



# A rare iatrogenic mesenteric laceration and hemorrhagic shock after colonoscopy.

## Case report and literature review



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### A rare iatrogenic mesenteric laceration and hemorrhagic shock after colonoscopy. Case report and literature review

**AIM:** We report a particular case study of the unexpected death of a 70-year-old caucasian man (affected by crohn's disease) due to the laceration of the ileocolic mesentery and its blood vessels following a colonoscopy procedure carried out only a few hours previously.

**MATERIAL OF THE STUDY:** The autopsy showed that the lacerated blood vessels (i.e. the collateral and terminal branches of the superior mesenteric artery), which run along the section of the intestines between the end of the ileum and the ascending cecum, had led to a severe intra-abdominal hemorrhage and, consequently, fatal hemorrhagic shock.

**RESULTS:** In such cases, both an autopsy and complete histological analysis are essential in order to determine the exact point responsible for the intestinal hemorrhage and to better understand the pathological mechanism involved.

**DISCUSSION:** The unexpected death due to severe peritoneal hemorrhaging following a minimally invasive diagnostic clinical procedure, such as a colonoscopy, is particularly rare in Literature. In fact, amongst the several endoscopy procedures commonly used today, it is one of the safest procedures with the lowest recorded rate of complications. Furthermore, it is an even rarer event that a routine diagnostic colonoscopy can result in a fatality, with only two cases reported.

**CONCLUSIONS:** In the case of sudden death following such a routine diagnostic clinical procedure, the forensic scientist should not disregard the fact that also damage, which appears negligible (caused by the normal procedures used in carrying out a colonoscopy) can actually also result in severe and fatal hemorrhaging.

**KEY WORDS:** Colonoscopy, Fatal hemorrhage, Forensic pathology

## Introduction

The colonoscopy is a widely used method for diagnosing and treating colonic diseases. The procedure is carried out by inserting a probe, measuring in diameter of about 11mm to 13mm, into the anal passage. In order to facilitate the introduction of the apparatus, air is pre-

viously blown into the colon, thus keeping it dilated. During the procedure, either small fragments of tissue can be obtained for biopsy purposes or polyps, of both small and large dimensions, can be removed.

In particular, a colonoscopy with a retrograde ileoscopy denotes the *gold standard* for the diagnosis of the possible relapse of Crohn's disease, especially in the region of terminal ileum, where the disease is most typically and frequently detected<sup>1,2</sup>. This method, in fact, allows for the detection of typical irregular lesions, often interlaid by macroscopically unscathed areas, as well as ulcers and areas of obstruction or narrowing, stenosis, which can prevent the penetration of the instrument. In addition, the ileoscopy allows for a greater diagnostic resolution compared to that of imaging techniques, such as

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RMN, TC e ETG<sup>3-5</sup>. Paparo et al, in particular, showed how optical colonoscopy with retrograde ileoscopy is the method of choice also to confirm the clinical suspicion of anastomotic recurrence, even if the ileal side of ileocolic anastomoses may not be assessed due to technical complexities in approximately 1/3 of cases<sup>6</sup>.

Thanks to endoscopic examinations, based on Rutgeerts et al.<sup>7</sup> score system, it is possible to categorize patients affected by Crohn's disease into 5 distinct groups according to the gravity of the endoscopic results with such a classification, not only being useful for the planning of medical-pharmacological treatment or surgery, but also for prognostic purposes.

However, it is important to note that this procedure is not completely void of complications. According to literature, despite its rarity, in 0.005 to 0.085% of diagnostic examinations and up to 5% of therapeutic colonoscopies<sup>8-10</sup>, there is the likelihood of the colon becoming perforated. Abdominal bleeding, during or after a diagnostic colonoscopy, is also very rare, ranging from 0.001-0.687% of cases, and usually follows a polypectomy, especially in patients on anticoagulants or patients with a coagulopathy<sup>8,11,12</sup>.

