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Case Report Special Issue

Colonic Infarction Following Open and Endovascular Abdominal Aortic Aneurysm Repair in Patients with Dolicosigma-2 Case Reports and Revision of Literature

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Abstract

Background: Colonic ischemia is a major adverse event after abdominal aortic aneurysm repair, both in open surgical or endovascular procedures, with poor prognosis and high mortality rates.

Case Report: We report two different cases of colonic infarction, the first following a standard EVAR procedure and the second following open abdominal aortic aneurysm repair. Both patients had a patent Inferior Mesenteric Artery (IMA), intact patent iliac hypogastric arteries pre and post-operatively and had in common a dolicosigma as additional anatomical finding. Informed consent for aneurysm repair and publishing of our case studies was obtained for both patients.

Discussion: Colon ischemia accompanying aortic surgery may be an intra-operative finding or a postoperative diagnosis and may be due to several causative factors. The impact of IMA exclusion on colonic perfusion has been largely evaluated, as well as the importance in maintaining adequate blood supply with the preservation of at least one hypogastric artery in case of chronic occlusion of the iliac arteries or distal aorta. Laboratory and clinical parameters may heighten suspicion of bowel ischemia, but they don't have high enough sensitivity and therefore can't be considered the only diagnostic modality. Colonoscopy still remains the gold standard for documenting ischemic bowel after aneurysm repair.

Conclusion: Early diagnosis is an essential aspect when colonic ischemia occurs as an adverse event after abdominal aortic surgery. Colonscopy has to be performed as early as possible for a certain diagnosis, while clinical parameters and radiological exams, even useful, sometimes may represent confusing factors that could delay the exact diagnosis. Angio-CT scan may be helpful as well in identifying patients with predisposing factors or anatomical variants that can increase the risk of colon ischemia.

Keywords: Abdominal aortic aneurysm repair; Colon ischemia; Dolicosigma; Inferior mesenteric artery

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Introduction

Colonic Ischemia (CI) is a major adverse event both after open or endovascular Abdominal Aortic Aneurysm (AAA) repair, with a current incidence ranging from 1.5% to 3% during elective surgery [1-13]. Presumed causes of CI are non-occlusive ischemia due to shock or vasopressive drugs, inferior mesenteric artery and/or internal iliac arteries occlusion and atheroembolization [2, 14-16].

We report two different cases of colonic infarction, the first following a standard EVAR procedure and the second following open abdominal aortic aneurysm repair, in patients with a patent Inferior Mesenteric Artery (IMA) and intact patent iliac hypogastric arteries pre and post-operatively; both patients had in common a dolicosigma.

Materials and Methods

Patient 1

A 82-year-old man presented with an asymptomatic 6.5cm infra-renal Abdominal Aortic Aneurysm (AAA). He was at high risk for open surgical repair due to several comorbidities. Spiral Computed Tomography (CTA) documented an aortic morphology suitable for a standard endovascular graft, with a straight aortic neck of 28 mm of diameter and 3cm of length from the lowest renal artery, patency of visceral vessels, Inferior Mesenteric Artery (IMA) and 2 couples of lombar arteries; iliac arteries were radiologically free from atherosclerosis as well as femoral accesses (Figure 1). The patient was offered and gave his written informed consent to endovascular aortic aneurysm repair and to publish this case study. An AFX2 endovascular device (Endologix, Irvine, California, United States) with its main body and Vela proximal cuff was successfully deployed, using total percutaneous approach and with preservation of both internal iliac arteries at the end of the procedure (Figure 2). The operation lasted 1 hour and a small quantity of radiographic contrast was used.

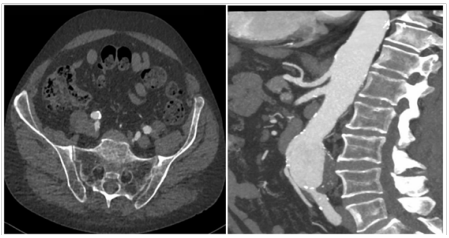

Figure 1: Pre-operative Spiral Computed Tomography (CTA) demonstrates regular patency of visceral vessels, Inferior Mesenteric Artery (IMA) and both hypogastric arteries.

