Best Practice & Research Clinical Gastroenterology 31 (2017) 15–25

Contents lists available at ScienceDirect

Best Practice & Research Clinical Gastroenterology

journal homepage: https://ees.elsevier.com/ybega/default.asp

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Acute mesenteric ischemia (part I) – Incidence, etiologies, and how to improve early diagnosis

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Keywords:
Acute mesenteric ischemia
Acute on chronic mesenteric ischemia
Nonocclusive mesenteric ischemia
Mesenteric venous thrombosis
Etiology
Incidence
Diagnosis
Computed tomography

A B S T R A C T

Acute mesenteric ischemia (AMI) is generally thought to be a rare disease, but in fact, it is more common cause of acute abdomen than appendicitis or ruptured abdominal aortic aneurysm in patients over 75 years of age. In occlusive AMI, surgical treatment without revascularization is associated with as high as 80% overall mortality. It has been shown that early diagnosis with contrast-enhanced computed tomography and revascularization can reduce the overall mortality in AMI by up to 50%. However, only a minority of patients with AMI are being treated actively with revascularization in the United States, and the situation is very likely similar in Europe as well. What can we do to improve diagnostic performance, so that more patients get proper treatment? The diagnosis is a collaborative effort of emergency department surgeons, gastrointestinal and vascular surgeons, and radiologists. The etiological categorization of AMI should be practical and guide the therapy. Furthermore, the limitations of the diagnostic examinations need to be understood with special emphasis on computed tomography findings on patients with slowly progressing "acute-on-chronic" mesenteric ischemia.

Introduction

In 1926, A.J. Cokkinis wrote "the diagnosis is impossible, the prognosis hopeless and the treatment useless" [1]. Ninety years later, it is still a common presumption that acute mesenteric ischemia (AMI) is a rare condition which inescapably leads to the death of the patient. The reason for such dreary reputation is not so much based on facts but because AMI is too often found too late when the treatment outcome is inevitably poor. In the early 1990s in Finland, two-thirds of patients with AMI were treated with mere surgical exploration or comfort care resulting in certain death. With good luck, in one-third of the cases, the patient could be treated with bowel resection yielding 50% survival. Open surgical revascularization was attempted in only 7% of the cases and the results were discouraging. The overall mortality of patients with AMI was more than 80% [2].

What has changed in the past two decades? The most important evolutionary step is that today, we have the ability to perform multi-slice contrast-enhanced computed tomography (CT), the most important diagnostic examination in AMI, to nearly all patients with acute abdominal pain at any given time. Second, our endovascular capabilities have taken a leap from the conventional time-consuming catheter-directed thrombolysis to mechanical thrombectomy using dedicated aspiration catheters, and to utilizing stents that are designed especially for visceral arteries. We have seen that with early diagnosis and treatment, more than half of patients with AMI can be rescued [3]. In the United States, endovascular treatment has become nearly as common therapeutic approach as open revascularization in AMI according to studies based on the Nationwide Inpatient Sample (NIS) by Schermerhorn, Lo, and colleagues [4,5]. The in-hospital mortality of American patients undergoing open or endovascular repair for AMI declined from 51% in year 1995 to 26% in 2010 [5].

However, what does not seem to have changed, is that even today, according to NIS, the overall revascularization rate in AMI was no more than 6% in the year 2010 in the United States [5]. In another study, Beaulieu and co-workers found a total of 23744 hospital admissions for AMI registered in the NIS database from 2005 through 2009. At that time, only 3% received an attempt at open (n = 514) or endovascular (n = 165) revascularization, while

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http://dx.doi.org/10.1016/j.bpg.2016.10.018
1521-6918/

17% were treated with bowel resection alone, and an alarming rate of 80% received no intervention whatsoever [6]. There are no other large population based data of the revascularization rate in AMI, but we can only assume that not all patients in Europe, either, get timely diagnosis and proper treatment.

To overcome the diagnostic-related challenges in AMI, we must first acknowledge that AMI is not a rare entity but actually a quite common condition in elderly patients. Second, we must understand the complex pathophysiology and diverse clinical presentation of the disease. The CT signs at early stages of AMI are often subtle and difficult to detect, and therefore, the key to diagnosis is clinical suspicion. Third, the modern treatment of AMI requires a multidisciplinary team of gastrointestinal surgeons, vascular surgeons, and interventional radiologists. We need a practical etiological categorization of AMI that will guide the treatment and a simple algorithm for the various treatment options in different situations.

Incidence

Between 1970 and 1982 in Malmö (Sweden), autopsies were conducted on as many as 87% of the deceased in the population of approximately 250 000 inhabitants [7]. According to this data, the annual incidence of AMI, diagnosed at autopsy or operation, was 12 per 100 000 inhabitans. The distribution of etiology in AMI was roughly 2/3 thromboembolic occlusive mesenteric ischemia, 1/6 non-occlusive mesenteric ischemia (NOMI), and 1/6 mesenteric venous thrombosis (MVT). Thus, the most common cause of AMI was acute occlusion of the superior mesenteric artery (SMA) with incidence rate of 8.6/100 000/year. The SMA occlusion was caused by embolism in 70% and thrombosis in 30% of the cases [8]. The incidence rate of fatal NOMI was given as 2.0/100 000/year, and the incidence rate of MVT with intestinal necrosis was estimated at 1.8/100 000/year [9,10]. An interesting finding in the Malmö cohort was that the incidence of acute SMA occlusion was 1.5 times higher than the incidence of ruptured abdominal aortic aneurysm [7].

