



## Original

### Experience and perioperative factors affecting the results of acute mesenteric ischemia. Results from a Chilean tertiary referral center

#### *Experiencia y factores perioperatorios que afectan a los resultados en isquemia mesentérica aguda. Resultados de un hospital terciario chileno*

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### Abstract

**Introduction and objective:** acute mesenteric ischemia has a low incidence but high mortality. The results of this disease are not well reported in developing countries. This study aims to describe the results of a Chilean tertiary university center and the factors that affect its morbidity and mortality.

**Material and methods:** retrospective analysis of all patients undergoing emergency surgery for acute mesenteric ischemia between 2016 and 2021 at the hospital clínico universidad de chile. Patients managed without surgery were excluded. Demographic characteristics, perioperative factors, details of the first surgery, 30-day mortality, and hospital stay, among others, were analyzed.

**Results:** 32 patients were included. The median age was 73.5 years (45-92). The most frequent comorbidities were arterial hypertension (62.5 %), diabetes *mellitus* (28.1 %) and known cardiovascular disease 34.4 % (acute myocardial infarction, chronic angina, cerebrovascular accident, acute limb ischemia, peripheral arterial occlusive disease). 40.6 % had a thrombotic arterial cause, 18.8 % embolic arterial, 25 % thrombotic venous and 15.6 % non-occlusive (NOMI). The most frequent reason for consultation was abdominal pain (84.4 %). In the first surgical intervention, 81.3 % required intestinal resection, with an anastomosis performed in 53.1 %. 25 % were revascularized, with a vascular surgeon on the surgical team in 65.6 %. The median hospital stay was 21 (2-129) days. The median time from the emergency department to surgery was 10.75 hours (4.75-196).

Mortality at 30 days was 40.6 %, with no differences between etiologies. There was a trend of lower mortality when a vascular surgeon participated in the surgical team (OR 0.74; CI 0.17-3.24) or when an intestinal anastomosis was performed (OR 0.62; CI 0.15-2, 58); while a higher mortality was observed among those > 70 years of age (OR 5.6, 95 % CI 1.15-27.37), and patients with hyperlactatemia (OR 1.75; CI 0.35-8.71) or acidosis (OR 1.54; CI 0.31-7.72), although these results did not reach statistical significance.

**Conclusions:** mortality is consistent with that reported internationally. There is a trend of lower mortality among patients operated on by a vascular surgeon or when an anastomosis is performed, the latter probably due to a better physiological/intestinal state; with higher mortality in patients with hyperlactatemia and acidosis. The greatest limitation of this study is the small sample, consistent with its low incidence.

#### Keywords:

Mesenteric ischemia. Mortality. Predictive factors. Vascular surgical procedures. Thrombectomy.

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## Resumen

**Introducción y objetivo:** la isquemia mesentérica es poco frecuente, pero tiene una alta mortalidad. Existen pocos reportes de esta patología en países subdesarrollados. Este estudio pretende describir los resultados de un centro universitario terciario chileno y los factores que afectan a su morbimortalidad.

**Material y métodos:** análisis retrospectivo de los pacientes intervenidos de urgencia por isquemia mesentérica aguda entre 2016 y 2021 en el Hospital Clínico Universidad de Chile. Se excluyeron los pacientes manejados sin cirugía. Se analizaron factores perioperatorios, detalles operatorios, la mortalidad a 30 días y la estancia hospitalaria, entre otros.

**Resultados:** se incluyeron 32 pacientes. La mediana de edad fue de 73,5 años (45-92). Las comorbilidades más frecuentes fueron hipertensión (62,5 %), diabetes *mellitus* (28,1 %) y enfermedad cardiovascular conocida: infarto agudo de miocardio, angina crónica, accidente cerebrovascular, isquemia aguda de extremidades y enfermedad arterial oclusiva periférica (34,4 %). El 40,6 % tenía causa arterial trombótica; el 18,8 %, arterial embólica; el 25 %, venosa, y el 15,6 %, no oclusiva (NOMI). El motivo de consulta más frecuente fue el dolor abdominal (84,4 %). En la primera intervención, el 81,3 % requirió resección intestinal. Se realizó una anastomosis en el 53,1 %. El 25 % de los pacientes fueron revascularizados, con un cirujano vascular en el equipo quirúrgico, en el 65,6 %. La mediana de estancia hospitalaria fue de 21 días (2-129). La mediana de tiempo a la cirugía fue de 10,75 horas (4,75-196).