Figure 2: Final intra-operative angiography reveals regular deployment of the graft with preservation of both hypogastric arteries.

Postoperatively the patient was good, with normal life parameters and referring only a mild discomfort in the left lower side of abdomen, but without frank abdominal pain and/or tenderness. During first post-operative day he manifested two episodes of diarrhea with blood striated feces, mild pain on left flank without vomit and full blood count revealed just an elevated white cell count (14×10E9); urea, electrolytes, LDH, liver and renal analyses were all normal. The patient underwent spiral Computed Tomography (CTA) that didn't reveal any bowel pathological finding and confirmed the correct deployment of the graft with patency of all visceral vessel and both hypogastric arteries (with thrombosis of the IMA secondary to graft deployment) (Figure 3).

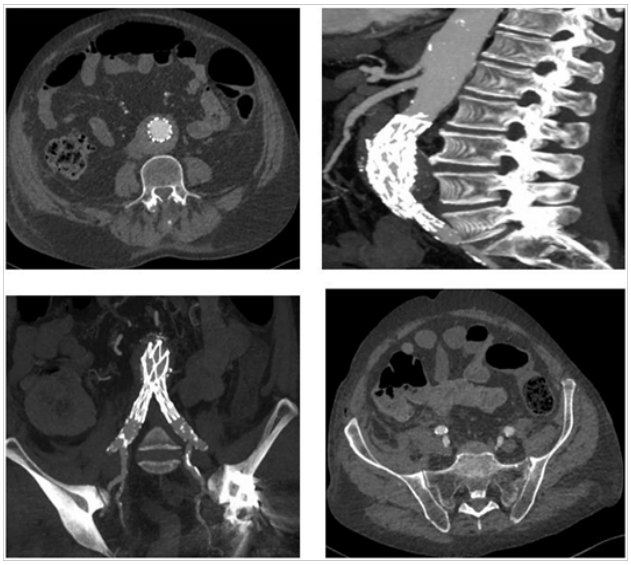

Figure 3: Spiral Computed Tomography (CTA) on 1st post-operative day reveals correct deployment of the graft with patency of main visceral vessel, thrombosis of the IMA secondary to graft deployment and patency of both hypogastric arteries.

On second post-operative day full blood count returned within normal range, the left flank abdominal pain was still present and the patient was visited by a general surgeon who performed a rectal exploration (feces were present in the ampoule without blood marks) and didn't give any further indication.

On the third-fourth day his symptoms progressed and patient's condition significantly deteriorated, the lower abdominal pain worsened with tenderness, (no signs of peritonism were present), as well as biochemical exams, with rise of creatinine values (265mmol/L), LDH (630U/L) and ions (potassium of 5.3mmol/L); white blood cell count was still normal. He developed also acute atrial fibrillation. The general surgeon positioned a naso-gastric tube (that didn't reveal pathologic findings), the patient repeated a computed tomography of abdomen which revealed a paralytic ileus. With a suspicious diagnosis of colon ischemia as the only cause of clinical deterioration, the patient firstly underwent colonscopy (which confirmed the diagnosis) and subsequent underwent laparotomy which showed transmural ischemia and infarction of the upper rectum, sigmoid, descending colon and the splenic flexure. A colonic resection with formation of Hartmann's pouch and tansverse colostomy was performed.

Following colonic resection, he was transferred to Intensive Care Unit where he had significant respiratory problems. His general condition progressively worsened, he refused several times tracheostomy and unfortunately he died after 12 days of hospitalization.

Patient 2

A 68-year old man presented with an asymptomatic 4.5cm infra-renal Abdominal Aortic Aneurysm (AAA) with rapid progression in the last 9 months, combined with a 3cm left common iliac aneurysm. He had only hypertension and hypercolesterolmia and he was fit for an open surgical repair. Spiral Computed Tomography (CTA) confirmed the presence of the aneurysm and the presence of a dolicosigma as an additional anatomical finding; the patient provided his written informed consent both for intervention and publishing this case study and underwent uncomplicated repair with a 16×9mm Hemashield Platinum aorto-bisiliac grafting. No direct intraoperative signs of colonic hypoperfusion or ischemia were detected. On the second post-operative day he developed slight diarrhoea, abdominal distension with diffuse pain (specially on the left side of the abdomen) and hyperpyrexia; peristalsis was still present. On third post-operative day persisted abdominal distension with nausea and vomit; digital rectal examination and plain abdominal X-ray performed the same day suggested an irregular rectal mucosa and "thumbprinting" in his left colon and a provisional diagnosis of ischemic colitis was made. Therefore, the patient firstly underwent rigid sigmoidoscopy and subsequent re-laparotomy which showed transmural ischemia and infarction of the sigmoid colon; a colonic resection and a T-L anastomosis with the descending colon was performed, with a transient ileostomy which was closed a month later. The patient was discharged from hospital after ten days of recovery in good conditions, nowadays is still alive and healthy.

