Review paper

Cite as: Smereczyński A, Kołaczyk K, Goncerz G: The ileocecal valve in transabdominal ultrasound. Part 1: Sonographic anatomy and technique. J Ultrason 2024; 24: 14. doi: 10.15557/JoU.2024.0014.

**Submitted:** 19.04.2023
**Accepted:** 30.06.2023
**Published:** 11.04.2024

# The ileocecal valve in transabdominal ultrasound Part 1: Sonographic anatomy and technique

Andrzej Smereczyński[1], Katarzyna Kołaczyk[2], Grzegorz Goncerz[3]

[1] *Department of Genetics and Pathomorphology, Pomeranian Medical University; Self-Education Ultrasound Study Group, Szczecin, Poland*
[2] *Department of Diagnostic Imaging and Interventional Radiology, Pomeranian Medical University, Szczecin, Poland*
[3] *Department of Anatomy, Jagiellonian University, Kraków, Poland*

*Corresponding author: Grzegorz Goncerz; e-mail: goncerz@mp.pl*

DOI: 10.15557/JoU.2024.0014

**Keywords**
ileocecal valve; ileocecal bowel segment; sonoanatomy; scanning technique; ultrasonography

**Abstract**

The ileocecal valve is a part of the gastrointestinal tract that separates two intestinal segments differing in both anatomy and function. Dysfunction or surgical removal of the valve usually results in the development of small intestinal bacterial overgrowth syndrome. The available literature lacks a broader discussion and ultrasound presentation of the ileocecal valve. The aim of this study is to present our experience in transabdominal ultrasound of the ileocecal valve in comparison with colonoscopic and computed tomography colonography data. In this part of the manuscript, we discuss the anatomical structures in the right iliac fossa that make up the ileocecal segment of the intestine. The ileocecal valve, which comes in two morphological forms: labial and papillary, is its central part. As shown in computed tomography colonography, the first type is more common, accounting for 76%, the second type accounts for 21%, whereas ileocecal valve lipomatosis is found in 3% of cases. Post-mortem studies have shown a significantly higher incidence of valve lipomatosis, which was found in up to 4 out of 5 cases. Our observations correspond with these findings. Ileocecal valve lipomatosis presents on ultrasound as a hyperechoic, well-circumscribed lesion, with no evident vascularity on color Doppler. This image should be differentiated especially from a lipoma, a relatively common large intestinal pathology. The paper presents two methods of preparation for an ultrasound scan (i.e. only on an empty stomach or after cleansing the intestine) and determines the optimal imaging methods for the ileocecal valve using transabdominal ultrasound. At the end of the ileocecal examination, it should be remembered to assess the lymph nodes in the right iliac fossa.

## Introduction

The aim of the study is to share our experience in transabdominal ultrasound (TUS) imaging of the ileocecal valve (ICV) compared with colonoscopic and computed tomography colonography (CTC) findings available in literature. The lower-right abdominal quadrant, which mainly accommodates intestinal structures, is prone to a variety of pathologies, inflammatory processes in particular. Acute appendicitis is the most common condition requiring urgent surgical intervention. The ileocecal region is also frequently affected by infectious diseases, such as yersiniosis, campylobacteriosis, salmonellosis, as well as attacked by viruses and fungi. It is also here that conditions such as Crohn's disease and less common neutropenic enterocolitis, tuberculosis, Behçet's disease, cecal diverticulitis, epiploic appendagitis, as well as pathologies related to Meckel's diverticulum occur. Furthermore, cancer, lymphoma, carcinoid, enterogenous cyst, and several other lesions can be expected in this area.

The ileocecal valve plays a key role in the proper functioning of this region, constituting a site of transition between the small and large bowel – gastrointestinal segments showing different motor activity, resorption capacity, microbiota and pH. Dysfunction, involvement by a disease process or surgical removal of ICV may lead to multiple abnormalities, mainly small intestinal bacterial overgrowth syndrome and ileocecal intussusception. Although literature offers many descriptions of the anatomy and disease processes of ICV, these are mainly based on colonoscopy and CTC[1–8]. Apart from Pistor *et al.*, who assessed the morphology and behavior of ICV during water infusion, we have not found any studies in the available literature that would relate to the imaging of ICV using transabdominal ultrasound[9].

