Annals of Medicine and Surgery 4 (2015) 76–79

Contents lists available at ScienceDirect

Annals of Medicine and Surgery

journal homepage: www.annalsjournal.com

Case report

Endovascular recanalisation of an acute superior mesenteric artery occlusion. A case report and review of the literature

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HIGHLIGHTS

- Early diagnosis by CT angiography is essential in acute mesenteric ischaemia.
- CT is limited in detecting non-specific secondary signs of bowel ischaemia.
- Endovascular interventions are safe alternatives to surgical revascularisation.
- Laparotomy is often required to determine bowel viability and need for resection.

ARTICLE INFO

Article history:
Received 27 June 2014
Received in revised form
21 July 2014
Accepted 23 July 2014

Keywords:
Acute mesenteric ischaemia
SMA occlusion
CT angiography
Endovascular intervention
Thrombectomy
Angioplasty

ABSTRACT

Introduction: Acute mesenteric ischaemia (AMI) continues to have a high mortality, ranging from 60 to 80%.
Presentation of case: A 78-year-old male presented with a 20-hour history of abdominal pain, secondary to a superior mesenteric artery (SMA) thromboembolic occlusion diagnosed on computed tomography (CT) angiography. Following confirmation of bowel viability at laparotomy, endovascular intervention using combined thrombolysis, angioplasty and thromboaspiration was performed. Despite successful recanalisation of the occlusion, his condition continued to deteriorate fatally due to progressive sepsis.
Discussion: We discuss the role of biphasic CT in diagnosis of AMI, and review the evidence for endovascular interventions now increasingly used in the emergent management of thromboembolic AMI.
Conclusion: Early diagnosis using CT angiography is essential, as it is highly sensitive in detecting a visceral arterial occlusion. However, laparotomy is often required to accurately determine bowel viability and the need for resection. Endovascular interventions appear to be effective alternatives to open surgery with appropriate patient selection.

1. Introduction

Acute mesenteric ischaemia (AMI) is caused by a sudden decreased perfusion of the intestines due to impairment of venous or arterial blood flow, and accounts for ~2% of acute abdomen emergencies. AMI is predominantly caused by arterial emboli from cardiac arrhythmias (40–50%), thrombosis at pre-existing lesions (25%), with the remainder due to non-occlusive causes and venous thrombosis [1]. The superior mesenteric artery (SMA) is the commonest site for thromboembolic occlusion due to its oblique origin from the aorta [2]. Patients classically present with severe abdominal pain disproportionate to clinical signs, with minimal tenderness before transmural bowel infarction and peritoneal involvement occurs [3]. Blood tests are non-specific, although there is invariably leucocytosis and raised serum lactate. A high index of clinical suspicion is critical in reducing mortality, which remains as high as 60–80% [1].

In the past, clinical suspicion of an acute SMA occlusion would lead to an urgent exploratory laparotomy to determine bowel viability [4]. The now widespread use of computed tomography (CT) angiography has enabled earlier and more accurate diagnosis, and has also created a window for revascularisation using less invasive endovascular interventional techniques [5]. We present a case of acute SMA occlusion managed using a novel combination of endovascular interventions comprising localised thrombolysis, angioplasty and thromboaspiration. We review the literature on endovascular interventional techniques currently in use, and discuss the evidence for their expanding role as alternatives to surgery in management of early acute SMA occlusions.

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http://dx.doi.org/10.1016/j.amsu.2014.07.005

