

Surgical Management Approaches of Acute Mesenteric Ischemia: A Review

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Abstract: Acute mesenteric ischemia (AMI) is an unusual however highly lethal vascular emergency situation, in which intense intestinal ischemia or even infarction may take place if efficient treatment is not supplied immediately. High mortality rates of 30% to 65% have been reported in a number of big scientific series in the past years. The aim of this study was to discuss the surgical management of AMI, also we intended to overview the diagnostic procedures, and mortality and morbidity associated with surgical treatment outcomes. A comprehensive search was conducted through: PubMed/Midline, of the English-language published literature containing human subject, using the terms “acute” and “mesenteric” or “mesentery,” AND “surgical management” or treatment” was performed to identify all articles reporting AMI treated surgical procedures between up to December 2016. Our evaluation of relevant literature found that the conventional management of AMI was open surgical technique, particularly for those presenting emergently with an intense abdominal area. However, the mortality and intestinal resection rate of OS stays high, despite improvements in medical diagnosis and surgical strategy. Endovascular treatment appears to have a higher rate of bowel conservation as well as increased survival and lower problem rate compared with OS, and as such is a good option for treating AMI.

Keywords: Acute mesenteric ischemia (AMI), mesentery, surgical management, treatment, surgical technique.

1. INTRODUCTION

Acute mesenteric ischemia (AMI) is an unusual however highly lethal vascular emergency situation, in which intense intestinal ischemia or even infarction may take place if efficient treatment is not supplied immediately. High mortality rates of 30% to 65% have been reported in a number of big scientific series in the past years ^(1,2,3).

The mortality rate of severe mesenteric ischemia (AMI) is 50% to 70% and has actually remained at this high level for decades ⁽⁴⁾. The factors for this are on the one hand inadequate understanding of its scientific image in differential diagnosis of stomach pain, when it is ruled out, and on the other hand an unacceptable dead time prior to treatment even when a diagnosis of AMI is thought about ⁽⁵⁾. This is often caused by the lengthy use of inappropriate diagnostic treatments. As a result, even when mesenteric infarction is suspected diagnosis takes approximately 7.9 hours, and treatment another 2.5 hours before mesenteric reperfusion is accomplished ⁽⁶⁾.

The diagnosis of AMI is difficult and it will often go unacknowledged as a cause of death. A population-based research study from a nationwide family doctor database in the UK approximated the overall incidence of AMI at 0.63 per 100,000 individual years ⁽⁷⁾, while a population-based research study in Sweden with an 87 % autopsy rate estimated the incidence more than twenty times greater at 12.9 per 100,000 individual years ⁽⁴⁾. Sixty-five percent of severe remarkable mesenteric artery occlusions were detected at autopsy. The occurrence increases significantly with age and there seems an equivalent incidence in men and women after changing for age and gender in the population ⁽⁴⁾. While the mean age is around 70 years in most studies, a number of report cases in their 20 s ^(8,9,10).

4 various etiological types of AMI have actually been recognized: arterial embolism (EAMI), arterial thrombosis (TAMI), venous thrombosis (VAMI) and non-occlusive mesenteric ischaemia (NOMI). Although they have various clinical and pathophysiological features this does not help with early diagnosis of the disease ^(8,9,10).

Although open surgical treatment (OS) remains the treatment of choice for the majority of AMI, endovascular treatment (ET; ie, percutaneous transluminal angioplasty [PTA] and stent placement) has actually become a promising alternative^(11,12). Endovascular treatment may bring back bowel perfusion faster than open revascularization, such as surgical embolectomy or bypass grafting. In addition, the morbidity and mortality of ET during short-term follow-up seem to be lower than OS, as recommended by case reports and little series^(13,14). Nevertheless, more conclusive data from bigger scale or multicenter randomized controlled trials are not offered. Especially, a hybrid technique (HT), retrograde open mesenteric stenting has gained increasing attention given that it was first reported in 2004⁽¹⁵⁾.

The aim of this study was to discuss the surgical management of AMI, also we intended to overview the diagnostic procedures, and mortality and morbidity associated with surgical treatment outcomes.

