Review paper

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The ileocecal valve in transabdominal ultrasound. Part 2: Pathological lesions

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Keywords
ultrasonography; ileocecal valve; lesions

Abstract

The aim of this paper is to present our experience in transabdominal ultrasonography of ileocecal valve lesions. The ileocecal valve, located in the central part of the ileocecal bowel segment, is rarely the primary site of disease processes. It is usually involved by pathologies in adjacent bowel segments. These are primarily infectious diseases such as yersiniosis, campylobacteriosis and salmonellosis. Typical location of Crohn's lesions also promotes valve involvement. The appearance of the lesions in these cases is characterized by a symmetrical submucosal thickening of the bowel involved over a longer segment. Non-malignant valvular hyperplasia is relatively commonly identified as lipomatosis, manifested by symmetrical enlargement and smooth outlines. However, valvular lipoma causing an asymmetrical hyperechoic bulge is a rare finding. ileocecal valve lipomatosis or lipoma should not be misdiagnosed as a lipoma of the cecoascending part of the colon and, the other way round, a right colonic lipoma should not be mistaken for a fatty valve. Polyps on the ileocecal valve, although sometimes detected, were not identified in our material. Adenocarcinoma, which is found in the cecum in approximately ¼ of cases, is the most common malignancy, followed by neuroendocrine tumor and, rarely, lymphoma. In three cases of malignant involvement of the ileocecal valve, we observed irregular hypoechoic thickening with complete loss of wall stratification, with the lesions causing symptoms of small bowel obstruction in two of these cases. The nearly forgotten ileocecal valve syndrome, also known as Bauhin's ileocecal valve syndrome, characterized by intermittent right iliac fossa pain, is also briefly discussed. Transabdominal ultrasound can be used as an initial diagnostic tool in some of these pathologies.

Introduction

The aim of this paper is to present our experience in transabdominal ultrasonography of lesions of the ileocecal valve (ICV).

The ICV is rarely the primary site of a disease process. It is most often involved by pathological processes in the ileocecal segment of the bowel.

Pistor *et al.*[1] have distinguished the following ICV pathologies:

- fatty ICV (discussed in the first part of the paper);
- transvalvular prolapse of the terminal ileum;
- retrograde transvalvular prolapse of the colonic mucosa into terminal ileum;
- ICV polyps (pedunculated and sessile);
- lymphatic hyperplasia of the gastrointestinal tract;
- Crohn's disease;
- ulcerative colitis;
- eosinophilic gastroenteritis;
- ICV oedema (e.g. in hypoalbuminemia);
- reflux ileitis;
- yersiniosis;
- actinomycosis;
- histoplasmosis;
- amoebiasis;
- tuberculosis;
- malignant tumors;
- benign tumors;
- gaping ICV.

This list should be extended with other known bacterial diseases, such as campylobacteriosis, salmonellosis, yersiniosis, *Clostridioides difficile* infection and typhoid fever, as well as neutropenic enterocolitis, viral infections (adenoviruses, rotaviruses, cytomegaloviruses), histoplasmosis and various parasitic diseases. Additionally, the following conditions should be considered in this location: damage caused by non-steroidal anti-inflammatory drugs (drug-induced injury) or radiotherapy, systemic vasculitis (mainly Behçet disease), ischemic lesions, venous stasis due to portal hypertension and endometriosis with Crohn's-like lesions[2–6]. It is not uncommon for ingested foreign bodies, gallstones and bezoars to be retained in this region (Fig. 1, Fig. 2).

Inflammatory processes with ICV involvement

Lesions caused by various types of infections are most common. In these cases, the ileocecal segment usually contains no or only a negligible amount of contents, making it easier to visualize the lesions. Colonoscopy reveals a variety of mucosal lesions, such as hyperemia, macular eruptions, erosions, ulcerations of various shapes and depths, strictures, fistula openings and gaping ICV (most commonly in tuberculosis). Only the so-called diaphragms, mainly located in the right colon, typically occur following NSAID-induced damage to the inner layer of the bowel. In these cases, constricting rings of fibrous tissue form in areas of healed ulcers. Although the described mucosal lesions are mostly undetectable on ultrasound, wall thickening of varying severity, usually involving specific layers, or blurred stratification, rarely with total hypoechoic infiltration, may be seen. Advanced lesions also cause a hyperechoic reaction of the surrounding adipose tissue. Additionally, there may be a fistula or an abscess in the area, and it is not uncommon to observe hyperemia of the described lesions on color Doppler.

A longer-lasting process may result in stricture due to inflammatory infiltration or permanent fibrotic stricture, leading to symptoms of bowel obstruction. These ileocecal lesions relatively often involve the ICV. The gallery of ileocecal lesions caused by food poisoning and infectious agents is presented in Fig. 1, Fig. 2, Fig. 3, Fig. 4, Fig. 5, Fig. 6, Fig. 7, Fig. 8, Fig. 9, Fig. 10, Fig. 11, Fig. 12.

Figure 13 shows a severely enlarged ICV with features of hyperemia due to an abscess formed in the right iliac muscle as a complication of suppurative appendicitis. These lesions can be seen on a video recording, where the vascular topography of both lips of the ileocecal valve can be traced (Video recording).

The sonograms presented (Fig. 1, Fig. 2, Fig. 3, Fig. 4, Fig. 5, Fig. 6, Fig. 7, Fig. 8, Fig. 9, Fig. 10, Fig. 11, Fig. 12, Fig. 13), even with the

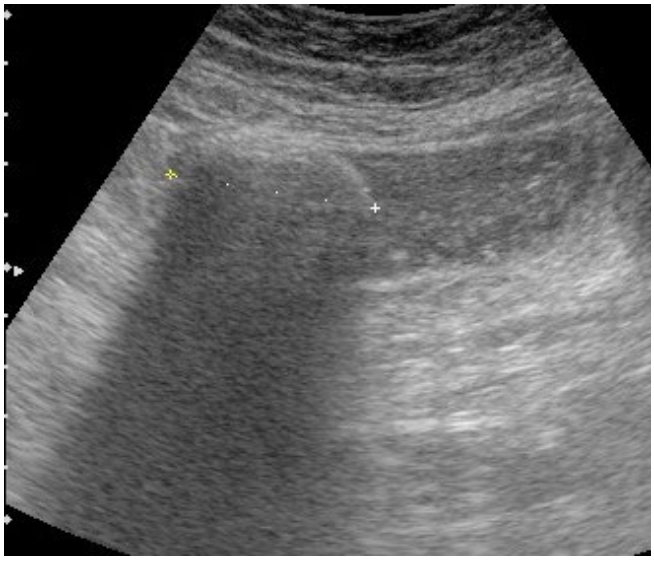

Fig. 1. *A blocked gallstone causing small bowel obstruction was found in the terminal ileum using distance indicators*