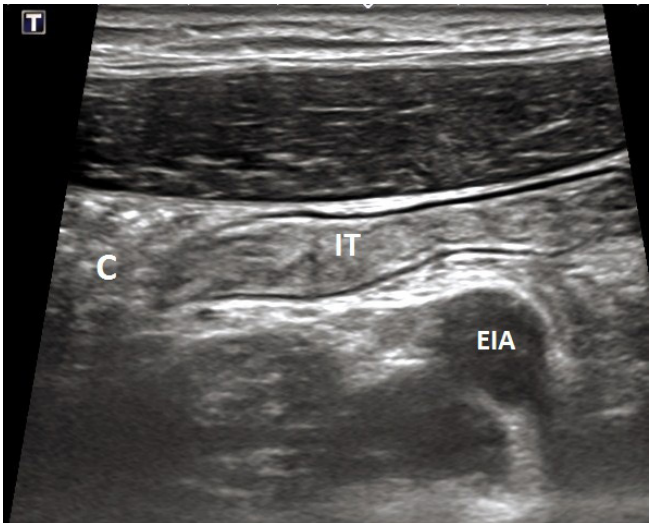


**Fig. 1.** *Right iliac fossa. EIA – right external iliac artery. TI – terminal ileum without distinct mucosal folds with pronounced muscularis. C – cecum with a thin wall, filled with feces. ICV not visible*

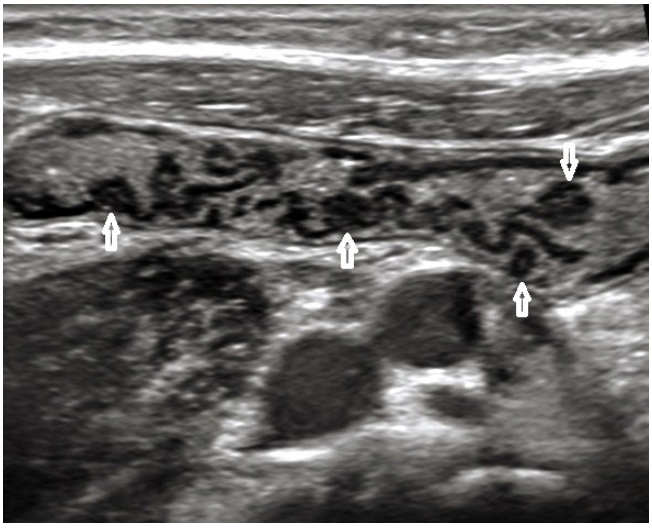

**Fig. 2**. *Terminal ileum in a 12-year-old boy. The arrows indicate reactively enlarged Peyer's patches*

## Anatomy of the ileocecal region

The final segment of the ileum, which is a dozen or so centimeters long, is sometimes referred to as the terminal ileum (TI). It has a straight course, runs to the right and posteriorly, where it most often connects with the large bowel from the medial side via the ICV. As shown in studies using double-contrast barium enema[10], ICV was placed medially in 82%, laterally in 15% and on the posterior wall in 3% of cases. Importantly, the opening of the appendix has a similar location.

TI has the narrowest lumen of the entire small intestine and joins to the wall of the right iliac fossa via the cecum. Our observations have shown that ultrasound detects a strongly pronounced muscle layer in TI, while the folds of the mucous membrane are either atrophic or sparse, and arranged longitudinally (Fig. 1).

In fasted patients, TI is closed and does not show peristaltic movements, with evidently increased activity even after consuming water. Under normal conditions, there is a disproportion between the thickness of the TI walls and the thickness of the cecal walls. The TI wall is thicker, while the cecum has the thinnest wall of all parts of the large bowel[8]. The ileocecal region has a well-developed lymphatic system, forming clusters of lymphoid follicles (Peyer's patches) in the TI mucosa[8,11]. Sometimes they may be reactively enlarged in children, as shown in Fig. 2.