Discussion

Colon ischemia due to aortic surgery may be an intraoperative finding or a postoperative diagnosis, depending on several causes such as embolization of aneurysm contents, decreased perfusion from hypotension, ischemia-reperfusion injury, colonic distention, mesenteric interruption (by previous partial colectomy) or congenitally inadequate mesenteric collaterals [17-49].

A study of J-P. Becquemin et al. [18], found that the type of treatment, rupture, duration of operation, renal disease, pulmonary

dysfunction, blood loss, femoral anastomosis and hypogastric artery loss were statistically associated with the onset of CI.

The ischemic damage of colon could be divided in three different anatomical stages. The first stage is characterized by a transient low-degree damage of mucosal and sub mucosal tunic with high treatment rates and low mortality, while the second by intermediate grade damage including the muscle coat. Both of them are reversible and are normally managed with a conservative treatment, even if damage can lead to fibrosis and stricture of the intestine after healing. In the last stage, transmural damage leads to gangrene and perforation and the surgical treatment is the only choice even if with poor prognosis and a high mortality rates.

Colonic infarction secondary to aortic reconstruction is associated with a nearly 90% mortality. The primary cause in conventional surgery is the generalized hypoperfusion and reperfusion injury resulting from aortic cross clamping and/or hemorrhage [19]. Rare cases of intestinal embolization have been documented after open [20] as well as endovascular AAA repair, [21-23] but IMA occlusion or IIA thrombosis is more commonly associated with bowel ischemia.

The impact of IMA exclusion on colonic perfusion has been largely evaluated. Velazquez et al., reported no episodes of colonic ischemia in patients with a pre-operatively patent IMA that had subsequently thrombosed after endovascular aortic aneurysm repair [24]. However IMA is located between two nutrient systems that can provide collaterality in case of occlusion; the cephalic system involves the SMA with the Riolan and inter-mesenteric arches, while the caudal system involves the IIA via the middle rectal arteries anastomosed with the superior rectal ones. Iliopoulos et al., stated that the cephalic system was a major source of collaterality but that the caudal system was not sufficiently developed to be effective [25]; however, in case of chronic occlusion of the iliac artery or the distal aorta, the IIA may become a determining factor in maintaining adequate blood supply and in these cases anastomoses between the IIA and IMA can be important [26-27]. Some authors have recommended reconstruction of at least one IIA to improve vascularization of the descending colon after AAA repair [28-29], as well as others have suggested tactical reimplantation of a patent IMA to prevent intestinal necrosis [30,31-49]. It is common opinion that maintenance of IMA perfusion has to be taken into consideration if patients have an occlusion of the celiac trunk, SMA or if both hypogastric arteries are occluded; in literature there are several case reports describing endovascular preservation of IMA perfusion to prevent colon ischemia [32-34].

Also collateral pathways between Superior Mesenteric Artery (SMA) and IMA are an important aspect to take into consideration. In Dadian's series [13] between eight patients with colonic ischemia following EVAR one patient had a previous colectomy and Maldonado et al., [15] reported a series of seven patients with pelvic ischemia, four of whom had colonic ischemia and between them one had a previous colectomy.