Fig. 2. A. *The arrows point to the two lips of the ileocecal valve in front of which a bezoar (irregular echogenic cluster) has stopped.* **B.** *The same bezoar. Color Doppler revealed color twinkling artifacts in the bezoar*

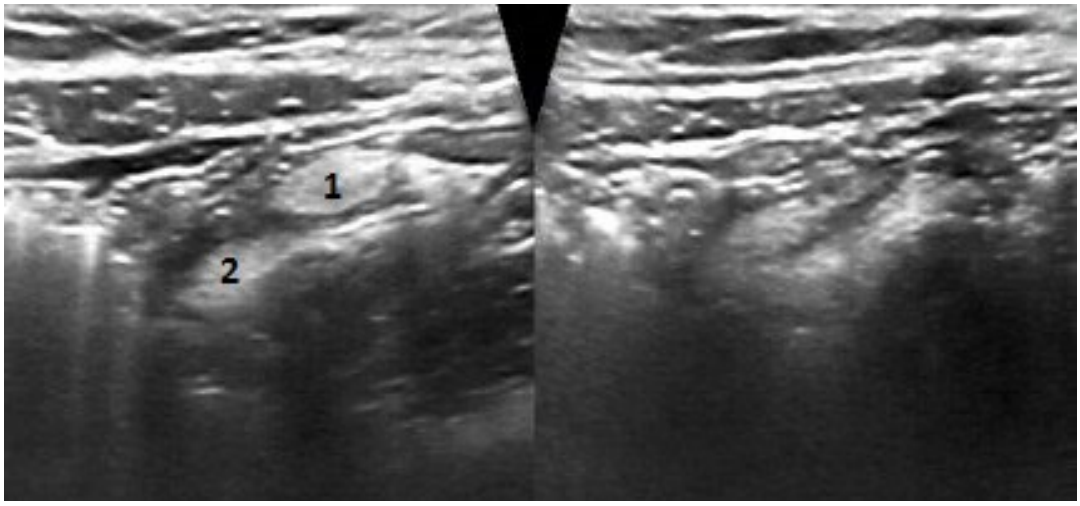

Fig. 3. *A 24-year-old patient with food poisoning manifested by loose stools. Echogenic ileocecal valve lips, marked with numbers 1 and 2, may be seen in the shrunken cecoascending part of the colon*

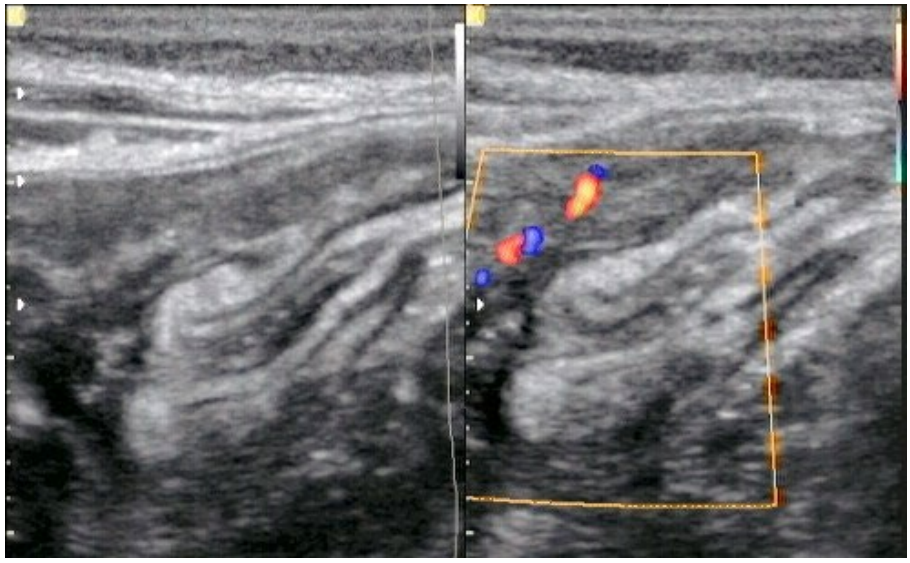

Fig. 4. *Sonographic image showing ileocecal valve lips after a dietary error in a 34-year-old woman with diarrhea*

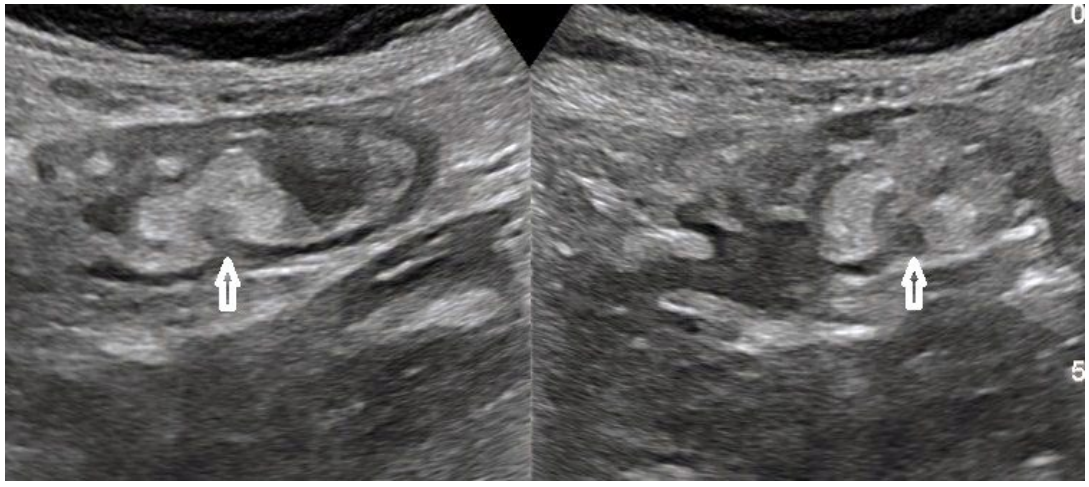

Fig. 5. *Two cross-sections of a near-empty cecum show echogenic ileocecal valve (arrows) in a 31-year-old woman with campylobacteriosis*

