

# ILEOCECAL INTUSSUSCEPTION OF THE ADULT INDUCED BY THE GASTROINTESTINAL STROMAL TUMOR OF THE ILEOCECAL VALVE - A CASE REPORT

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## ABSTRACT

*Adult intussusception is a rare entity which is distinct from paediatric cases in incidence, aetiology, and management. It represents 5% of all intussusceptions and is the cause of 1% of all intestinal obstructions, 0,08% of all abdominal surgeries and 0,003-0,02% of all hospital admissions. Ileocolic intussusception in adults is a unique variant in which nearly 100% of cases have a malignant lead point. In our report, we described a case of a patient with ileocecal intussusception caused by a rare type of the gastrointestinal tumor. The female patient was admitted to hospital for occasional pain in the lower right quadrant of the abdomen followed by abdominal discomfort and appearance of blood in the stool. The result of CT scan of the abdomen and pelvis showed a tumor mass and intussusception at the ileocecal junction, which was confirmed preoperatively. Open right hemicolectomy was performed adhering to oncological principles. The final pathological diagnosis indicated the gastrointestinal stromal tumor of the ileocecal valve. The diagnosis of intussusception in adults is delicate, and timely surgical treatment can be vital. Patients with the palpable abdominal mass, digestive tract obstruction, gastrointestinal bleeding, or lead point computed tomography must undergo a surgical examination. Given a high risk of malignancy, primary surgical resection using oncologic principles presents the best option for the treatment of ileocecal intussusception in adults.*

**Keywords:** Intussusception in adults, ileocecal valve, GIST tumors.



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## INTRODUCTION

Intussusception in adults is a very rare occurrence. It represents 5% of all intussusceptions and is the cause of 1% of all intestinal obstructions, 0,08% of all abdominal surgeries and 0,003-0,02% of all hospital admissions (1). The overall incidence of intussusception in adulthood has been estimated to be around 2-3 cases/1,000,000 population/year (2). Most often, in 66% of cases, we are talking about intussusception of the small intestine into the small intestine, while ileocecal forms and intussusceptions at different levels of the colon occur in 34% of cases (3). In 60% of cases, intussusception of the small intestine in adults is caused by benign lesions. The rest are caused by malignancy (30%) or are idiopathic (10%). However, most colonic intussusceptions are caused by malignancy (60%) (1).

In our report, we described a case of a patient with ileocecal intussusception caused by a rare type of the gastrointestinal tumor.

## CASE REPORT

The female patient, 79 years old, was admitted to hospital for occasional pain in the lower right quadrant of the abdomen followed by abdominal discomfort and appearance of blood in the stool. The patient reported intermittent bloating, and weight loss of 15 kg in the last 6 months. The patient also reported occasional nosebleeds and occasional coughing up of blood. We found out from the patient's past medical history that she underwent cardiac surgery 25 years ago - triple coronary bypass surgery and a few years later, resection of the aortic arch aneurysm. In addition to the cardiovascular disease, the patient suffers from hypertension, chronic obstructive pulmonary disease and diabetes. Due to the diseases mentioned above, the patient receives an extensive therapy, including oral anticoagulants. She denied any tobacco, alcohol or illicit drug use.

The examination included her vital signs: the temperature of 36.5 degrees Celsius, blood pressure of 160/100 mm Hg, and oxygen saturation of 93% on room air. The patient had irregular heartbeat (arrhythmia absoluta). The physical examination revealed presence of the palpable mass and mild pain in the lower right quadrant of the abdomen. There was no tenderness of palpation. The rectal examination revealed presence of the raspberry-colored mucus.

The basic laboratory blood tests were performed. During the examination, there were signs of anaemia: RBC  $3.16 \times 10^9/L$  (reference range 3.86 - 5.08); HGB 83g/L (reference range 110 - 157); HCT 0,259 (reference range 0.356 - 0.470). Prothrombin time (PT) and international normalized ratio (INR) were raised to 52.6 (reference range: 9.1-12.1) and 4.760 (reference range for patients with the anticoagulant

therapy: 2.0-4.0), respectively. Partial thromboplastin time (PTT) was 64.0 sec (reference range: 25.0-35.0). The blood tests for inflammatory markers were negative. The analysis of tumor markers for colorectal cancer was performed. The results were in the reference range: CEA 1.7ng/mL (reference range: 0.0 - 5.0); AFP 7.11 IU/ml (reference range: 0.00 - 7.40). The urine analysis was negative for the urinary tract infection. The gynecological examination was unremarkable. The plain abdominal X-ray and abdominal ultrasound showed normal findings.