2. METHODS

A comprehensive search was conducted through: PubMed/Midline, of the English-language published literature containing human subject, using the terms “acute” and “mesenteric” or “mesentery,” AND “surgical management” or “treatment” was performed to identify all articles reporting AMI treated surgical procedures between up to December 2016. At the first stage, only studies were reviewed that was focusing on surgical treatment of AMI. in this study we included, reviews, systematic reviews, and RCTs, but case reports were excluded.

3. RESULTS

Various surgical reports have actually indicated that acute mesenteric ischemia (AMI) is associated with a poor prognosis^(16,17,18). The basis of treatment for this condition typically emphasizes early diagnosis, resection of infarcted bowel, targeted surgical or nonsurgical restoration of blood flow to ischemic intestine, second-look laparotomy, and supportive extensive care^(19,20).

o Causes of Acute mesenteric ischemia:

The bulk, two-thirds, of patients with severe mesenteric ischemia suffers from intense SMA occlusion whereas non-occlusive mesenteric ischemia and mesenteric venous thrombosis is less common⁽⁴⁾. The frequency of intense mesenteric ischemia depends upon the patient series studied⁽²⁰⁻³⁰⁾ (**Table1**). The frequency was reported to be 17.7% among patients undergoing emergency situation laparotomy⁽²⁰⁾ and as high as 31% among non-trauma patients handled with damage-control surgery⁽³⁰⁾.

Table 1: Frequency of acute mesenteric ischemia in patients with acute abdomen n (%)

Patient selection criteria	Population	Study period	Frequency of acute mesenteric ischemia	#Ref.
Emergency laparotomy	Atlanta, United States	1996-2001	53 (17.7)	(20)
Suspected peritonitis	Ferrara, Italy	1995-2001	2 (2.1)	(21)
Emergency abdominal surgery and age ≥ 70 yr	Valladolid, Spain	1986-1995	27 (3.8)	(22)
Forensic autopsy, peritonitis	Malmö, Sweden	1970-1982	6 (4.4)	(23,24,25)
Acute abdomen and age ≥ 50 yr	Karlskrona, Sweden	2000-2003	9 (8.9)	(26)
Long-term open abdomen treatment	Malmö, Uppsala, Falun, Gävle	2006-2009	11 (9.9)	(27)
Emergency laparotomy	Eastborne, United Kingdom	2008-2010	3 (3.1)	(28)
Emergency laparotomy and age ≥ 80 yr	Gillingham, United Kingdom	2005-2010	5 (5.0)	(29)
Damage-control laparotomy and non-trauma patients	Auckland, New Zealand	2008-2010	13 (31.0)	(30)

○ **Diagnosis of AMI prior to surgical intervention:**

Keeping a high index of suspicion and awareness amongst physicians evaluating patients who are struggling with AMI is not enough to enhance results. The typical medical trial of extreme stomach pain however very little findings at assessment (pain out of proportion), bowel emptying, and presence of a source of embolus in senior patients with intense embolic exceptional mesenteric artery (SMA) occlusion is not a consistent finding. Although patients with severe thrombotic SMA occlusion typically have actually known cardiovascular disease and a history of undiagnosed attacks of stomach angina, clinicians discover it very hard to detect this condition prior to progression towards peritonitis⁽³¹⁾. There is no plasma marker that is accurate enough as an early diagnostic aid⁽³²⁾. The evolution of available high-resolution CT scanners with fast restorations in the sagittal, coronal and transversal aircrafts has made early medical diagnosis possible, and increased the percentage of patients that may be thought about for mesenteric revascularization⁽³³⁾. Embolic occlusion appears frequently as an oval-shaped clot surrounded by contrast in a non-calcified arterial sector located in the distal and middle part of the main stem of the SMA, whereas thrombotic occlusion generally appears as a clot superimposed on a heavily calcified occlusive sore at the ostium of the AMI.

One of the most essential factors relative to effective outcome is early medical diagnosis. Intestinal ischemia is discovered in 1 or 2 of 1,000 health center admissions⁽³⁴⁾, or 1% to 2% of all patients confessed with gastrointestinal diseases⁽³⁵⁾. Because of its relative rarity, physicians may not recognize the early nonspecific signs and symptoms and thus associate a patient's complaints to other causes (36). A high percentage of patients in the current research study provided a history of peptic ulcer disease, seen especially in patients with arterial thrombosis. This finding may, in part, have actually contributed to the delay in diagnosis seen in this cohort of patients. Such a delay can often lead to therapy that ultimately proves to be without advantage⁽³⁷⁾. As the early report shows, however, younger patients are also affected, and failure to recognize that patients over a wide age variety are at risk for intestinal ischemia will delay medical diagnosis. Some authors have actually promoted early arteriography in patients with believed AII both for diagnostic purposes and to help optimize surgical treatment for the underlying arterial pathology⁽³⁸⁾ (**Figure 1**).