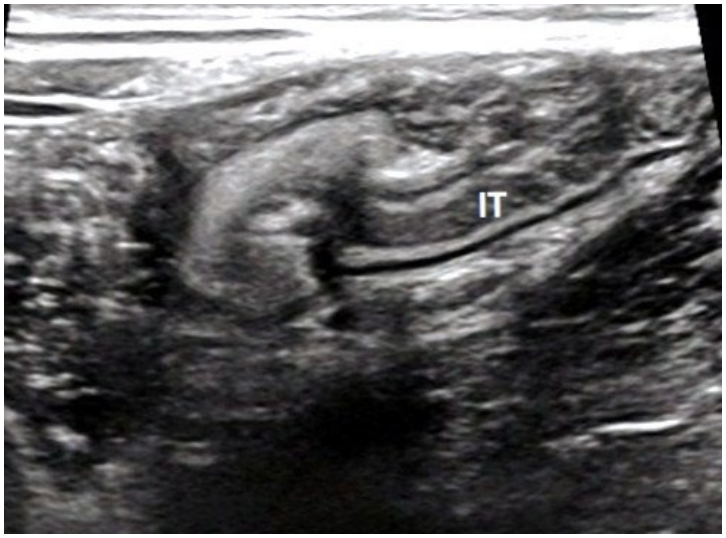

Fig. 6. *Salmonellosis in a 51-year-old man. Hyperechoic ileocecal valve and accentuated terminal ileum (IT)*

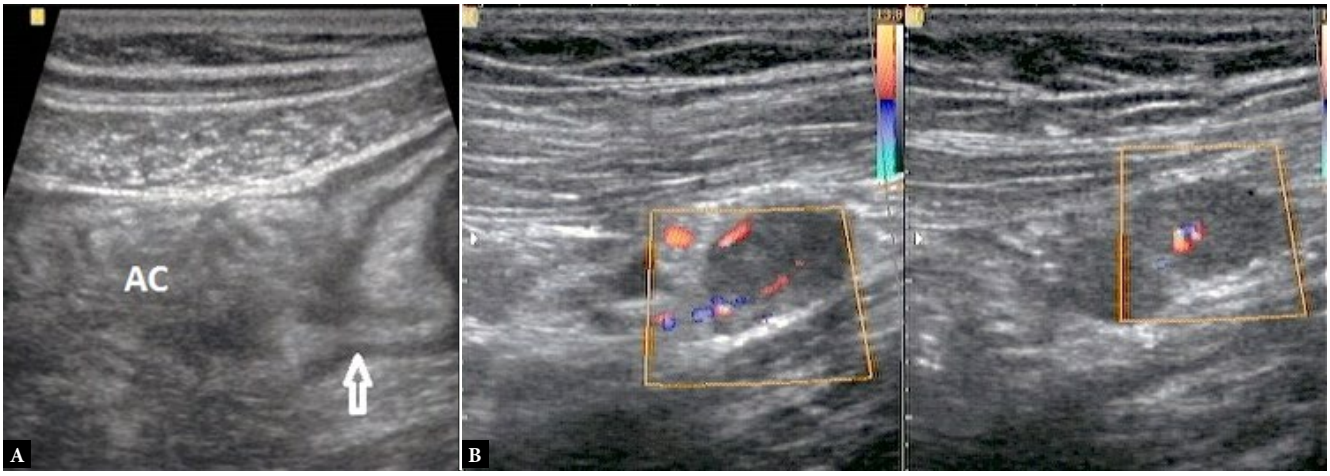

Fig. 7. *Yersiniosis in a 24-year-old woman.* **A.** *Edematous ileocecal valve and mucosal folds in the ascending colon (AC).* **B.** *An enlarged lymph node with features of hyperemia is seen in the mesentery of the small bowel*

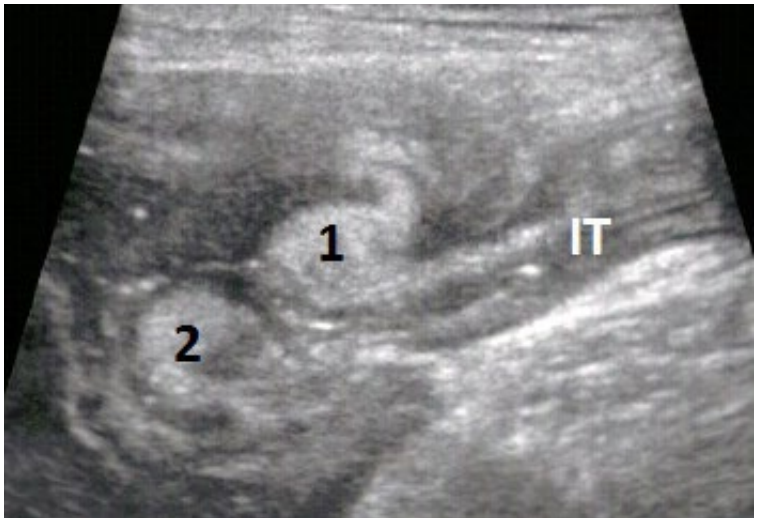

Fig. 8. *A 56-year-old man with symptoms of gastroenteritis. Bilabial (1 – superior lip, 2 – inferior lip) ileocecal valve with features of lipomatosis and terminal ileum (IT)*

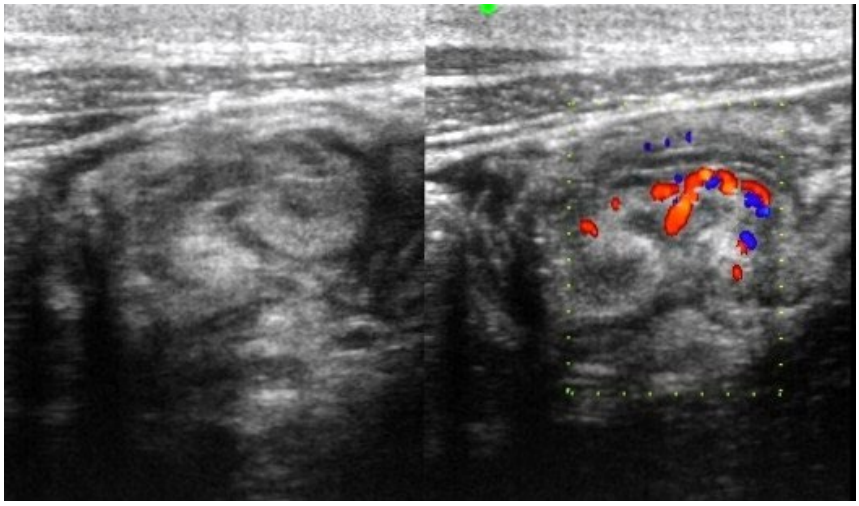

Fig. 9. *An 18-year-old patient with Crohn's disease. Two cross-sections of an inflamed bilabial ileocecal valve*