The arterial supply of internal abdominal organs is characterized by a high degree of variation in origin, trajectory and branching patterns; the greater part of descriptions in literature relate to different variations of vascularization due to anomalies of the superior mesenteric artery and these variations frequently cause difficulties even for experienced specialists during surgical and diagnostic procedures. There are different case reports describing abnormalities of colon vascularization due to the presence of an aberrant "middle" mesenteric artery supplying the distal segment of the ascending and transverse colon [35,36], as well as the presence of an inferior mesenteric artery supplying the entire colon vascularization [37] or an inferior mesenteric artery arising direct from the superior mesenteric artery instead of abdominal aorta [38]. M. C. Rusu et al., described the presence of an Accessory Aberrant Colic Artery (LAACA) originating from the superior mesenteric artery and anastomosed with the middle colic and proper left colic arteries [39]. Furthermore, J. launge et al., proposed an interesting review on Riolano's arch, analyzing the literature related to the vasculature of the colon to emphasize its clinical importance [40]. All these examples are useful because demonstrate the extreme variability in colon vascularization and the fact that a case of necrosis following aortic surgery can be attributed to underdeveloped collaterals.

There are different methods that a vascular interventionist can employ to predict ischemia, including measurement of IMA stump pressure and sigmoid intramucosal pH, both of which have proven to be valuable predictors of colonic ischemia [41-42]. Lebuffe et al., suggested that non-invasive regional and automated capnometry by using semi-continuous sigmoid-to-arterial [P(r-a) CO2] PCO2 gap monitoring may be used to detect preoperative intestinal ischemia in aortic surgery [43]. Another study of M. Poeze et al. [44], investigated the value of D- or L-lactate serum concentration after acute aneurysm repair in prediction of colonic ischemia; results indicated that blood lactate levels provide a marker of metabolism as well as tissue perfusion and that D-lactate may be a more specific marker for colonic ischemia after surgery than L-lactate (which has a raised concentration in other critical illnesses). However, laboratory and clinical parameters may heighten suspicion for ischemia, but have not demonstrated high enough sensitivity or specificity to be used as the only diagnostic modality.

Colonoscopy remains the gold standard for documenting an ischemic bowel and this exam has to be performed as soon as possible when a suspicious diagnosis of colon ischemia is present [45-46]; a retrospective study of Levison et al., recommended selective sigmoidoscopy to detect ischemia when more than two perioperative risk factors were present [47]. BJ. Champagne et al., instituted an aggressive approach with routine colonoscopy after ruptured abdominal aortic aneurysm repair to identify the true incidence of postoperative bowel ischemia and to reduce overall mortality through early treatment, demonstrating that routine surveillance colonoscopy can be safely used as a valid method in detecting early colon ischemia [48].

Our patients had in common a dolicosigma with a pre-operatively patent IMA that subsequently thrombosed after EVAR and that was not reimplanted after open surgery (due to good intraoperative vitality of the bowel evaluated before closure of the abdomen), which could have predisposed him to colonic ischemia. These case reports show the importance of performing colonscopy as soon as possible even if biochemical exams and/or patient's clinic are not diriment for colon ischemia. Moreover, it's always useful the meticulous examination of all anatomical aspects of the CT-exam, with technical focus not only on the aorta and its main branches. In these cases probably the presence of a dolicosigma has been a fundamental aspect causing the absence of vascular compensation from SMA and hypogastric arteries due to sudden thrombosis of IMA. The exact pre-operative knowledge of these anatomical variants could permit tactical surgical reimplantation of a patent IMA to prevent intestinal necrosis even with the

absence of intra-operative signs of bowel ischemia, as well as trying to perform IMA endovascular savage when EVAR has been chosen as the repair modality.

Conclusion

Colonic necrosis still remains a major adverse event with poor prognosis and a high mortality rates. These case reports show the importance of performing an early diagnosis based on high suspicious findings and highlights that colonscopy is the best resource that the surgeon has to perform an early diagnosis of colon ischemia with subsequent immediate open surgical repair. Pre-operative angio-CT scan may be helpful in identifying patients with predisposing factors that increase the risk of colon ischemia; however, it is important not to forget that clinical parameters and radiological exams, even if useful in heighten suspicion for ischemia, may be sometimes confusing factors that delay the exact diagnosis. In conclusion, clinical suspect of colon ischemia after abdominal aortic aneurysm repair must be always high especially during first post-operative days.

Conflict of Interests

The authors certify that there is no conflict of interest with any financial organization regarding the material discussed in the manuscript.

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Author's Contribution

Each author participated to the elaboration of the manuscript.

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