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Review Article

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Inverted Colonic Diverticulum: A Mini Review of Diagnostic Challenges and Clinical Implications

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Abstract

Inverted Colonic Diverticulum (ICD) is uncommon yet clinically significant endoscopic finding, frequently misdiagnosed as a polyp. Misdiagnosis of this entity can result in inappropriate interventions such as biopsy or polypectomy, which may result significant consequences one of which is perforation. This mini-review encapsulate the current knowledge about ICD, including its prevalence, pathophysiology, endoscopic features, diagnostic maneuvers and clinical consequences. It also delineates the reported pitfalls and emphasizes the importance of heightened caution and awareness throughout colonoscopic examination.

Keywords: Inverted colonic diverticulum; Colonoscopy; Polypoid lesion; Diverticular disease; Endoscopic maneuvers

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Introduction

ICDs are an uncommon but clinically significant entity that manifests as a polypoid lesion, presenting either as a sessile or less commonly, as a pedunculated structure. Because they usually lack a stalk, ICDs can be difficult to distinguish from colonic polyps [1].

ICDs were first reported in the 1970s; they were initially thought to be rare. However, recent literature suggests that their incidence is likely higher than currently reported due to misidentification and limited awareness among endoscopists [1,2]. Despite the increasing recognition of ICDs since the 2000s, the number of reported cases remains low; this highlights the insufficient attention to this issue [2].

This mini-review aims to clarify the endoscopic features of ICDs, describe diagnostic maneuvers that aid in differentiating them from true polyps and summarize clinical outcomes and management considerations.

Prevalence:

Diverticular Disease (DD) represents one of the most common conditions in Western countries and it's among the main findings on colonoscopy, occurring in 5% of individuals at 40 years of age and increasing to 65% by 80 years [3]. In contrast, Inverted Colonic Diverticulum (ICD) is a much less common finding, identified in approximately 0.7% to 1.7% of individuals undergoing colonoscopy, with a mean age of 58.8 years and a slightly higher prevalence in males [1,2,4]. The sigmoid colon is the predominantly affected site, with 69% of the reported ICDs located in this segment. Additionally, concomitant diverticular disease is observed in approximately 88% of individuals with ICD [1].

The prevalence of colonic polyps also increases with age [5]. According to Hirata et al., patients with diverticular disease are more likely to have colonic polyps compared to those without [6]. Therefore, the probability of encountering both ICDs and polyps may be higher in

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elderly patients [5]. Supporting this, a study by Gulaydin et al. identified ICD in 1.73% of 810 patients undergoing colonoscopy, with approximately 43% of these cases exhibiting synchronous colonic polyps during the same examination [2].

Pathophysiology

ICDs are rare variants of colonic diverticula, which are considered benign lesions with no inherent malignant potential. Structurally, colonic diverticula are classified as pseudodiverticula, formed by the herniation of the colonic mucosal and submucosal layers through a point of weakness in the circular muscle layer, mainly where the major branches of the vasa recta penetrate the colonic wall [5]. The pathophysiology of ICDs remains incompletely understood. It is hypothesized that these lesions initially originate as typical diverticula and then intermittently reverse in response to changes in intraluminal and intra-abdominal pressure, as seen in external compression of the sigmoid colon during colonic intubation and aspiration of intraluminal air during colonic extubation [1,7].

Interestingly, the increased incidence of polyps within diverticular segments is thought to result from repeated episodes of diverticulitis, which may induce the development of non-neoplastic polyps either within the diverticular area or inside the diverticulum itself [1].

Clinical presentation

Symptoms associated with ICDs are generally nonspecific and resemble those of diverticular disease, including abdominal pain, changes in bowel habits and bleeding per rectum. Although uncommon, atypical presentations such as intussusception and active bleeding from an inverted diverticulum have also been documented in the literature [1,4].

Indications for colonoscopy in the reported ICD cases include abdominal pain, gastrointestinal bleeding, anemia, altered bowel habits, a positive fecal occult blood test, weight loss and a previous history of colon polyps, ulcerative colitis or episode of diverticulitis or suspected colorectal malignancy [2]. Despite these clinical indications, most ICDs are asymptomatic and are discovered incidentally during colonoscopy [5].

Radiologic and Imaging Characteristics

Although most reported cases of ICD do not specify whether imaging was performed prior to colonoscopy, a few available reports have described the identification of these lesions on radiologic studies. These include air-contrast barium enema studies, in which ICDs typically appear as smooth, broad-based, sessile polypoid lesions with a central umbilication or dimple that may fill with contrast material, producing a characteristic appearance of barium within the lesion. In some cases, insufflation of air caused eversion of the diverticulum, aiding in its differentiation from true polyps [8].

