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Role of Multidetector Computed Tomography in Diagnosis of Acquired Gastrointestinal Fistulas

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Abstract

Introduction Fistulas are abnormal communication between two epithelialized surfaces. Gastrointestinal fistulas are communication between the gut and another epithelialized surface. Fistulas are classified according to anatomic (internal or external), physiologic (output volume), and etiologic characteristics. In the case of clinical suspicion of a fistula, a multidisciplinary approach helps in diagnosing and management. Multidetector computed tomography (MDCT) has an advantage over other imaging modalities due to its ability to reconstruct high-resolution images in seconds, which limits motion or peristalsis artifacts, and is ideal for patients who are uncooperative or who are seriously ill.

Aim Evaluation of MDCT as an initial tool in the diagnosis and characterization of gastrointestinal fistulas.

Methods During this prospective observational study, MDCT was used to assess patients with clinical suspicion of gastrointestinal fistulas. When necessary, contrast agents were used to identify the enteric fistulous tract. The etiology and characterization of the fistulas were determined. Further, the gastrointestinal fistulas were confirmed via endoscopy, cystoscopy, or surgery.

Results The most common type of gastrointestinal fistula is enterocutaneous fistula (ECF) (39%) and the most common cause of gastrointestinal fistulas is postoperative (47%). ECFs were classified according to their etiology, anatomy, and favorable characteristics (85% favorable) along with complexity (64% complex) to aid in the management process. In addition to pancreaticopleural fistulas (22%), biliary (11%), esophageal (8%), and pelvic fistulas (19%) were also observed. There were 19% of fistulas (esophageal and biliary) that were asymptomatic. Endoscopy confirmed such asymptomatic fistulas that were not convincingly detected on CT.

Conclusion In this study, we concluded that with the appropriate clinical history, MDCT can accurately depict enteric fistulas. In addition to characterizing fistulas, MDCT is equally useful for detecting secondary complications like inflammation, obstruction, or abscesses.

Keywords

- gastrointestinal fistulas
- multidetector computed tomography
- enterocutaneous fistulas
- pelvic fistulas
- pancreaticopleural fistulas

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Introduction

An abnormal communication between two epithelized surfaces is known as a fistula. Essentially, there are three methods of categorizing fistulas—anatomic, physiologic (output volume), and etiologic.[1] The fistulas are categorized into internal and external categories, when divided according to their anatomic components. Enterocutaneous fistulas (ECFs) are the most common external gastrointestinal fistulas (GIFs).[2] Nowadays, the majority (80%) of enteric fistulas result from abdominal surgeries. Rest of the enteric fistulas are secondary to inflammatory bowel diseases (IBDs) such as Crohn's disease, fistulizing tumors, diverticulitis, intra-abdominal sepsis, trauma, and radiation enteritis.[3,4] Increased morbidity and mortality rates have been associated with fistula sites, underlying diseases, low hospital volume, surgeon experience, and high intraoperative blood loss. It is recommended that computed tomography (CT) or magnetic resonance imaging (MRI) studies be performed on the patients to provide cross-sectional information about fistulas and underlying disorders as a consistent basis for treatment selection and planning. A multidetector CT (MDCT) is preferred in uncooperative or severely ill patients, such as patients in early postoperative hospitalization, because the images are obtained in seconds with high spatial resolution, thus reducing motion or peristalsis artifacts.[5]

Fistulas can be identified, delineated, and classified using MDCT. Fistulas can be classified according to their type (internal/external), anatomical location, cause (inflammatory, tumor, postoperative, spontaneous), and complexity (-simple/complex). External fistulas are pathological connections between any part of the gastrointestinal tract and the skin, while internal fistulas connect another organ to the portion of the gastrointestinal tract. Complex fistulas are often associated with abscess, inflammation, or obstruction.

Detecting the site and extent of the fistula correctly, as well as the presence of any associated complications, is a difficult radiologic challenge in patients with fistulas. All these factors directly affect their management.

Objectives

The primary objective of this study is to detect visceral fistulas initially by using MDCT as a clinical suspicion-based diagnosis. Fistulas of the gastrointestinal tract are then classified accordingly. As a secondary objective, we will assess the usefulness of contrast-enhanced (CE) MDCT in detecting secondary complications, such as inflammation, obstruction, or abscesses.