La mortalidad a 30 días fue del 40,6 %, sin diferencias entre etiologías, con tendencia a una menor mortalidad cuando participó un cirujano vascular en el equipo quirúrgico (OR 0,74; IC 0,17-3,24) o cuando se realizó una anastomosis intestinal (OR 0,62; IC 0,15-2,58); con mayor mortalidad en > 70 años (OR 5,6; IC 95 %, 1,15-27,37) y con hiperlactatemia (OR 1,75; IC 0,35-8,71) o acidosis (OR 1,54; IC 0,31-7,72), aunque no alcanzaron significación estadística.

**Conclusiones:** la mortalidad es coherente con la informada internacionalmente. Existe una tendencia de menor mortalidad entre los pacientes operados por un cirujano vascular o cuando se realiza una anastomosis. Esto último se debe probablemente a un mejor estado fisiológico/intestinal, con mayor mortalidad en pacientes con hiperlactatemia y acidosis. La mayor limitación es la pequeña muestra, en concordancia con su baja incidencia.

### Palabras clave:

Isquemia mesentérica.  
Mortalidad. Factores predictivos.  
Procedimientos quirúrgicos vasculares.  
Trombectomía.

## INTRODUCTION

Acute mesenteric ischemia (AMI) is defined as the sudden interruption, or critical reduction of blood flow to the intestinal area to a point that is insufficient enough to meet the metabolic demands of visceral organs, leading to damage and necrosis. It can progress into a catastrophic condition if remains untreated (1-3). AMI can be occlusive, or non-occlusive (NOMI) (4). Based on its etiology, it is subcategorized into arterial embolic (50 %), arterial thrombotic (15- % to 25 %), or venous thrombotic (5 % to 15 %) (2,4). Its overall incidence is low (0.09 % to 0.2 % of all acute admissions to the ER). While it is a rare cause of abdominal pain, it is a common reason for emergency intestinal resection (5,6). However, its incidence rate increases significantly with age (7). Despite its low incidence rate, AMI is characterized by high mortality rates, ranging from 30 % to 80 %, depending on the duration of the condition, with a high morbidity rate among survivors (8-11). Timely diagnosis and intervention are essential to reduce the mortality rates associated with AMI (12,13).

The primary treatment for AMI is surgical and supportive, often requiring advanced surgical tech-

niques for revascularization. Traditionally, open surgery has been the standard approach for AMI. However, over the past 2 decades, endovascular or hybrid strategies (simultaneous endovascular and open approaches) have emerged as important and effective alternatives to treat AMI, although the availability of a vascular-endovascular surgeon is crucial to implement these alternatives (2,7).

While there are numerous reports on this topic from developed countries, there are few reports on the surgical treatment outcomes of AMI in developing countries.

The aim of this study is to describe the results of patients undergoing emergency surgery for AMI at a developing country tertiary referral center and analyze the perioperative factors affecting morbidity and mortality in this setting.

## MATERIAL AND METHODS

This was a retrospective, analytical study, a review of clinical and surgical records of patients admitted with a diagnosis of AMI who underwent some form of surgical intervention from January 2016 through

December 2021 at Hospital Clínico de la Universidad de Chile, Santiago de Chile, Chile. This teaching hospital is a tertiary referral center located in Santiago de Chile, Chile, with a training program for general and vascular surgeons. The hospital has an emergency operating room available at night, equipped with a C-arm machine, depending on the availability of a medical technologist on call who must meet the needs of all clinical services. During the night, the availability of the angiography suite depends on the availability of the on-call personnel. There is no 24/7 vascular surgeon on call, but consultation can be made via telemedicine. In cases where, based on imaging and clinical assessment, the vascular surgeon believes that revascularization is possible, support from the vascular surgeon from the operating room is a possibility, if available. If not, the on-call surgical team must manage the case.

Patients with a diagnosis of AMI, defined by consistent clinical symptoms and radiological images, who underwent surgery with or without revascularization were included. Patients who were not treated surgically were excluded. The exclusion criteria for surgery included patients with rapid deterioration who, due to their overall instability and hemodynamics, were deemed unable to tolerate such extensive surgery. Other patients excluded from surgery included those with non-occlusive mesenteric ischemia (NOMI) whose underlying disease was not resolved, or who did not show overt improvement toward greater stability. Patients with venous thrombotic ischemia who did not show any clear signs of mural necrosis on imaging (pneumatosis or signs suggestive of intestinal perforation), or whose clinical symptoms did not suggest it were also excluded from surgery.

