Successful reimplantation of the hypertrophied inferior mesenteric artery during an open abdominal aortic aneurysm repair

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Abstract: Ischemic colitis is the most common form of an iatrogenic intestinal ischemia following an aortic surgery. It can be transient and self-limiting but, when severe, is associated with mortality even as high as 80%. Careful preoperative assessment can help to anticipate the need for the inferior mesenteric artery (IMA) reimplantation. Some patients lack the sufficient collateral blood supply to the colon and can benefit from the IMA reimplantation, which not only reduces the risk of postoperative colonic necrosis but also can be lifesaving. We report a case of a successful reimplantation of the IMA based on the careful preoperative planning. If unrecognized, this undoubtedly would lead to postoperative colonic ischemia. Therefore, we feel it is important to share our experience regarding the successful management of the presented case.

Keywords: inferior mesenteric artery reimplantation, abdominal aortic aneurysm, ischemic colitis, colonic blood supply, Carrel patch

Introduction

Ischemic colitis remains a rare entity after an elective open abdominal aortic aneurysm (AAA) repair with a reported incidence ranging from 1% to 3% [1]. Although this can be transient and self-limiting condition, when severe, the mortality rate can be as high as 80% [2]. Computed tomography (CT) remains a useful adjunct in establishing the diagnosis, but endoscopy is the procedure of choice [3]. Subsequent treatment algorithm depends on the severity of the clinical symptoms. Conservative approach includes administration of the intravenous fluids, antibiotics, and optimization of the hemodynamic status [4], whereas in patients who developed peritonitis, surgery remains the only treatment option [3]. The inferior mesenteric artery (IMA) ligation during an aortic reconstruction is the most important risk factor in the development of colonic infarction [2]. Although safe in the majority of cases, patients who lack the adequate collateral colonic blood supply are at risk of colonic necrosis. Consequently, ligation of the IMA can have devastating consequences. Despite several intraoperative methods, which are available in order to assess the adequacy of the left colon blood supply, none proved to be reliable and clinically applicable [1]. Most authors suggest that this is a result of a good intraoperative oxygenation and cardiac output, which optimizes blood supply to the colon [1, 2]. Furthermore, the intraoperative assessment can be misleading, because the sufficient blood flow at operation can be inadequate postoperatively, when hypotension or hypovolemia develops [2]. Therefore, the IMA reimplantation offers a potential solution, which can limit colonic ischemia following AAA repair.

The presented case highlights the fact that CT imaging is at the centre of the preoperative AAA assessment. This allows the surgeon to predict when IMA reimplantation is needed in order to avoid colonic ischemia. We feel that it is important to share our experience of the successful management of the presented case.
Case Report

A 76-year-old male presented with an incidental finding of an infrarenal abdominal aortic aneurysm (AAA). The patient complained of the right upper quadrant pain (RUQ) and 1 kilogram weight loss over the period of 2 weeks. The weight loss was investigated with the barium enema, which was unremarkable.

The pain was radiating to the back and was associated with nausea and several episodes of diarrhea. The patient denied any change in bowel habit and rectal bleeding. There was no history of previous abdominal pain or surgical history. Past medical history included hypertension, recurrent deep venous thrombosis, polycythemia rubra vera (treated with regular venesections), and Barrett’s esophagus. Medications included antihypertensives and warfarin. The patient was an ex-smoker with no alcohol consumption.

On admission, the patient was afebrile. His hemodynamic parameters were normal with blood pressure of 164/96 mmHg and heart rate of 80/min. Examination of the cardiovascular and respiratory systems was unremarkable. Abdomen was soft with RUQ tenderness and negative Murphy’s sign. There was no rebound tenderness, and AAA was not palpable. Digital rectal examination was normal.

Laboratory tests showed elevated white cell count (WBC) of $11.7 \times 10^9/L$ and C reactive protein of 22 mg/L. The remaining biochemical markers including liver function tests, amylase, urea, electrolytes, and hemoglobin (15.6 g/dL) with mean corpuscular volume were all normal. His international normalized ratio was 6.3. Urinary dipstick was negative. An erect chest and plain abdominal radiographs were unremarkable.

In a view of clinical and laboratory findings, the provisional diagnosis of a biliary colic was made. Subsequently, an abdominal ultrasound (US) was performed, which revealed large calculus in the gallbladder and no common bile duct dilatation. Additionally, an infrarenal abdominal aortic aneurysm (AAA) was found. This prompted an urgent computed tomography (CT), which confirmed the presence of an infrarenal AAA measuring 6.8 cm.
6.8 cm (anteroposterior diameter) (Fig. 1). Furthermore, it demonstrated a significantly enlarged IMA with tortuous collateral reconstituting the superior mesenteric artery (SMA) and patent coeliac axis (Fig. 2). There was no evidence of a rupture. The internal iliac arteries were patent bilaterally.