Methods

In this 1-year prospective study, 36 patients with suspected visceral fistulas were included (September 2020 to August 2021). This cross-sectional observational study was done at the Department of Radiology, King Edward Memorial Hospital, Mumbai, Maharashtra, India over the course of 1 year. All studies were performed on 160 slice MDCT scanner, Aquilion Prime, and PHILIPS 64-slice Brilliance CT unit. A high-resolution CECT abdomen with slice thickness of 0.5 mm was performed. Patients with symptoms that suggest an enteric fistula, including those with surgical history, preoperative neoplastic pathology, chromic infectious or inflammatory conditions, or trauma, were included in the study whereas pregnant patients, psychiatry patients, those patients refusing the study, and patients with congenital enteric fistulas were excluded from the study.

Results

The majority of patients had surgical procedures, including bowel operations ($n = 14$) and hysterectomy (3). Thirty-eight percent of patients had chronic inflammatory conditions. Eighty percent of patients were above the age of 40. More than 77% of the patients were men.

Clinically, 29 out of 36 patients' symptoms included leakage at the stoma site ($n = 14$), vaginal leak ($n = 3$), hematuria and passage of fecal matter through urine ($n = 2$), pneumaturia ($n = 1$), suprapubic pain postsurgery ($n = 1$), and dyspnea in patients with acute necrotizing or chronic pancreatitis ($n = 8$).

The esophageal fistulas ($n = 3$) and biliary fistulas ($n = 4$) were asymptomatic.

CT findings detecting esophageal fistulas included tracking of air and mediastinal fat stranding (66%) and mediastinal collection (33%).

CT findings detecting esophageal fistulas also included tracking of air and medial fat stranding ($n = 2$) and medial fat collection ($n = 1$). Most of the symptoms of internal biliary fistulas are nonspecific and attributable to the accompanying etiologic disease which makes diagnosis difficult.

Biliary fistulas in our study were mostly internal. Among biliary fistulas, cholecystoenteric (25%) and cholecystoduodenal (75%) types were identified. Endoscopy confirmed such asymptomatic fistulas that were not convincingly detected on CT.

Pancreatic fistulas in our study were caused by necrotizing pancreatitis ($n = 8$), with internal fistula ($n = 7$) showing peripancreatic collections communicating with the pleural cavity through the esophageal or aortic hiatus. The findings were confirmed with pleural fluid analysis of amylase levels. Magnetic resonance cholangiopancreatography (MRCP) was used in some cases to identify site of pancreatic duct disruption. There was one case of pancreaticocutaneous fistula ($n = 1$).

Fourteen cases of ECF were identified in the 36 patients who underwent MDCT.

ECF involved the small bowel more frequently (50%) than the rectum (7%) or colon (42%). Most ECFs were favorable (85%). In the majority of cases, ECFs were associated with collection or obstruction (71%), and a few were simple fistulas (28%). Therefore, ECFs were characterized accordingly. Characterization of ECFs is shown in ►**Table 1**.

Among pelvic fistulas, postoperative causes are the most common (80%) and are often associated with intra-abdominal collections or less frequently neoplastic causes (14%). Vesical ($n = 4$) and vaginal ($n = 3$) fistulas often presented as

Table 1 Characterization of enterocutaneous fistulas

ECF	Etiology	Anatomy	Type	Favorable	Associated
Colocutaneous	IBD	Complex	III	Unfavorable	Reactive appendicitis
Ileocutaneous	Postinflammatory	Complex	II	Favorable	Lesser sac collection
Ileocutaneous	Postsurgery for SBIO	Simple	II	Favorable	NAD
Ileocutaneous	Postsurgery for perforated peritonitis	Complex	II	Favorable	Collection in RIF
Ileocutaneous	Postoperative	Simple	II	Favorable	NAD
Rectocutaneous	Ulcerative colitis with total proctocolectomy and ileal pouch anastomosis	Simple	III	Unfavorable	NAD
Colocutaneous	Postoperative	Simple	III	Favorable	NAD
Ileocutaneous	Postoperative	Complex	III	Favorable	Parastomal hernia
Colocutaneous	Postoperative	Complex	III	Favorable	Abdominal collection
Colocutaneous	Postoperative	Complex	III	Favorable	Abdominal collection
Colocutaneous	Postoperative	Complex	III	Favorable	Perisplenic collection
Colocutaneous	Postoperative	Complex	III	Favorable	Anterior abdominal wall collection
Enterocutaneous	Postoperative	Simple	II	Favorable	NAD
Ileocutaneous	Postoperative	Complex	II	Favorable	Infraumblical collection

