ANNALI ITALIANI DI CHIRURGIA

Digital Edition
e-publish on-line
ISSN 2239-253X
Direttore Nicola Picardi

Acute mesenteric ischemia as late complication of previous endovascular treatment in young woman.
Case report and literature review

Ann Ital Chir, 2021; 10 - June 21
pii: S2239253X21033119
Online Epub

Paolo Tamellini, Tommaso Miccoli, Andrea Recchia, Gianguido Pruner, Luca Garriboli, Antonio Maria Jannello

Department of Vascular Surgery, IRCCS Ospedale Sacro Cuore Don Calabria, Negrar (VR), Italy

Acute mesenteric ischemia as late complication of previous endovascular treatment in young woman. Case report and literature review

BACKGROUND: *Acute mesenteric ischemia (AMI) represents a severe complication of chronic mesenteric ischemia (CMI) which is a disorder caused by severe stenosis or occlusion of mesenteric arterial supply. If untreated, patients could face mesenteric infarction and death.*
CASE REPORT: *A 41-year-old female smoker and drug abuser, previously treated with angioplasty and stenting of the superior mesenteric artery (SMA) for CMI four years before, was admitted to our institution suffering from acute abdominal pain due to complete occlusion of the stent. After a few hours of thrombolytic therapy, she experienced sudden worsening of clinical conditions, including AMI, due to complete rethrombosis of the SMA. Thereafter, she underwent urgent thrombectomy and a subsequent retrograde 6 mm prosthetic aorto-mesenteric bypass graft. The patient reported complete relief of symptoms afterwards. A CT scan at 1-month follow-up showed primary patency of the bypass in the absence of clinical recurrence.*
DISCUSSION: *In cases of CMI, treatment options include surgical, endovascular or hybrid approaches. Endovascular therapy, based on percutaneous angioplasty with or without stenting, seems to be effective, although it can have worse mid-term and long-term results.*
CONCLUSION: *In patients already treated with an endovascular revascularization of the SMA or celiac trunk (CT), open surgical repair through a single retrograde aorto-mesenteric prosthetic bypass in cases of acute mesenteric ischemia, seems to offer a valid and safe approach in order to prevent bowel infarction.*

KEY WORDS: Acute mesenteric ischemia Angioplasty, Bypass, Stent, Thrombolysis

Introduction

Chronic mesenteric ischemia (CMI) is a disease that results from progressive stenosis of mesenteric vessels. Atherosclerosis is the most common cause, while fibromuscular dysplasia, polyarteritis nodosa and Takayasu's arteritis represent rarer causes. CMI presents with postprandial abdominal pain, inanition, fear of food and weight loss like many other abdominal and systemic illnesses do. For that reason, diagnosis is often delayed. Untreated, patients face severe malnutrition and death from complications of acute mesenteric ischemia (AMI). A 10-year review at the Mayo Clinic, of patients with AMI, showed that 43% had prior symptoms of untreated CMI [1]. Further to this, a study from the Henry Ford Hospital reported that 52% of patients who presented with AMI had symptoms of CMI [2].
The mesenteric circulation is richly collateralized and arises from the celiac trunk (CT), the superior mesenteric artery (SMA) and the inferior mesenteric artery (IMA).

Pervenuto in Redazione Aprile 2020. Accettato per la pubblicazione Giugno 2020.
Correspondence to: Paolo Tamellini, Department U.O. Vascular Surgery, Institution, IRCCS Ospedale Sacro Cuore Don Calabria, Via Don Sempreboni 5, 37024 Negrar di Valpolicella (Verona), Italy (e-mail: paolo.tamellini@ sacrocuore.it)