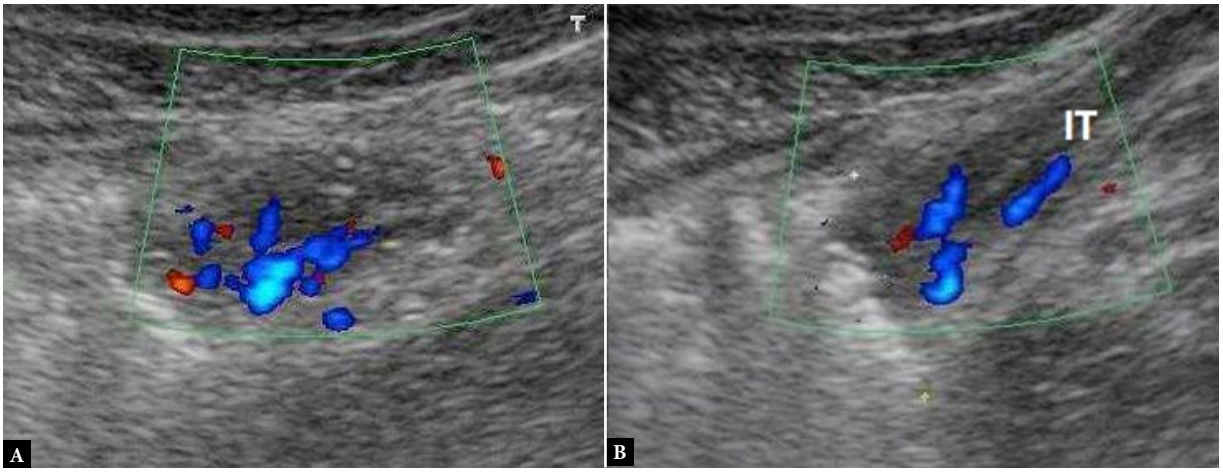

Fig. 10. *A 24-year-old female patient with Crohn's disease.* **A.** *An infiltrated hypoechoic ileocecal valve is difficult to delineate but highly hyperemic.* **B.** *The terminal ileum (IT) shows similar, pronounced features of hyperemia*

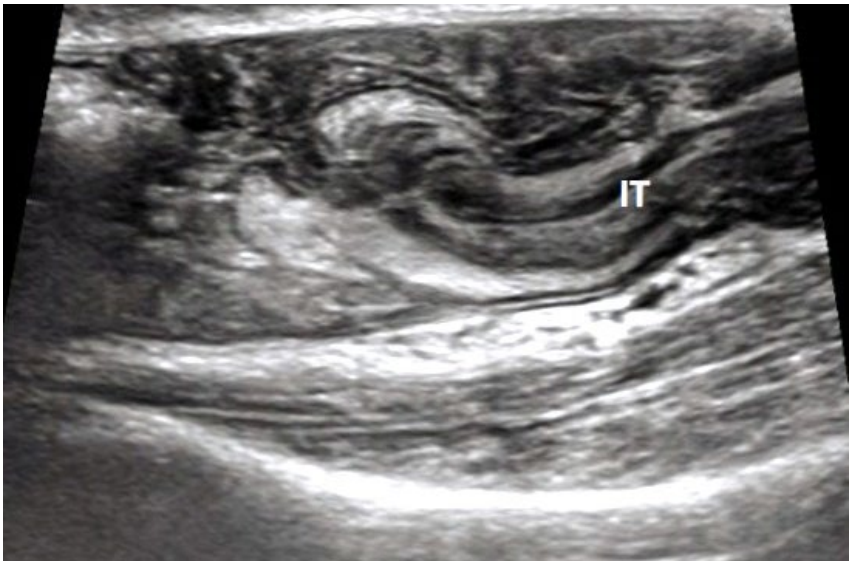

Fig. 11. *A 27-year-old man with celiac disease. Ileocecal valve and thickened mucosal folds in the terminal ileum (IT) are visible*