Abbreviations: ECF, enterocutaneous fistula; IBD, inflammatory bowel disease; SBIO, small bowel intestinal obstruction; NAD, not applicable.

fecaluria, pneumaturia, or vaginal discharge suspecting fistulas. Among vesical fistulas 50% patients presented with fecal matter passing through the urine, 25% with pneumaturia and 25% with suprapubic pain, and among vaginal fistulas all of them presented with vaginal discharge. Pelvic fistulas on clinical suspicion were identified on CECT without rectal or oral contrast (28%) or delineated using rectal contrast (57%) or oral contrast (14%). Methods used to elicit the symptomatic pelvic fistulas are shown in ►**Table 2**.

Discussion

MDCT has a pivotal role in identifying the cause of fistulas and hence improvement of the treatment process. Stawicki et al showed in their study that approximately 85 to 90% of GIF result from surgical procedures.[6] In our study, postoperative fistulas (►**Fig. 1**) are the most common type (47%) while inflammatory fistulas are the second most common (38%).

Clinical history is important for diagnosis of suspected enteric fistulas. Symptoms vary depending upon the organ of involvement. In intestinal fistula, the history and physical exam will reveal the underlying disease and complications.[7] We found that 80% of the fistulas we studied were symptomatic, and clinical history played an important role in the diagnosis of the fistulas.

According to Little et al, indirect CT findings of enteroatmospheric fistula include thickening of the esophageal wall (81%), mediastinal fatty stranding (81%), thickening of the airway wall (77%), fluid or debris in the airways (65%), and focal or diffuse esophageal dilation with air (65%). Compared with aspiration or pneumonia, mediastinal fluid collections were infrequent (15%).[8] In our study, CT findings detecting esophageal fistulas included tracking of air and

Table 2 Methods used to elicit the symptomatic pelvic fistulas

Pelvic fistula	Symptoms	Method	Etiology
Rectovaginal fistula	Vaginal discharge	Rectal contrast	Posthysterectomy
Rectovaginal fistula	Vaginal discharge	IV contrast	Posthysterectomy
Rectovaginal fistula	Vaginal discharge	Rectal contrast	Posthysterectomy
Rectovesical fistula	Hematuria, and Passage of fecal matter in urine	Rectal contrast	Postoperative in k/c/o Ca rectum
Colovesical fistula	Pneumaturia and dysuria	IV contrast	Diverticulitis, post-renal transplant
Rectovesical fistula	Passage of fecal matter in urine	Rectal contrast	Rectosigmoid mass
Ileovesical fistula	Postoperative suprapubic pain	Oral contrast	Postoperative

Abbreviations: Ca, cancer; IV, intravenous.