CMI is thought to be primarily a disease of both the CT and SMA, as it is rarely seen in patients with single-vessel disease [3,4]. Surgical treatment involves revascularization of the mesenteric vessels; inflow may be from the supra-celiac aorta (antegrade reconstruction), the infra-renal aorta or from the common iliac artery (retrograde reconstruction). Outflow may be to the celiac or more commonly to the SMA only (single-vessel repair) or to a combination of CT, SMA and rarely IMA (multivessel repair). Controversy surrounds the issues of antegrade versus retrograde reconstruction and single-vessel versus multivessel repair. Short-term and mid-term data show good results for open surgical revascularization in CMI, but long-term data (>5 years of follow-up) are lacking. Endovascular therapy has also been used to treat CMI. Although no prospective randomized control data are available, studies indicate that in the short-term, percutaneous angioplasty with or without stenting is effective; however, mid-term and long-term data are not available [5,6]. The real advantage of endovascular therapy is its minimally invasive nature; its disadvantages are the need for re-intervention and poor durability [6].

Case Report

In 2015, a 41-year old female with a history of smoking and cocaine drug abuse was admitted to our institution for abdominal angina complaining of postprandial pain 30-60 minutes after a meal, usually located in the right mid-abdomen and associated with chronic diarrhea. Results of initial examination were unremarkable although she had experienced an 8 kg weight loss in the last year. The patient had a negative gastroscopy; however, color Doppler scanning showed chronic occlusion of the CT and a sub-occlusive stenosis at the origin of the SMA. The stenosis was confirmed by abdominal CT-scan. A left brachial artery approach was used and a 6 Fr introducer sheath was placed according to the Seldinger method. Terumo guidewire was firstly advanced in the descending thoracic aorta and a 5 Fr diagnostic Pigtail catheter was used to perform angiography of the whole abdominal aorta. The examination confirmed the chronic occlusion of the CT, the presence of a short but strict stenosis 5 mm after the origin of the SMA, with an extension of 8 mm and the patency of the IMA. After selective cannulation of the SMA with a 4 Fr Bernstein catheter, exchange of the guidewire with a stiff Rosen version and subsequent predilatation of the vessel with a 5 mm angioplasty balloon, a 6x19 mm balloon expandable bare-metal stent (Express Vascular SD, Boston Scientific), post-dilatated with 6 mm angioplasty balloon, was deployed at the point of the stenosis. A final control angiography was performed and showed regular patency of the vessel and of all its main branches. The punctured artery was compressed for two hours. During the procedure, 5000 international units (IU) of unfractionated heparin were administered; afterward, the patient received dual antiplatelet therapy (100 mg aspirin and 75 mg of clopidogrel) to be continued as a lifelong treatment. She was discharged after three days of hospitalization. Post-operatory and 3-months later, Doppler ultrasound controls showed regular patency of the vessel without any sig-

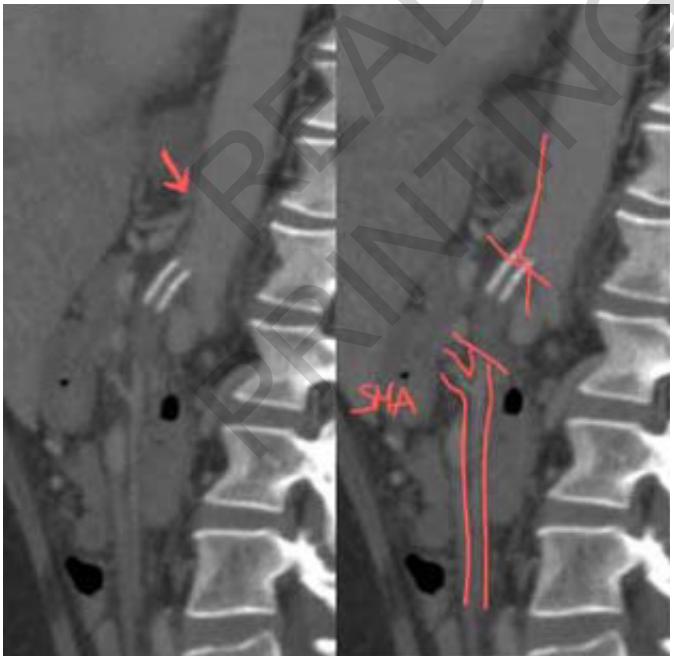

Fig. 1: Urgent CT-scan showing pre-existing occlusion of the celiac trunk (red arrow), complete thrombosis of the stent till the first tract of the SMA and its distal patency.