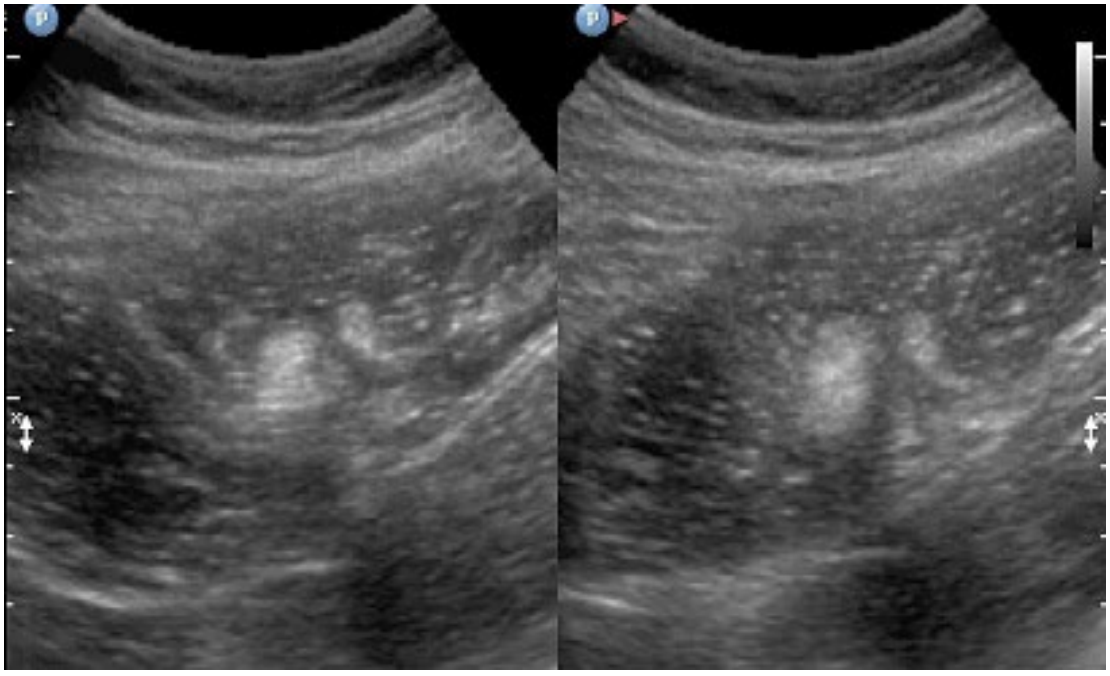

Fig. 12. *Ileocecal valve in a 69-year-old woman with lambliosis*

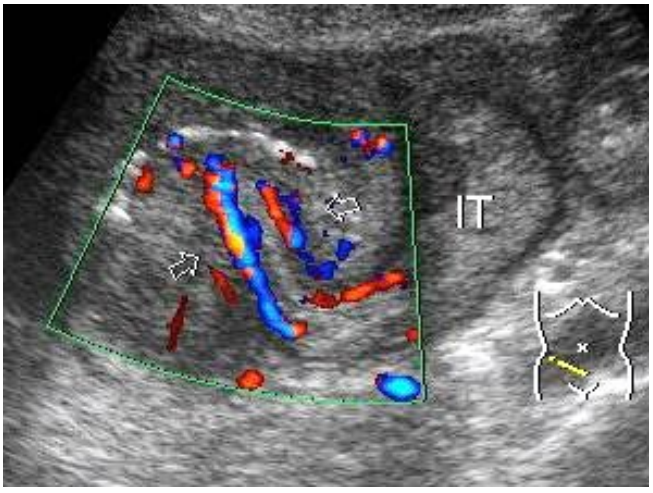

Fig. 13. *Pronounced vascularization in the ileocecal valve lips in a 24-year-old man with a right iliac muscle abscess formed in the course of suppurative appendicitis. IT – terminal ileum*

accompanying clinical context, do not allow the identification of a specific etiological agent. However, an inflammatory nature of the lesions could be assumed, as the ICV was enlarged symmetrically, showed a smooth surface, generally with uniformly increased echogenicity and, in some cases, features of hyperemia. These symptoms were accompanied by sonographic features of inflammation, mainly involving the terminal ileum and, in some cases, mesenteric lymphadenopathy. The visualization of the described lesions was possible due to the almost complete absence of feces in this gastrointestinal segment. This symptom indicates diarrheal bowel movements and confirms the obtained medical history. It is worth noting that a similar situation should be expected in patients who have taken a laxative before an ultrasound scan.

Proliferative lesions

Polyps are the most common proliferative lesions in the colon[2,3,5]. They are mostly hypoechoic on ultrasound. In such cases, reliable diagnosis is based on detecting blood supply by color Doppler (Fig. 14), but this is possible only for larger lesions (>1 cm), mostly adenomas[7,8]. An ICV polyp causes valve deformation; however, we have not been able to detect such a lesion at this location. Lipomas, mentioned in the first part of the paper, come second. Leiomyomas and neurinomas are a much less common finding here[2]. Neuroendocrine neoplasms (NENs), often small but well-vascularized, should not be a surprising finding in the ileocecal segment (Fig. 15).

Adenocarcinoma, which is found in the cecum in about ¼ of cases, is the most common malignancy[2], followed by NEN and, far less frequently, non-Hodgkin's lymphoma[2,3,5,6]. It should be remembered that 70% of NENs are found in the right part of the large bowel, especially in the cecum[9]. In three cases of ICV cancerous involvement, we observed irregular hypoechoic thickening of the valve, with complete loss of its wall stratification (Fig. 16, Fig. 17, Fig. 18). Only a small bowel segment was involved. This type of tumor can also manifest as a polyp[2,5]. Involvement of a longer segment is rare and is most commonly seen in signet ring cell carcinoma (SRCC)[3].

Impaired patency and dysfunction of ICV

More severe ICV lesions can cause small bowel obstruction. Figure 19 shows small bowel obstruction due to severe ICV stricture in eosinophilic enteritis (EE). In this case, it was not possible to pass a colonoscope through the valve. A cancerous infiltration in this region led to a similar effect, as shown in Fig. 17 and Fig. 18. The area

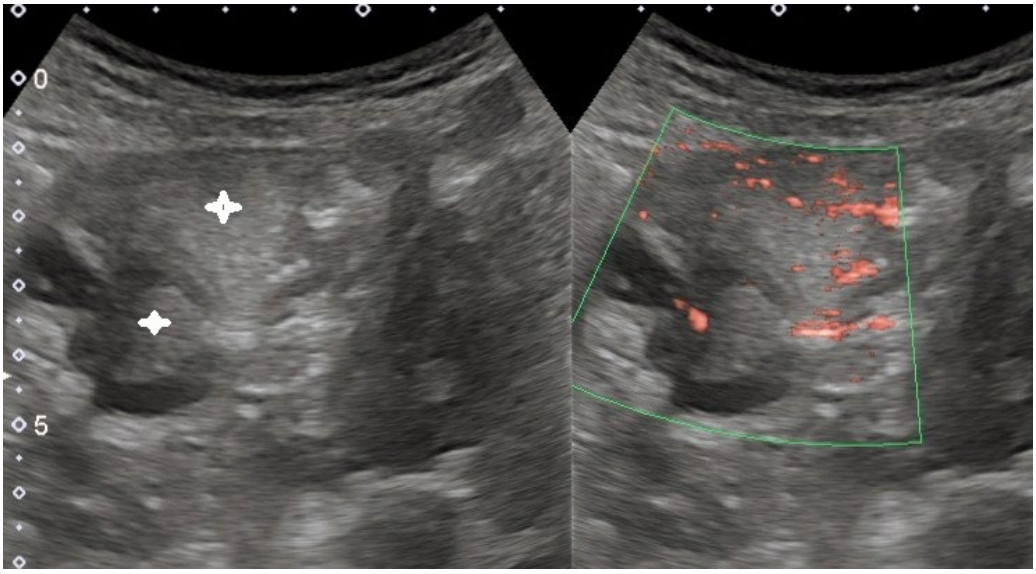

Fig. 14. *Two hyperechoic polyps (asterisks) and their vascularization can be seen in the cecum; histopathology showed tubular adenomas*

Fig. 15. *A well-vascularized cecal lesion identified as a neuroendocrine tumor*

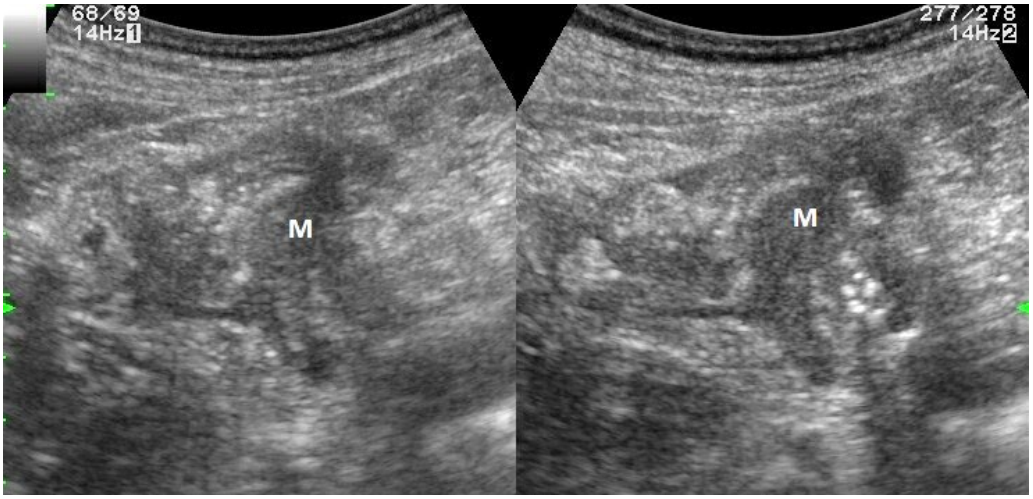

Fig. 16. *Ileocecal valve infiltration (M) by an adenocarcinoma. A bezoar forming in front of the ileocecal valve can be seen to the right of the split-screen ultrasound image*

