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PICTORIAL ESSAY

Spectrum of Normal Findings, Anatomic Variants and Pathology of Ileocecal Valve: CT Colonography Appearances and Endoscopic Correlation

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Abstract

Knowledge of the potential variants of ileocecal valve, the most frequent pathologic conditions as well as some pitfalls encountered during the analysis of CT Colonography images are thus indispensable for radiologists who perform and interpret such examinations and for general practitioners who are approaching this technique. Awareness of these different diagnostic possibilities is mandatory for radiologists evaluating CT Colonography datasets. Combined analysis of 2D axial and reformatted slices and 3D endouminal views provides the highest level of diagnostic accuracy. We present the multidetector CT Colonography findings with endoscopic correlation and discuss the possible pathologies and the practical implications

Key words: Computed tomographic colonography—Virtual colonoscopy—Video colonoscopy—Ileocecal valve

CT colonography (CTC) is a rapid evolving method for detection of colorectal polyps and cancer that enables both two-dimensional (2D) and three-dimensional (3D) evaluation of the colon [1–3].

To date, CTC has been found in multiple studies to be nearly as sensitive as Video colonoscopy in the detection of polyps 10 mm and larger [4–7].

The ileocecal valve (ICV) is a normal anatomic muscular structure located between the small and large intestine.

ICV is easily identified during CTC examinations on the medial aspect of the cecum. However, radiologists should be aware of possible anatomical variants as well of different pathologic processes, benign and malignant, which might affect the ICV, in order to avoid image misinterpretation.

The present pictorial essay reviews the normal anatomy of ICV and the anatomic variants, the most frequent pathologic conditions as well as some pitfalls encountered during the analysis of CTC images.

CT Colonography Technique

Following bowel preparation using predominantly cathartic agents alone or combined with some fecal tagging agents and gaseous colonic distension with either air or CO_2, multidetector-row CT (MDCT) scans of the abdomen and pelvis from the diaphragm to the pubic symphysis are acquired with the patient in prone and supine position [8]. Scanning protocol depends on the available CT equipment, but on MDCT an effective slice thickness of 3 mm or less and a reconstruction interval of 1 mm are advisable [9, 10]. MilliAmpere/second value is dependent on dose delivery, with low-dose protocol using 70 mAs or less [9, 10].

Spectrum of normal findings, anatomic variants and pathology of Ileocecal Valve: CT Colonography appearances and endoscopic correlation. A pictorial essay.

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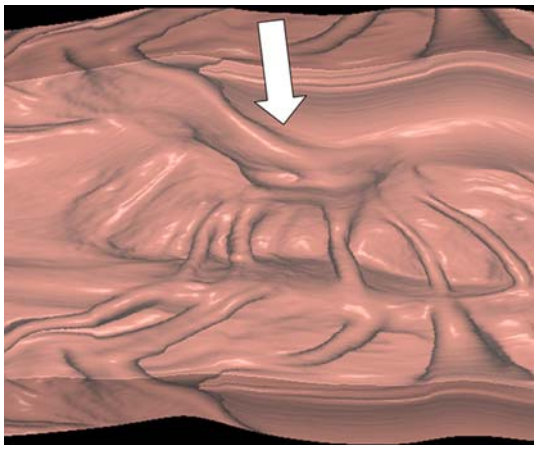

Fig. 1. 360_virtual dissection colonography shows entire luminal surface of ileocecal valve region displaying ileocecal valve along its entire longitudinal axis (*arrow*).

Image post-processing is performed on dedicated off-line workstations, suitable for 3D data management and reconstruction. Minimal requirements for the analysis of a VC study includes the simultaneous display of axial slices, reformatted sagittal and coronal planes (sometimes also oblique reformations may be available), and endoluminal views. Other complimentary projections include Tissue Transition Projection or (''virtual double contrast enema''), unfolded cube display and ''virtual dissection'', with the colon sliced lengthwise and laid open for en face inspection.

Virtual dissection is a new 3D rendering technique that draws a midline trace through the colon and displays the entire luminal surface of the colon as a flattened 2D image. The image produced resembles the pathologic display of a resected colon specimen. Using this software ICV is displayed along its entire longitudinal axis (Figure 1).