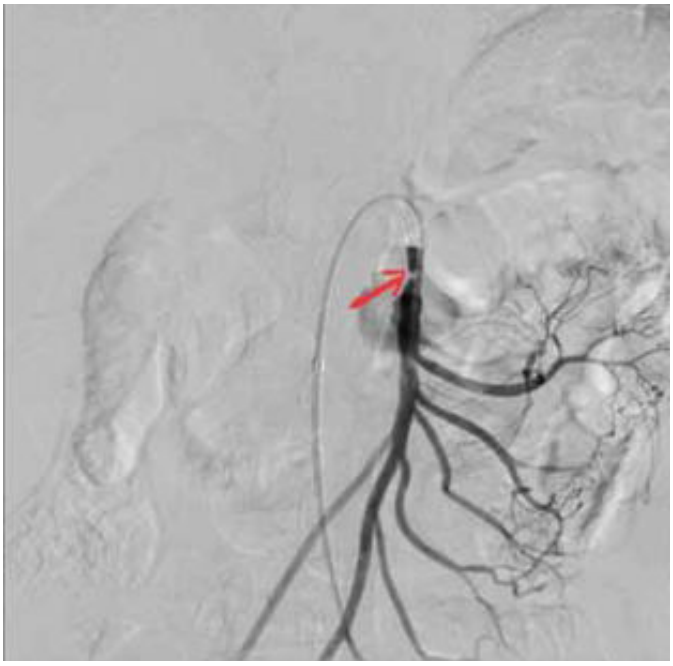

Fig. 2: Angiography after first 6 hours of thrombolysis showing good SMA patency with residual thrombosis (red arrow) at the distal edge of the stent.

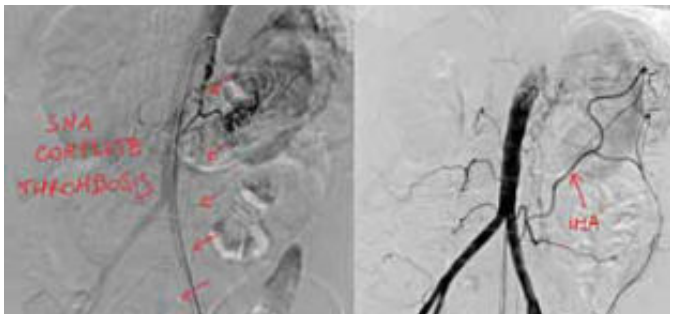

Fig. 3: Urgent angiography showing acute complete thrombosis of SMA and its main branches (red arrows) with good patency of IMA.

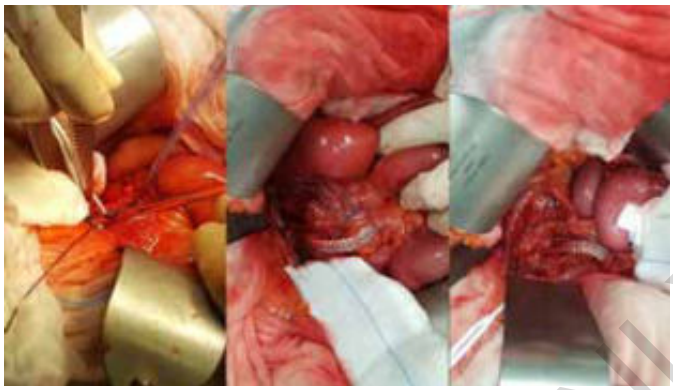

Fig. 4: Urgent laparotomy with SMA exposure, proximal and distal trombectomy with Fogarty's catheter (left image) and subsequent retrograde 6 mm aorto-mesenteric bypass graft.