Finally, amongst the most important complications cited in literature, what also emerges is the possibility of damage to the spleen, once again, a rare occurrence, but also possibly in some cases, life-threatening, seen in the form of either a sub-capsular hematoma, a splenic laceration or avulsion<sup>13-15</sup>. The sole recorded case of death following a colonoscopy was due to a splenic capsular avulsion leading to a traumatic hemoperitoneum and hemorrhaging<sup>16</sup>. However, no cases of death following the laceration of the mesentery or the ileocolic blood vessels have been reported after a colonoscopy. Therefore, it can be said that, in line with the information available to us, the herein presented case is extremely rare and, as yet, no such similar case has been reported in literature.

Specifically, our case study is a man, who for 20 years had been affected by Crohn's disease, detected in the ileum. Following a diagnostic colonoscopy to investigate the nature of stenotic lesions and to ascertain whether caused by inflammation or the presence of a neoplasm, he presented a laceration of the fatty mesentery and of the blood vessels of the intestine, including the terminal ileum and the ascending colon, resulting in a massive hemoperitoneum and leading to severe hemorrhaging and his death within 6 to 7 hours after the procedure.

## Case Report

### CASE HISTORY

A 70-year-old Caucasian man, suffering from Crohn's disease of the ileum for about twenty years, underwent

a diagnostic colonoscopy to investigate an intestinal obstruction and bowel wall thickening, (diagnosed by Magnetic Resonance Imaging - MRI). The examination was conducted apparently without any complications. The patient was not taking anticoagulant/antiaggregant drugs and he left the clinic and went home after the procedure. In the afternoon of the same day (approximately five hours after the colonoscopy), he reported a general feeling of discomfort with mild pain in his limbs. About two hours later, the man's body was found at home, lying on the ground, on his side, with blood-stained undergarments.

From the medical history data, the man (who had been treated for several years by the same hospital) had already undergone colonoscopies on other occasions, without any complications whatsoever.

### AUTOPSY AND HISTOLOGICAL FINDINGS

An autopsy was performed about 65 hours later to ascertain the cause of death and to investigate any hypothesis of professional liability of the physician who had conducted the colonoscopy.

The external examination was unremarkable: at the opening of the abdominal wall, adhesions were found in the right iliac fossa and about 2000 cc of free blood fluid found in the peritoneal cavity (Fig. 1A). After bulk dissections of the large and small intestine, diffuse hemorrhagic infiltrations and lacerations of the mesocolon and small bowel mesentery were detected (Fig. 1 B, C). The affected gastrointestinal tract, together with the mesocolon and small bowel mesentery, were therefore totally formalin-fixed.

The spleen and liver had no traumatic lesions. Signs of acute or chronic myocardial infarction were not present and coronary arteries revealed no significant findings. The other organs showed no significant pathological findings.

After the formalin fixation, the colon and small bowel was analyzed by performing sagittal sections of the viscera. There were no obvious macroscopic perforations or lesions of the large arterial or venous vessels. On the contrary, a marked hemorrhagic infarction of the mesentery, with simultaneous multifocal stenotic tracts of interest to the small intestine, were observed (Fig. 1D).

Histological examinations of colonic samples showed a focal nodular inflammatory infiltrate of the section ("Crohn-like" inflammation) and ulcers due to a chronic idiopathic inflammatory disease (Fig. 2 A, B). In addition, there were marked and widespread hemorrhagic infiltrations of the mesocolon and of the small bowel mesentery, with the involvement of the muscular coat (tunica muscularis) and the serous membrane (Fig. 2C). However, there were no morphological findings of iatrogenic damage to the mucosa and intestinal wall.



Fig. 1: Autoptic findings: (A) Massive intra-abdominal hemorrhage. (B-C) Diffuse hemorrhagic infiltrations and lacerations of the mesocolon and small bowel mesentery. (D) Hemorrhagic infiltration of the bowel mesentery after fixation in formalin.