The ileocecal valve acts as a boundary between the cecum and the ascending colon. It has two symmetrical lips (upper or ascending lip and lower or cecal lip) connected by the anterior and posterior frenula (Fig. 3). Two basic types of ICV: labial (76%) and papillary (21%) were distinguished based on CT colonography. Lipomatosis of the ileocecal valve is found in 3% of cases. In our study, ICV was fully visualized in 82% of patients[3]. A similar morphological classification of ICV is used in colonoscopy[8]. It is worth adding at this point that ICV is sometimes misidentified, most often as a polypoid formation, which the authors of papers on CTC warn against[1,6]. It is also worth mentioning the high tendency of ICV to accumulate fat tissue.

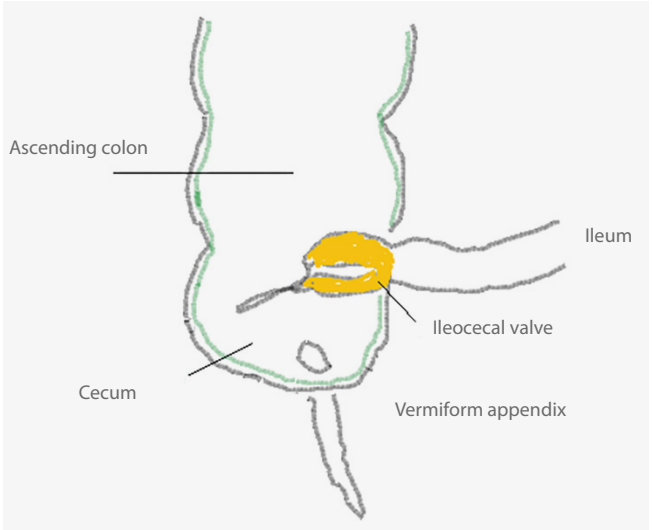


**Fig. 3.** *A schematic drawing of ICV location*

Yitta *et al.*[3] assessed ICV radiodensity in 212 subjects, obtaining a mean radiodensity of –26.3 HU ±14 HU (–60 HU to +18.3 HU), while Summers *et al.* [1] reported this parameter to be below –124 HU. Tawfik and McGregor described a group of 8 patients with the so-called ICV lipohyperplasia, including 3 patients complaining of pain in the right iliac fossa, and 2 patients with inflammatory and necrotic ICV mucosal lesions. Furthermore, the same authors reported post-mortem findings on ICV lipomatosis in 51 patients. Mild, moderate, and severe lipomatosis was found in 27.5%, 39.2% and 13.7% of cases, respectively, while no ICV lipohyperplasia was fund in 19.6%[12]. It seems that ICV lipomatosis may have clinical significance, as cases of dysfunction of this structure have been described, manifesting in impaired small intestinal patency and even persistent ileocecal intussusception[13–15]. As for the size of ICV, it is difficult to determine its normal ranges, and its volume is greater than 1.5 $cm^3$[1]. Trilisky *et al.*[6] are not convinced about

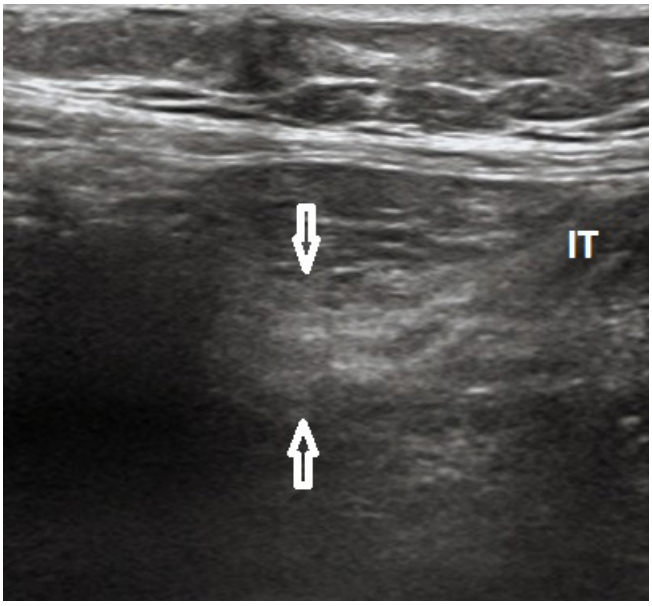


**Fig. 4**. *Terminal ileum (TI) ending with a poorly delineated ICV (arrows), visible in fasting ultrasound using transducer pressur*