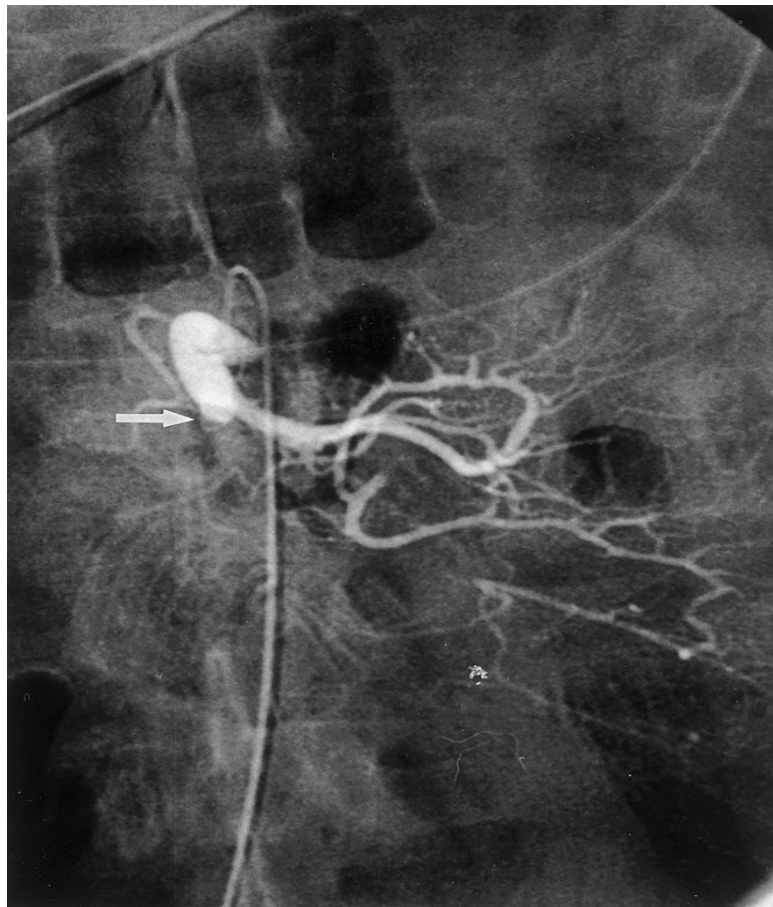


Figure 1: Selective arteriogram of the superior mesenteric artery that shows findings consistent with an embolus (arrow) The proximal branches are perfused; the distal artery is occluded.⁽³⁸⁾

○ **Surgical treatment approaches of AMI:**

Aggressive management is likewise essential for effective result^(39,40). In general, treatment includes fluid resuscitation, intrusive hemodynamic tracking, prophylactic antibiotics, and systemic anticoagulation with heparin. These principles are specifically important in patients with mesenteric venous thrombosis. Heparin is necessary to prevent propagation of thrombus, and long-term anticoagulation with warfarin is had to prevent reoccurrence, which is reported in more than one third of patients⁽⁴¹⁾. Close tracking of fluid status is required because in patients with venous thrombosis, considerable bowel congestion can develop; this in turn can result in sequestration of big volumes of fluid⁽⁴²⁾. If undertreated, this process can advance to shock, hypovolemia, and hemoconcentration, exacerbating the ischemia. Surgical treatment is reserved for patients in whom indications of bowel infarction develop; if required, these patients might need wide resection⁽⁴³⁾. There are anecdotal reports of venous thrombectomy, however this has actually disappointed enhanced result and is normally not recommended⁽⁴¹⁾. Patients with arterial causes of AMI ought to go through emergent surgery to revascularize ischemic bowel and resect infarcted bowel. Revascularization can be accomplished by extraction of thrombus or embolus and/or bypass of the occlusive sore. After revascularization, a conservative method to bowel resection is required to maintain as much intestine as possible. In all patients, bowel that is not infarcted but of questionable practicality needs to not be resected; in these cases, a second-look laparotomy is shown⁽⁴⁴⁾.