Histological examinations of other organs (i.e. the heart, kidneys, brain, lungs and spleen) were all considered normal and no further pathological findings emerged. The cause of death was attributed to a hemorrhagic shock due to blood vessel lacerations (upper mesenteric branches) which complicate colonoscopies in patients with Crohn's disease.

## Discussion

Crohn's disease is a multi-factorial disease characterized by the chronic inflammation of the intestine, which can affect the entire gastrointestinal tract, from the mouth to the anus. The annual incidence of the disease is 3.1-20.2 per 100,000 with a prevalence of 201 per 100,000 people. Traditionally, the most affected countries are Europe and North America, while the disease is rare in Eastern Europe and Asia. In about 90% of cases, the disease mostly affects the last part of the small intestine (ileum) and the colon<sup>17-19</sup>.

The origin of the disease is not yet well known and treatment involves the early initiation of immunosuppressive therapy, either associated or not associated with new biological drugs such as infliximab and adalimumab. Since no curative treatment is currently available, the therapy is characterized by a treat-to-target approach. The objective is the resolution of inflammation by way of optimizing therapy and serious monitoring (colonoscopy, entero-RM), avoiding any invasive surgical approaches<sup>20,21</sup>.

Local complications are numerous and their frequency increases with the duration of the disease (from 19% to 60% from the first to the eighth year)<sup>22</sup>. They include internal or external fistulas, intestinal obstructions, perforation, bleeding, and abscesses. In particular, ulcers resulting from inflammation, if left untreated, can create intestinal narrowing (stenosis) or deepening, to the point of creating pathways with surrounding organs (fistulas). Fistulae and abscesses are more frequent in inflammatory forms (inflammatory behavior, 62.0%) and fistulizing colic localizations (penetrating behavior, 13.4%);

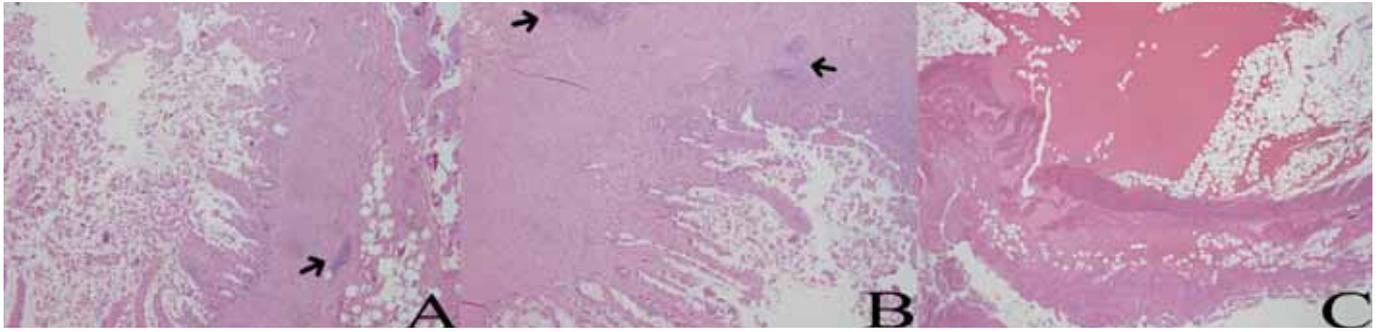


Fig. 2: Histological findings: (A-B) Inflammatory infiltrate of the section ("Crohn-like" inflammation) and ulcers. H&Ex10. (C) Hemorrhagic infiltrations of the mesocolon and of the small bowel mesentery. H&Ex10.

and obstruction in stenosing forms of the distal ileum (stricturing behavior 24.6%). Anal lesions also appear in 31.8% of cases of specific colic localization diseases<sup>23</sup>. The development of adenocarcinoma in the small intestine or in the inflamed colon is a rare but possible complication.