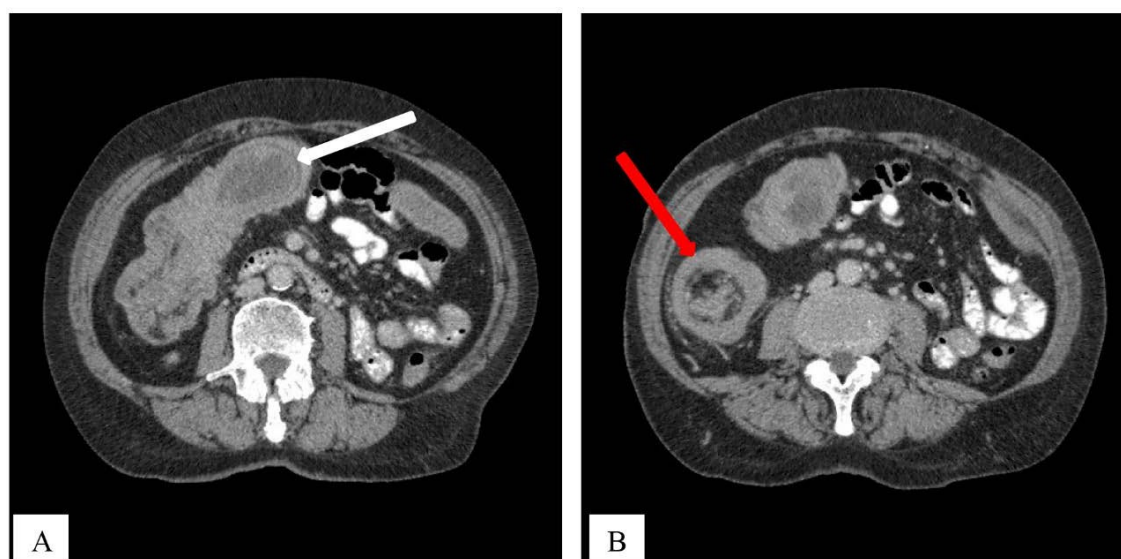
CT-scan confirms extensive ileocecal intussusception extending up to the transverse colon. A nodular structure was observed near the distally involved small intestine, which may suggest a tumor and would explain intussusception in the patient at this age. Edema of the bowel wall and free fluid in the lumen were observed (Figure 1).

Surgical intervention is indicated. Intraoperative findings indicate intussusception about 20cm of the terminal ileum in the lumen of the cecum (Figure 2A). Ileocecal valve cannot be identified. In the lumen of the cecum, there is a palpable tumor mass about 8 cm in diameter (Figure 2B). The appendix does not participate in intussusception. No signs of bowel ischemia were observed, there was no free fluid in the abdomen. Open right hemicolectomy was performed adhering to oncological principles (Figure 3). Re-establishing of the intestinal continuity was done with side- to- side ileocolic anastomosis. The patient tolerated the procedure well with minimal blood loss and no complications.

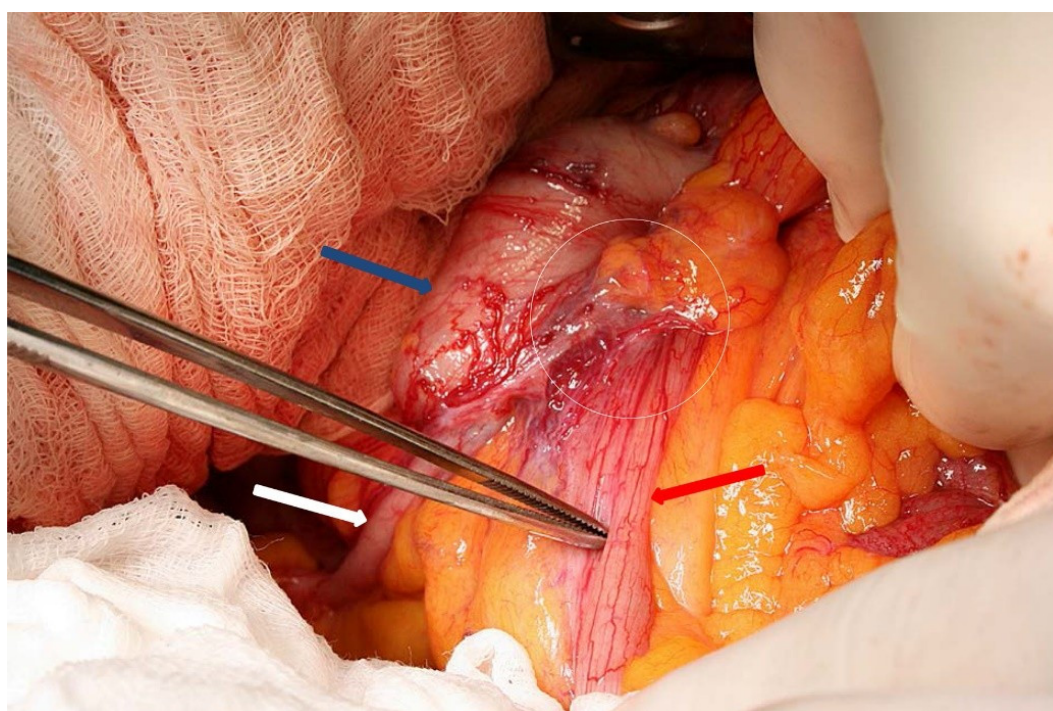
The final pathologic diagnosis indicated the gastrointestinal stromal tumor of the ileocecal valve. The tumor size was 76 mm in diameter; the base of the tumor was on the ileocecal valve, 26 mm in diameter (Figure 4). The tumor did not grow into the intestinal wall. In the surrounding pericolic adipose tissue, 18 lymph nodes with no metastatic deposits were found and analyzed. Immunophenotype profile: CD117++, CD34++, alpha-smooth muscle actin ( $\alpha$ -SMA)+, desmin+, S-100+. GIST diagnosis was confirmed on the routine HE-stained sections ( $\times 100$ ) of the tumor tissue (Figure 5A) and immunohistochemical analysis ( $\times 100$ ). Tumor cells were diffuse positive for CD117 (Figure 5B). GIST diagnosis was confirmed on (e-h) immunohistochemical analysis ( $\times 100$ ). Tumor cells were focally positive for desmin,  $\alpha$ -SMA, CD34 (Figure 5C); S-100 protein and Ki-67 ( $\times 200$ ) proliferation index was very low (Figure 5D).

The patient was discharged thirteen days after the operation.