Revascularization procedure:

Revascularization is preferentially carried out prior to bowel surgical treatment. On table SMA angiography must then be carried out⁽⁴⁵⁾ if an explorative diagnostic laparotomy is performed as the very first diagnostic action. Any previous CT of the abdomen must be inspected right away. If no vascular cosmetic surgeon is readily available, resection of apparent bowel necrosis should be carried out, the abdominal areas closed, and the patient transferred to a vascular centre. From the nationwide Swedish pc registry of vascular treatments, SWEDVASC, there has been a steady boost in acute SMA revascularizations for intestinal ischemia considering that 2004⁽⁴⁵⁾.

There are 4 retrospective research studies^(45,46,47) reporting results after open vascular and endovascular surgical treatment for intense SMA occlusion. Comparison between endovascular and open surgical treatment doubts due to the existence of numerous prospective confounders, specifically disease severity and sign period. In comparison with studies reporting on results after emergency situation bowel surgical treatment just for intense SMA occlusion, bowel morbidity and short-term death is clearly decreased after intestinal revascularization. There seems to be lower bowel morbidity and lower mortality after endovascular treatment for severe thrombotic occlusion compared with open vascular surgery^(45,46,47). One important element of the endovascular or hybrid method compared to open vascular surgical treatment, which may influence result, is that angiographic monitoring is part of the treatment after endovascular surgical treatment⁽⁴⁵⁾, whereas there is space for much enhancement in the portion and quality of tracking after open vascular surgery.

Second-Look Surgery procedure for in Acute Mesenteric Ischemia:

The “second-look” laparotomy has been accepted by most clinicians as part of the surgical management for mesenteric vascular disease, but dispute continues with respect to its method, timing, energy, and whether it ought to be done consistently or selectively^(48,49,50). A number of strategies have actually been proposed for second-look laparoscopy. Some involve the establishment of a pneumoperitoneum through a previously positioned abdominal drain;⁽⁴⁸⁾ others leave trocar sleeves of different sizes protruding through the stomach wall⁽⁵⁰⁾. A basic strategy includes placing a 12-mm plastic laparoscopic cannula sleeve in the superior element of the injury⁽⁵²⁾. All the above methods prevent further bowel infarction from unnecessary laparotomy and reduce the risk of problems from anesthesia and reoperation. Years ago, lots of surgeons carried out a prepared second-look laparotomy on all patients after preliminary AMI surgery, regardless of whether its origin was venous or arterial, and unrelated to the treatment, anastomosis, or creation of a stoma. This practice conserved lives by finding further necrotic bowel and resecting it promptly, the positive rate of expedition was quite low. As a result, many patients were operated on needlessly, which may consequentially worsen the already major condition of the patients and increase death. To avoid this, some cosmetic surgeons adopted a selective technique and carry out a 2nd laparotomy just when the patient degraded clinically, firmly insisting that reoperation can be securely prevented if the patient stays well⁽⁵¹⁾. It is well understood that the patient's early postoperative course, consisting of physical evaluation and lab parameters, can be misguiding with respect to the practicality of the staying intestinal system⁽⁵²⁾. Some clinicians now recommend that the choice to re-explore must be made at the time of the initial operation, and the cosmetic surgeon

must not deviate from this strategy after leaving the operating room^(53,54). A patient with AMI is still seriously ill even after surgery. Resection of a significant amount of intestinal tract makes the patient vulnerable to numerous postoperative issues, which might lead to death. In a nonrandomized case-- control study⁽⁵⁵⁾.

Second-look laparotomy remains the gold requirement for determination of additional bowel practicality and an operation is the only way to remove dead bowel. Throughout the operation, bowel viability can be assessed by health examination (evaluation of bowel and palpation of vessels), hand-held Doppler ultrasound assessment and intravenous injection of fluorescein⁽⁵⁶⁾. These methods are handy but far from being particular and delicate adequate to enable omitting the second-look treatment⁽⁵⁷⁾. Signs for the second-look treatment remained practical even when more objective approaches such as Doppler ultrasonography and fluorescein screening became available. We utilize neither Doppler nor fluorescein screening pre-operatively. We believe that if the bleeding is enough on the cutting end and the arterial pulse is palpable on the mesenteric side of the bowel in a normotensive patient, the patient is open to anastomosis, unless intra-abdominal sepsis or peritonitis exists.