Normal Findings and Anatomic Variants

ICV, also known as *valvula Bauhini* or *Sphincter coli*, is formed by corresponding portions of the bluntly ending ileal walls called upper and lower lips (labia), that are formed by an intrusion of the circular muscle layer of the ileum within the cecum [11]. The proper function of this structure, acting not only mechanically, but also as a true sphincter, is to regulate transit of ileal contents into the cecum and preventing, under normal conditions, reflux of caecal content into the ileum.

A good familiarity with spectrum of different appearances, site and dimension of this structure is necessary in order to distinguish a normal from an abnormal ICV [12].

ICV is commonly located on the medial aspect of caecal wall; ICV does not projects freely into the colon but it is supported and suspended by fixed folds of the cecum, called frenula of the valve. Fleishner et al. [13] reported in 7% of the cases a direct implantation of the ileum into the posterior wall of the colon.

The endoscopic appearance of ICV, simulated also by CTC endoluminal views, has been classified, according to its morphology, into two types: papillary with a domelike protrusion having its mouth at the apex (Figure 2), or labial, appearing as a slit-like opening [14] (Figure 3). In most of the cases CTC endoluminal images may depict the orifice, as a tiny central depression on the valve (Figure 4), and occasionally an open valve may be visualized [15] (Figure 5).

The use of CO_2 is slightly better in adequacy of distension comparing to air and may prevent opening of the ICV thus providing lower degree of distension of small bowel [16, 17]. There is no consensus about the normal size of the valve and consequently when it has to be defined as enlarged. Lasser and Rigler [18] measured normal valves and assessed that normal thickness for each lips is up to 1.5 cm.

Hinkel and El-Amin in a more recent study defined the maximal height of the ICV nearly 4 cm [19, 20] Possible etiologies producing enlargement of ICV include idiopathic and post-traumatic edema, submucosal fat accumulation, herniation of ileal mucosa, tumor (benign and malignant) and inflammatory lesions involving the valve.

Lipomatosis

Lipomatosis of the ICV is a frequent condition, also known as lipohyperplasia, hypertrophy, fatty degeneration or ICV syndrome, characterized by enlargement of the valve due to submucosal fatty infiltration. Lipomatosis is usually asymptomatic and surgical resection must be avoided.

On endoluminal CTC view, the valve is enlarged, although this finding is aspecific and the diagnosis can be easily established only if axial CT images, observed using abdominal window setting, show significant fatty tissue within the lips of ICV (Figure 6). The absence of a distinct capsule helps in differentiating this condition from a true lipoma arising from the lips of the valve [20].

In some cases lipomatosis may be associated with Crohn's disease [21].

In order to exclude the presence of Crohn's disease, even if Crohn's disease as well as ulcerative colitis represent a contraindication to CTC exam, when incidentally discovered a careful evaluation of the terminal ileum together with surrounding peri-colic fatty tissue has to be assessed.

Inflammatory Lesions

Several inflammatory processes of the ileo-caecal region may involve ICV, with the most frequent being Crohn's

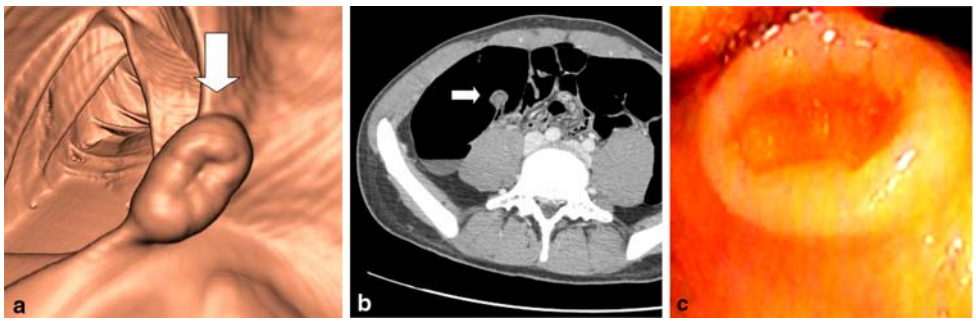

Fig. 2. 82-year-old man with " papillary type" ileocecal valve. **A** Three dimensional threshold-rendered endoluminal CT colonograph of ascending colon shows 2 cm polypoid lesion (*arrow*). **B** Axial CT scan at same level as **A** reveals polypoid lesion is papillary type of normal ileocecal valve with a characteristic domelike protrusion. **C** Endoscopic image shows a normal papillary type of ileocecal valve (*arrow*).