Demographic variables such as age, sex, and comorbidities, were recorded. The time elapsed from symptom onset to arrival at the ER or clinical suspicion (for already hospitalized patients), time to CT scan, its findings, and time until surgery were analyzed. The lab test results were also recorded, as well as the need for the use of vasopressors prior to surgery.

Intraoperative factors, such as the condition of the intestinal loops, the presence of peritonitis, or feces in the peritoneal cavity, the need for intestinal resection, the length of resected intestine, the revascularization method, anastomosis, or abandonment

of intestinal ends, and the presence or absence of a vascular surgeon in the operating room were reviewed.

The following outcomes were measured: 30-day survival, 1-year survival, length of the ICU stay, the overall length of stay, and the no. of total surgeries, among others. These outcomes were compared to the type of mesenteric ischemia (arterial thrombotic, arterial embolic, venous thrombotic, and NOMI).

Associations among categorical variables were analyzed using odds ratios and the chi-square test; for categorical-numerical associations, the Student t-test or Wilcoxon test were used, as appropriate, and for numerical variables, Pearson's correlation coefficient R was used. An alpha error of 0.05 was defined as statistically significant, and 95 % confidence intervals were built. Statistical analysis was conducted using IBM SPSS Statistics v21.0 for Windows, and graphs were created using PRISM Graph-Pad. This study was reviewed and approved by Hospital Clínico de la Universidad de Chile Scientific and Ethical Research Committee for Human Research (no. 55/22). Verbal consent was obtained from the patients or their family members.

## RESULTS

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A total of 32 patients were included in the study, 17 of whom were men. The patients' mean age was 70.1 years (45-92). The most widely reported comorbidities were arterial hypertension (62.5 %), diabetes mellitus (28.1 %), known previous cardiovascular diseases such as acute myocardial infarction, chronic angina, stroke, acute limb ischemia, peripheral arterial occlusive disease (34.4 %), and smoking (21.9 %). Only 2 patients had a previous episode of AMI (Table I).

The most common reason for consultation was abdominal pain (84.4 %), with signs of peritoneal irritation only present in 28.1 % of the cases. Computed tomography (CT) was the preferred diagnostic imaging modality in all patients, with a portal venous phase in 40.6 % of the cases, and an arterial phase added in 59.4 % of the cases. Lab tests were performed in all the patients. Radiological findings included intestinal ischemia in 93.8 % of the cases, regardless of the type of CT performed, and the

etiology was suggested by the images acquired in 25 cases (78.1 %) (Table II). During this period, 8 patients were admitted with a diagnosis of AMI who were treated non-surgically (support and anticoagulation, or palliative care). These were mostly cases of venous thrombosis (5) or NOMI (3).

Stratifying by etiology in the operated patients (including postoperative findings), 40.6 % showed arterial thrombotic causes; 18.8 %, arterial embolic causes; 25 %, venous causes; and 15.6 %, NOMI (Table I).

In the index surgery, all patients underwent laparotomy. The time elapsed since the arrival at the ER until surgery was actually performed ranged between 4.75 hours and 196 hours, with a median of 10.75 hours. At the time of physical examination, 87.5 % of the patients showed some degree of small intestine involvement; 21.9 %, colon involvement; and 5 patients, both colon and small intestine involvement. A total of 81.3 % of the patients required intestinal resection due to the presence of overt necrosis. The decision to perform primary

anastomosis, ostomy, or abandonment of intestinal ends was made based on the degree of shock, vasoactive drug doses, the presence, or not, of purulent or fecal peritonitis, and the overall health status of the patient. Anastomotic intestinal reconstruction was performed in 53.1 % of the cases, 3.1 % of the patients underwent ostomy creation, 25 % were left with abandoned intestinal ends, and the remaining ones were laparostomized for a second follow-up 48 hours later to reassess vitality. All the patients (except for 2) were laparostomized for a second assessment surgery within 48 hours. In the case of the 2 patients who did not undergo laparostomy, the palliative closure of the abdominal wall was performed, which involved laparorrhaphy without any revascularization attempts, or intestinal resection after the intraoperative and clinical findings suggested a grim prognosis and exceptional survival, such as extensive intestinal necrosis involving proximal small intestine associated with the patient's precarious physiological baseline condition.