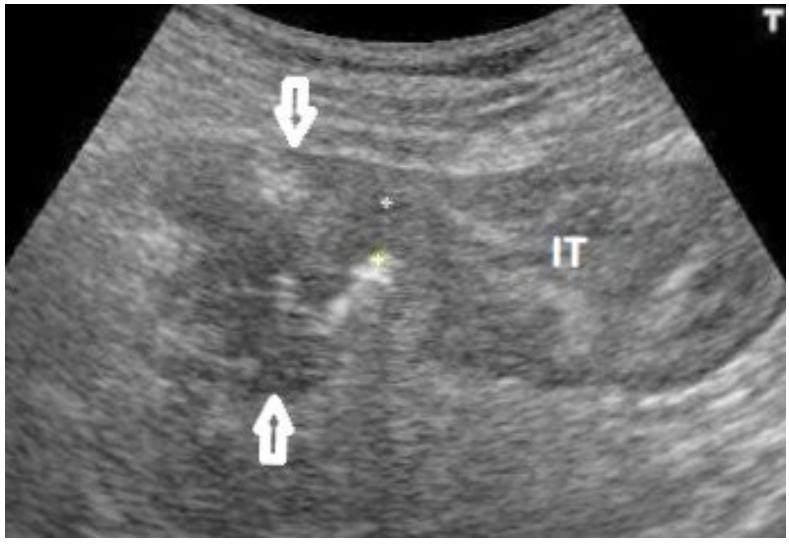

Fig. 17. *Carcinoma in the ileocecal segment infiltrates the ileocecal valve (arrows*). IT – terminal ileum

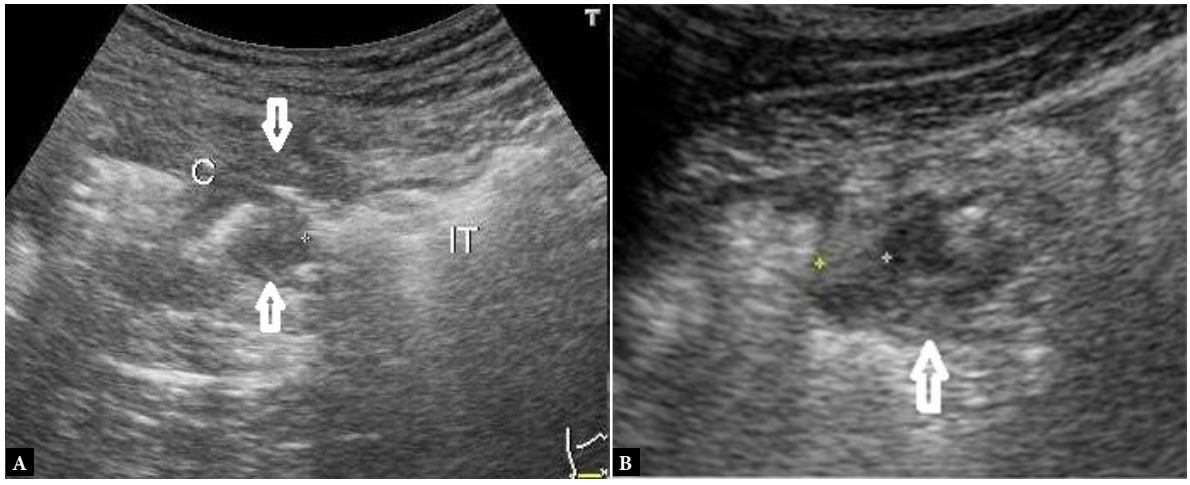

Fig. 18. *A 69-year-old patient.* **A.** *Irregular cancerous infiltration involving the ileocecal valve region, causing gaseous distension of the terminal ileum (IT). C – cecum.* **B.** *Ileocecal valve alone, showing irregular hypoechoic thickening (arrow and distance indicators)*

around ICV may be the site of intestinal intussusception (known as ileocecal or ileocolic intussusception). Such an image is shown in Fig. 20. Enlargement of a fatty ICV, which was established intraoperatively, was the cause of intussusception.

At this point, it is important to briefly discuss the nearly forgotten ileocecal valve syndrome, also known as Bauhin's ileocecal valve syndrome[10–13]. Lasser and Rigler[10] reported their long-term follow-up of 18 women over 45 years of age, 16 of whom periodically developed transient abdominal pain with intestinal flatulence. Contrast infusion showed an enlarged ICV in these patients. The authors of this study suggested that this is sometimes caused by partial or complete ileocecal intussusception, probably due to fat accumulation in the valve. Other investigators[10,11] have also reported a similar clinical picture in patients with ICV lipohyperplasia. In contrast, fibrosis and hypertrophy of neural tissue dominated in a case of an enlarged ICV described by Nesher *et al.*[13] According to our observations, the ICV syndrome is not as rare as publications on this topic. It manifests as transient colic in the right iliac fossa, sometimes accompanied by flatulence, which requires the exclusion of appendicitis in the first instance. Despite a number of laboratory and imaging tests run in these patients, it is not possible to establish a definite etiology. Images obtained in a 56-year-old female doctor with periodic colic in the right lower abdomen, occasionally accompanied by loose stools, are an example (Fig. 21). Colonoscopy revealed small ICV and terminal ileum erosions, bacteriological stool cultures were negative, and there was a minor non-specific inflammatory reaction in the specimens. A follow-up ultrasound scan showed that the valve was not enlarged and the patient was asymptomatic despite no treatment used.

Liu and Wang[14] found ileocecal ulceration on ileocolonoscopy in 31 patients (17 patients with ICV syndrome), but only 10 (32.3%) of these patients could be diagnosed with Crohn's disease. At this point, it is worth recalling a relatively common colonoscopic finding of terminal ileum prolapse through the ICV into the cecum[5]. This can be considered a tendency towards terminal ileum intussusception.

