

The effectiveness of gastric tonometry in the diagnosis of acute mesenteric ischemia in cases where a contrast-enhanced computed tomography cannot be obtained

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ABSTRACT

Objective: The aim of the study was to evaluate the effectiveness of gastric tonometry in the diagnosis of acute mesenteric ischemia in cases where a contrast-enhanced computed tomography cannot be obtained.

Material and Methods: The gastric pH (pHi) and gastric CO₂ (gpCO₂) were measured with gastric tonometry catheter, preoperatively and postoperatively at 24 hours, in patients with suspicion of acute mesenteric ischemia. Simultaneous evaluation of blood gases and blood lactate levels were performed. Patients were divided into two groups after surgery. Group 1 included patients with mesenteric ischemia, and Group 2 consisted of patients without mesenteric ischemia.

Results: Forty-two patients (26 males, 16 females) were evaluated. The mean age was 61.4±13.3 years. There was no significant difference between the groups in terms of demographic factors and co-morbid diseases. There were no significant differences between groups in terms of pHi and gpCO₂ levels (7.24±0.2 and -3±12.0 in Group 1, 7.18±0.06 and -3±1.9 in Group 2, respectively), intra-abdominal pressure, lactate levels, and survival. Among all the study parameters, only arterial pH had statistical significance in the diagnosis of acute mesenteric ischemia (7.23±0.21 versus 7.35±0.07 for Groups 1 and 2, respectively,) (p<0.05).

Conclusion: Gastric tonometry is not a useful method in the early diagnosis of acute mesenteric ischemia.

Key Words: Acute mesenteric ischemia, gastric tonometry, contrast-enhanced tomography

INTRODUCTION

Mesenteric ischemia results from decreased blood flow to the intestines due to mesenteric vascular obstruction, and consequently cellular damage occurs as a result of oxygen and nutrition deficiency (1). Acute mesenteric ischemia (AMI) is an abdominal emergency, and constitutes approximately 2% of gastrointestinal diseases with a mortality rate ranging between 50%-90%; it is life threatening with a poor prognosis (2, 3). Being above the age of 50 and having a cardiovascular disease are frequently encountered risk factors for AMI (4). Acute mesenteric ischemia is characterized by a sudden onset abdominal pain, and the abdominal examination findings may not be distinctive without intestinal ischemia and necrosis. In this case, there are abdominal findings that are not in proportion with physical examination and they do not adequately aid in the early diagnosis of AMI (5, 6). There are several diagnostic methods; however, the essential factors that reduce mortality are early diagnosis and appropriate treatment (7). Even though computerized tomography (CT) has a high sensitivity for diagnosis, some technical problems limit the use of CT-angiography such as renal failure and serious allergic reaction (8).

Gastric tonometry (GT), a method that measures gastric mucosal pH, has been used to assess the adequacy of splanchnic circulation (9, 10). In a multi-center study, it was expressed that GT could be beneficial for the early diagnosis of splanchnic ischemia (11).

In parallel with this evidence, we aimed to assess the efficiency of GT for early diagnosis in suspected AMI cases.

MATERIAL AND METHODS

This clinical and prospective study was conducted on 48 cases who were admitted to the General Surgery Intensive Care Unit (GSICU) due to AMI suspicion and were unable to undergo mesenteric angiography or multi-slice CT due to contrast allergy and renal failure within the last two years following approval from the ethics committee of Erciyes University, School of Medicine. The surgical indications were determined on the basis of the essential clinical suspicion by taking into account the history, physical examination, laboratory values (blood count and biochemical parameters) as well as imaging methods (abdominal ultrasonography). All the cases were operated on after their consent was obtained. All the cases received a definitive diagnosis during the operation. Following the operation, the cases were divided into two groups. Group 1 consisted of cases diagnosed with AMI while Group 2 consisted of cases not diagnosed with AMI. Age, sex, biochemistry and blood count values as well as concomitant diseases were recorded. Before the operation, a urinary catheter and a GT catheter (Tonometrics™ Catheter, To-

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Figure 1. Mesenteric venous emboli



Figure 2. Mesenteric arterial thrombosis (arrows indicate thrombi)

no-16F, Datex Ohmeda, Helsinki, Finland) were inserted 50 cm distal to the nose into the stomach. Correct positioning of the tonometry catheters of all cases was radiologically controlled. Continuous arterial blood pressure measurements were taken via a catheter inserted through the radial artery. In all cases, ranitidine was administered intravenously for stress ulcer prophylaxis and more accurate measurement of the gastric pH. The intra-catheter pressure was measured using a urinary catheter. The pHi and gpCO₂ values were measured preoperatively and at the 24th postoperative hour using GT. The cut-off value of gastric pHi was obtained from previous studies (12). At the same time, arterial blood gas and blood lactate values were studied.

Statistical Analysis

The differences between groups were assessed using the chi-square, Mann-Whitney U and Student t-test. A value of $p < 0.05$ was considered statistically significant.

RESULTS

Six patients who died within the first 24 hours were excluded from the study; therefore, 42 cases were assessed. Three AMI cases were considered to have venous embolism while the rest had arterial embolism (Figures 1, 2). The analyses of data in both groups of cases are summarized in Table 1; 26 of the cases were male, 16 female and their mean age was 61.4 ± 13.3 .