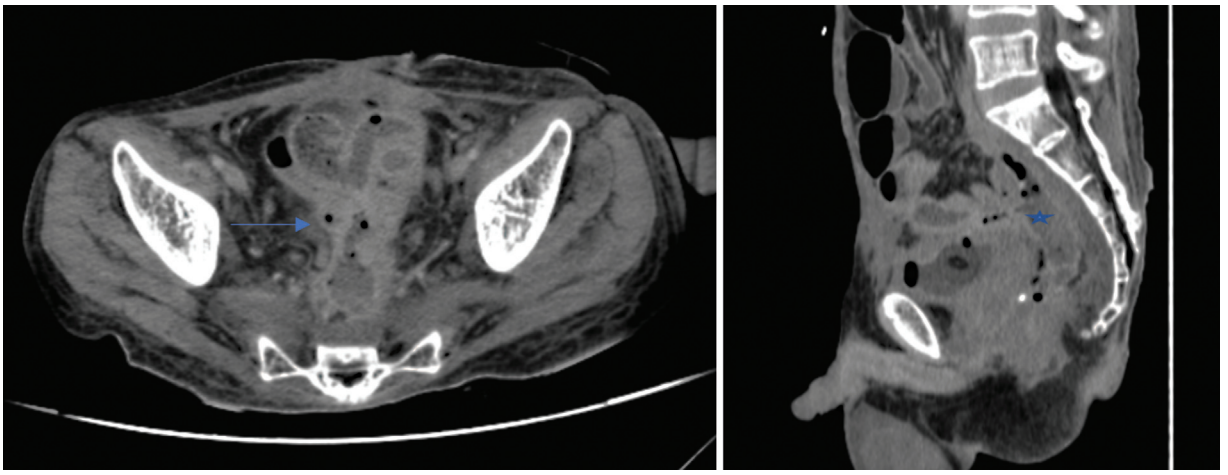

Fig. 1 Axial and sagittal contrast-enhanced computed tomography (CECT) images in postoperative patient show rectovesical fistula (arrow) with associated collection in mesorectal and presacral space (asterisk) and small bowel obstruction.

mediastinal fat stranding (66%) and mediastinal collection (33%) (►**Fig. 2**).

Cholecystocolonic fistula (CCF) is the second most common type of cholecystoenteric fistula (10–20%) after cholecystoduodenal fistula (75%).[9] In our study, biliary fistulas with cholecystoenteric (25%) and cholecystoduodenal (75%) types were identified. Even though there are no imaging techniques that are highly accurate at detecting CCF, abdominal-pelvic CT may provide data on fistulous communication and anatomical details.[10]

Pancreaticopleural fistula (PPF) formation typically occurs in a background of recurrent pancreatitis, induced by excessive alcohol consumption.[11] All of the PPFs in our study were the result of necrotizing pancreatitis with peripancreatic collections communicating with the pleural cavity through the esophageal or aortic hiatus. According to Wypych et al, PPF should be considered in cases of massive pleural effusion and encapsulated pleural fluid collections in patients with acute pancreatitis and surgery involving the pancreas.[12] The findings of this study are consistent with one we conducted in which CECT abdomen detected PPFs in necrotizing pancreatitis patients with dyspnea and gross pleural effusions (►**Fig. 3**). On CECT abdomen, PPF is identified as fluid density extending from the pancreas caudally across the diaphragm and communicating with the left pleural space. This can be confirmed on MRCP. CT,

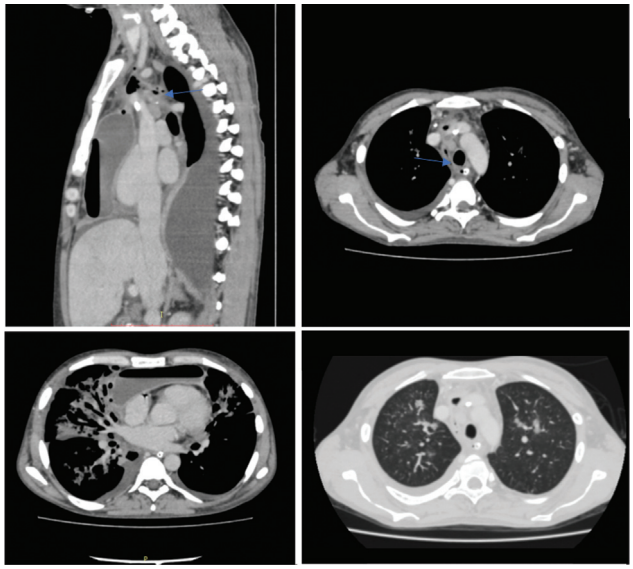

Fig. 2 Sagittal and axial images of contrast-enhanced computed tomography (CECT) thorax show suspicious esophageal communication (arrow) with the mediastinal collection secondary to necrotizing mediastinitis. Axial CT (lung window) images shows diffuse tree in bud opacities in both lungs suggestive of endobronchial process. Patient had history of coughing while eating and recurrent aspiration pneumonia. Therefore, bronchoesophageal fistula was suspected, which was confirmed during endoscopy.