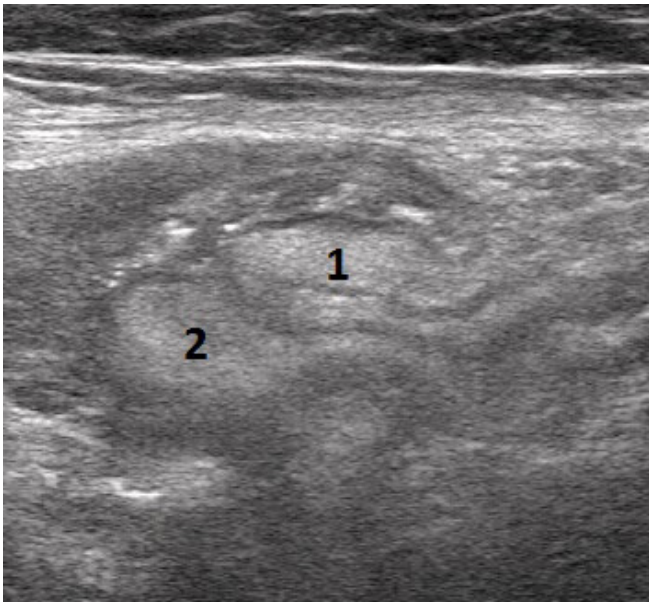


**Fig. 6.** *US after bowel cleansing. Lipomatosis of bilabial ICV. The upper lip is denoted with "1" and the lower lip is denoted with "2"*

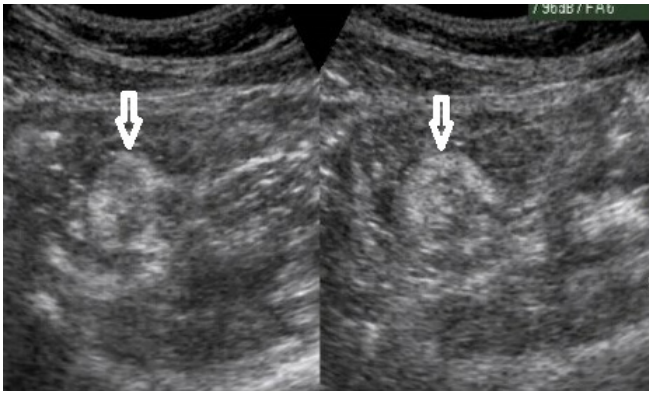

**Fig. 5.** *US after bowel cleansing. Papillary ICV can be seen in two cross-sections (arrows)*

the accuracy of ICV dimensions reported in other publications, according to which the thickness of a single lip may reach 1.5 cm and the height up to 4 cm. In turn, El-Amin *et al.*[10], based on double-contrast barium enema, reported the following mean values: height 1.7 cm (0.7–3.7 cm), width 2.8 cm (1.1–6.0 cm). Furthermore, the same study found asymmetrical size of the ICV lips in 12% of cases. A surprisingly low lip thickness of 2–3 mm was reported by Pistor *et al.*[9] It should be remembered that the assessment of the size of this anatomical structure is performed after forced cleansing of the large bowel for CTC, colonoscopy and contrast enema, which may cause colonic irritation and edema.

During colonoscopy, the valvular mucosa shows weaker vascularization than the adjacent walls of the large intestine. This structure is supplied by an arcade formed by the ileocolic artery[8]. This region is drained by tributaries of the superior mesenteric vein. It is innervated by sympathetic fibers of the cecal and appendicular plexuses, and the peripheral branches of the vagus nerve are responsible for parasympathetic innervation. The ileocecal valve is activated by a neural reflex or retrograde mechanical action when the ascending cecum is highly distended. The motor function of closing and opening the ICV is regulated directly by a complex annular system of the circular muscles of the TI and cecum[11]. Short-chain fatty acids play an important role in this process[8].