**Figure 1.** Computed Tomography abdomen and pelvis with oral contrast.

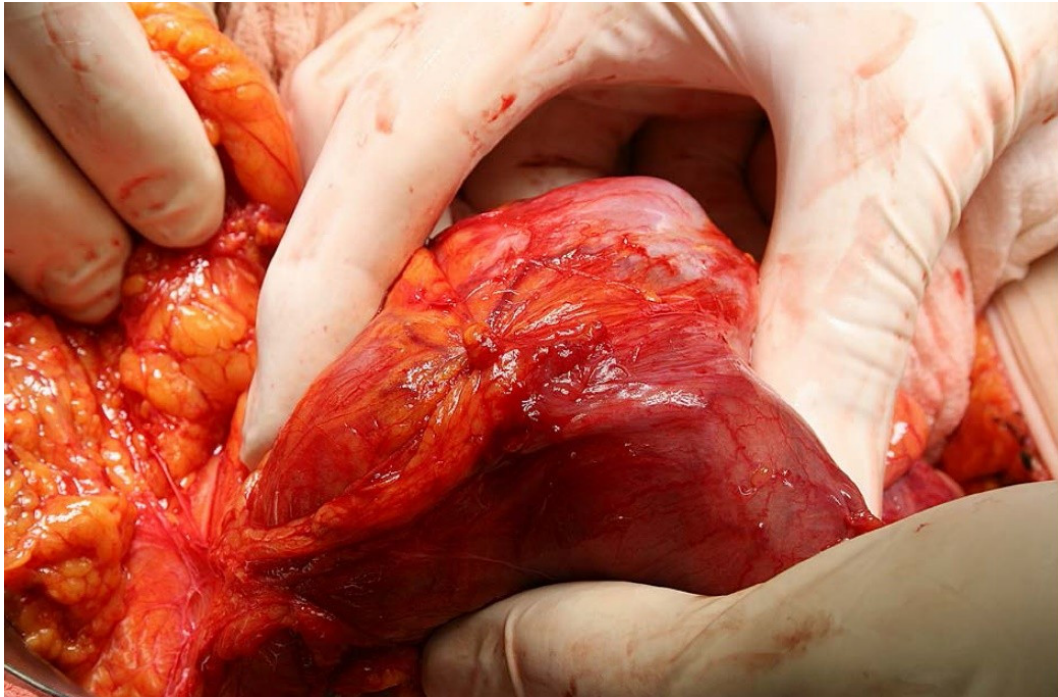


**Figure 2A.** Surgical specimen.



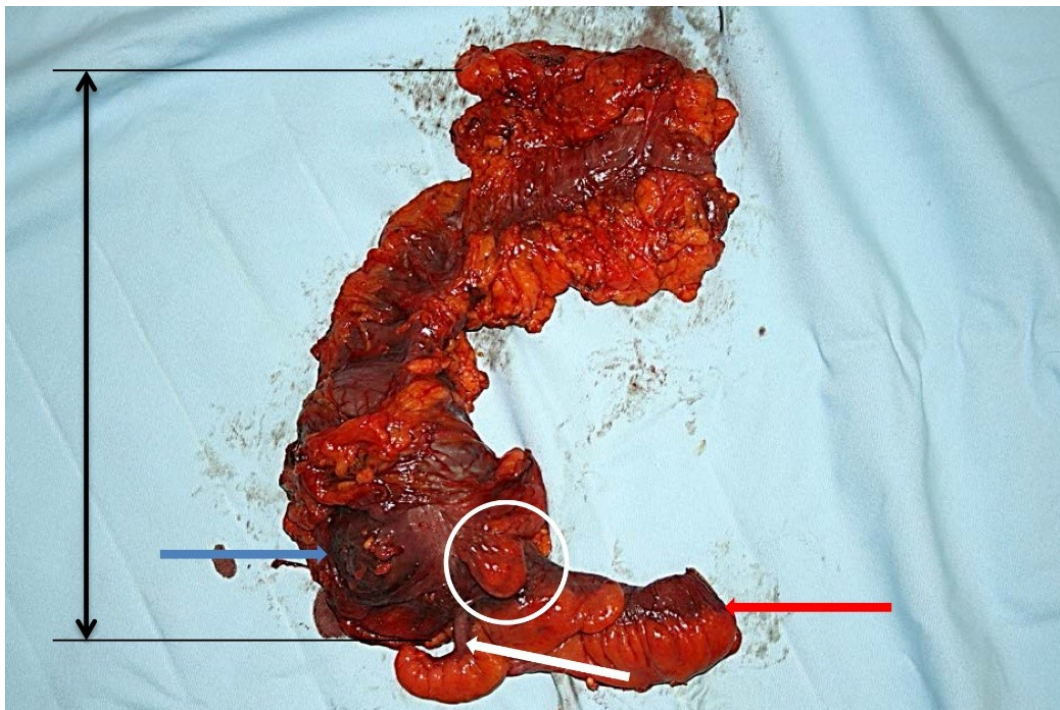
The terminal ileum (red arrow) telescoping (white circle) into the cecum (blue arrow).  
The appendix is seen in a normal position (white arrow).