In a big French research study, although the total survival of patients with AMI enhanced from the early 1980's to early 1990's, the percentage of second-look treatments remained the same⁽⁵⁸⁾. Endean et al⁽⁹⁾ specified that 15 of 43 (35%) patients with AMI with either apoplexy or embolism went through a second-look treatment.

Open SMA embolectomy:

A lot of patients with embolic SMA occlusion will have a main stem embolus and a comprehensive intestinal ischemia⁽⁴⁾. Open SMA embolectomy is an excellent treatment alternative⁽⁵⁹⁾. After laparotomy, exposure of the SMA, transverse arteriotomy, insertion of Fogarty catheter nr 3 downstream and 4 upstream, and balloon embolectomy, is carried out. The outcome ought to be monitored at least by an ultrasonic transit time flow meter, but angiography of the SMA with antero-posterior and lateral views after femoral artery leak and catheterization of the origin of the SMA gives better details about the status of the whole vascular tree, and identifies stenosis and dissection at the closure site, recurring peripheral embolus in arterial branches unclear, and venous go back to the portal vein. The minority of patients with a peripheral embolic SMA occlusion⁽⁴⁾ in one or numerous branches and a restricted bowel section of ischemia might be dealt with primarily with brief bowel resection and primary bowel anastomosis without trying intestinal revascularization⁽⁴⁾. A lot of patients with acute thrombotic SMA occlusion due to thrombosis superimposed on an underlying regional occlusive atherosclerotic sore in the proximal SMA, have comprehensive intestinal ischemia, which requires revascularization for longer survival⁽⁴⁾. Hybrid (integrating open vascular and endovascular surgical treatment) or endovascular approach in acute thrombotic occlusions of the SMA seems beneficial compared to classical open vascular procedures. Endovascular treatment in thrombotic occlusions suggests less surgical injury in these typically elderly fragile patients and needs less intensive care resources than the technically more difficult open vascular reconstructions in the emergency setting⁽⁶⁰⁾. It has been learned from experience that there is rarely any indicator for revascularization of both the SMA and the celiac trunk, and that SMA revascularization plainly is more crucial. The SMA is exposed at the junction of the mesocolon and the small bowel mesentery. A puncture is made in the main trunk of the vessel with a micro puncture needle and the occlusion is typically easily recanalized with a 0.018 mm guidewire into the aorta⁽⁶⁰⁾. If a fresh thrombus at the occlusion site is suspected, the SMA is clamped distally to prevent distal embolization. The proximal SMA sore is then crossed with a stiff, braided 4 Fr catheter, exchanged for a 260 cm long 0.035-inch hydrophilic guidewire. The wire is snared in the aorta using a snare passed through the brachial or femoral artery and then drew out producing through-and-through gain access to. A little transverse arteriotomy is then performed at the level of the leak and an over-the-wire Fogarty balloon is entered the aorta if thrombectomy seems essential. Thrombectomy is performed over the wire and the SMA inflow examined. No arteriotomy is carried out if thrombectomy is not required. Periodically, predilatation with a 3 mm balloon of the occlusive and difficult sore is required. With minor traction on the wire, a 6-7 Fr flexor, destination or introducer, is then positioned antegrade in the SMA over the through-and-through wire. A balloon-expandable stent at the calcified ostium is frequently put across the sore, sometimes followed by a distal self-expandable stent extension into the SMA. Results after stenting are controlled by angiography as well as pressure measurements (**Figure 2**). If there is a residual pressure gradient throughout the stent (> 12 mmHg), additional percutaneous transluminal angioplasty and/or stenting is performed. The access hole after withdrawal of the through-and-through guidewire in the SMA is treated by manual compression. Antegrade stenting is much better than retrograde stenting, considering that the treatment can be carried out in a usual manner with standard devices without exposing the operators to an increased dosage of radiation⁽⁶⁰⁾.