**Table I.** Demographic factors and comorbidities

	Overall n = 32	Venous thrombotic n = 8 (25 %)	Non- occlusive n = 5 (15.6 %)	Arterial embolic n = 6 (18.8 %)	Arterial thrombotic n = 13 (40.6 %)
Sex:					
Man	53.1 %	5 (62.5 %)	3 (60 %)	1 (16.7 %)	8 (61.5 %)
Woman	46.9 %	3 (37.5 %)	2 (40 %)	5 (83.3 %)	5 (38.5 %)
Age: median (range)	73.5 (45-92)	66 (45-83)	74 (64-79)	76.5 (60-38)	75 (45-92)
Diabetes	28.1 %	1 (12.5 %)	1 (20 %)	2 (33.3 %)	5 (38.5 %)
Hypertension	62.5 %	4 (50 %)	4 (80 %)	5 (83.3 %)	7 (53.8 %)
Cardiovascular disease	34.4 %	1 (12.5 %)	2 (40 %)	0 (0 %)	5 (38.5 %)
Atrial fibrillation / Flutter	15.6 %	0 (0 %)	1 (20 %)	3 (50 %)	1 (7.7 %)
Dyslipidemia	15.6 %	1 (12.5 %)	1 (20 %)	1 (16.7 %)	2 (15.4 %)
Smoking	21.9 %	0 (0 %)	1 (20 %)	2 (33.3 %)	4 (30.8 %)
Chronic kidney disease	6.3 %	0 (0 %)	0 (0 %)	0 (0 %)	2 (15.4 %)
Neoplasm	3.1 %	0 (0 %)	0 (0 %)	1 (16.7 %)	0 (0 %)
Venous thromboembolic disease	6.3 %	2 (25 %)	0 (0 %)	0 (0 %)	0 (0 %)
Previous event	6.3 %	0 (0 %)	0 (0 %)	0 (0 %)	2 (15.4 %)

**Table II.** Radiological findings

Findings	n (%)
Intestinal distress	30 (93.8 %)
Non-occlusive mesenteric ischemia	10 (31.3 %)
Arterial thrombosis	7 (21.9 %)
Venous thrombosis	6 (18.8 %)
Arterial embolism	2 (6.3 %)
No vascular etiological findings	7 (21.9 %)

A vascular surgeon was present in the surgical team in 65.6 % of all procedures performed. Revascularization attempts were made in 25 % of the cases, all performed by a vascular surgeon, with 0 revascularization attempts being performed by a general surgeon. The preferred method for revascularization was balloon thrombectomy (5 out of 8 attempts), with an iliac-mesenteric bypass being performed in the remaining ones; fibrinolysis was not used as a complementary technique in any case. There is a significant limitation when using endovascular and open techniques in a single surgical act, mainly due to the unavailability of the angiography suite on a 24 hours basis, as it must be shared with the interventional cardiology, neurology, and interventional radiology teams. Therefore, only 1 case used a hybrid approach, in which attempts were made to recanalize the superior mesenteric artery using an endovascular approach. However, these attempts proved unsuccessful due to the presence of an uncrossable occlusion, which is why a more traditional open approach had to be used to solve the case (Table III).

The overall 30-day mortality rate was 40.6 %, with no etiology-based differences being reported ( $p = 0.42$ ). The overall 1-year mortality was 65.5 %, with a significantly higher risk in patients older than 70 years (OR, 5.6; 95 %CI, 1.15-27.37;  $p = 0.034$ ) (table IV) (Fig. 1). There was a trend towards a lower mortality rate when a vascular surgeon was present in the surgical team (OR, 0.74; 95 %CI, 0.17-3.24;  $p = 0.69$ ), or when intestinal anastomosis was performed (OR, 0.62; 95 %CI, 0.15-2.58;  $p = 0.51$ ). Nonetheless, these findings did not reach statistical significance. There was no correlation between the length of resected intestine and the 30-day, or 1-year mortality rates ( $p = 0.367$ ) (Table V).