In the elderly, the therapy of Crohn's disease has to be mainly pharmacologic with the usage of new immunomodulatory drugs; instead, surgery has always a major role in acute complications, in complex fistulas and in refractoriness to medical therapy as shown by Carlomagno et al<sup>24</sup>.

The diagnosis and follow-up of Crohn's disease includes, among other tests, the colonoscopy, a minimally invasive procedure with a low rate of complications, usually minor, while fatal cases are extremely rare.

In our study, a case of death due to the laceration of the mesentery and ileocolic blood vessels, following a colonoscopy, which then led to a hemorrhagic shock, is described. In particular, the vessels involved are represented by the terminal branches of the ileo-colic artery and the right colic artery, which are the collateral branches of the superior mesenteric artery. These blood vessels, which are anastomosed into arches, supply arterial blood to the small intestine, the cecum and the ascending colon.

In this context, only two cases are described in literature in which the patient developed a laceration of the mesentery after a colonoscopy but, thanks to the swift action of the surgical treatment, the bleeding was promptly stopped, thus preventing death.

Specifically, Choi YJ et al<sup>25</sup> describe the case of a 20-year-old man, hospitalized for hematochezia and with a family history of colon cancer, who, eight hours after colonoscopy, began to complain of pain in the lower abdominal quadrants and progressive anemia: twelve hours later, a laparoscopic exploration was performed showing a large formation of blood due to the laceration of the mesocolon of the descending colon, promptly treated with heat probe coagulation.

Previously, only Hernandez EJ et al<sup>26</sup> had described a case of a 72-year-old man, suffering from anemia, who

underwent a colonoscopy to remove two sigma-rectal polyps. He too, eight hours after the procedure, began to complain of diffuse abdominal pain: the CT scan performed showed a hematoma of 13x15x18cm below the gallbladder and the exploratory laparotomy performed highlighted the laceration of the mesocolon underlying the transverse colon. Also, in this case, the hemorrhage was resolved during surgery and death was avoided.

In literature, in fact, the laceration of the vessels running inside the ileo-colic mesenteric fat was defined as the cause of death from hemorrhagic shock only in cases of blunt trauma with high kinetic energy<sup>27</sup>.

On the other hand, our case study is the first case of death following a colonoscopy due to a massive hemoperitoneum occurring as a result of the laceration of the mesentery and blood vessels running in the terminal ileum and ascending colon (collateral branches of the upper mesenteric artery). In fact, in the cases described above, the patients who underwent the colonoscopy were in-patients and not out-patients. Moreover, in the second case cited above, the colonoscopy was for operative purposes, and not only diagnostic, a factor that increases the risk of bleeding. Finally, in our particular case, no previous episode of closed trauma had been reported.

In addition, our patient had been suffering from Crohn's disease. It is worth noting that the mesentery of patients suffering from this pathology is often retracted, thickened, with as much as four times the amount of adipose tissue compared to the normal, hardened and inelastic mesentery<sup>28-30</sup>.

Fat-wrapping or creeping-fat is a characteristic phenomenon of Crohn's disease, so much so that some surgeons use it to understand where the disease extends to and to establish the limit of surgical resection. It is referred to as adipose hypertrophy, i.e. an apparent increase in the sub-serious adipose tissue of the intestine that is in continuity with the adipose tissue of the mesentery, such as to create a much larger amount of fat sleeve than is normally the case<sup>31</sup>. However, the cause is not a growth of the adipose tissue, but an increase in the volume of the sub-serosa tissue. This pathological condition causes

edema caused due to the dilatation and obstruction of the sub-serosa lymphatics (lymphocytic lymphangitis).

In our case study, we can report that the mesentery, together with the fibrotic and hardened retroperitoneal tissues, were stretched and lacerated during the normal colonoscopy procedures and it was the mesenteric injury and laceration of the blood vessels that led to the accumulation of 2000cc of blood in the peritoneal cavity and to the hemorrhagic shock. This complication determined the death of the patient about 6-7 hours after the procedure.