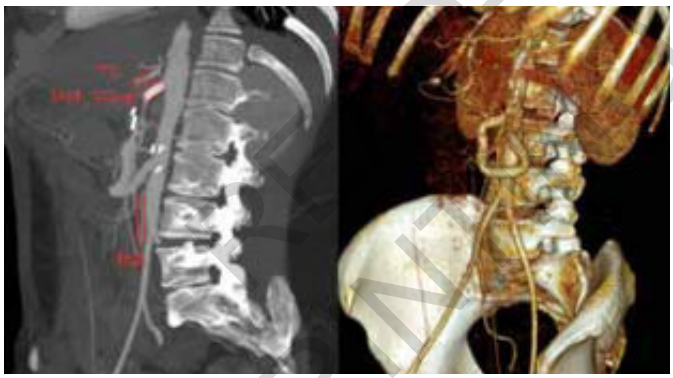

Fig. 5: Angio-CT scan at 1 month showing pre-existing occlusion of the celiac trunk, patency of both aorto-mesenteric graft and distal tract of the SMA and patency of IMA.

nificant variation of flow velocities, confirming the correct placement of the stent. After the procedure, the patient experienced complete relief of all symptoms.
In 2019, four years later, she was admitted for the second time to our institution, suffering from acute abdominal pain. She underwent Duplex ultrasound scan and then an urgent abdominal angio-CT which showed an already known occlusion of the CT, complete thrombosis of the stent up to first tract of the SMA with distal patency of the artery and patency of a hypertrophic IMA (Fig. 1). She underwent urgent abdominal aortic angiography using a right femoral artery approach with a 5 Fr introducer sheath and 5 Fr diagnostic Pigtail catheter, which confirmed the diagnosis. As a first-treatment strategy, we decided to start primary thrombolysis; a 4 Fr straight catheter (Tempo) was positioned at the origin of the vessel, injecting 200,000 IU of Urokinase (UK) to saturate the thrombus and then starting a continuous infusion of UK (70,000 IU per hour). To maintain an adequate level of anticoagulation, a bolus of 5000 IU of heparin sulfate was administered to the patient and 1000 IU/h was continued intravenously. The first control angiography was performed 6 hours later showing a good recanalization of the artery with residual thrombotic stenosis at the distal edge of the stent (Fig. 2); for this reason, we decided to continue the thrombolysis for another six hours. However, after two hours, the patient experienced a sudden surge in acute abdominal pain with two episodes of retching and profuse sweating. An urgent angiography study was performed showing complete rethrombosis of the stent with distal thrombosis of the main trunk of the artery and of its main branches (Fig. 3). Urgent surgical repair was decided upon, and a median laparotomy was performed. The SMA was exposed in its intra-mesenteric segment, taking care to avoid damage to any visceral collaterals. After a small longitudinal arteriotomy and selective proximal and distal thrombectomy with Fogarty's catheter, which gained small but sufficient backflow, a retrograde revascularization from the infrarenal aorta was performed. A 6 mm Dacron graft was anastomosed with a 5/0 Prolene suture to the anterior wall of the infra-renal aorta just above the origin of IMA and then passed through the mesentery directly to the SMA with an end to side anastomosis configuration (Fig. 4). During the procedure, 5000 IU of unfractionated heparin were administered. Coverage of the prosthetic graft by intestinal loops with the mesentery was performed and a post-procedure angiographic control revealed patency of the graft with an optimal outcome on the visceral circulation. Standard closure of laparotomy was then performed. The patient made an uneventful recovery and was discharged on the fifth post-operative day. At 1-month follow-up, an angio-CT scan showed a pre-existing occlusion of the CT, patency of the SMA downstream including its main visceral branches, and patency of the IMA (Fig. 5). The patient reported complete relief of her symptoms.