## ICV ultrasound technique

According to our findings, there are two ways to visualize ICV, which differ in terms of patient preparation. In the first case, the patient undergoes an ultrasound scan after a 6–8-hour fast, preferably overnight (that is, without drinking, eating, taking medicines, smoking or chewing anything). In this method, ICV itself is rarely detected and poorly delineated (Fig. 4). It is more likely to be visualized in slim patients. However, under normal conditions, it is almost always possible to visualize the TI (empty) and the cecum (filled with feces and gas) (Fig. 1). The second method involves cleansing the intestines with an oral laxative and undergoing the examination on an empty stomach, as mentioned above. Here, a partially or completely contracted cecum with easily detectable ICV is often visible (Fig. 5). There is usually no gas in the cecum, but loose stools can be detected, which are most often hypoechoic. Against this background, ICV can be easily distinguished, most often as an echogenic formation with smooth outlines, located on the posteromedial wall of the large intestine, on the border of the cecum and the ascending colon.

As in abdominal US, the assessment of the ileocecal segment should also involve using a 1–6 MHz convex transducer and/or a 7–12 MHz linear transducer, depending on the anatomical conditions. The same ICV scanning technique is used in both preparation methods. In the right iliac fossa, the right external iliac vessels should be visualized first, followed by the cecum and TI. It is not uncommon to see an unchanged appendix at this location. After identifying these three anatomical structures, the main stage of the examination should take place, i.e. continuous movement of the transducer dorsally and slightly sideways along the long axis of the

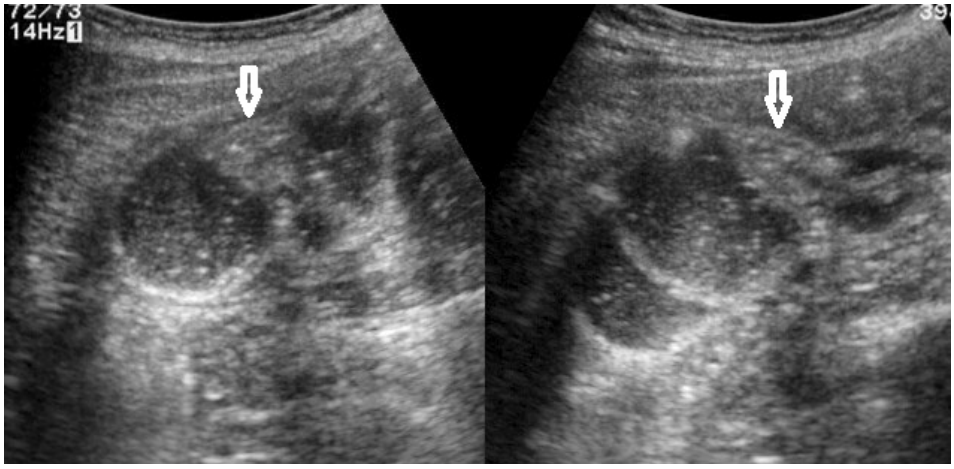


**Fig. 7.** *Papillary ICV on two sections shown after CT enteroclysis (arrows). The valve is surrounded with fluid*

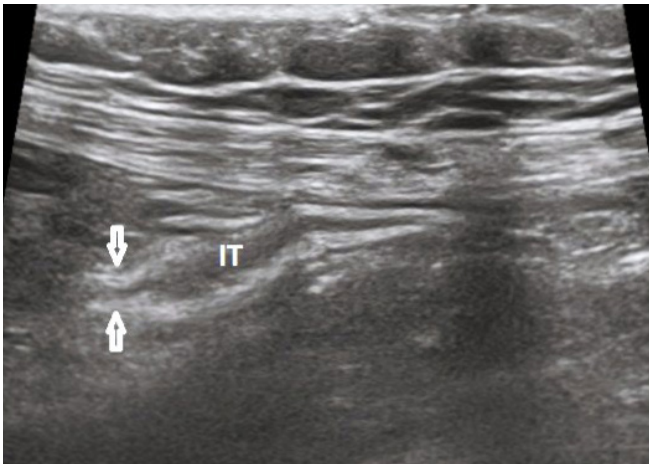


**Fig. 8.** *Fasting US using transducer pressure revealed the terminal ileum (TI) ending with non-lipomatous ICV (arrows)*