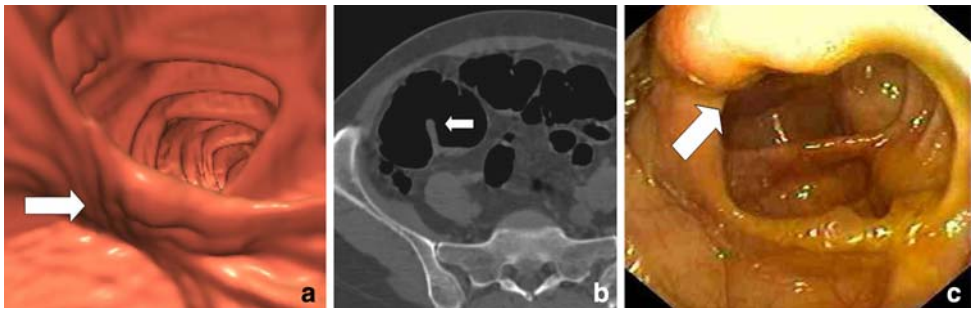

Fig. 3. 64-year-old man with "labial type" ileocecal valve. **A** Three dimensional threshold-rendered endoluminal CT colonograph of ascending colon shows a normal ileocecal valve, appearing as a slit-like opening (*arrow*). **B** Axial CT scan at same level as **A** reveals ileocecal valve characterized by a slightly raised fold with the mouth separating the folds margin (*arrow*). **C** Endoscopic image shows a normal labial type appearance of ileocecal valve (*arrow*).

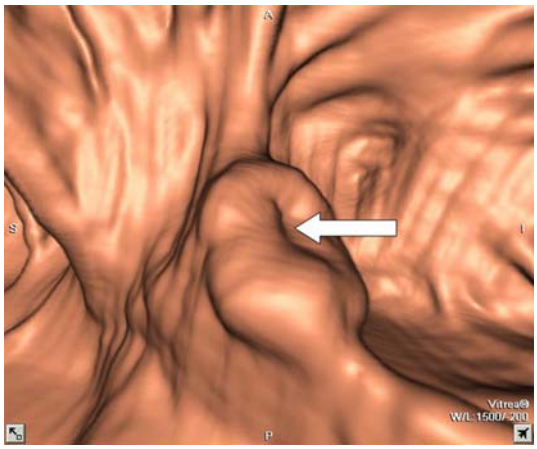

Fig. 4. 72-year-old man with normal ileocecal valve. Three dimensional threshold-rendered endoluminal CT colonograph of ascending colon depicts the orifice of the valve as a tiny central depression (*arrow*).

disease and ulcerative colitis. But tuberculosis, ameobiasis, typhoid fever and actinomycosis may also be observed.

In Crohn's disease the valve is usually enlarged due to a panenteric lymphedema; a thickened wall of the terminal ileum as well as stranding of the surrounding fatty tissue and multiple locoregional lymphadenopathies are among the other possible associated findings (Figure 7).

In the case of ulcerative colitis ICV is more rigid or irregular, but usually not enlarged; quite often it is open due to incontinency, as opposite to Crohn's disease where it is typically tightly closed (Figure 8).

Neoplasms

Another possible cause of ICV enlargement is represented by neoplasms.

ICV can be the site for both benign and malignant lesions. Since ICV contains histological elements of both cecum and small bowel, it can be involved by malignant tumors arising from each of these segments.

Lipoma accounts for the most common benign lesion of ICV whose major differential diagnosis is lipomatosis. Polyps may arise from the valve and have the same appearance as in other colonic areas (Figure 9).