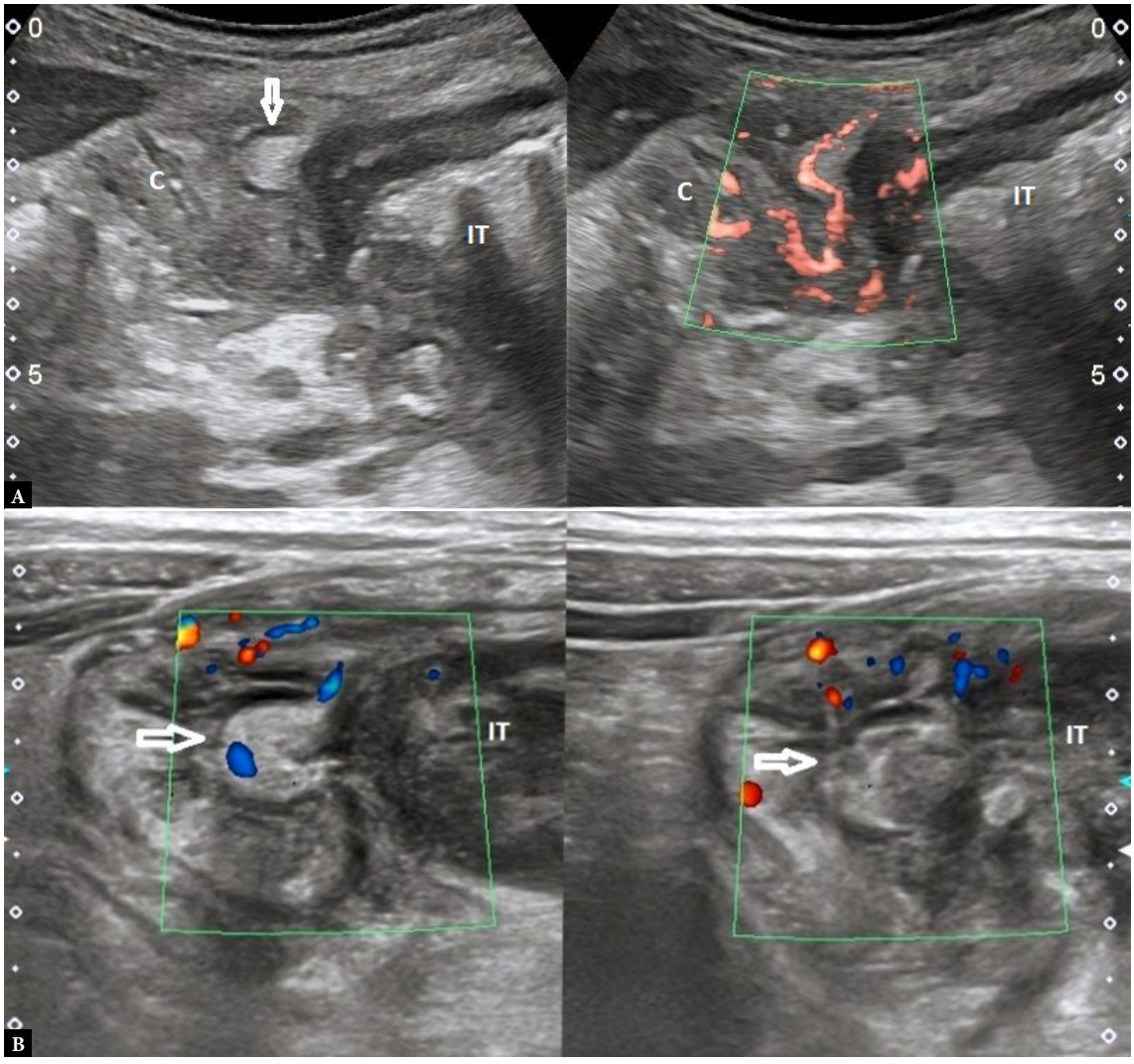

Fig. 19. *A 27-year-old woman with eosinophilic enteritis causing ileocecal valve stenosis (arrow).* **A.** *The dilated terminal ileum (IT) with retained echogenic contents and aggregate echoes. C – cecum.* **B.** *Tightly closed ileocecal valve (arrows) imaged with a linear transducer*

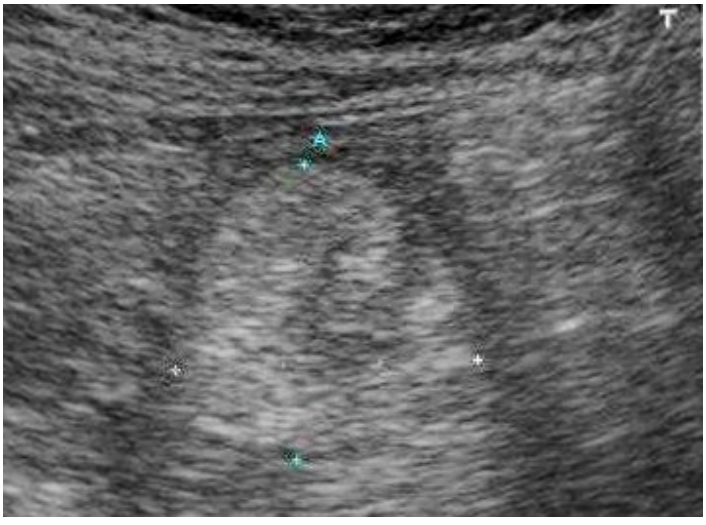

Fig. 20. *Intussusception of the terminal ileum into the ileocecal valve (distance indicators)*