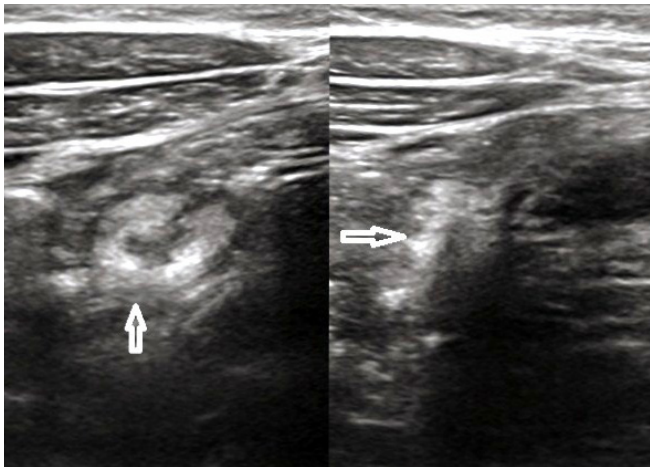

**Fig. 9.** *Fasting US using transducer pressure shows a lipomatous and closed ICV in two cross-sections (arrows)*

straight TI, at the end of which, within the large intestine, a structure, most often uniformly echogenic and with a bilabial (Fig. 6) or papillary (Fig. 7) configuration should be exposed. It should be visualized in two cross-sections. Less frequently, a poorly developed valve without signs of fatty tissue is seen (Fig. 8). In the first method of preparation, i.e. reporting for the examination on an empty stomach, it is often necessary to dose the transducer pressure in order to achieve the expected visualization effect. In some cases, the patient may be also placed in an oblique position on the left side, with the transducer positioned on the right side and gradually moved medially with pressure applied. In this way, by flattening the cecum and squeezing out its contents, ICV can be visualized.

The appearance and behavior of ICV depend on whether it has been triggered by some stimulating factor or not. When the patient presents with no gastrointestinal lesions and is prepared according to the first method, the ICV should be closed and does not show any motor activity during scanning (Fig. 9). The presence of ICV motor activity indicates its activation and at the same time excludes its misinterpretation as a cecal pathology (Fig. 10). Normal ICV shows no vascularity on color Doppler, even after setting the parameters to very slow flow (Fig. 11). The situation becomes more challenging when the patient presents with mesenteric malrotation. Such a defect is evidenced by an abnormal topography of the superior mesenteric vessels, i.e. the location of the superior mesenteric artery on the right side of the homonymous vein.

## Differentiation

Lipoma is the only lesion that lipomatous ICV can be confused with. Therefore, the ability to identify the previously described anatomical structures of the ileocecal segment of the intestine and visualize ICV on ultrasound is important. This type of encapsulated mesenchymal tumor has a very similar appearance and is often found in the large intestine as it is the second most common benign lesion after adenomatous polyps[16,17]. Colonic lipomas may be found in the cecum (19%), ascending colon (38%), transverse colon (22%), descending colon (13%) and sigmoid colon (8%). This type of tumor affecting the ileocecal valve may come as a big surprise, as in these cases it has an asymmetric configuration, but still a smooth surface[18,19]. For the purpose of comparison, the divided Fig. 12 shows a lipoma in the ascending colon (left) and a lipomatous ICV (right). In the case of any further diagnostic doubts, the patient may be administered about 500 mL of liquid (water, tea or juice). The motor activity of ICV, which usually appears after 30–60 minutes, should dispel any

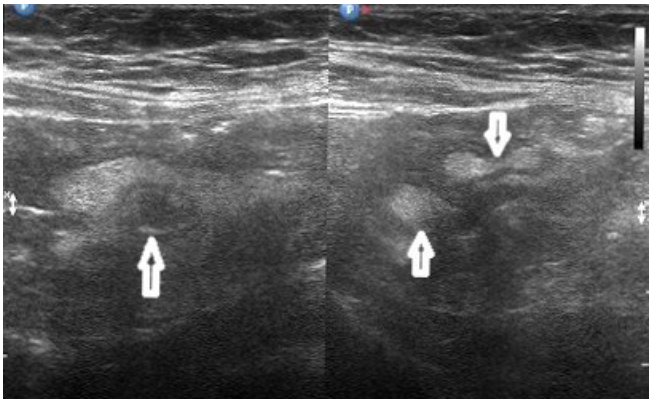

**Fig. 10.** *US after bowel cleansing. ICV is closed (left side of the sonogram). The arrow indicates the visualized paravalvular segment of TI. After a while, the lips of the valve parted – arrows (right side of the sonogram)*