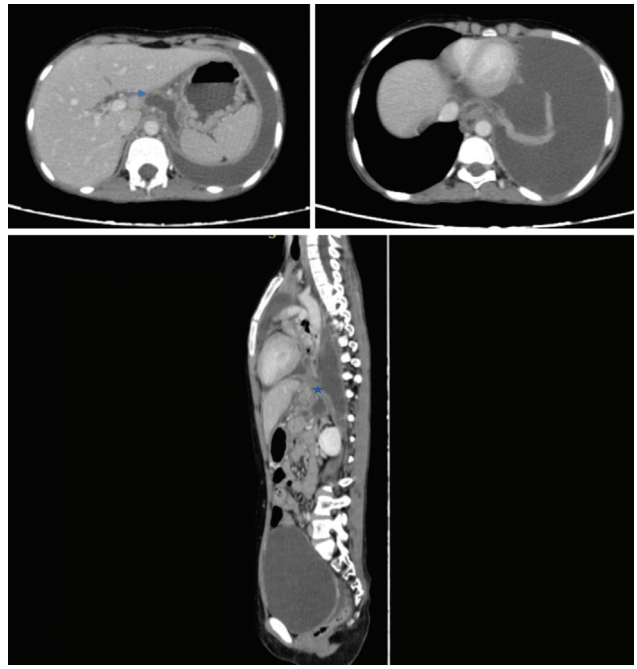

Fig. 3 Multiplanar cross-sectional images in a patient with necrotizing pancreatitis. Axial and sagittal contrast-enhanced computed tomography (CECT) abdomen and chest images show pancreatic and peripancreatic collection (arrow) extending through the diaphragmatic crura (asterisk) and communicating with pleural fluid suggestive of pancreaticopleural fistula.

endoscopic retrograde cholangiopancreatography, and MRCP are most widely used in current practice, and the sensitivity of each modality in detecting PPF is 47, 78, and 80%, respectively.[13]

External fistulas are pathological connections between any part of the gastrointestinal tract and the skin. They are the most common type of postoperative fistula.[14] In our study, external fistulas including ECFs were 39%. Complex fistulas are associated with abscess, inflammation, or obstruction. The management is heavily influenced by the underlying etiology (spontaneous or iatrogenic) and the anatomical classification (simple fistula or complex fistula).[15] It has also been suggested that complex or external fistulae are generally more resistant to healing.[16] There were more complex (64%) ECFs than simple (36%) fistulas associated with abscess or collection (50%) or reactive appendicitis (7%) or parastomal hernias (7%) in this study. Characterization of ECFs is required particularly for management of ECF and hence reduce the morbidity and mortality in surgical settings. Schein and Decker showed that organ of origin is another classification used for ECF and is useful as well in the consideration of management options: type I (abdominal, esophageal, gastroduodenal), type II (small bowel), type III (large bowel), and type IV (enteroatmospheric, regardless of origin).[17] Unfavorable fistulas include tract length of < 1 cm and favorable fistulas include tract > 2 cm. Favorable fistulas are more likely to close spontaneously and have better prognosis.[18] The ECF can be collapsed or patent, containing gas and/or fluid. The latter can produce the characteristic "tram-track" appearance on a CT scan. This allows us to approximate the length of the fistula.

In this study, ECF with large bowel (57%) are more frequent than those with a smaller bowel (43%) (►**Fig. 4**).

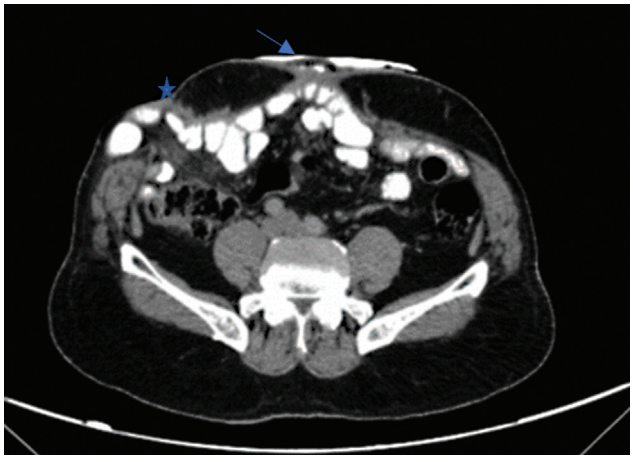

Fig. 4 Multiplanar cross-sectional images of a postoperative patient show enterocutaneous fistula (arrow) from proximal ileum. Axial images also show stoma site hernia (asterisk).

Additionally, 85% are favorable while 15% are unfavorable.