**Figure 2B.** Surgical specimen. Externally visible tumor which represents a lead point.



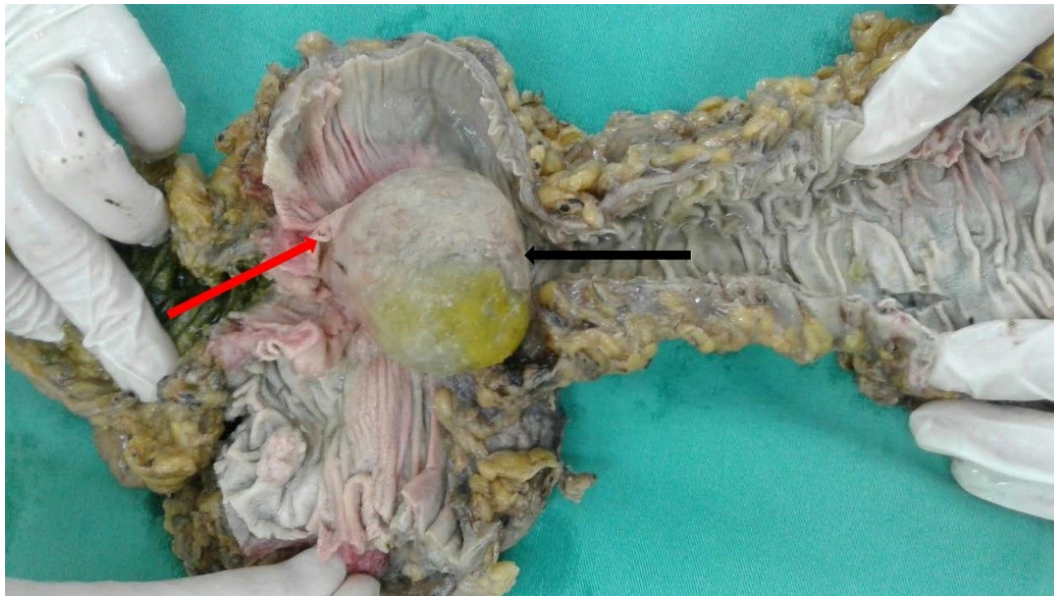
Note that the bowel is healthy, and mesentery has no enlarged lymph nodes.

**Figure 3.** Surgical specimen.



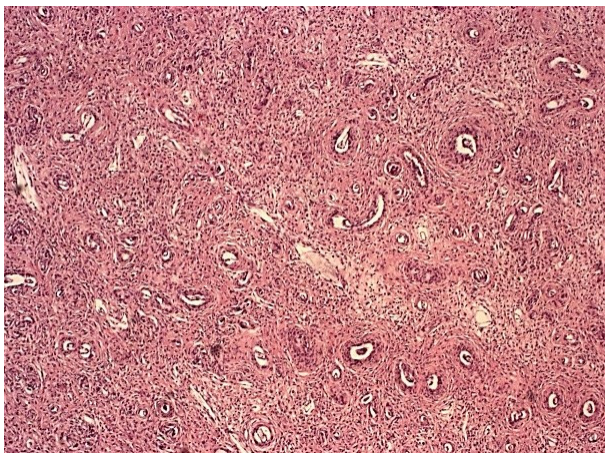
Resected segment showing intussusception (the terminal ileum- red arrow; the site of intussusception- white circle; the cecum- blue arrow; the right colon- black arrow; the appendix is seen in a normal position- white arrow)

**Figure 4.** Macroscopic appearance.



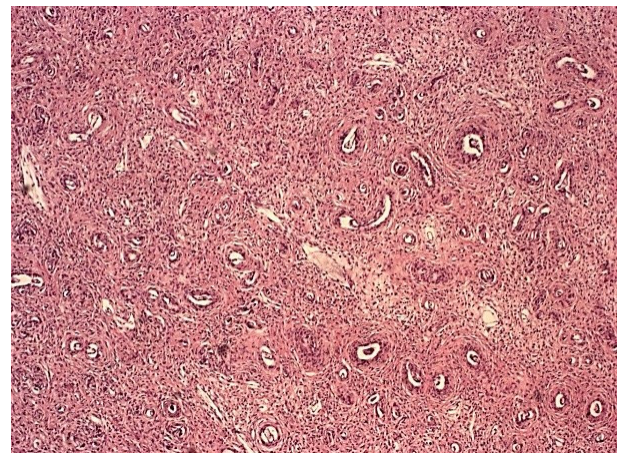
The opened fragment of the right colon showed a tumoural mass 76mm in diameter (black arrow) protruding into the lumen of the cecum. The base of the tumor was on the ileocecal valve, 26 mm in diameter (red arrow).