Discussion

Although visceral vessel stenosis is seen in many routine aortic angiograms performed in patients older than 65 years [7], mesenteric ischemia is an uncommon cause of chronic abdominal pain and there is often a significant

delay between the onset of symptoms and subsequent treatment. Most patients present with a typical history of postprandial abdominal pain and significant weight loss secondary to a decrease in food intake, while other symptoms can include diarrhea or gastrointestinal bleeding [8]. The most common cause is atherosclerosis but among others, cocaine consumption has a detrimental effect on the vascular supply to the mesenteric area causing abdominal ischemic changes and the risk of AMI. These patients are usually younger than 50 years and admitted with acute or sub-acute cardiac or vascular complications. The mechanism of cocaine-induced thrombosis is not well understood, but it is thought to be related to both intimal injury and platelet aggregation. Studies into the possible mechanisms of cocaine-induced arterial and visceral injury have primarily examined coronary circulation [9,10], supporting the hypothesis that cocaine use contributes to coronary obstructive lesions as a result of chronic intimal proliferation and acute platelet thrombosis. Vasoconstriction may also contribute to this process and seems to be related to the strong inhibition of noradrenaline reuptake, negative effects on channels in the endothelium membranes, and interferences with platelet aggregation [11,12].

Mesenteric duplex ultrasonography is the first choice for diagnostic investigation into CMI. Computed tomographic angiography and magnetic resonance are increasingly used for imaging the mesenteric vessels, but digital subtraction angiography still remains the gold standard for planning revascularization. Two functional tests have also been evaluated in patients with CMI for detection of mucosal hypoxia: PCO_2 tonometry and visual light spectroscopy [13,14], but neither provide much additional information in the diagnosis of CMI and therefore they are seldom performed.

Nowadays, revascularization can be performed through different methods including endovascular repair, open surgical or hybrid techniques. Percutaneous transluminal angioplasty (PTA), with or without stenting, has been reported to be associated with a lower risk of morbidity and mortality when compared to open surgery [15-17], making it a valid treatment option not only for those patients with high operative risk [18], but also as a first-treatment solution in younger patients. Focal stenoses are ideally suited for angioplasty, and its advantages are numerous; local anesthesia, no need for laparotomy or dissection in a scarred field and lower morbidity and mortality [19]. Unfortunately, the rate of recurrent stenosis and symptoms is generally higher than that of open surgery [15,16,20,21,24]. Furthermore, there is still no complete consensus as to which type of stent to use, specifically whether covered or bare metal is preferable in the treatment of CMI [25,26].

However, arguably the most difficult decision is how to approach treatment of patients with recurrent symptoms and failed previous endovascular procedures, much like the patient described in our case report. A key point to take into consideration regarding AMI is the clinical and radiological presence of bowel infarction. An interesting retrospective study by Hsu et al. was conducted on patients diagnosed with AMI who had undergone mesenteric artery angioplasty or stenting at a single institution [27]. These patients were divided into 3 different groups: those who received endovascular treatment alone, those who received endovascular treatment before exploratory laparotomy and those who received it after. The study makes two conclusions: firstly, patients who did not undergo laparotomy experienced the highest survival rate, and secondly, the timing of the laparotomy was found to play an important role in avoiding bowel infarction. In our case, when the patient came to our institution with an AMI due to complete occlusion of the previous stent at upper mesenteric artery origin, we decided to start thrombolysis as a first-line treatment strategy in order to avoid urgent exploratory laparotomy and because signs and symptoms of bowel infarction were absent. However, a few hours later, with sudden failure of this treatment and recurrence of symptoms, we decided to perform an urgent laparotomy in order to avoid loss of time and prevent catastrophic complications. Surgical revascularization can be carried out in an antegrade or retrograde fashion, with inflow coming from either the supra-celiac aorta or the descending thoracic aorta, when performing antegrade reconstruction, and from either the infrarenal aorta or iliac artery for retrograde. In patients with hostile anatomy, where distal inflow sources are heavily diseased, an antegrade bypass can be considered [28]. The supra-celiac aorta is often relatively free of disease and less prone to kinking when the graft is oriented in an antegrade fashion, however dissection is technically more demanding and requires a hemodynamically stressful aortic clamping, so it is typically reserved for elective bypasses in more stable patients [29]. Nonetheless Kansal et al [30] retrospectively compared different types of bypass showing no statistically significant difference in terms of symptom-free survival between the two approaches (primary patency at 1 year 95.2% for antegrade bypasses versus 88.2% for retrograde bypasses). Increased evidence of minor complications, such as prolonged ileus, has been reported when adopting the antegrade approach; however a comparable incidence of major complications (mainly cardiac for retrograde bypass and respiratory for antegrade bypass) was reported. McMillan et al [31] showed a 94.9% patency in retrograde bypasses in their series of 38 consecutive bypasses, while Foley et al. 20 reported a 79% primary patency rate at 9 years, of bypasses performed in a retrograde fashion. The retrograde graft can be oriented in a "lazy-C" configuration starting from the right common iliac artery, avoiding any aortic clamping and preventing kinking. Alternatively, as in our case report, a shorter retrograde bypass can also be configured from the infra-renal aorta. Much debate has arisen in the past about the number of vessels that should be revascular-

