne-Slove A, et al. Plasma citrulline: A marker of enterocyte mass in villous atrophy-associated small bowel disease [J]. Gastroenterology, 2003, 124(5): 1210-9.
[18] Pan L, Wang X, Li W, et al. The intestinal fatty acid binding protein diagnosing gut dysfunction in acute pancreatitis: a pilot study [J]. Pancreas, 2010, 39(5): 633-8.
[19] Van Noord D, Mensink P B, DE KNEGT R J, et al. Serum markers and intestinal mucosal injury in chronic gastrointestinal ischemia [J]. Dig Dis Sci, 2011, 56(2): 506-12.
[20] Teng J, Xiang L, Long H, et al. The Serum Citrulline and D-Lactate are Associated with Gastrointestinal Dysfunction and Failure in Critically Ill Patients [J]. Int J Gen Med, 2021, 14: 4125-34.
[21] Piton G, Manzon C, Cypriani B, et al. Acute intestinal failure in critically ill patients: is plasma citrulline the right marker? [J]. Intensive Care Med, 2011, 37(6): 911-7.
[22] Kocsis D, Papp M, Tornai T, et al. [Intestinal fatty acid binding protein: marker of enterocyte damage in acute and chronic gastroenterological diseases] [J]. Orv Hetil, 2016, 157(2): 59-64.
[23] Relja B, Szermutzky M, Henrich D, et al. Intestinal-FABP and liver-FABP: Novel markers for severe abdominal injury [J]. Acad Emerg Med, 2010, 17(7): 729-35.
[24] Wang J, Yu L, Xia Y, et al. [Diagnostic value of citrulline and intestinal fatty acid binding protein on acute gastrointestinal injury in critical patients: a prospective study of 530 patients] [J]. Zhonghua Wei Zhong Bing Ji Jiu Yi Xue, 2017, 29(11): 999-1003.
[25] Piton G, Capellier G. Biomarkers of gut barrier failure in the ICU [J]. Curr Opin Crit Care, 2016, 22(2): 152-60.
[26] Zou L, Song X, Hong L, et al. Intestinal fatty acid-binding protein as a predictor of prognosis in postoperative cardiac surgery patients [J]. Medicine (Baltimore), 2018, 97(33): e11782.
[27] Reintam Blaser A, Padar M, Mändul M, et al. Development of the Gastrointestinal Dysfunction Score (GIDS) for critically ill patients - A prospective multicenter observational study (iSOFA study) [J]. Clin Nutr, 2021, 40(8): 4932-40.
[28] Liu X, Wang Q, Yang D, et al. Association between Gastrointestinal Dysfunction Score (GIDS) and disease severity and prognosis in critically ill patients: A prospective, observational study [J]. Clin Nutr, 2023, 42(5): 700-5.
[29] Berger M M, Hurni C A. Management of gastrointestinal failure in the adult critical care setting [J]. Curr Opin Crit Care, 2022, 28(2): 190-7.
[30] Sun J K, Liu Y, Zou L, et al. Acute gastrointestinal injury in critically ill patients with COVID-19 in Wuhan, China [J]. World J Gastroenterol, 2020, 26(39): 6087-97.
[31] Zhang D, Fu R, Li Y, et al. Comparison of the clinical characteristics and prognosis of primary versus secondary acute gastrointestinal injury in critically ill patients [J]. J Intensive Care, 2017, 5: 26.