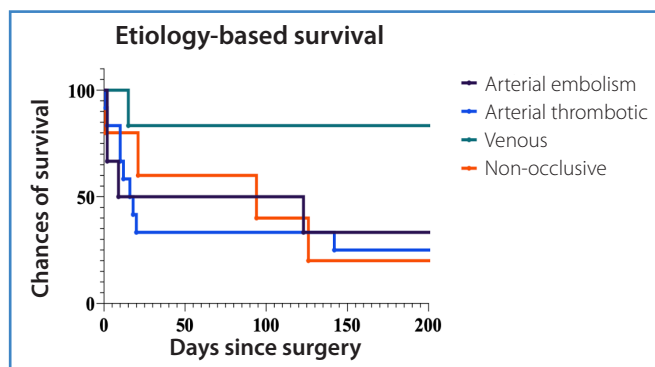
Regarding the lab test results, there was a trend towards a higher 30-day mortality among patients with hyperlactatemia (OR, 1.75; 95 % CI, 0.35-8.71;  $p = 0.49$ ), or acidosis (OR, 1.54; 95 % CI, 0.31-7.72;  $p = 0.6$ ), although these findings did not reach statistical significance. The median length of stay was 21 days (2-129), with no linear correlation with the length of resected intestine ( $p = 0.76$ ), or etiology-induced variations ( $p = 0.821$ ) (Table V).

**Table III.** Surgical details

Surgical details	n (%)
Surgical findings:	
Colon involvement	7 (21.9 %)
Small intestine involvement	28 (87.5 %)
Colon and small intestine involvement	5 (15.6 %)
Purulent peritonitis	3 (9.4 %)
Fecal peritonitis	6 (18.8 %)
Intestinal resection:	
Colon or small intestine resection	26 (8.3 %)
Small intestine resection	24 (75 %)
Colon resection	6 (18.8 %)
Reconstruction:	
Intestinal or colon anastomosis	17 (53.1 %)
Entero-enteric anastomosis	15 (46.9 %)
Enterocolonic anastomosis	2 (6.3 %)
Colocolonic anastomosis	0(0 %)
Ileostomy	0(0 %)
Colostomy	1 (3.1 %)
Mucous fistula	1 (3.1 %)
Intestinal ends abandonment	8 (25 %)
Open abdomen (laparostomy)	30 (93.8 %)
Abdominal closure (palliative)	2 (6.3 %)
Revascularization:	8 (25 %)
Bypass	3 (9.4 %)
Thrombectomy	5 (15.6 %)
Vascular surgeon in surgical team	21 (65.6 %)
Resected intestine length (cm): median (range)	90 (0-300)

**Table IV.** Results

Results	Overall	Arterial embolism	Arterial thrombotic	Veonus thrombotic	Non-occlusive	<i>P</i>
30-day mortality	13 (40.6 %)	3 (50 %)	7 (53.8 %)	2 (25 %)	1 (20 %)	0.42
1-year mortality	21 (65.6 %)	4 (66.7 %)	10 (76.9 %)	3 (37.5 %)	4 (80 %)	0.26
Length of ICU stay: median (range)	7 (2-107)	21 (2-129)	16 (0-69)	17 (3-28)	15 (2-94)	0.69
Length of hospital stay: median (range)	23.65 (0-107)	13 (2-129)	21 (2-85)	18 (15-32)	32 (7-95)	0.95