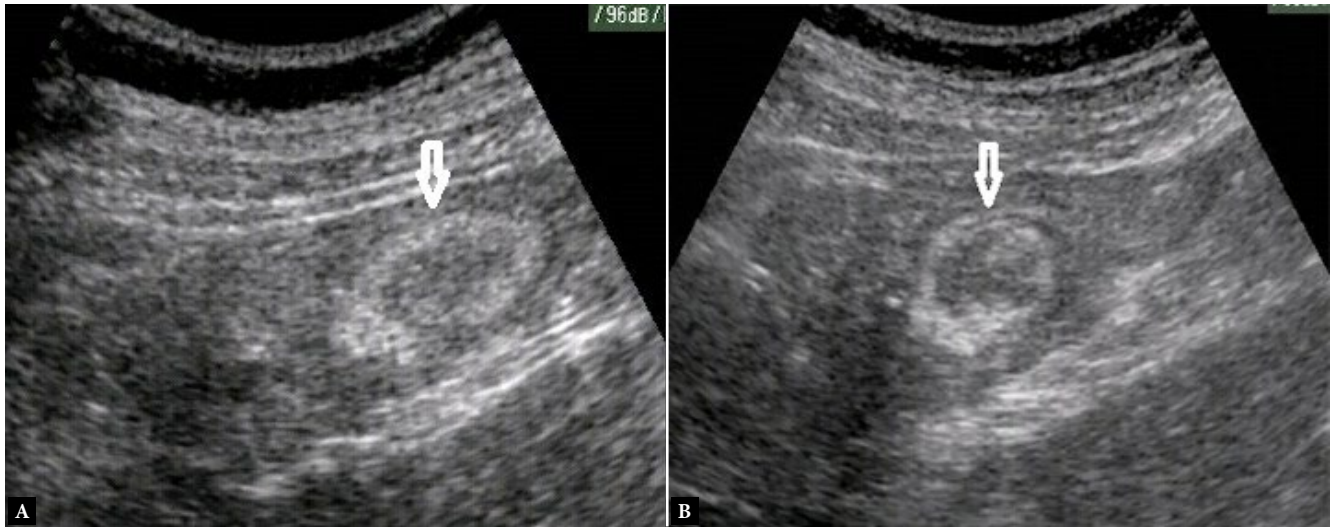

Fig. 21. *A 56-year-old woman with intermittent right iliac fossa pain and loose bowel movements.* **A.** *Enlarged ileocecal valve in a parasagittal section.* **B.** *Ileocecal valve in a cross-sectional view*

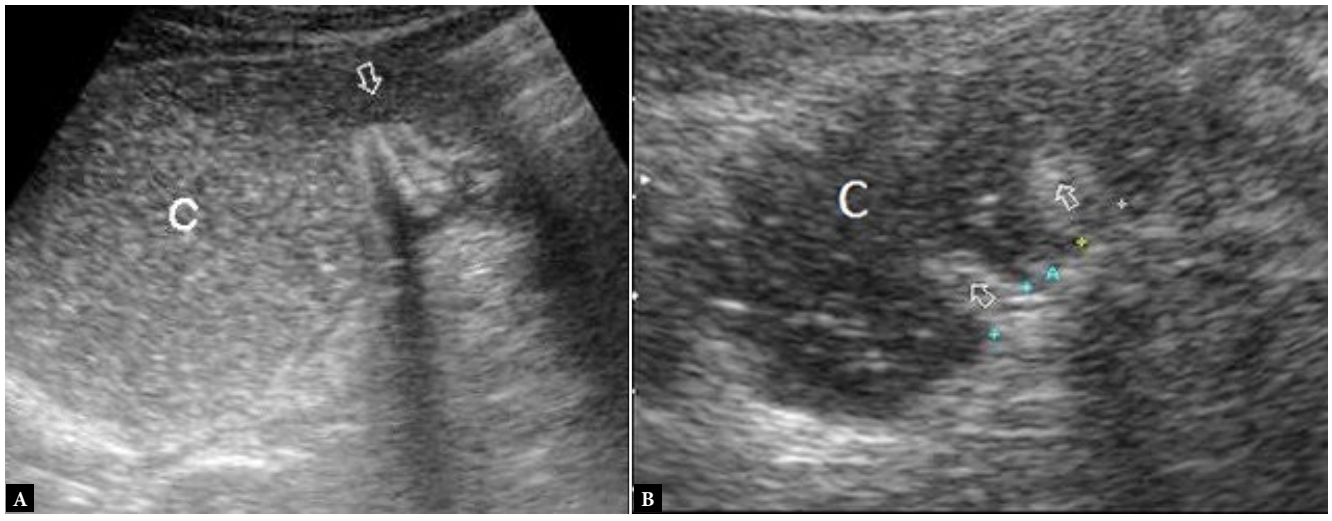

Fig. 22. *A 59-year-old man with a major cancerous stricture of the ascending colon (not visible on sonogram).* **A.** *A closed ileocecal valve (arrow) is visible in the cecum distended by loose stool (C).* **B.** *Image of an open ileocecal valve (arrows on the lips) appeared several times with retrograde flow of contents into the terminal ileum*

In two cases with almost complete cancerous obstruction of the right colon, we observed frequent reflux of loose feces into the terminal ileum through ICV opening due to increased colonic pressure preceding the stricture (Fig. 22). Occasionally, a lazy movement of ICV lips can also be observed in patients with diarrhea or after the use of a laxative. Silva *et al.*[3] found an open ICV on CT colonography almost exclusively in subjects in the supine position. The so-called tightness of the ileocecal valve can be assessed during contrast infusion in the colon. El-Amin *et al.*[15] found barium contrast reflux into the ileum in 75% of patients examined using this method. However, the conditions in such an examination deviate from natural conditions and it is therefore difficult to determine the extent to which this modality is actually useful in assessing ICV tightness.

There is little data in the literature on congenital ICV defects. Mousari and Sarparast[16] described a case of ICV atresia found shortly after birth and pointed out that such a congenital defect is extremely rare. Also, nothing is known about milder defects of this anatomical structure. Recent years have witnessed an increasing number of surgical and endoscopic ICV-sparing procedures[17,18]. After all, this valve plays a crucial role in limiting the passage of contents from the colon to the ileum, as well as regulating the rate of content flow from the small intestine into the colon. Maintaining ICV integrity has many benefits, including preventing small intestinal bacterial overgrowth (SIBO) and diarrhea, as well as contributing to the resorptive capacity of the ileum.

In conclusion, it is worth mentioning that the experience gained with ultrasound imaging of ICV will be particularly helpful during US-guided hydrostatic reduction of ileocecal intussusception in children[19].

Conclusions

The pathological involvement of the ileocecal valve that can be visualized by ultrasound is represented mainly by inflammatory chang-

es, usually arising from bacterial infections, Crohn's disease, as well as malignant invasion and lipomatosis. Carcinoid, terminal ileum intussusception and the so-called ICV syndrome are less common. Visualization of these lesions is made possible by the almost hollow segment of the cecum, which is encountered in patients with diarrheal bowel movements.

Conflict of interest

The authors do not report any financial or personal connections with other persons or organizations which might negatively affect the contents of this publication and/or claim authorship rights to this publication.

Author contributions

Original concept of study: AS. Writing of manuscript: AS. Analysis and interpretation of data: AS, GG. Final acceptation of manuscript: AS, GG. Collection, recording and/or compilation of data: AS, KK. Critical review of manuscript: AS, GG.

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