Pelvic fistulas with proper clinical history can be elicited on MDCT with oral or rectal contrast. MRI has a better advantage in perianal fistulas. The etiology of intrapelvic fistulas may be related to obstetrical complications, pelvic malignancy, radiation therapy, IBD, or iatrogenic or traumatic causes. Various types of pelvic fistulas are identified after pelvic disease or pelvic surgery.[19] According to this study, the majority of pelvic fistulas were postoperative (85%) or neoplastic (14%) (►**Fig. 5**) in origin. Vesical fistulas are diagnosed primarily on clinical grounds with over 75% of affected patients describing pathognomonic features of pneumaturia, fecaluria, and recurrent urinary tract infections.[20] In this study, among vesical fistulas 50% patients presented with fecal matter passing through the urine, 25% with pneumaturia (►**Fig. 6**) and 25% with suprapubic pain. The vesical fistula detected on MDCT was confirmed on cystoscopy. In Berger et al, 19 patients were identified and 2.37% complained of flatus per vagina, 89% reported stool per vagina, and 68% noted vaginal discharge.[21] In our study, among vaginal fistulas all of them presented with vaginal discharge. More proximal fistulas are best diagnosed with vaginography or CT with rectal contrast.[22] In our study, the rectovaginal fistulas delineated on rectal contrast (►**Fig. 7**) were repaired surgically.

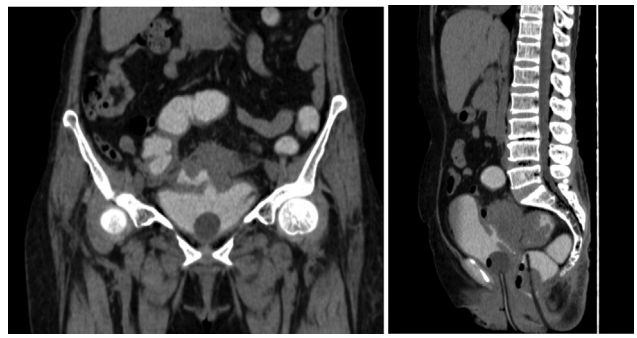

Fig. 5 A patient with hematuria and passage of fecal matter in urine. Coronal and sagittal reformat of computed tomography (CT) abdomen shows colovesical fistula secondary to a rectal mass, well elicited with rectal contrast.

Conclusion

In our study, MDCT was performed on 36 patients with clinically suspected acquired GIFs. Across a range of clinical histories, MDCT could elicit enteric fistulas. The MDCT can help identify fistulous tracts and characterize them to reduce morbidity and mortality in patients. Additionally, MDCT can detect the secondary complications like abscesses and obstruction.

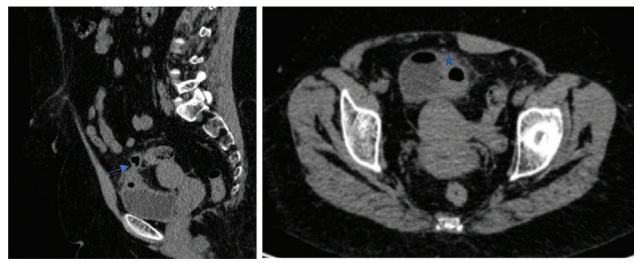

Fig. 6 Patient with transplanted kidney came with chief complaint of pneumaturia. Multiplanar reconstruction of cross-sectional images show diverticular abscess (asterisk) and colovesical fistula (arrow) with sigmoid colon.

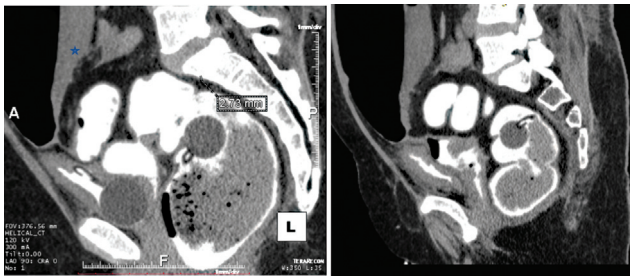

Fig. 7 A patient with posthysterectomy status with chief complaint of vaginal discharge. Computed tomography (CT) shows rectovaginal fistula with large abdominopelvic collection (asterisk) demonstrated with rectal contrast.

Conflict of Interest
None declared.

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