**Figure 1.** Etiology-based survival.

**Table V.** Prognostic factors

Condition or event	30-day mortality		1-year mortality	
	OR (95 %CI)	<i>p</i>	OR (95 %CI)	<i>p</i>
Previous cardiovascular disease	1.35 (0.31-5.94)	0.687	3.38 (0.8-19.6)	0.163
Preoperative vasoactive agents	3.27 (0.73-14.55)	0.114	4.09 (0.71-23.67)	0.102
Intestinal resection	1.47 (0.23-9.49)	0.687	2.25 (0.37-13.67)	0.371
Intestinal anastomosis	0.62 (0.15-2.58)	0.513	0.52 (0.12-2.32)	0.388
Colon involvement	1.13 (0.21-6.14)	0.892	4 (0.42-38.45)	0.205
Small intestine involvement	2.25 (0.21-24.40)	0.496	7.5 (0.68-83.26)	0.067
Small intestine resection	1.19 (0.23-6.17)	0.835	2.41 (0.47-12.54)	0.283
Colon resection	1.6 (0.27-9.53)	0.604	3.13 (0.32-30.79)	0.311
Abandoned intestinal ends	1.67 (0.33-8.37)	0.533	5 (0.53-47.29)	0.133
Vascular surgeon in the surgical team	0.74 (0.17-3.24)	0.687	0.296 (0.05-1.72)	0.163
Fecal peritonitis	1.6 (0.27-9.53)	0.604	3.125 (0.32-30.79)	0.311
Purulent peritonitis	-	-	0.23 (0.02-2.81)	0.216
Elevated lactate levels (> 2 mmol/L)	1.75 (0.35-8.71)	0.492	1.33 (0.28-6.33)	0.717
pH < 7.35	1.54 (0.31-7.72)	0.599	0.94 (0.18-4.79)	0.938
Leukocytes > 10 x 10 <sup>3</sup> /mL	0.42 (0.08-2.32)	0.314	0.25 (0.03-2.40)	0.205
Renal dysfunction (creatinine > 1.2)	0.95 (0.23-3.92)	0.946	1.93 (0.43-8.61)	0.388
Excess base < -4	1.04 (0.23-4.77)	0.961	0.36 (0.06-2.11)	0.248
HCO <sub>3</sub> < 20 meq/L	3.21 (0.55-18.87)	0.185	0.94 (0.18-4.79)	0.938
Total bilirubin > 2 mg/dL	1.07 (0.25-4.59)	0.926	1.08 (0.24-4.88)	0.923
> 70 years	3 (0.62-14.47)	0.163	5.6 (1.15-27.37)	0.027

## DISCUSSION

Regarding the demographic variables of our series, the prevalence of this condition in both sexes is close to 50 %. Advanced age is a significant risk factor for mortality in patients with AMI, while the incidence of AMI increases exponentially with age (7). This is consistent with the fact that, in our series, patients older than 70 years had higher 1-year mortality rates, which was statistically significant. In patients older than 75 years, AMI is a more common cause of acute abdomen than appendicitis (1). The mean age of our series was 70 years, which is consistent with reports from international experiences.

Elderly patients often present with comorbidities such as cardiovascular diseases, diabetes, and chronic kidney disease, which can complicate their recovery. In our case, the most common comorbidities were AHT, T2DM, a previous cardiovascular disease, and smoking, all of which are associated with elevated atherosclerotic risk factors.

The clinical scenario of a patient complaining of unbearable abdominal pain with an unremarkable abdominal examination is classic for early AMI (14). The reason for the delayed appearance of clinical findings of peritoneal irritation is the progression of ischemia from the mucosa to the serosa. There is a wide spectrum of presentations, ranging from subtle symptoms to a patient in extreme shock. Therefore, a high index of clinical suspicion is required here. According to different series, the most common symptom is abdominal pain (11), which is consistent with the findings made by our center, where abdominal pain was present in 84.4 % of the patients. If the physical examination shows signs of peritonitis, there is likely irreversible intestinal ischemia with intestinal necrosis. In our case, these signs were present in 28.1 % of the patients.

Lab test results can help corroborate clinical suspicion. Over 90 % of the patients will have an abnormally elevated white blood cell count (15). The second most widely found abnormality is metabolic acidosis with elevated lactate levels reported in 88 % of the cases (12).

Dehydration, anaerobic intestinal metabolism, shock, and reduced oral intake often seen in these patients lead to lactic acidosis. Elevated serum lac-

tate levels > 2 mmol/L are associated with irreversible intestinal ischemia (HR, 4.1; 95 %CI, 1.4-11.5;  $p < 0.01$ ) in cases of AMI (16). There was a tendency towards higher 30-day mortality rates in patients with hyperlactatemia (OR, 1.75; 95 %CI, 0.35-8.71;  $p = 0.49$ ), or acidosis (OR, 1.54; 95 %CI, 0.31-7.72;  $p = 0.6$ ), but these findings did not reach statistical significance, probably due to the small sample size.

Among the intraoperative factors reported, there were no statistically significant differences in mortality based on findings of purulent or fecal peritonitis, or the number of centimeters of intestine resected.

Delayed diagnosis is a dominant factor explaining high mortality rates, ranging from 30 % to 70 % (14). Every 6-hour delay in diagnosis doubles the mortality rate (17). In our center, the median time from ER admission to surgery was 10.75 hours, being the longest diagnostic delay, 196 hours. This is probably due to its overall low incidence and the presence of nonspecific symptoms and signs. Therefore, the key remains maintaining a high index of suspicion for the disease. Additionally, another factor that may play a role in this delay is the preoperative resuscitation period, which includes primarily fluid administration, blood products as needed, IV antibiotics, and anticoagulation. Efforts should be directed towards effective multidisciplinary management to reduce this period.