In fact, a colonoscopy involves the overcoming of certain anatomical angles of the colon (so-called "flexure") but also angles, strains and deviations caused by pathological factors, such as stenosis and visceral and peritoneal adhesions. In order to be able to proceed, after having dilated the anus with the introduction of air, it is often indispensable to have to rotate, move, retract and push the probe in and out many times and with this action, also the colon is affected, along with the underlying mesentery.

In the present case, the internal abdominal hemorrhage was conspicuous but it happened for resurfacing over a fairly prolonged time, so as not to be evident in the immediate post-colonoscopy period, but only once the patient had returned home, rendering any type of diagnostic and therapeutic intervention to save him impossible.

The autopsy showed that the patient's mesentery had all the macroscopic pathological characteristics as described above and the histology findings confirmed the presence of a marked hemorrhagic infiltration, mainly involving the mesocolon and the small bowel mesentery. The laceration of the mesentery and blood vessels that caused the hemorrhage and the consequent fatal hemoperitoneum were caused by the mesentery corresponding to the terminal ileum and the ascending colon, precisely the exact localization of the acute involvement of Crohn's disease.

In addition, the patient had long been treated with steroid drugs which, as reported in the data sheet, can lead to coagulative disorders for thrombocytopenia.

## Conclusions

This article describes an extremely rare complication of a colonoscopy, which has no precedent in literature.

Only a careful and complete investigation of the circumstantial, autopsy and histological data allowed for a correct diagnosis in this difficult and most complex case. In addition, the fixation of the small and large bowel (tract affected by the bleeding) and the subsequent histological examination allowed us to identify the source of the bleeding and make a differential diagnosis in regards to the complications, complications which are rare but in more detail, those such as intestinal perforation or splenic trauma.

This case should be considered, despite its rate of rari-

ty for a fatal outcome, as a warning to gastroenterologists. Operators should inform patients of the risk, albeit minimal, of bleeding following colonoscopy. Bleeding complications and their potential severity should always be reported when dealing with informed consent. Such measures are also important in avoiding medical and legal disputes<sup>32</sup>.

Moreover, attention should be paid not only to subjects taking anticoagulant drugs or having to undergo operational procedures (such as polyps' removal), but also to subjects undergoing a colonoscopy as a control examination for inflammatory bowel diseases. These patients present subversions in the normal anatomical architecture of intestinal fat (due to fat-wrapping/creeping-fat) with increased fibrotic areas, as well as a greater predisposition to bleeding.

Therefore, for patients suffering from these diseases, an anamnesis and full examination before a colonoscopy, together with a careful observation period following the procedure is crucial, as well as appropriately informing patients of possible symptoms indicative of bleeding. The timely recognition of bleeding complications allows, in fact, for better therapeutic procedures and, therefore, higher chances of survival<sup>31,32</sup>.

From the Medico-Legal point of view, the Public Prosecutor asked for the case to be dismissed, due to no erroneous conduct of the doctor, who performed the colonoscopy, having been identified. In fact, it was reported that the death occurred due to an unacknowledged complication of this procedure, which was neither preventable nor avoidable.

## Riassunto

Un uomo di 70 anni (affetto da Morbo di Crohn) decedeva improvvisamente poche ore dopo l'esecuzione di una colonscopia operativa. L'autopsia mostrava la lacerazione del mesentere e dei vasi sanguigni (rami collaterali e terminali dell'arteria mesenterica superiore) che decorrono nel tratto di intestino compreso tra l'ileo terminale e il cieco-colon ascendente,

La morte improvvisa ed inaspettata dovuta ad emorragia peritoneale massiva a seguito di procedure diagnostiche ambulatoriali minimamente invasive risulta particolarmente rara. Fra le varie procedure endoscopiche diffuse oggi, la colonscopia risulta molto sicura e gravata da un basso tasso di complicanze. Risulta estremamente raro che una colonscopia diagnostica di routine possa provocare complicanze fatali quale la lacerazione del mesentere e dei vasi sanguigni, in assenza di perforazione intestinale. Nel nostro caso questa complicanza provocava una massiva emorragia intra-addominale e quindi uno shock emorragico fatale.