ICV is also a very rare site for gastrointestinal cancers: to date only few cases of adenocarcinomas have

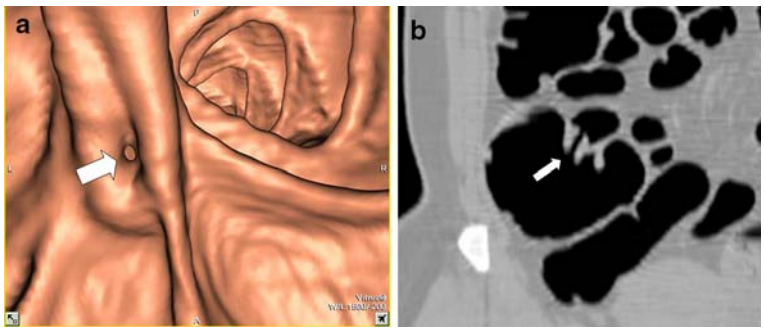

Fig. 5. 45-year-old man with open ileocecal valve. **A** Three dimensional threshold-rendered endoluminal CT colonograph of ascending colon shows an opening in the expected region of ileocecal valve (*arrow*). Differential diagnosis comprises diverticulum or incontinent ileocecal valve. **B** Coronal reformatted CT scan at same level as **A** reveals an ileocecal valve characterized by opening of leaflets (*arrow*).

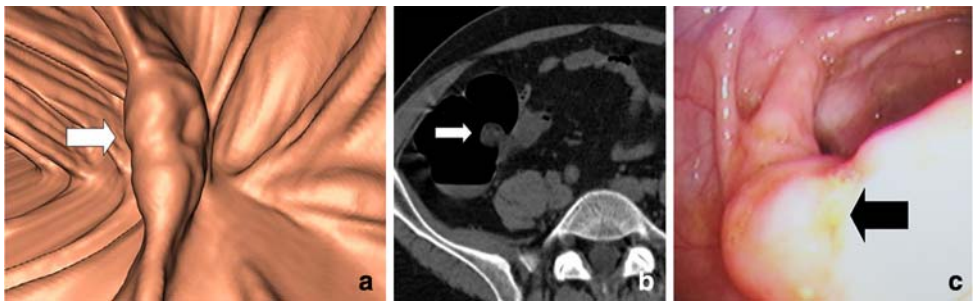

Fig. 6. 62-year-old woman with lipomatosis of ileocecal valve. **A** Three dimensional threshold-rendered endoluminal CT colonograph of ascending colon shows a pseudomass apperance of ileocecal valve (*arrow*). **B** Axial CT scan at same level as **A** reveals pesudomass appearance is actually due to a submucosal fatty infiltration (*arrow*). The diagnosis can be easily established using abdominal window setting. **C** Endoscopic examination showing lipomatosis of ileocecal valve (*arrow*).

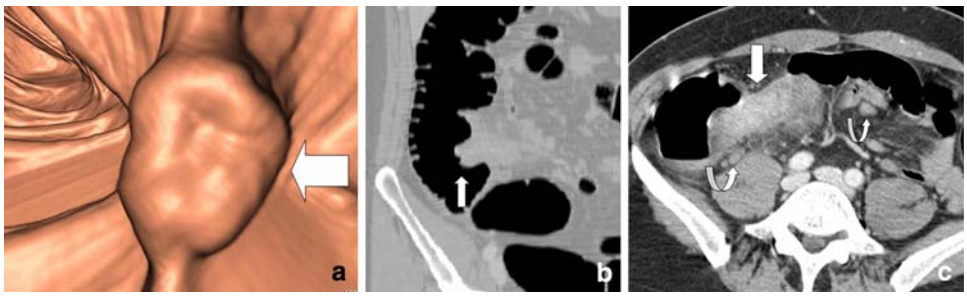

Fig. 7. 58-year-old man affected by Crohn disease with enlarged ileocecal valve. **A** Three dimensional threshold-rendered endoluminal CT colonograph of ascending colon shows an enlarged ileocecal valve (*arrow*). **B** Coronal CT reformatted scan at same level as **A** depicts an enlarged ileocecal valve (*arrow*) due to a panenteric lymphedema. **C** Axial CT scan using abdominal window reveals a thickened wall of the terminal ileum (*arrow*) as well as multiple locoregional lymphadenopathies (*curved arrow*).

been reported [22]. These tumors are usually vegetating sessile lesions with a large base of implant and are characterized by irregular mucosal surface (Figure 10). Sometimes, tumor surface may appear smooth resulting in a difficult differentiation from a benign lesion (Figure 11).