More advanced imaging techniques, such as computed tomography colonography and Endoscopic Ultrasound (EUS), have also been reported to detect ICDs. Features suggestive of ICD on EUS include thickened but otherwise normal mucosal and submucosal layers, often accompanied by hypertrophy of the muscularis propria in a polyp-like lesion. These lesions are typically soft and flatten with balloon compression [9,10].

Colonoscopic Features and Diagnostic Maneuvers

The resemblance between ICD and polyps poses a clinical risk because, unlike polyps, ICDs wall consists primarily of mucosa and submucosa with minimal or no overlying muscle fibers [11]. Consequently, biopsy or polypectomy can lead to perforation [2].

ICD is typically identified through passive observation or with the aid of provocative colonoscopic maneuvers. Several features have been described to differentiate ICD from true polyps [2]. These include the presence of an elevated, sessile lesion within a bed of diverticula, with a smooth, shiny pink mucosa that is indistinguishable from the surrounding tissue; a normal colonic pit pattern and occasional central indentation [1].

Another feature is the presence of Aurora rings, which are pale concentric mucosal rings at the base of the lesions, enhanced by both Narrow-Band Imaging (NBI) and indigo carmine dye, as demonstrated in **figure 1**. These rings are considered sensitive for ICD and are hypothesized to be caused by edema in the lamina propria that resulted from repeated inversion of the diverticulum, causing bulging of the mucosa between the rings [4,12]. However, this sign is not always reliable, particularly in smaller ICDs and in cases with poor bowel preparation [13,14].

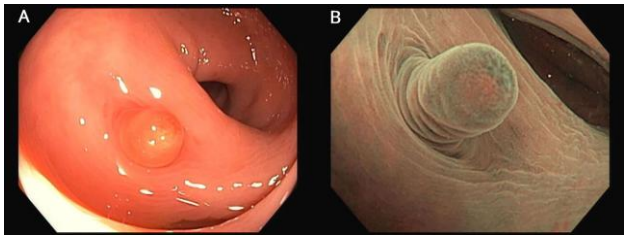


Figure 1: A: Inverted diverticulum in white-light colonoscopy, presenting as an elevated sessile lesion with fine concentric folds; B: Inverted diverticulum under Narrow-Band Imaging (NBI), showing pale concentric rings known as Aurora rings [13].

Various provocative colonoscopic maneuvers have been described in the literature to aid in distinguishing

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ICDs from colonic polyps. The first among these is gentle probing of ICD using closed biopsy forceps. When probing a solid polyp, one would not expect to observe a central dimple. In contrast, ICDs typically present as soft, pliable lesions that dimple upon invagination, producing the characteristic radiating pillow sign, which consists of a central indentation surrounded by radiating mucosal folds [15]. This feature is crucial in distinguishing ICDs from lipomas, which may also indent due to their soft nature but do not show radiating folds because true invagination is absent [11,15]. Despite its diagnostic utility, this technique poses some risks because ICDs lack prominent muscular layer; direct pressure from forceps may lead to perforation. Additionally, successful execution of this maneuver requires optimal scope positioning, specifically, proper apposition and an overhead angle, which can be technically difficult [12].

Other diagnostic maneuvers include air insufflation and water jet deformation. Air insufflation may result in flattening or reversion of an ICD [12]. However, its clinical reliability is limited, as insufflated air leaks into adjacent colonic regions, reducing local pressure and rendering the maneuver ineffective [7]. An alternative method is the application of a directed water jet, which can induce indentation, flattening or even eversion of the ICD due to its thin wall, a phenomenon referred to as the water jet deformation sign **(Figure 2)** [7]. This maneuver is best performed using a water pump to generate a moderately vigorous flow, delivered through a catheter inserted *via* the colonoscope's working channel and aimed at the target lesion [7]. A water jet can be applied from a distance without requiring direct contact or overhead orientation and can produce graded and controlled pressure by adjusting the distance, minimizing the risk of colonic perforation [7]. However, despite these advantages, this maneuver has demonstrated limited reliability in larger ICDs, where mechanical eversion is more difficult [11].

Despite their utility, a negative finding from any of the aforementioned maneuvers doesn't definitively exclude the diagnosis of an ICD due to variability in lesion size, morphology and location [11,12]. This limitation is particularly evident in larger ICDs, where these techniques tend to be less effective, reducing their overall sensitivity [12].

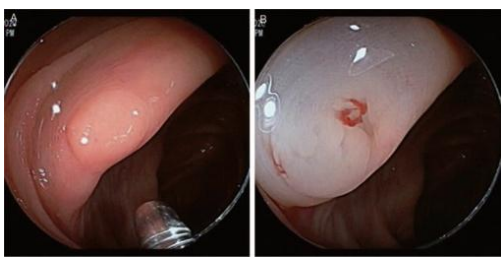


Figure 2: A: Shiny pink polypoid lesion observed during colonoscopy; B: Flattened lesion with central dimpling after submucosal saline injection [7].