In questi casi è importante un'analisi autoptica ed istologica completa per comprendere l'origine precisa della massiva emorragia intestinale e capire il meccanismo

patologico. Nei casi di morte improvvisa a seguito di procedure diagnostiche ambulatoriali, il patologo forense deve sempre tener presente che anche lesività trascurabili (quali quelle prodotte dalle comuni manovre necessarie per l'esecuzione di una colonscopia approfondita e corretta) possono determinare un'emorragia massiva fatale.

## References

- Gionchetti P, Dignass A, Danese S, Dias Magro FJ, Rogler G, Lakatos PL, et al.: *3rd european evidence-based consensus on the diagnosis and management of crohn's disease, 2016; part 2: Surgical management and special situations*. J Crohns Colitis, 2017; 11:135-49.
- Maaser C, Sturm A, Vavricka SR, Kucharzik T, Fiorino G, Annese V, et al.: *ECCO-ESGAR Guidelines for diagnostic monitoring in IBD. Part 1: Initial diagnosis, monitoring of known IBD, detection of complications*. J Crohn's and Colitis, 2018; 1-32.
- Horsthuis K, Bipat S, Bennink RJ, Stoker J: *Inflammatory bowel disease diagnosed with US, MR, scintigraphy, and CT: Meta-analysis of prospective studies*. Radiology, 2008; 247:64-79.
- Horsthuis K, Stokkers PC, Stoker J: *Detection of inflammatory bowel disease: diagnostic performance of cross-sectional imaging modalities*. Abdom Imaging, 2008; 33:407-16.
- Marshall JK, Cawdron R, Zealley I, Riddell RH, Somers S, Irvine EJ: *Prospective comparison of small bowel meal with pneumocolon versus ileo-colonoscopy for the diagnosis of ileal Crohn's disease*. Am J Gastroenterol, 2004; 99:1321-29.
- Paparo F, Denegri A, Revelli M, Puppo C, Garelo I, Bacigalupo L, et al.: *Crohn's disease: Value of diagnostic imaging in the evaluation of anastomotic recurrence*. Ann Ital Chir, 2014; 85:271-81.
- Rutgeerts P, Geboes K, Vantrappen G, Beyls J, Kerremans R, Hiele M: *Predictability of the post-operative course of Crohn's Disease*. Gastroenterology, 1990; 99:956-63.
- Kim SY, Kim HS, Park HJ: *Adverse events related to colonoscopy: Global trends and future challenges*. World J Gastroenterol, 2019; 25(2):190-204.
- Lohsiriwat V: *Colonoscopic perforation: incidence, risk factors, management and outcome*. World J Gastroenterol, 2010; 16(4):425-30.
- Church J: *Complications of colonoscopy*. Gastroenterol Clin North Am, 2013; 42(3):639-57.
- Wexner SD, Garbus JE, Singh JJ, SAGES Colonoscopy Study Outcomes Group: *A prospective analysis of 13,580 colonoscopies. Reevaluation of credentialing guidelines*. Surg Endosc, 2001; 15:251-61.
- Kavic SM, Basson MD: *Complications of endoscopy*. Am J Surg, 2001; 181:319-32.
- Ullah W, Rashid MU, Mehmood A, Zafar Y, Hussain I, Sarvepalli D, et al.: *Splenic injuries secondary to colonoscopy: Rare but serious complication*. World J Gastrointest Surg, 2020; 12(2):55-67.
- Andrade EG, Olufajo OA, Drew EL, Bochicchio GV, Punch LJ: *Blunt splenic injury during colonoscopy: Is it as rare as we think?* Am J Surg, 2018; 215(6):1042-045.