**Figure 5A.** Microscopic appearance.

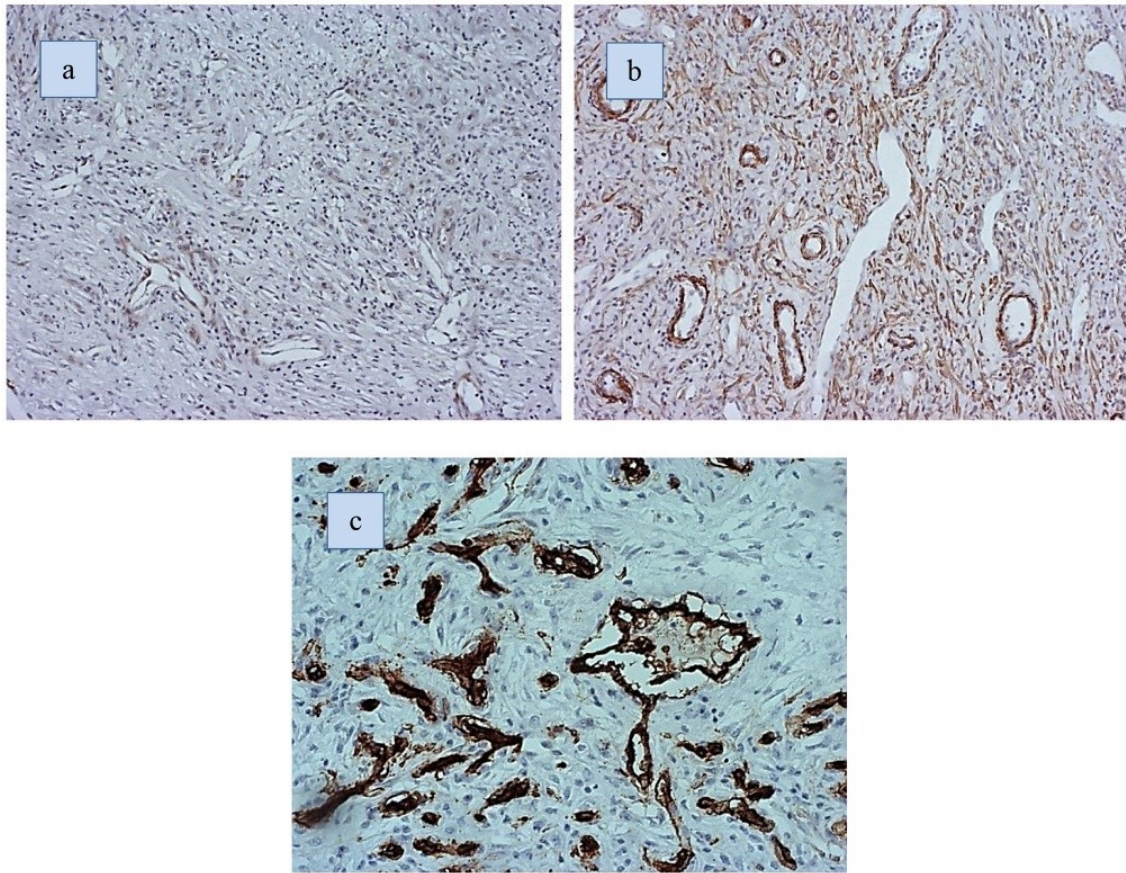


HE-stained sections ( $\times 100$ ) of the tumor tissue

**Figure 5B.** Microscopic appearance. Tumor cells were diffuse positive for CD117.

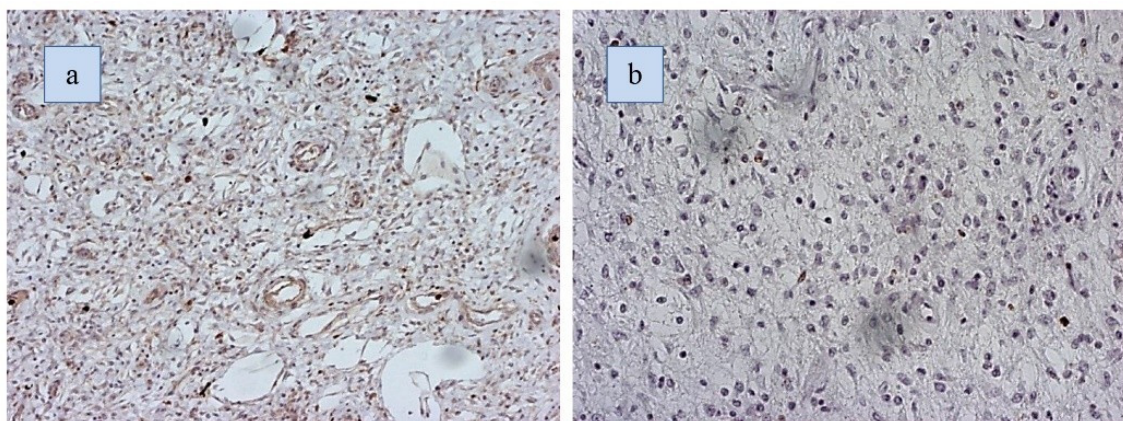


**Figure 5C.** Microscopic appearance.



Tumor cells were focally positive for desmin (a),  $\alpha$ -SMA (b) and CD34 (c)

**Figure 5D.** Microscopic appearance. S-100 protein (a) and Ki-67 (b) ( $\times 200$ ) proliferation index were very low



## DISCUSSION

Intussusception is defined as the telescoping of the proximal part of intestine together with the mesentery into the adjacent segment, leading to impaired peristalsis, obstruction and possible disorders of intestinal vascularization (4).

Intussusception is usually classified either according to the etiology (benign lesion, malignant lesion, or idiopathic) or by the location (entero-enteric, ileo-colic, ileo-cecal, colocolic or appendiceal) (5, 6).

Intussusception was first described by Dr. Paul Barbet in 1674 and first treated by Sir Jonathan Hutchinson in 1871. (7). Before 1871, intussusception was classified as a serious life-threatening condition that had a high mortality rate (7).

Intussusception in adults is a very rare occurrence. It represents 5% of all intussusceptions and is the cause of 1% of all intestinal obstructions, 0,08% of all abdominal surgeries and 0,003-0,02% of all hospital admissions (1). Some studies report the cases of intussusception in adults in patients younger than 13 and older than 90 years, with the highest incidence occurring in the 30-50 age group. The ratio of men to women was approximately 2:1 (8). In the case we presented, the patient was at older age compared to the average age of patients with intussusception in adults.