ized (single vs. multiple) and the choice of conduit for mesenteric bypass grafting; some groups have advocated multivessel reconstruction, whereas others prefer a single-vessel approach [32-35].

The decision to use an autogenous conduit (vein) versus a prosthetic conduit (Dacron or PTFE) is still determined by individual surgeon preference. Synthetic bypass grafts are usually preferred because of a better size match, ease of handling, availability, kink resistance and a general perception that long-term patency is better. If a good quality vein is available, it is generally preferred when the risk of graft infection is consistent[36].

Finally, few authors have reported the use of a hybrid approach to treat AMI, specifically the "retrograde open mesenteric stenting (ROMS)" [37,38]. ROMS allows confirmatory angiography to be followed immediately by definitive revascularization in the same operative setting, avoiding aortic clamping and also avoiding issues of prosthetic conduits in a field that is often contaminated. However, this technique seems to have a high rate of restenosis and a close duplex surveillance follow-up is mandatory.

Conclusions

The decision to perform endovascular, as opposed to surgical repair, in cases of CMI should take into account several factors including: anatomy of lesions, nutritional status of the patient, life expectancy and any comorbidities. Patients who have undergone angioplasty for CMI, with or without stenting, should always undergo strict lifelong follow-up. In cases of AMI due to sudden thrombosis of SMA and a failed endovascular approach, open surgical repair with a single retrograde prosthetic bypass represents a valid and safe strategy in the hands of experienced surgeons. In all cases, the key aim in a setting of AMI, remains minimizing time loss when performing revascularization.

Riassunto

Riportiamo il caso di una ischemia mesenterica acuta gravemente sintomatica, complicanza tardiva di pregressa rivascolarizzazione endovascolare, insorta in modo inusuale in donna giovane.

Il caso giunto alla nostra osservazione riguarda una giovane donna (41 a.), tabagica e con precedente abuso di droga, giunta alla nostra osservazione per reocclusione mesenterica di precedente PTA/stenting. Dopo un primo approccio endovascolare con infusione locoregionale di trombolitico, in seguito al drammatico peggioramento clinico, abbiamo provveduto di necessità al confezionamento in urgenza di by-pass aorto-mesenterico.

Viene descritto il caso e viene fornita una revisione della Letteratura sullo specifico argomento.

References

1. Park WM, Gloviczki P, Cherry KJ, Jr, Hallett JW, Jr, Bower TC, et al.: *Contemporary management of acute mesenteric ischemia: Factors associated with survival.* J Vasc Surg, 2002; 35:445-52.

2. Cho JS, Carr JA, Jacobsen G, Shepard AD, Nypaver TJ, Reddy DJ: *Long-term outcome following mesenteric artery reconstruction: A 37-year experience*. J Vasc Surg, 2002; 35:453-60.

3. Foley MI, Moneta GL, Abou-Zamzam AM, Edwards JM, Taylor LM, Yeager RA, et al.: *Revascularization of the superior mesenteric artery alone for treatment of intestinal ischemia*. J Vasc Surg, 2000; 32:37-47.

4. McAfee MK, Cherry KJ, Naessens JM, Pairolero PC, Hallett JW, Gloviczki P, et al.: *Influence of complete revascularization on chronic mesenteric ischemia*. Am J Surg, 1992; 164:220-24.