Lymphosarcoma arising from ICV usually involves terminal ileum while adenocarcinoma is usually confined to cecum (Figure 12).

Lymphomas of ileocecal region has the same radiological features of those involving other intestinal segments.

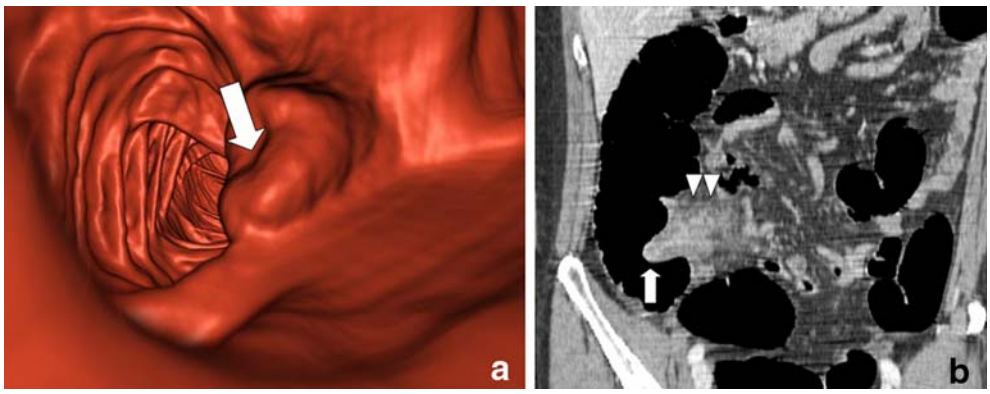

Fig. 8. 76-year-old man affected by Crohn's disease incidentally discovered at CTC exam with enlarged ileocecal valve. **A** Three dimensional threshold-rendered endoluminal CT colonograph of ascending colon shows, an enlarged ileocecal valve (*arrow*). **B** Coronal CT reformatted scan using abdominal window at same level as **A** depicts an enlarged and tightly closed ileocecal valve (*arrow*) as well as multiple locoregional lymphadenopathies (*arrowheads*).

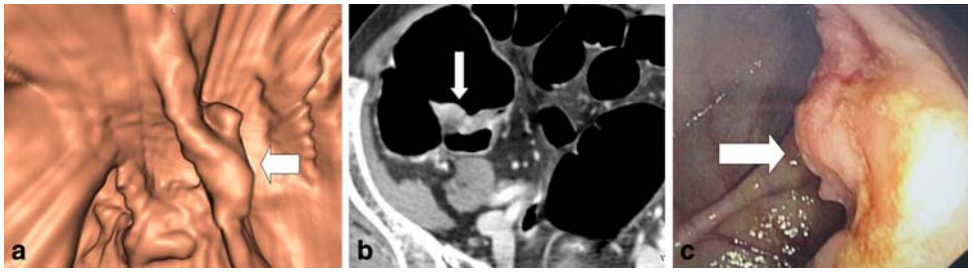

Fig. 9. 54-year-old man with polyp on the Ileocecal valve. **A** Three dimensional threshold-rendered endoluminal CT colonograph of ascending colon shows a sessile polypoid lesions on the Ileocecal valve (*arrow*). **B** Axial CT scan obtained colon window at same level as **A** shows a polypoid lesion (*arrow*) protruding within colonic lumen and located between two lips of labial ileocecal valve. **C** Coronal CT image obtained at same level as **B** showing relationship between polypoid lesion (*arrow*) and ileocecal valve