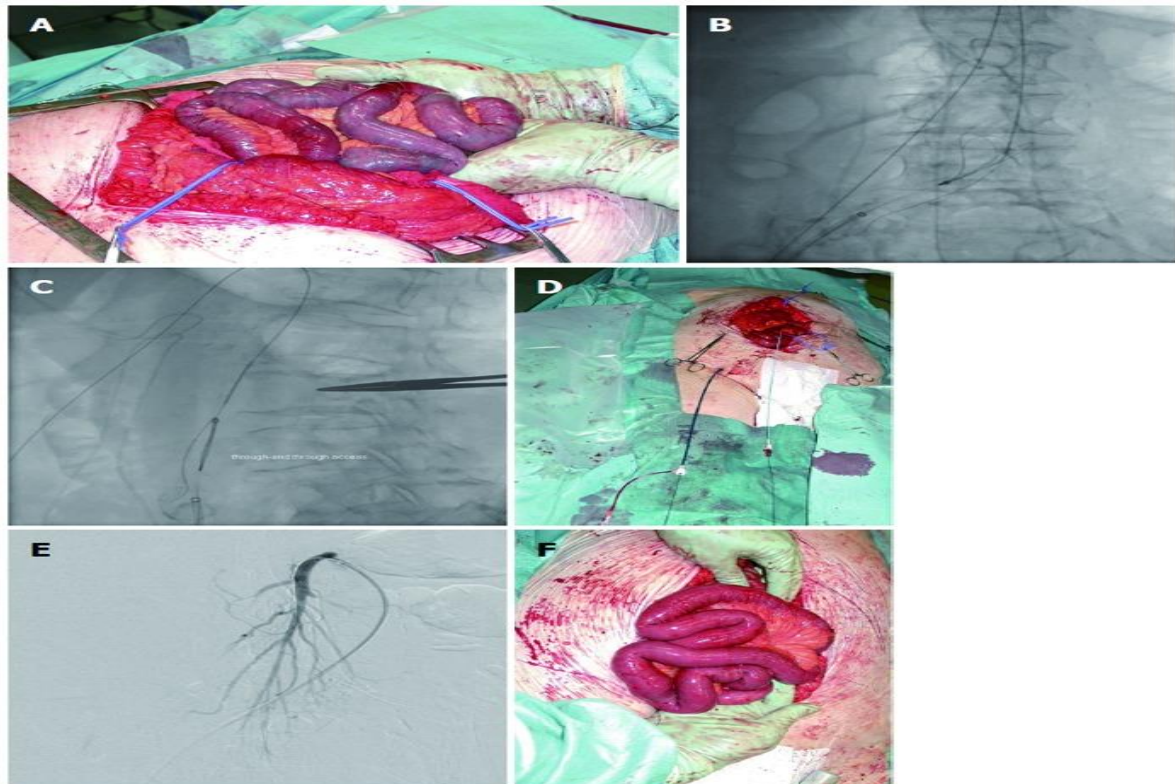


Figure 2: Hybrid approach in a patient with computed tomography verified acute thrombotic occlusion. **A:** Laparotomy shows extensive small bowel ischemia with appearance of cyanosis, poor peristalsis and slight dilatation of small bowel loops. The superior mesenteric artery (SMA) was exposed followed by retrograde puncture of the SMA, passage of a guidewire across the occlusive lesion, which was first dilated with a 2 mm balloon, followed by passage of a 4 Fr Cobra slip catheter downstream from the infra-renal aorta; **B-E:** After retrograde puncture in the right common femoral artery, a long introducer and a snare (**B**) were brought up to catch the guidewire (**C**) introduced from the SMA, to establish through-and-through access (**D**) by bringing the guidewire out of the introducer that was inserted in the groin. The introducer was then advanced into the proximal SMA, followed by antegrade stenting with a short balloon expandable stent, then a longer self-expandable stent extension was introduced (**E**); **F:** Rapid recovery of normal color of the small bowel loops and peristalsis was noted before closing the abdomen. The patient had an uneventful recovery. ⁽⁶⁰⁾

4. CONCLUSION

Our evaluation of relevant literature found that the conventional management of AMI was open surgical technique, particularly for those presenting emergently with an intense abdominal area. However, the mortality and intestinal resection rate of OS stays high, despite improvements in medical diagnosis and surgical strategy. Endovascular treatment appears to have a higher rate of bowel conservation as well as increased survival and lower problem rate compared with OS, and as such is a good option for treating AMI. Other evidence supported that Second-look laparoscopy has become a diagnostic method with potential healing options. Second-look procedure has become more common in mesenteric vessel occlusion with unpredictable intestinal viability observed throughout the primary surgery.

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