5. Matsumoto AH, Tegtmeyer CJ, Fitzcharles EK, Selby JB, Tribble CG, Angle JF, et al.: *Percutaneous transluminal angioplasty of visceral arterial stenoses: Results and long-term clinical follow-up*. J Vasc Interv Radiol, 1995; 6:165-74.

6. Kasirajan K, O'Hara PG, Gray BH, Hertzer NR, Clair DG, Greenberg RK, et al.: *Chronic mesenteric ischemia: Open surgery versus percutaneous angioplasty and stenting*. J Vasc Surg, 2001; 33:63-7.

7. Hansen KJ, Wilson DB, Craven TE, et al.: *Mesenteric artery disease in the elderly*. J Vasc Surg, 2004; 40:45-52.

8. Thomas JH, Blake K, Pierce GE, Hermreck AS, Seigel E: *The clinical course of asymptomatic mesenteric arterial stenosis*. J Vasc Surg, 1998; 27:840-44.

9. Simpson RW, Edwards WD: *Pathogenesis of cocaine-induced ischemic heart disease: Autopsy findings in a 21-year-old man*. Arch Pathol Lab Med, 1986; 110:479-84.

10. Moliterno DJ, Willard JE, Lange RA, et al.: *Coronary-artery vasoconstriction induced by cocaine, cigarette smoking, or both.* N Engl J Med, 1994; 330:454-59.

11. Angel W, Angel J, Shankar SJ: *Ischemic bowel: Uncommon imaging findings in a case of cocaine*. Radiol Case Rep Enteropathy, 2013; 7:38-43.

12. Hoang MP, Edward L, Aditi A: *Histologic spectrum of arterial and arteriolar lesions in acute and chronic cocaine-induced mesenteric ischemia: Report of three cases and literature review*. Am J Surg Pathol, 1998; 22:1404-140.

13. Sana A, Moons LM, Hansen BE, Dewint P, van Noord D, Mensink PB, et al.: *Use of visible light spectroscopy to diagnose chronic gastrointestinal ischemia and predict response to treatment.* Clin Gastroenterol Hepatol, 2015; 13(1):122-30.e1.

14. Otte JA, Geelkerken RH, Oostveen E, Mensink PB, Huisman AB, Kolkman JJ: *Clinical impact of gastric exercise tonometry on diagnosis and management of chronic gastrointestinal ischemia*. Clin Gastroenterol Hepatol, 2005; 3:660-66.

15. Park WM, Cherry KJ Jr, Chua HK, et al.: *Current results of open revascularization for chronic mesenteric ischemia: A standard for comparison*. J Vasc Surg, 2002; 35:853-59.

16. Brown DJ, Schermerhorn ML, Powell RJ, et al.: *Mesenteric stenting for chronic mesenteric ischemia*. J Vasc Surg, 2005; 42:268-74.

17. Oderich GS, Malgor RD, Ricotta JJ ND: *Open and endovas-*

cular revascularization for chronic mesenteric ischemia: Tabular review of the literature. Ann Vasc Surg, 2009; 23: 700-12.

18. Pecoraro F, Rancic Z, Lachat M, Mayer D, Ammann-Vesti B, Pfammatter T, et al.: *Chronic mesenteric ischemia: Critical review and guidelines for management*. Ann Vasc Surg, 2013; 27:113-22.

19. Karina S. Kanamori, Gustavo S. Oderich, , Javairiah Fatima, Timur Sarac, Stephen Cha, Manju Kalra, Randall De Martino, and Thomas C. Bower: *Outcomes of reoperative open or endovascular interventions to treat patients with failing open mesenteric reconstructions for mesenteric ischemia.* J Vasc Surg, 60,(6)1612-619 e2.

20. Foley MI, Moneta GL, Abou-Zamzam AM, Edwards JM, Taylor LM, Yeager RA, et al.: *Revascularization of the superior mesenteric artery alone for treatment of intestinal ischemia*. J Vasc Surg, 2000; 32:37-47.

21. Cho JS, Carr JA, Jacobsen G, Shepard AD, Nypaver TJ, Reddy DJ*: Long-term outcome following mesenteric artery reconstruction: A 37-year experience*. J Vasc Surg, 2002; 35:453-60.