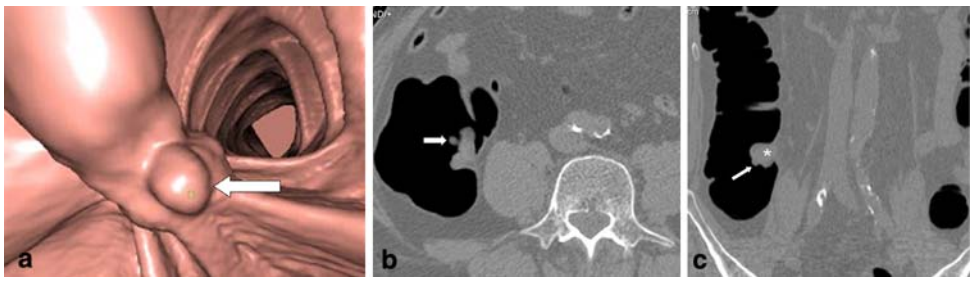

Fig. 10. 72-year-old woman with adenocarcinoma of ileocecal valve. **A** Three dimensional threshold-rendered endoluminal CT colonograph of ascending colon shows an iloececal valve characterized by irregular surface (*arrow*). **B** Axial CT scan using abdominal window at same level as A reveals a vegetating sessile lesion with a large base of implant (*arrow*) that enhanced following intravenous administration of contrast agent. **C** Endoscopic examination reveals an engorged mass on ileocecal valve (*arrow*) representing an adenocarcinoma of ileocecal valve.

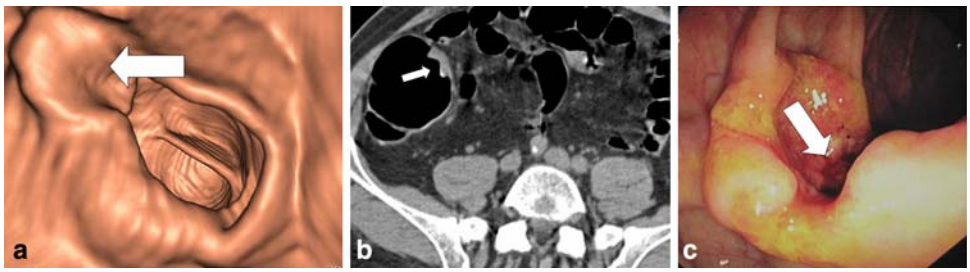

Fig. 11. 66-year-old man with adenocarcinoma of ileocecal valve. **A** Three dimensional threshold-rendered endoluminal CT colonograph shows a smooth iloececal valve (*arrow*). **B** Axial CT scan using abdominal window at same level as **A** reveals a vegetating sessile flat lesion (*arrow*). Note, tumour surface may appear smooth resulting in a difficult differentiation from a benign lesion. **C** Endoscopic image demonstrates the perspective indicated on axial and 3D images showing the lesion (*arrow*).

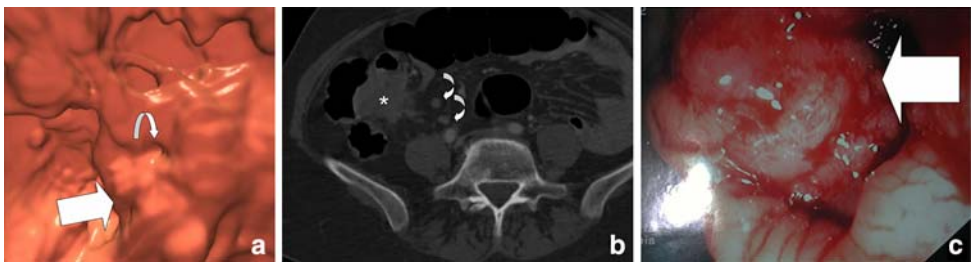

Fig. 12. 58-year-old woman with lymphosarcoma of ileocecal valve. **A** Three dimensional threshold-rendered endoluminal CT colonograph of ascending colon shows an irregular and enlarged iloececal valve (*arrow*) whereas the orifice is clearly visible (*curved arrow*). **B** Axial CT scan shows a huge mass (*) involving either the ileocecal valve or the terminal ileum representing a lymphosarcoma. Note lymphosarcoma arising from the valve usually involves terminal ileum while adenocarcinoma is usually confined to the cecum. Multiple locoregional lymphadenopathies are visible (*curved arrows*). **C** Endoscopic examination shows a huge mass (*arrow*) in the expected region of ileocecal valve, protruding into the lumen and narrowing it.