In direct contrast to pediatric etiologies, adult intussusception is associated with an identifiable cause in 90% of symptomatic cases, with an idiopathic cause in 10% of cases (9). Benign or malignant neoplasms cause two-thirds of cases of intussusception in adults; the remaining cases are caused by infections, postoperative adhesions, Crohn granulomas, intestinal ulcers (Yersinia), and congenital abnormalities such as Meckel diverticulum. In our case, the patient's past medical history was negative for gastrointestinal diseases. Also, our patient had no previous abdominal surgery or abdominal trauma. Of the cases caused by neoplasms, 50% of them are malignant (10). Malignant lesions include primary tumors such as carcinoids, adenocarcinoma, malignant polyps, GISTs, leiomyosarcomas, lymphoma and metastatic tumors, most commonly melanoma (11). The most common malignant cause of colonic intussusception is primary colonic adenocarcinoma and the most common benign cause is colonic lipoma (10). Ileocolic intussusception in adults is a unique variant in which nearly 100% of cases have a malignant lead point, namely, cecal adenocarcinoma involving the ileocecal valve (12). In the case of our patient, there are two significant characteristics. First, the lead point of ileocecal intussusception is a rare type of the gastrointestinal tumor - GIST. And second, the ileocecal valve is an extremely rare primary localization of GISTs and gastrointestinal tumors in general (13-20).

In the extensive literature reviewed, no similar cases have been described. These facts may be a starting point for further research.

In adults, the clinical presentation of intussusception is otherwise nonspecific, rarely presenting with the classic triad of acute abdominal pain, palpable mass, and bloody stool (21, 22, 8). Instead, it presents with symptoms of the small or large bowel obstruction. The most common presenting symptom is abdominal pain, (22, 23) with associated symptoms consistent with partial obstruction: nausea, vomiting, obstipation, gastrointestinal bleeding, change in bowel habits, constipation, or bloating (8, 24). Wang et al. (12) found abdominal cramping pain in nearly 80% of patients as a leading symptom; the palpable abdominal mass, however, was found in less than 9%. The symptoms are usually acute, lasting for days to weeks, but they can rarely be chronic, and lasting for months to years (12).

Our patient did not have the acute abdominal pain, but rather occasional chronic pain in the lower right quadrant of the abdomen that lasted for months. The symptoms of bowel obstruction were mild in the form of abdominal discomfort and occasional bloating. Such a clinical picture can be explained by the fact that the onset and duration of clinical symptoms of intussusception are significantly longer in the colon than in the disease of the small intestine, 62.5 to 35.7%, respectively (12). The symptoms in our patient were not specific for intussusception. Intermittent abdominal pain and bloating along with occasional rectal bleeding are symptoms associated with a long list of differential diagnoses. However, the physical examination that revealed presence of the palpable mass in the lower right quadrant of the abdomen helps in narrowing down and focusing attention to a subset of possible etiologies. Diagnostic procedures were performed.

A number of different radiologic methods have been described as useful in the diagnosis of intussusception: CT scan, barium studies, abdominal ultrasound, plain film, angiography, and radionuclide studies (25). The plain abdominal X-rays are typically the first diagnostic tool and show signs of the intestinal obstruction, and may provide information regarding the site of obstruction. However, some authors cite a series of cases of intussusception in adults in which the plain x-rays of the abdomen were not relevant for a diagnosis, (26) which is confirmed in the case of our patient. The result of the plain abdominal X-ray was negative. Contrast studies can help to identify the site and cause of intussusception, particularly in more chronic cases. In the past, colon intussusception was diagnosed with a contrast enema showing a crab claw-like shadow, but the accuracy of preoperative diagnosis was only 20-25 % (27). In the case of our patient, a contrast study was not done for technical reasons. Ultrasound is well established as the first-line imaging modality for diagnosing intussusception in children (28). Features on the ultrasound include a typical 'target lesion' or 'pseudo-kidney' appearance on longitudinal imaging (28). The 'target lesion' demonstrates concentric layers of different echogenicities, which correspond to the oedematous bowel wall and central invaginated mesenteric fat (29). In children, the ultrasound may be 98-100% sensitive and 88-

89% specific in diagnosing intussusception (28). Ultrasonography as a diagnostic test of intussusception in adults requires an experienced examiner. The limitations include obesity and bowel gases that can trap typical findings, and information about mesenteric vasculature, location, and surrounding interior is not clearly defined (30). In the case of our patient, the abdominal ultrasound examination was not relevant to the diagnosis. Despite the extensive experience of the diagnostician, the typical 'target lesion' or 'pseudo-kidney' was not observed. Flexible endoscopy including colonoscopy and small bowel enteroscopy may be a useful diagnostic tool in patients with subacute or chronic intermittent bowel obstruction (31). It permits the confirmation of intussusception, location and biopsy to aid with the diagnosis and plan of surgery (32). Small lesions can be snared endoscopically if the surrounding bowel appears normal without signs of inflammation or ischemia, however, lesions larger than 2 cm with a wide base should not be excised due to the increased risk of perforation of the bowel (30). Colonoscopy is most useful for adult intussusception involving the colon, terminal ileum and cecum, (25) however, due to the age and multiple morbidity of our patient, colonoscopy was not performed.

A contrasted CT scan of the abdomen and pelvis is the most sensitive and specific radiological investigation for intussusception and is the modality of choice in adults (33). The reported diagnostic accuracy of CT in adult intussusception varies but may reach 100% (34). The characteristic features include a soft tissue mass, target or sausage shaped, enveloped with an eccentrically located area of low density. The findings of a bowel within bowel configuration with or without mesenteric fat and mesenteric vessels are pathognomonic for intussusception (35). CT scan of the abdomen and pelvis of our patient showed a target lesion in the right lower quadrant with obstruction of contrast and pericolon fat accumulation, indicating intussusception at the ileocecal junction. (Fig. 1) CT scan also provides other critical information such as the length and diameter of intussusception, three dimensional views of the bowel and surrounding viscera, possible lead point, type and location of intussusception, mesenteric vasculature, possibility of strangulation, and likelihood of partial or complete bowel obstruction (36). CT in our patient demonstrates a swirling mass containing fat in the region of the ascending colon/cecum. Intussusception of the ileum into the cecum is detected which extends through to the mid-transverse colon. At the apex, a tumor is suspected. The bowel wall is thickened (the intussusciptions), but no signs of the vascular compromise have been observed. Perihepatic, mesenteric, right colic gutter and pelvic free fluid. No free gas (Fig. 1).