22. Mateo RB, O'Hara PJ, Hertzer NR, Mascha EJ, Beven EG, Krajewski LP: *Elective surgical treatment of symptomatic chronic mesenteric occlusive disease: Early results and late outcomes*. J Vasc Surg, 1999; 29:821-31; discussion 832.

23. Kasirajan K, O'Hara PJ, Gray BH, et al: *Chronic mesenteric ischemia:open surgery versus percutaneous angioplasty and stenting*. J Vasc Surg, 2001; 33:63-71.

24. Rose SC, Quigley TM, Raker EJ: *Revascularization for chronic mesenteric ischemia: Comparison of operative arterial bypass grafting and percutaneous transluminal angioplasty.* J Vasc Interv Radiol, 1995; 6:339-49.

25. Oderich GS, Erdoes LS, Lesar C, Mendes BC, Gloviczki P, Cha S, et al.: *Comparison of covered stents versus bare metal stents for treatment of chronic atherosclerotic mesenteric arterial disease*. J Vasc Surg, 2013; 58:1316-323.

26. Haben C, BS, Park WM, Bena JF, Parodi FE, Lyden SP: *Improving midterm results justify the continued use of bare-metal stents for endovascular therapy for chronic mesenteric ischemia*. Journal of Vascular Surgery, 2019.

27. HsuaA, Ravi Bhattacharyaa K, Kiu Chana H, Huberb TC, Gardnerb B, Stoneb JR, Angleb JF: *Effect of timing on endovascular therapy and exploratory laparotomy outcome in acute mesenteric ischemia*. Annals of Gastroenterology, 2019; 32, 600-04.

28. Giswold ME, Landry GJ, Taylor LM Jr, Moneta GL: *Outcomes after redo procedures for failed mesenteric revascularization*. Vasc Endovascular Surg, 2004; 38:315-19.

29. Johnston KW, Lindsay TF, Walker PM, et al.: *Mesenteric arterial bypass grafts: early and late results and suggested surgical approach for chronic and acute mesenteric ischemia*. Surgery, 1995; 118:1-7.

30. Kansal N, LoGerfo FW, Belfield AK, et al.: *A comparison of antegrade and retrograde mesenteric bypass.* Ann Vasc Surg 2002; 16:591e6.

31. McMillian WD, McCarty WJ, Bresticker MR, et al.: *Mesenteric artery bypass: Objective patency determination*. J Vasc Surg, 1995; 21:729-41.

32. Beebe HG, MacFarlane S, Raker EJ: *Supraceliac aortomesenteric bypass for intestinal ischemia*. J Vasc Surg, 1987; 5:749-54.

33. Calderon M, Reul GJ, Gregoric ID, et al.: *Long-term results of the surgical management of symptomatic chronic intestinal ischemia.* J Cardiovasc Surg (Torino), 1992; 33:723-28.

34. Rapp JH, Reilly LM, Qvarfordt PG, Goldstone J, Ehrenfeld WK, Stoney RJ: *Durability of endarterectomy and antegrade grafts in the treatment of chronic visceral ischemia.* J Vasc Surg, 1986; 3:799-806.

35. McAfee MK, Cherry KJ Jr, Naessens JM, et al.: *Influence of complete revascularization on chronic mesenteric ischemia*. Am J Surg, 1992; 164:220-24.

36. Mark C: *Wyers: Acute mesenteric ischemia: Diagnostic approach and surgical treatment*. Semin Vasc Surg, 2010; 23:9-20.

37. Wyers MC, Powell RJ, Nolan BW, Cronenwett JL: *Retrograde mesenteric stenting during laparotomy for acute occlusive mesenteric ischemia*. J Vasc Surg, 2007; 45:269-75.

38. Milner R, Woo EY, Carpenter JP: *Superior mesenteric artery angioplasty and stenting via a retrograde approach in a patient with bowel ischemia. A case report.* Vasc Endovascular Surg, 2004; 38:89-91.