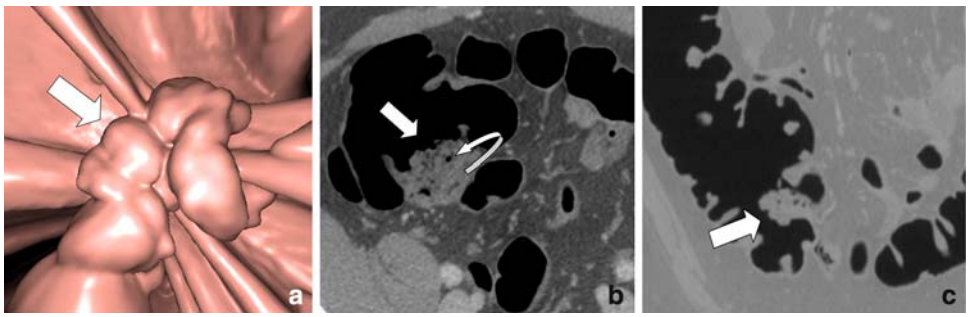

Fig. 13. **A** Endoluminal 3D view showing a bulky pseudo-lesion (*arrow*) on the region of ileocecal valve. This finding which may simulate an endoluminal vegetating neoplastic lesion is due to residual fecal material. **B** Characterization of the pseudo-lesion (*arrow*) as fecal residues can be obtained analyzing 2D axial slices, where inhomogeneities due to multiple air bubbles are noted (*curved arrow*). **C** Coronal 2D image showing realtionship between an open ileocecal valve and pseudo-lesion (*arrow*).

Pitfalls

Possible pitfalls in interpretation are represented by the presence of stool that may mimic an endoluminal mass lesion inside the colon in the region of ileocecalvalve (Figure 13), or alternatively by a lesion, either a tumor or a polyp, arising close the valve, which might be misinterpreted as the valve itself. In rare cases an appendiceal stump protruding into the cecum might simulate an ICV (Figure 14).

Conclusions

ICV is a normal structure, with several anatomical variants, possibly involved by different pathologic conditions, either neoplastic or inflammatory. Awareness of

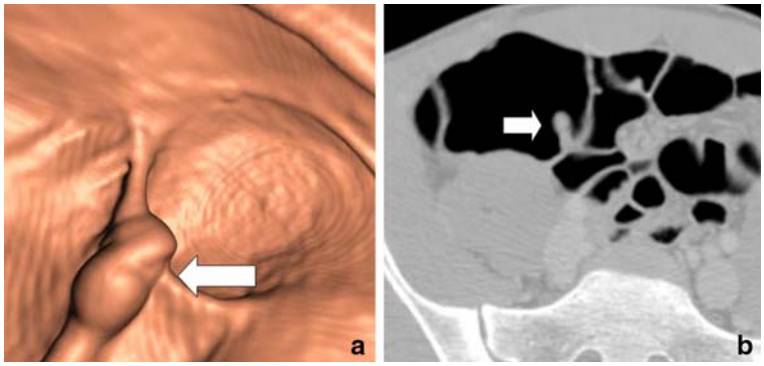

Fig. 14. 22-year-old man with history of appendectomy and an appendiceal stump. **A** Close-up three dimensional threshold-rendered endoluminal view from CT Colonography shows a 1 cm raised polypoid lesion in the cecum (*arrow*). **B** Axial CT scan in the same region as A reveals polypoid lesion is actually an appendiceal stump (*arrow*). **C** Endoscopic imaging confirms the presence of appendiceal stump (*arrow*) located in the cecum.

these different diagnostic possibilities is mandatory for radiologists evaluating CT Colonography datasets. Combined analysis of 2D axial and reformatted slices and 3D endouminal views provides the highest level of diagnostic accuracy.

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