2. Case report

A 78-year old male presented with a 20-hour history of acute onset severe sharp central abdominal pain and vomiting. On arrival to the emergency department he was pale, tachycardic and hypertensive, with mild central abdominal tenderness. Abnormalities in his blood tests included mild acute renal impairment, leucocytosis and a raised arterial lactate (3.3 mmol/L; normal range 0.5–1 mmol/L). His medical history included atrial fibrillation, ischaemic heart disease and hypertension. An urgent CT mesenteric angiogram was performed and a complete thromboembolic occlusion ~4 cm distal to the origin of the SMA was evident on arterial phase images (Fig. 1A). He was promptly fluid resuscitated and commenced on empirical antibiotics but his clinical condition continued to deteriorate with severe abdominal pain and uncontrolled tachycardia, and an urgent laparotomy was performed at 05:00 h. At laparotomy there were no signs of free fluid or perforation, and the bowel was determined to be viable. It was decided, based on local expertise and facilities available, to transfer the patient to the interventional radiology suite for urgent endovascular revascularisation. Access was established via the right common femoral artery and a 6-French introducer sheath system (Terumo Corporation, NJ, USA). Selective SMA angiography confirmed a segmental thromboembolic occlusion ~4 cm from its origin (Fig. 1B). Selective catheterisation of the SMA was performed using a 0.0014-inch guidewire and SOS Omni® selective catheter (Angiodynamics, NY, USA). The thrombus was initially laced with a 20 mg bolus of tissue plasminogen activator (tPA), followed by angioplasty with a 4 × 20 mm balloon under fluoroscopic control. Remaining fragments of thrombus were removed by thromboaspiration until the occluded segment was fully recanalised. A 6-French closure device (Angioseal®, St. Jude Medical, MN, USA) was used for haemostasis at the femoral access site. The procedure duration was one hour and there were no complications. The patient was then recommenced on a heparin infusion to maintain the activated partial thromboplastin time ratio between 1.5 and 2.5. Within hours his abdominal pain had improved dramatically and the arterial lactate had normalised. Despite this initial improvement over subsequent days his clinical condition continued to deteriorate with progression of sepsis. A repeat CT abdomen 6 days post-intervention demonstrated normal bowel without any secondary signs of intestinal ischaemia (Fig. 1C). In addition to worsening renal impairment he developed acute respiratory distress syndrome (ARDS) requiring ventilation, and unfortunately died 10 days later.

3. Discussion

This case reiterates the important principles in acute mesenteric ischaemia (AMI) of early diagnosis and urgent bowel revascularisation, and serves as a stark reminder of its high mortality. Despite prompt diagnosis of the SMA occlusion, confirmation of viable bowel at laparotomy, and successful endovascular recanalisation of the occlusion, the patient continued to deteriorate. The repeat