Recent data on the incidence of AMI

Due to current low autopsy rates, there is no recent population-based data that would be comparable to the Malmö cohort. The analysis of the NIS registry indicated that the incidence of AMI declined from 8.4 to 6.7/100 000/year between the years 1995 and 2010 in the United States [5]. Similarly, in two contemporary Swedish series of AMI, the reported incidence rates of acute occlusion of the SMA were lower than during the Malmö autopsy study; between 5.3 and 5.4/100 000/year [11,12]. From year 2009–2013 in Kuopio (Finland), practically all patients with acute abdomen from a well-defined population of 250 000 inhabitants were treated in one institution (Kuopio University Hospital); in Kuopio hospital area, the incidence rate of AMI was 7.3/100 000/year for all etiologies and 4.5/100 000/year for occlusive AMI [13]. The incidence of AMI increased exponentially with age (Fig. 1). In patients aged over 75 years, AMI was more prevalent cause of acute abdomen than appendicitis (Table 1).

Changes in cardiovascular risk factors over time

AMI is a disease of the elderly, and the population is aging in Finland, Sweden, United States, and many other western countries. Aging of the population means more burden from cardiovascular diseases. However, interestingly, the incidence of AMI does not seem to have increased. On the contrary, it has been shown that the incidence of cardiovascular events have declined, at least in Finland, and the prevalence of cardiovascular risk factors (smoking, serum total cholesterol, and systolic blood pressure) have also decreased [14,15].

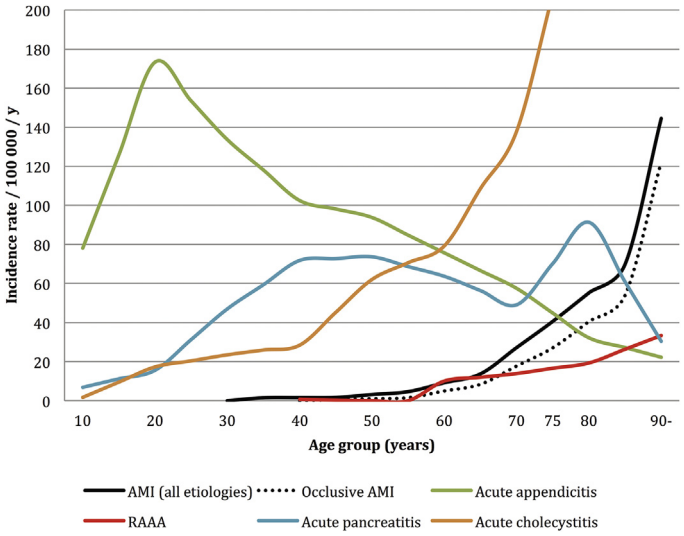

Fig. 1. The age-related incidence rates of acute mesenteric ischemia (AMI), ruptured abdominal aortic aneurysm (RAAA), acute pancreatitis, acute appendicitis and acute cholecystitis in Kuopio/Finland between the years 2009 and 2013 [13].

In the United States, the National Health and Nutrition Examination Survey demonstrated that warfarin use has grown 2.5 times and statin use has almost tripled over a decade from 1999 to 2010 [5]. The increased use of oral anticoagulants may have contributed to the decrease in the incidence of embolic events. Between 1970 and 1982 in Malmö, SMA embolism was the most common cause of AMI with embolism-to-thrombosis ratio of 1.4:1 [16]. From 1993 to 2000, Endean et al. reported embolism-to-thrombosis ratio of 1:1 in 58 American patients with thromboembolic AMI [17] while Ryer et al. reported 0.6:1 ratio in 78 patients between 1990 and 2010 [18]. Although there is no definitive proof of any change in the etiological spectrum of AMI over time, it would seem that atherosclerotic occlusive disease is currently the most common cause of AMI [19].

Prevalence of asymptomatic mesenteric artery stenosis

A patient with acute abdominal pain and chronic calcified occlusion of the SMA represents a special challenge for the clinician. Does the patient have AMI or is the SMA occlusion just an incidental finding? The prevalence of asymptomatic mesenteric artery stenosis has been reported as 6–29% depending on the study [20]. Unfortunately, the studies vary a great deal in terms of the population (e.g. American, European, Korean), the definition of mesenteric artery stenosis (e.g. the numbers of celiac artery (CA) and SMA stenoses are often merged and not given as separate values), the grade of the stenosis included (ranging from 1 to 100%, 50–100% or 70–100%), and the methods of assessing the stenosis (ultrasonography, angiography, CT, or autopsy). What we really would like to know, is 1) the prevalence of SMA occlusion or hemodynamically significant (≥70%) SMA stenosis, especially in the aged population, and 2) how many of those people have significant concomitant CA and inferior mesenteric artery (IMA) obstruction (i.e. 2- or 3-vessel disease). In addition, 3) the natural outcome of chronic SMA occlusion is of great interest.

The current data on the prevalence of asymptomatic mesenteric artery stenosis is listed in Table 2. Based on the available data, the following conclusions can be drawn:

- The prevalence of a hemodynamically significant (>70%) SMA stenosis is approximately 2% in elderly patients aged roughly 70 years or more [21,22].