- Keeven N, Inboriboon PC: *A case of splenic laceration presenting as a delayed complication of colonoscopy*. J Emerg Med, 2019; 56(4):437-40.
- Thompson K, Stier MA: *Death due to a rare complication of colonoscopy and the potential medicolegal implications*. J Forensic Sci, 2018; 63(2):619-21.
- Torres J, Mehandru S, Colombel JF, Peyrin-Biroulet L: *Crohn's disease*. Lancet, 2017; 29:389(10080):1741-755.
- Gajendran M, Loganathan P, Catinella AP, Hashash JG: *A comprehensive review and update on Crohn's disease*. Dis Mon, 2018; 64(2):20-57.
- Burish J: *Crohn's disease and ulcerative colitis. Occurrence, course and prognosis during the first year of disease in a european population-based inception cohort*. Dan Med J, 2014; 61(1)B4778.
- Agrawal M, Colombel JF: *Treat-to-target in inflammatory bowel diseases, what is the target and how do we treat?* Gastrointest Endosc Clin N Am, 2019; 29(3):421-36.
- Serban ED: *Treat-to-target in Crohn's disease: Will transmural healing become a therapeutic endpoint?* World J Clin Cases, 2018; 6(12):501-13.
- Van Assche G, Dignass A, Panes J, Beaugerie L, Karagiannis J, Allez M, et al.: *The second european evidence-based consensus on the diagnosis and management of crohn's disease: Definition and diagnosis*. J Crohns Colitis, 2010; 4:7-27.
- Barros KSC, Flores C, Harlacher L, Francesconi CFM: *Evolution of clinical behavior in crohn's disease: Factors associated with complicated disease and surgery*. Dig Dis Sci, 2017; 62(9):2481-488.
- Carlomagno N, Grifasi C, Dumani X, Lo Conte D, Renda A: *Clinical management of Crohn's disease in the elderly*. Ann Ital Chir, 2013; 84:263-67.
- Choi YJ, Park JS, Kim GE, Han JY, Nah SY, Bang BW: *Mesocolon laceration following colonoscopy*. Korean J Gastroenterol, 2014; 63(5):313-15.
- Hernandez EJ, Ellington RT, Harford WV: *Isolated transverse mesocolon laceration during routine colonoscopy*. J Clin Gastroenterol, 1999; 28(1):46-48.
- Shkrum MJ: *Delayed fatal hemorrhage due to small bowel mesenteric laceration*. Am J Forensic Med Pathol, 2015; 36:236-38.
- Jacobs E, Cosyns JP, Fiase R: *Retroperitoneal, mesenteric and multifocal fibrosis: Review of their aetiopathogenesis. A possible role of adipocytes as in Crohn's disease?* Acta Gastroenterol Belg, 2010; 73(2):252-60.
- Desreumaux P, Ernst O, Geboes K, Gambiez L, Berrebi D, Müller-Alouf H, et al.: *Inflammatory alterations in mesenteric adipose tissue in Crohn's disease*. Gastroenterology, 1999; 117(1):73-81.
- Peyrin-Biroulet L, Chamaillard M, Gonzales F, Beclin E, Decourcelle C, Autunes L, et al.: *Mesenteric fat in Crohn's disease: A pathogenic hallmark or an innocent bystander?* Gut, 2007; 56(4):577-83.
- Mao R, Kurada S, Gordon IO, Baker MR, Gandhi N, McDonald C, et al.: *The mesenteric fat and intestinal muscle interface: Creeping fat influencing stricture formation in Crohn's disease*. Inflamm Bowel Dis, 2019; 25:421-26.
- Zandonà C, Turrina S, Pasin N, De Leo D.: *Medico-legal considerations in a case of splenic injury that occurred during colonoscopy*. J Forensic Leg Med, 2012; 19:229-33.