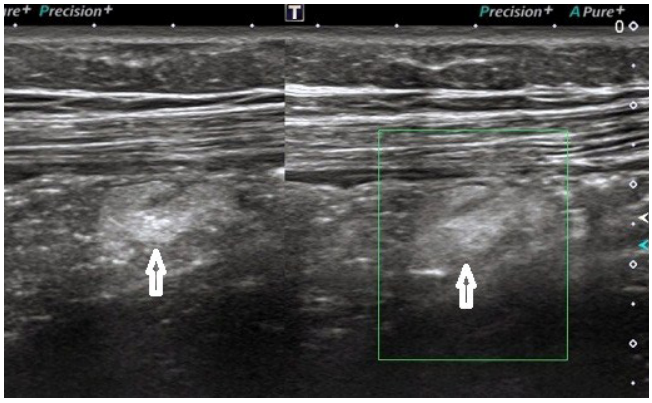


**Fig. 11.** *Assessment of the vascularization of a lipomatous ICV in B-mode (on the left) and color Doppler (on the right). Despite setting the color Doppler to a very slow flow (2.6 cm/s), it was not possible to show ICV vascularity*

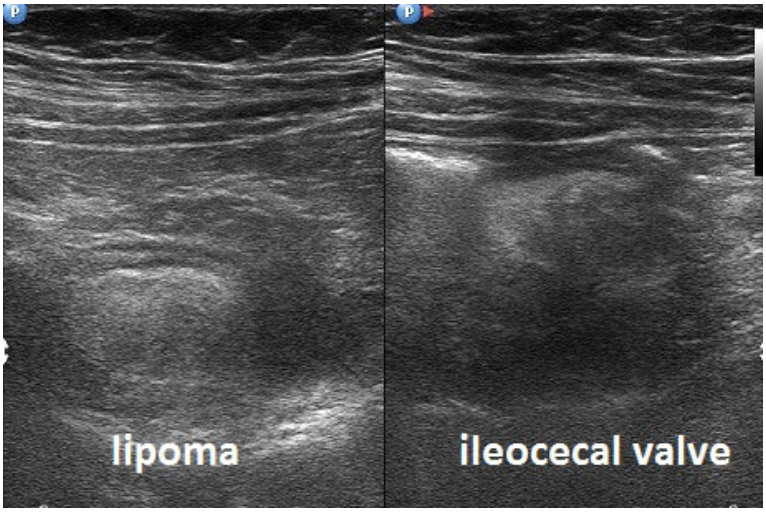


**Fig. 12.** *The divided sonogram compares the appearance of a lipoma of the ascending colon (on the left) with that of ICV lipomatosis (on the right)*

doubts. At the end of the ileocecal examination, it should be remembered to assess the lymph nodes in the right iliac fossa.

## Conclusions

The ileocecal valve is an important anatomical and functional structure separating the small intestine from the large intestine. It may appear as either labial or papillary form. It can be visualized in transabdominal ultrasound provided that the proposed methodology is used. In approximately 4 out of 5 cases, lipomatosis of varying severity can be expected, resulting in a hyperechoic appearance. The differential diagnosis should primarily include a lipoma of the cecum and the ascending colon.

### Conflict of interest

*The authors report no financial or personal relationships with other individuals or organizations that could adversely affect the content of the publication and claim ownership of this publication.*

### Author contributions

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

## References

1. Summers RM, Yao J, Johnson CD: CT colonography with computer-aided detection: automated recognition of ileocecal valve to reduce number of fals-positive detections. Radiology 2004; 233: 266–272. doi: 10.1148/radiol.2331031326.
2. Regge D, Gallo TM, Nieddu G, Galatola G, Francchia M, Neri E *et al.*: Ileocecal valve imaging on computed tomographic colonography. Abdomin Imaging 2005; 30: 20–25. doi: 10.1007/s00261-004-0225-0.