Subsequently, the patient underwent a preoperative assessment while waiting for an urgent in house open AAA repair. An arterial duplex US revealed ectatic bilateral popliteal arteries. Echocardiogram was performed as part of a routine preoperative assessment and showed good left ventricular function with ejection fraction >55%. Lung function tests were unremarkable. Exercise tolerance test was within the normal limits. His warfarin was omitted and preoperative international normalized ratio (INR) was 1.3.

At operation, a standard laparotomy was performed and aorta was controlled proximally and distally. IMA was dissected and when clamped, led to a significant bowel ischemia. Although the entire large bowel became dusky, the sigmoid colon was most profoundly affected. The ileum appeared cyanosed, and there was no palpable mesenteric pulse. Therefore, the decision was made to proceed with the IMA reimplantation. A straight tube Dacron graft was used to restore arterial continuity. A button of an aortic wall (Carrel patch) surrounding the IMA orifice was cut out (Fig. 3). This was then sutured onto the Dacron graft using 5.0 Prolene (Fig. 4). The total ischemic time from the IMA clamping to the clamp release was 22 min.

There was a triphasic Doppler signal in the IMA post reimplantation, and the bowel has improved immediately. The reminder of the operation was uneventful. The patient has made a good post-operative recovery and did not require any form of intervention (endoscopy or a second look laparotomy) from the bowel point of view. He was discharged on day 7. During the routine follow-up at 6 and 12 months, the patient was asymptomatic with no bowel problems. Subsequently, he was discharged from a routine follow-up.

Discussion

Ischemic colitis remains an uncommon but potentially serious condition following an AAA repair [2]. In general, colon has good collateral blood supply from each anastomotic network between the superior mesenteric artery and IMA. These anastomoses can enlarge, dilate, and form a marginal artery of Drummond, which then provides entire colonic blood supply [5]. Therefore, even if the atherosclerotic process affects orifices of the coeliac axis, SMA, or IMA, the vast majority of patients remain asymptomatic. However, splenic flexure and sigmoid colon are more susceptible to an ischemic insult when compared with the rest of the colon. This is a consequence of a limited collateral supply in these two watershed areas [4]. Additionally, the marginal artery of Drummond, can be absent in about 5% and underdeveloped even in 50% of the population [3, 4]. As a result, such group of patients has an increased risk of colonic ischemia. For that reason, careful preoperative imaging is vital in order to identify patients who could benefit from the IMA reimplantation.

However, the role of the IMA reimplantation in reducing the risk of colonic infarction poses many deliberations among surgeons. Some suggest that routine IMA (patent) reimplantation prevents colonic ischemia and significantly reduces mortality [2, 6]. However, one must remember that such studies suffer from many deficiencies. For example, lack of routine post-operative endoscopic examination makes it impossible to estimate the overall incidence of colonic ischemia after aortic surgery [2]. On the other hand, others propose that reimplantation of the IMA does not ensure colonic viability [7, 8]. This is believed to be due to other factors, such as aforementioned hypotension, hypovolemia, and low cardiac output in the post-operative period [7]. Additionally, reimplantation prolongs the operation and may be a source of an additional hemorrhage [7, 8]. Yet again, some surgeons do not support this view, claiming that only an additional 15 min of the extra time is required for the IMA reimplantation [2]. Nevertheless, the most reasonable approach seems to be based on the individual case bases including an intraoperative visual assessment and palpation of the mesenteric vessels.

In our case, we have used the Carrel patch technique, which allows for a wider anastomotic orifice between the IMA and Dacron aortic graft and facilitates more precise suturing [9]. Another potential option is to perform an end to side anastomosis between the IMA and the left limb when bifurcated graft is used [1]. If however, the Carrel patch is not possible due to diffuse disease of the aortic wall, then the IMA can be opened longitudinally to ensure the appropriate size of the IMA opening [2].

The classic post-operative signs suggesting the colonic ischemia include bloody diarrhea, abdominal pain, and tenderness over the affected bowel [3]. Unfortunately, these are often absent, and high index of suspicion should alert the surgeon when the patient is not progressing at the expected rate [1]. An elevated lactate, WBC, alkaline phosphatase can be useful adjuncts along with the clinical signs, but are nonspecific [4]. Although CT is often used as a first line imaging modality, early sigmoidoscopy is advocated [1, 3]. Majority of patients respond to the conservative measures, such as intravenous fluids, antibiotics, bowel rest, and avoidance of vasoconstrictive drugs [3]. On the other hand, up to 20% of patients deteriorates and requires timely laparotomy with colonic resection and formation of the colostomy [1, 3].
Conclusion

This case highlights that knowledge of the intra-abdominal vascular anatomy prior to an aortic surgery is vital in safe operative planning. It helps to develop appropriate surgical strategy in order to avoid potential problems. The role of the IMA reimplantation in reducing colonic necrosis remains controversial. However, in selected cases where an inadequate perfusion of the colon exists, it can prevent colonic ischemia. Therefore, the decision regarding the IMA reimplantation should be tailored accordingly to the patient’s needs.

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