Before the advent of diagnostic modalities, immediate laparotomy and bowel resection without reduction were the standard of care and advocated by most surgeons (37, 38). The current controversy remains on the extent of surgical resection vs reduction of intussusception. The initial favor to resect en-block the intussuscepted bowel segment was based on the theoretical risks of venous embolization of tumor cells on the bowel manipulation as well as on the risks of perfo-

rating the ischemic, friable, edematous bowel which may lead to seeding of tumor cells and microorganisms into the peritoneal cavity (39). The laparoscopic approach offers both diagnostic and therapeutic options for intussusception in adults. Certain small bowel intussusception especially in younger patients may have a benign, physiological cause and laparoscopy with reduction may be an acceptable strategy. However, caution should be exercised when using laparoscopy in patients with a severe bowel obstruction where visualization may be poor, and the bowel manipulation may further risk perforation and increase surgery morbidity (40). Of two equally well-grounded opinions, we are closer to the opinion of authors who have the view that all colonic intussusceptions should be resected en-bloc without reduction, as most of these could harbor a pathological etiology and may not respond to the conservative management (25, 41- 43).

## CONCLUSION

Adult intussusception is a rare entity which is distinct from paediatric cases in incidence, aetiology, and management. Ileo-colic intussusception is often caused by the lead point pathology which can be a submucous lipoma but it may be a malignant lesion. Patients with the palpable abdominal mass, digestive tract obstruction, gastrointestinal bleeding, or lead point computed tomography must undergo a surgical examination. With advances in laparoscopic surgical techniques and outcomes, an experienced surgeon can approach this disease laparoscopically. Given a high risk of malignancy, reduction is most often prohibited and primary surgical resection using oncologic principles presents the best option for the treatment of ileocecal intussusception in adults.

## ETHICS APPROVAL AND CONSENT TO PARTICIPATE

The study was conducted in accordance with the ethical standards of the committee responsible for human experimentation (institutional and national) and the Helsinki Declaration of 1975, as revised in 2013. Voluntary written and informed consent was obtained from the patient prior to enrollment in the study.

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No funding was received from any sources.

## CONFLICT OF INTEREST

Authors declare no conflict of interest.

## REFERENCES

1. Potts J, Al Samaraee A, El-Hakeem A. Small bowel intussusception in adults. *Ann R Coll Surg Engl.* 2014;96(1):11-14
2. Manouras A, Lagoudianakis EE, Dardamanis D, et al. Lipoma induced jejunojejunal intussusception. *World J Gastroenterol.* 2007;13(26):3641-3644