3. Yitta S, Tatineny KC, Cipriani NA, Dachman AH: Characterization of normal ileocecal valve density on CT colonography. J Comput Assist Tomogr 2006; 30: 58–61. doi: org/10.1097/01.rct.0000191687.43591.c4.
4. Hoeffel C, Crema MD, Belkacem A, Azizi L, Levin M, Arrivé L *et al.*: Multi-detector row CT: spectrum of diseases involving the ileocecal area. Radiographics 2006; 26: 1373–1390. doi: org/10.1148/rg.265045191.
5. Silva AC, Beaty SD, Hara AK, Fletscher JG, Fidler JK, Menias CO *et al.*: Spectrum of normal and abnormal CT appearances of the ileocecal valve and cecum with endoscopic and surgical correlation. Radiographics 2007; 27: 1039–1054. doi: 10.1148/rg.274065164.
6. Trilisky I, Wroblewski K, Vannier MW, Horne JM, Dachman AH: CT colonography with computer-aided detection: recognizing the causes of false-positive leader results. Radiographics 2014; 34: 1885–1905. doi: 10.1148/rg.347130053.
7. Erden A, Öz DK, Çoruh AG, Erden I, Ateş FSÖ, Törüner M: Backwash ileitis in ulcerative colitis: are there MR enterographic features that distinguish it from Crohn disease? Eur J Radiol 2019; 110: 212–218. doi: 10.1016/j.ejrad.2018.11.027.
8. Tang S-J, Wu R: Ileocecum: a comprehensive review. Can J Gastroenterol Hepatol 2019: 1451835. doi: 10.1155/2019/1451835.
9. Pistor G, Eckman A, Grüssner R, Weltzien A: Funktionelle Echomorphologie der Bauchnischen Klappe. Rofo 1987; 146: 278283. doi: 10.1055/s-2008-1048483.
10. El-Amin LC, Levine MC, Rubesin SE, Shah JN, Kochman ML, Laufer I: Ileocecal valve spectrum of normal findings of double-contrast barium enema examination. Radiology 2003; 227: 52–58. doi: 10.1148/radiol.2271020396.
11. Bochenek A, Reicher M: Anatomia człowieka. Tom III. Wyd. Med. PZWL. Warszawa 2006.
12. Tawfik OW, McGregor DH: Lipohyperplasia of the ileocecal valve. Am J Gastroenterol 1992; 87: 82–87.
13. Shah JC, Shah AM, Pardanani RH, Creedon JJ: Lipomatosis of the ileocecal valve causing recurrent small bowel obstruction. Int Surg 1985; 70: 81–82.
14. Huang J, Yap R, Lambie N, Lam FF: Lipomatosis of the ileocecal valve: an unusual cause of small bowel obstruction. ANZ J Surg 2018; 88: 1352–1354. doi: 10.1111/ans.13922.
15. Katsinelos P, Paroutoglou G, Jouvaros G, Betisis A, Mimidis K, Papazigas B. *et al.*: Lipohyperplasia of the ileocecal valve as a cause of intussuscepion. Acta Gastroenterol Belg 2005; 68: 280–282.
16. Chehade HHEH, Zbibo RH, Nasreddine W, Abtar HK: Large ileocecal submucosal lipoma presenting as hematochezia: a case report and review of literature. Int J Surg Case Rep 2015; 10: 1–4. doi: 10.1016/j.ijsr.2015;03007.
17. Casiraghi T, Masetto A, Beltramo M, Girlando M, Di Bella C: Intestinal obstruction caused by ileocolic and colocolic intussusceptions in an adult patient with cecal lipoma. Case Rep Surg 2016: 3519606. doi: 10.1155/2016/3519606.
18. Parmar JH, Lawrence R, Ridley NTF: Submucous lipoma of the ileocecal valve presenting as cecal volvulus. Int J Clin Pract 2004; 58: 424–425. doi: 10.1111/j.1368-5031.2004.00063.x.
19. Stancu B, Chira A, Chira RI, Grigorescu I, Gherman CD, Dumitrașcu DL Ileocolic intussusception by ileo-cecal valve lipoma – an infrequent ultrasonographic occurrence. A case report. Med Ultrason 2016; 18: 394–395. doi: 10.11152/mu.2013.2066.183.ile.