Multidetector CT angiography has replaced formal angiography as the diagnostic imaging modality of choice. Since our hospital is a tertiary referral teaching center located in the capital city, it has a wide variety and availability of both imaging and laboratory studies. In this case, all patients underwent abdominal and pelvic CT scans, which was crucial to confirm the etiological diagnosis in 78.1 % of the patients, and identify signs of intestinal distress (present in 93.8 % of the patients from our series); findings that, in many cases, indicate surgical behavior and determine therapeutic alternatives. In our setting, it is common not to have a radiologist on call, and since this is a time-sensitive disease, it is essential to train emergency surgeons and vascular surgeons in image interpretation, with a focus on CT findings reflecting irreversible ischemia, such as decreased or absent visceral enhancement, pneumatosis intestinalis, portal venous gas, and free intraperitoneal air (18).

The etiology of AMI has changed over the years, with increasing rates of acute arterial thrombosis due to atherosclerosis, historically representing 20 % to 35 % of the cases, and recently increasing up to 40 %. The rates of mesenteric artery embolism dropped down to 25 % of the cases reported, from 50 % prior (2). NOMI represents 25 % of the cases (2). These changes were also seen in our series, with 40 % of AMI due to arterial thrombosis and only 18.8 % to arterial embolism, which is partly explained by the modern anticoagulant therapy used to treat atrial fibrillation.

Open surgery is effective in assessing intestinal viability and preventing delays in revascularization, especially when endovascular approaches are unavailable (1). The goals of surgical intervention for AMI include restoring blood supply to the ischemic intestine, resecting all nonviable regions, and preserving all viable intestine. There are few intraoperative tools to help surgeons make decisions regarding intestinal viability, especially in circumstances where although the intestine appears threatened it is not clearly ischemic. In the emergency setting in our country, most surgeons use their hands and eyes to look for the presence or absence of peristalsis or mesenteric pulsation to assess adequate blood flow. All the patients of the series underwent exploratory laparotomy as their initial intervention. Intestinal resection was performed in 81.3 % of the cases, primarily involving the small intestine.

The decision to perform primary anastomosis (whether enteroenteric or enterocolonic) was made in 53.1 % of the cases, primarily based on clinical criteria and the surgeon's criterion. We should mention that there was a trend toward lower mortality in this group of patients, although it did not reach statistical significance, likely due to the small sample size. This benefit could be explained by the fact that this group of patients was probably in better physiological condition at the time of surgery. Additionally, performing primary anastomoses could shorten the required period of open abdomen, thus reducing the complications associated with the technique, such as evisceration, fluid losses, intestinal fistulas, and wall retraction.

In our series, we should mention that revascularization attempts were made in 25 % of the cases

(8 patients), and all these surgeries were performed by vascular surgeons. Iliac-mesenteric bypass was performed in 3 patients, and Fogarty balloon thrombectomy in 5. Additionally, in 65.6 % of the cases, a vascular surgeon was present in the operating room. We should mention that no general surgeons attempted revascularization. There was a tendency toward lower mortality when a vascular surgeon was part of the surgical team, although it did not reach statistical significance. In this case, it should be the vascular surgeon more experienced in specific mesenteric revascularization techniques, so it should be expected that they would achieve better results, leading to reduced morbidity and mortality.

The data obtained in this study have been valuable at the institutional level because it was seen that the time elapsed from the ER admission to the operating room is of paramount importance and can significantly determine the patient's prognosis. As a result, the focus on continuous hospital improvement led to the formal protocolization of actions in response to suspected AMI. Through this intervention, the aim is to increase revascularization attempts during surgery and, consequently, achieve better outcomes for our patients.

## CONCLUSIONS

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The primary endpoint of 30-day (40.6 %) and 1-year mortality (65.6 %) in patients with AMI is high and consistent with the reported series (9-12). Therefore, early diagnosis and prompt treatment are crucial for improving outcomes. A multidisciplinary approach involving gastroenterologists, vascular surgeons, and intensivists is advised, as well as optimizing logistical response issues to improve patient care and reduce mortality rates.

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