A recently proposed technique involves submucosal saline injection beneath the suspected lesion. In a clinical trial by Lee and Kim, this maneuver resulted in flattening and central dimpling of the lesion, because only the surrounding submucosa was elevated, a finding attributed to the pseudo-diverticular nature of ICDs, which lack the muscular layer of the bowel wall. Unlike previous techniques, this method has demonstrated diagnostic reliability in both small and large ICDs. In addition, the use of indigo carmine dye for submucosal saline injection enhances the visualization of Aurora rings, thereby improving the accuracy of ICD identification. Nonetheless, as with other maneuvers, a negative response does not definitively rule out the presence of an ICD due to variations in morphology and anatomical location [14].

Management Strategies and Precautions

In cases where, after thorough endoscopic evaluation, uncertainty remains regarding whether a lesion represents an ICD or a polyp, it is advised to defer resection and instead schedule a follow-up colonoscopy [7]. When resection is pursued in the setting of suspected ICD, certain precautions can reduce the risk of perforation. For instance, prophylactic placement of resolution clips or over-the-scope clips can help close potential defects and prevent perforation [11]. Alternatively, a limited resection or biopsy performed after endoloop placement can minimize the risk of perforation [16]. Some authors also recommend prophylactic ligation of the lesion's base with clips prior to hot snare removal to enhance safety [1]. Although cold snare polypectomy is typically safe for polyps, the use of snare cautery may be safer in cases where an ICD is suspected, possibly by sealing the mucosal defect [11].

Histopathology

Histopathological analysis of ICDs across published reports consistently demonstrates a set of features supporting their benign nature. Common findings include normal or reactive colonic mucosa, crypt hyperplasia or elongation, mucosal and submucosal edema, lymphocytic infiltration and fibromuscular obliteration. These changes are likely attributable to chronic mechanical stress [5,10,12,16,17].

Unusual Features and Neoplastic Potential

Although ICDs are typically benign, rare reports have documented atypical presentations and malignant potential. One report documented neoplastic transformation arising directly within an ICD during a screening colonoscopy, where a 10 mm flat tubular adenoma with low-grade intraepithelial neoplasia was identified at the tip of the diverticulum and was

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successfully treated *via* endoscopic full-thickness resection using the ligate-and-let-go technique [18]. Another report described a sessile polyp originating on an ICD that was excised using hot snare polypectomy following prophylactic clip ligation of the pseudo-stalk [1]. These cases highlight the need for careful evaluation of ICDs, particularly when atypical features are noted.

Post-Polypectomy Outcomes and Complications

The true incidence of complications following invasive procedures on ICDs has not been well defined in the literature [5]. Complications have been reported in only a limited number of reports, typically involving perforations following inadvertent diverticulectomy or biopsy of polypoid lesions [1,2]. In some cases, diverticulectomy was performed without adverse outcomes, likely because the orifice of the ICD remained sealed by hypertrophied muscle or surrounding pericolic fat [1]. Nevertheless, the risk of free perforation remains and it is plausible that some adverse events have gone unrecognized or were misclassified as generic post-procedural complications [1].

Most reported cases of ICD-related perforation were mild and resolved with conservative management [5]. However, more serious outcomes have also been documented. For instance, one patient developed a perforation after polypectomy with hot biopsy forceps, necessitating surgical intervention with laparoscopic peritoneal lavage and drainage [2]. Another study described a sigmoid perforation after hot snare polypectomy, which presented as an acute abdomen and required laparoscopic repair [9]. In a different case, biopsy of the lesion was complicated by intra-abdominal abscesses formation, which required percutaneous drainage [17].

Factors contributing to misdiagnosis of ICDs and subsequent complications include inadequate lesion assessment, limited endoscopist experience and unsatisfactory quality of endoscopic imaging [2].

Conclusion

ICD is a rare but clinically significant entity that poses serious diagnostic challenges due to its close resemblance to colonic polyps. Accurate identification is crucial to avoid potentially serious complications following erroneous biopsy or resection of ICD. Awareness of characteristic endoscopic features and knowledge of the specific diagnostic maneuvers, including the radiating pillow sign, Aurora rings and submucosal saline injection, can significantly enhance diagnostic accuracy. Due to the inconsistency in ICD presentation and the low sensitivity of the colonoscopic maneuvers, a careful approach is required, especially if there is diagnostic uncertainty.

Further research is needed to optimize diagnostic protocols for ICD and to establish management guidelines. furthermore, consistent reporting of ICD cases should be encouraged to enhance understanding of this entity. Improved awareness and recognition of ICD will ultimately promote patient safety and optimize colonoscopic practice.

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