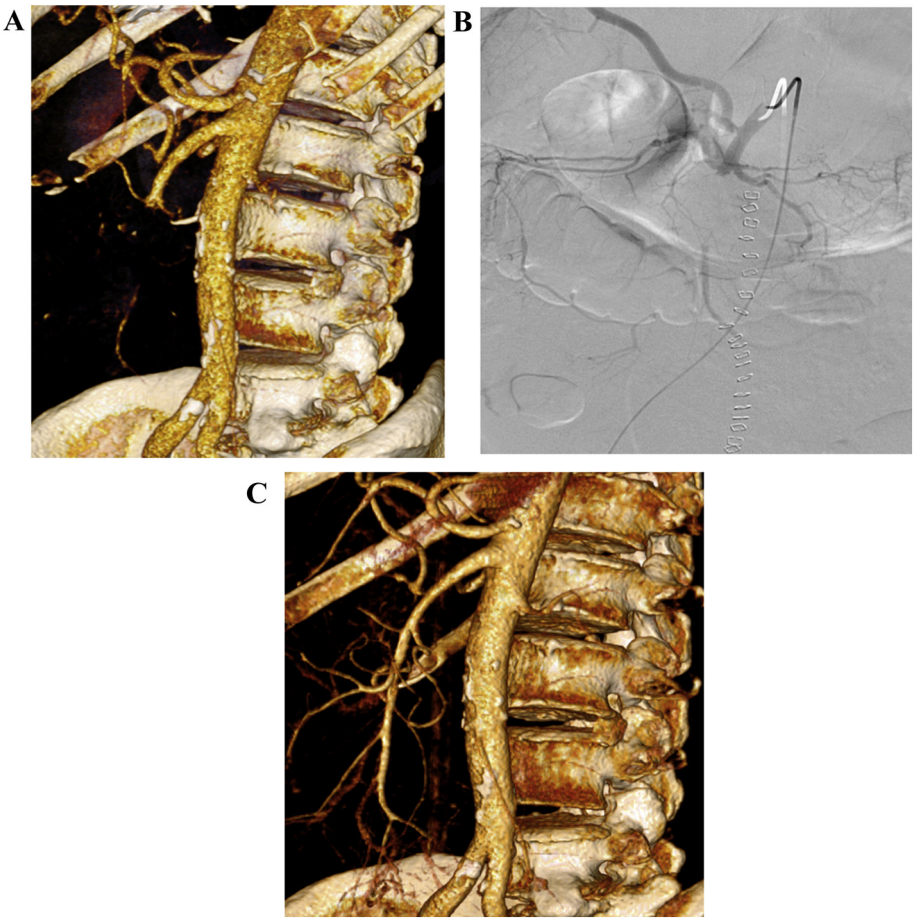

Fig. 1. (A) Three-dimensional volume rendering of arterial phase computed tomography (CT) angiography showing a segmental thromboembolic occlusion of the SMA immediately distal to the right colic branch. (B) Selective catheterisation and angiography of the SMA occlusion. (C) Successful revascularisation of the SMA following catheter-directed thrombolysis, angioplasty and thromboaspiration.

biphasic CT (arterial and portovenous phase) at day 6 post-revascularisation showed a patent SMA and no secondary signs of bowel ischaemia, such as pneumatosis, dilation, bowel wall thickening or oedema. While CT angiography (arterial phase) has been shown to have high sensitivity and specificity of 93% and 100% respectively [6] (and has been shown to yield survival benefit [7]), the accuracy of biphasic CT for secondary signs of ischaemia is less clear. In one case series [8], non-specific signs of ischaemia such as bowel wall thickening was present in 26–96% of cases, bowel dilation (in 56–91%), and fat stranding (58–75%). Pneumatosis, a more reliable and specific sign of ischaemia (almost 100%), is unfortunately of low sensitivity (42%) as it is often a late sign. Whether the absence of these signs on CT is reliable in excluding ischaemia is not clear [8]. In this case, a second look laparotomy may have more accurately determined bowel viability and the need for resection, although it remains unclear if this would have impacted positively on this patients' rapidly progressive renal and respiratory sepsis.

By enabling earlier diagnosis, CT angiography has also created opportunity for bowel revascularisation using less invasive endovascular intervention, and over the past decade the use of endovascular intervention has increased substantially, in one case series a six-fold increase from 1999 to 2006 [9]. There are now numerous case reports and retrospective case series in the literature, all documenting successful outcomes with both pharmacological and mechanical endovascular techniques, with few reported complications.

3.1. Localised thrombolysis

Catheter-directed (localised) thrombolysis has been performed successfully as a stand-alone treatment for acute SMA occlusion. Schoots et al. [10] reviewed 20 cases and 7 case series from 1966 to 2003. Angiographic resolution was successful in 43 of 48 patients using thrombolysis alone, with only 13 patients requiring further surgical intervention. Savassi-Rocha and Veloso [11] in a review paper also recommend thrombolysis as a viable alternative to both open surgical embolectomy, particularly for sub-total or secondary branch occlusions. It should be noted however that localised thrombolysis should not be attempted if there is suspicion of bowel necrosis due to bleeding risk [12], and that prolonged thrombolysis has been shown to cause intra-cranial haemorrhage [13]. Other authors contend that using thrombolysis as a sole treatment is not appropriate in an acute setting, as it can take hours for resolution of the occlusion [14]. For these reasons localised thrombolysis is most often used in combination with a mechanical technique.