3. Canovic D, Mitrovic S, Radovanovic D, Milosavljevic M, Zivic Z, Lazic D. Jejuno gastric intussusception as complication of gastric surgery. *Cent Eur J Med*. 2012; 7(1): 30-33.
4. Ibrahim D, Patel NP, Gupta M, Fox JC, Lotfipour S. Ileocecal intussusception in the adult population: case series of two patients. *West J Emerg Med*. 2010;11(2):197-200.
5. Toh Yoon EW. Treatment of adult idiopathic ileocolic intussusception with non-operative reduction under fluoroscopic guidance. *Gastroenterol Hepatol Endosc*. 1(4):88-89
6. Chiang JM, Lin YS. Tumor spectrum of adult intussusception. *J Surg Oncol*. 2008;98:444-447.
7. Hutchinson J. A Successful Case of Abdominal Section for Intussusception, with Remarks on this and other Methods of Treatment. *Med Chir Trans*. 1874;57:31-75.
8. McKay R. Ileocecal intussusception in an adult: the laparoscopic approach. *JLS*. 2006;10(2):250-253.
9. Zubaidi A, Al-Saif F, Silverman R. Adult intussusception: a retrospective review. *Dis Colon Rectum*. 2006;49(10):1546-1551.
10. Wang T, Wu C, Yu C, Hsiao W, Hsu C, Jao W. Clinical entity and treatment strategies for adult intussusceptions: 20 years' experience. *Dis Colon Rectum*. 2007;50(11): 1941-1949.
11. Shenoy S. Small Bowel Metastases: Tumor Markers for Diagnosis and Role of Surgical Palliation. *J Gastrointest Cancer*. 2016;47:210-213.
12. Marsicovetere P, Ivatury SJ, White B, Holubar SD. Intestinal Intussusception: Etiology, Diagnosis, and Treatment. *Clin Colon Rectal Surg*. 2017;30(1):30-39.
13. Sandrasegaran K, Rajesh A, Rydberg J, Rushing DA, Akisik FM, Henley JD. Gastrointestinal stromal tumors: clinical, radiologic, and pathologic features. *AJR Am J Roentgenol* 2005;184:803-811.
14. Humenansky KM, Gulati R. Small bowel gastrointestinal stromal tumor disguised as an adnexal mass: a source for midgut volvulus. *J Surg Case Rep*. 2018;2018(7): rjy157.
15. Judson I, Demetri G. Advances in the treatment of gastrointestinal stromal tumors. *Ann Oncol* 2018;10:20- 4.
16. Rubini P, Tartamella F. Primary gastrointestinal stromal tumour of the ileum pre-operatively diagnosed as an abdominal abscess. *Mol Clin Oncol* 2016;5:596-8.
17. McDonnell MJ, Runnoose S, Viswanath YKS, Wadd NJ, Dhar A. Gastrointestinal stromal tumours (GISTs): an insight into clinical practice with review of literature. *Frontline Gastroenterol* 2016;8:19-25.
18. Scola D, Bahoura L, Copelan A, Shirkhoda A, Sokhandon F. Getting the GIST: a pictorial review of the various patterns of presentation of gastrointestinal stromal tumors on imaging. *Abdom Radiol* 2017;42:1350-64.
19. Gastrointestinal stromal tumor. In: Amin MB, Edge SB, Greene FL, et al., eds.: *AJCC Cancer Staging Manual*. 8th ed. New York, NY: Springer, 2017, pp 523-9.
20. Casali PG, Dei Tos AP, Gronchi A: Gastrointestinal stromal tumor. In: DeVita VT Jr, Lawrence TS, Rosenberg SA, et al., eds.: *DeVita, Hellman, and Rosenberg's Cancer: Principles & Practice of Oncology*. 11th ed. Philadelphia, Pa: Wolters Kluwer, 2019, pp 895-906.
21. Elm'hadi C, Tarchouli M, Khmamouche M R. et al. Intestinal intussusception in a young women: unusual cause and specific management. *World J Surg Oncol*. 2015;13:252.
22. Mrak K. Uncommon conditions in surgical oncology: acute abdomen caused by ileocolic intussusception. *J Gastrointest Oncol*. 2014;5(4):E75-E79.
23. Sarma D, Prabhu R, Rodrigues G. Adult intussusception: a six-year experience at a single center. *Ann Gastroenterol*. 2012;25(2):128-132.
24. Voore N, Weisner L. Unusual cause of intussusception. *BMJ Case Rep*. 2015;2015
25. Gupta RK, Agrawal CS, Yadav R, Bajracharya A, Sah PL. Intussusception in adults: institutional review. *Int J Surg*. 2011;9(1):91-95.
26. Honjo H, Mike M, Kusanagi H, Kano N. Adult intussusception: a retrospective review. *World J Surg*. 2015;39(1):134-138.
27. Gordon RS, O'Dell KB, Namon AJ, et al. Intussusception in the adult: a rare disease. *J Emerg Med*. 1991;9:337-342.
28. Rafailidis V, Phillips C, Yusuf G, Sidhu P. A case of adult intussusception with greyscale, contrast-enhanced ultrasound and computerised tomography correlation. *Ultrasound*. 2017;25(2):120-125.
29. Cantisani V, Bertolotto M, Weskott HP, et al. Growing indications for CEUS: the kidney, testis, lymph nodes, thyroid, prostate, and small bowel. *Eur J Radiol* 2015; 84: 1675-1684.
30. Shenoy S. Adult intussusception: A case series and review. *World J Gastrointest Endosc*. 2017;9(5):220- 227.
31. Rahimi E, Guha S, Chughtai O, Ertan A, Thosani N. Role of enteroscopy in the diagnosis and management of adult small-bowel intussusception. *Gastrointest Endosc*. 2016;84:863-864.
32. Elena RM, Riccardo U, Rossella C, Bizzotto A, Domenico G, Guido C. Current status of device-assisted enteroscopy: Technical matters, indication, limits and complications. *World J Gastrointest Endosc*. 2012;4:453-461.
33. Zhou KZ, Mautone M, Naidoo P. A rare cause of adult ileocolic intussusception: ileal leiomyoma. *BJR Case Rep*. 2018;4(4):20170094.
34. Lianos G, Xeropotamos N, Bali C, et al. Adult bowel intussusception: presentation, location, etiology, diagnosis and treatment. *Il Giornale di Chirurgia* 2013; 34: 280-283.
35. Kim YH, Blake MA, Harisinghani MG, Archer-Arroyo K, Hahn PF, Pitman MB, Mueller PR. Adult intestinal intussusception: CT appearances and identification of a causative lead point. *Radiographics*. 2006;26:733-744
36. Gore RM, Silvers RI, Thakrar KH, Wenzke DR, Mehta UK, Newmark GM, Berlin JW. Bowel Obstruction. *Radiol Clin North Am*. 2015;53:1225-1240.
37. Brayton D, Norris WJ. Intussusception in adults. *Am J Surg*. 1954;88:32-43.

38. Sanders GB, Hagan WH, Kinnaird DW. Adult intussusception and carcinoma of the colon. *Ann Surg.* 1958;147:796-804.
39. Begos DG, Sandor A, Modlin IM. The diagnosis and management of adult intussusception. *Am J Surg.* 1997;173:88-94.
40. Siow SL, Mahendran HA. A case series of adult intussusception managed laparoscopically. *Surg Laparosc Endosc Percutan Tech.* 2014;24:327-331.
41. Barussaud M, Regenet N, Briennon X, de Kerviler B, Pessaux P, Kohneh-Sharhi N, Lehur PA, Hamy A, Leborgne J, le Neel JC, et al. Clinical spectrum and surgical approach of adult intussusceptions: a multicentric study. *Int J Colorectal Dis.* 2006;21:834-839.
42. Yakan S, Caliskan C, Makay O, Denecli AG, Korkut MA. Intussusception in adults: clinical characteristics, diagnosis and operative strategies. *World J Gastroenterol.* 2009;15:1985-1989.
43. Hanan B, Diniz TR, da Luz MM, da Conceição SA, da Silva RG, Lacerda-Filho A. Intussusception in adults: a retrospective study. *Colorectal Dis.* 2010;12:574-578.