Table 1. Analysis of group characteristics

	Group 1	Group 2	P
Case number (n)	36	6	-
Age	61.4 ± 13.3	62.4 ± 12.5	> 0.05
Mortality	61.1%	66.7%	> 0.05
Creatinine levels (mean, mg/dL)	> 2	> 2	-
Blood lactate level (mean, mEq/L)	2.3 ± 0.8	2.1 ± 0.9	> 0.05
gpCO ₂ (mean)	-3 ± 12	-3 ± 1.9	> 0.05
pHi (mean)	7.24 ± 0.2	7.18 ± 0.06	> 0.05
Blood gas values (mean)	7.23 ± 0.21	7.35 ± 0.07	< 0.05
Concurrent disease	HF, CRF, AF, VHD, DM	CRF, AF, DM	-
HF: Heart failure; CRF: Chronic renal failure; AF: Atrial fibrillation; VHD: Valvular heart disease; DM: Diabetes Mellitus			

Group 1 included 36 cases while Group 2 had 6 cases. In Group 1, 12 cases who received exploratory laparotomy had total intestinal necrosis, 2 patients underwent segmental small intestine resection, and 14 had massive small intestine resection. Eight cases received embolectomy and segmental intestine resection. In Group 2, 3 cases were identified to have ulcer perforation, 2 cases perforated appendicitis and 1 case primary peritonitis. Patients in both groups presented to the hospital in the late period, and the mean time from the onset of symptoms until admission to the GSICU was 4.2 ± 1.4 and 3.9 ± 1.5 days for Group 1 and Group 2, respectively. The mortality in the study group developed between post-operative 36th hour and 10th days. The mortality rates were 61.1% and 66.7% for Group 1 and Group 2, respectively. There were no statistically significant differences between groups in terms of demographic characteristics and concomitant diseases. There were no statistically significant differences between groups when assessed as per pHi, gpCO₂, intraabdominal pressure, lactate level, creatinine and survival. The arterial blood gas values were significantly low in Group 1 ($p < 0.05$).

DISCUSSION

We identified in our study that GT was not adequate for the diagnosis of AMI. The most important factors that determine prognosis in the diagnosis of AMI are earlier diagnosis and proper management before the occurrence of an irreversible damage on the intestinal wall (13, 14). The diagnosis of AMI is time-consuming and it may delay correct diagnosis (15). Several diagnostic methods such as Doppler ultrasonography, angiography and CT angiography have been used in the early diagnosis of AMI. Among these methods, the most useful one has been CT angiography, which can be implemented rapidly in the least invasive manner. This method has been the most common imaging method in the evaluation of acute abdominal conditions with AMI, since it provides information on not only mesenteric vessels, but also intestines, intra-abdominal organs and the surrounding tissues (16). Although CT has a high sensitivity in diagnosis, there are technical problems that limit the use of CT angiography such as renal failure and serious allergic reaction (8).

Selective mesenteric angiography is considered as gold standard for the treatment of acute arterial obstruction. This technique is an invasive procedure, which is not currently available in many centers. It requires a technical team and experience; it is not appropriate for patients with renal failure and contrast allergy (17). For that reason, we used GT in patients admitted to the SICU with a preliminary diagnosis of AMI, and who cannot undergo CT angiography due to renal failure or contrast allergy. Gastric tonometry is a non-invasive method that enables the identification of acidosis and provides continuous information on the adequacy of intestinal perfusion. Its use is suggested as an early warning in case of oxygen inadequacy to the gastrointestinal mucosa. Gastric tonometry is a method with high sensitivity in the critically ill patient with acute circulation failure or sepsis, who underwent high-risk major surgery and cardiac surgery; however, it is a non-specific method (18-20).

In this study, there were no differences between the two groups with respect to pH, gpCO₂ and lactate values. We have identified that this method is not useful for the early diagnosis of AMI; additionally, the application of GT was time-consuming and challenging for some of our patients. In parallel with our study, a few studies also demonstrated that the use of GT in critically ill patients was not adequate for the prediction of mortality or clinical process (21, 22).

The rate of mortality in cases with AMI is between 50-70%, which is rather high (14). The essential reasons why the mortality rates of mesenteric ischemia patients are high are as follows: lack of early diagnosis, old age of patients, frequent cardiac concomitant diseases and late presentation of patients at the hospital (23). Kassahun et al. (24) identified the rate of survival as 30% if diagnosis was made 24 hours following the onset of symptoms in AMI. In our series, the period of time that elapsed between the onset of symptoms and presentation to the hospital was more than 24 hours for the AMI cases and the survival rate was low.

We attributed the similarity of results between the two groups to these reasons: 1) The fact that the cases in both groups presented to our clinic in the late period; most of the cases in Group 1 had massive small intestine necrosis and the cases in the other group had delayed perforation; 2) The gastric arterial network was rich; the gastric arterial circulation was generally well-maintained until the development of cardiovascular collapse due to multi-organ failure. The only significant result in this study was the arterial blood gas value. We were of the opinion that this situation stemmed from the massive small intestine necrosis secondary to microvascular circulatory impairment. Blood gas measurement is not a good method for the early diagnosis; however, it is a good predictor to determine the severity and prognosis of the disease.

The limitation of our study was the fact that the numbers of cases in the two groups were not equal. One of the reasons for this situation was that the definitive diagnoses were made during the operation and the other reason was that the suspected AMI cases consisted of cases whose contrast CT scan could not be taken since they had renal function impairment. This situation limited our selection of cases. Therefore, the statistical power of the study has been reduced.

CONCLUSION

Gastric tonometry is not useful for the diagnosis of AMI since the arterial blood flow is not impaired unless an underlying cardiovascular failure develops.

Ethics Committee Approval: Ethics committee approval was received for this study from the ethics committee of Erciyes University Faculty of Medicine.

Informed Consent: Written informed consent was obtained from patients who participated in this study.

Peer-review: Externally peer-reviewed.

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