3.2. Mechanical intervention

The most commonly used mechanical endovascular intervention in acute SMA occlusion is thromboaspiration (also termed suction thrombectomy), and has been performed successfully by several authors [15–17]. Complications are rare, but can arise. In a retrospective case series of 10 patients with embolic SMA occlusion, one patient suffered a long SMA dissection leading to permanent short bowel syndrome and death [9]. Distal embolisation can also occur. Yang et al. [18] describe a case of thromboaspiration yielding dramatic pain relief, but resulting in occlusion of smaller jejunal branches of the SMA. In such cases, or if recanalisation with suction alone is sub-optimal, improved outcomes have been reported by combining suction with localised thrombolysis [19,20]. Using this combination, Heiss et al. [21] in a case series report requirement for laparotomy to only 6 of 15 patients. Rousseau et al. [22] increased the successful revascularisation of acutely occluded peripheral arteries from 61% to 83% relative to thrombolysis alone.

Angioplasty has also been used in combination with suction [23] and thrombolysis [24] to good effect. Stenting if performed early has been shown to prevent intestinal infarction and obviates the need for laparotomy [25,26]. Self-expanding stents are not generally used as they lack the required strength, but can be used in the tortuous distal SMA or immediately distal to an implanted stent to prevent hinging [14]. Angioplasty and stenting are mainly when an underlying lesion or stenosis is present, and are therefore more frequently used in *chronic* mesenteric ischaemia [27,28]. The risks of in-stent restenosis [29], dislocation and dissection [21] are well documented.

3.3. Hybrid revascularisation

A hybrid approach to the stenting of SMA occlusions has also been proposed. This involves laparotomy with distal clamping of the SMA and retrograde canalisation of the occlusion to facilitate endovascular intervention, usually angioplasty or thrombectomy. In a case series of 13 patients, Wyers et al. [30] compared a hybrid approach with *percutaneous* endovascular stenting and open surgical bypass. The hybrid approach was technically successful in 3 of 6 patients for whom the percutaneous approach failed, and overall mortality was lower in the hybrid group (although not statistically significant). The authors and other proponents [31–33] draw attention to the benefits of combining laparotomy (direct bowel examination to confirm viability) with endovascular intervention, particularly for patients who would otherwise require open surgical revascularisation [14]. However, using the hybrid approach it is also possible that patients for whom an early diagnosis has been made (and therefore suitable for percutaneous endovascular intervention) would be subjected to unnecessary laparotomy.

3.4. Endovascular versus surgical revascularisation

Whether the efficacy and safety of endovascular interventions in early acute SMA occlusion are equivalent or superior to those of open surgery has not yet been conclusively established, and there has been no prospective trial to date. Block and Acosta [34] did conduct a *retrospective* review of the Swedish Vascular Registry involving 121 open and 42 endovascular revascularizations of the SMA from 1999 to 2006. Thirty-day mortality (42 versus 28%, $p < 0.03$), one-year mortality (58 versus 39%, $p < 0.02$), and the need for bowel resection ($p < 0.001$) were all more favourable in the endovascular group. Despite this, the authors clarify that this apparent superior efficacy and safety could be related to differences in disease severity at presentation between the endovascular and open surgical groups.

4. Conclusion

This case serves as a stark reminder of the high mortality of acute mesenteric ischaemia, even despite successful recanalisation. Early diagnosis using CT angiography is essential, as it is highly sensitive in detecting a visceral arterial occlusion. CT is less accurate in detecting secondary signs of bowel ischaemia, and laparotomy is often required to accurately determine bowel viability and need for resection. Endovascular interventional techniques such as thromboaspiration, angioplasty and localised thrombolysis appear to safe and effective alternatives to open surgery in certain cases.

Conflict of interest

The authors have no conflicts of interest to declare.

Funding

No funding was required or used.

Ethical approval

Our institutional ethical review board does not require ethical approval for this case report and review.

Consent

Consent has been obtained.

Author contribution

JM, SM and DB were involved in the clinical management, and in discussion of the case.

JM was involved in the clinical management, undertook the review and prepared the manuscript.

Guarantor

Dr David Brophy, Consultant Interventional Radiologist, St Vincent's University Hospital Dublin, Ireland.

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