Magnetic Resonance Imaging in the Management of Anal Fistula and Anorectal Sepsis

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ABSTRACT

Complex perianal disease may be extremely debilitating for the patient with significant impingement on quality of life. The accurate identification of anatomical areas of involvement and subsequent appropriate management is crucial to achieving a successful outcome when treating anorectal sepsis and anal fistulae. Magnetic resonance imaging (MRI) has become a powerful tool in the evaluation of anal anatomy. In patients with complex disease MRI is an important adjunct in delineating disease location and extent, its relationship to sphincter muscles, and in planning management. MRI also plays an important role in evaluating the response to medical and surgical therapies.

KEYWORDS: MRI, anal fistula, anorectal sepsis, anovaginal fistula, Crohn's disease

Objectives: Upon completion of this article, the reader should understand the factors associated with recurrence of anorectal sepsis, persistence of fistulae despite surgical intervention, and the role of MRI in the management of such patients.

Magnetic resonance imaging (MRI) is now considered the predominant imaging modality in the management of patients with complex anorectal sepsis and/or fistulous disease.^{1,2} It has superseded fistulography, computed tomography (CT) scan and endoanal ultrasonography. It appears to have the greatest concordance with clinical findings and challenges examination under anesthesia (EUA) as the gold standard in the classification of fistulous disease.^{3,4} There is an increasing appreciation that EUA, when used alone, has significant limitations in the identification of fistulous tracts against a background of chronic sepsis and scarring.

Knowledge of pelvic anatomy and associated disease processes is essential to radiologists and surgeons involved in the management of anorectal sepsis. Ongoing technological advances continue to contribute

to significant improvements in the images obtained during MR imaging. MRI allows the classification of fistulous tracts and the identification of underlying infection. It directs the ensuing surgical management reducing the incidence of recurrent disease.^{5,6} It is particularly useful in the management of patients with perianal Crohn's disease. Such patients are often inadequately staged with subsequent potential for recurrent sepsis. This may result in the need for repeated anorectal surgeries with the attendant risk for incontinence.

When performing MRI, the entire perineum must be imaged because fistulous tracts, in particular, suprasphincteric and extrasphincteric tracts, may extend for several centimetres. MRI is particularly useful in showing the relationship of fistulas to the levator ani and ischioanal/ischiorectal fossa.

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More recently, MRI has been utilized in monitoring the reaction of fistulous tracts to medical treatment. Specific circumstances include assessing the response of perianal Crohn's disease to infliximab therapy and determining the extent of obliteration of anal fistula tracts in patients treated with fibrin glue instillation.

The additional cost involved in the use of MRI may not be justifiable in patients with simple anal fistula. However, in patients with complex perianal sepsis or fistula, combining preoperative MRI with examination under anesthesia (EUA) is the key to achieving a successful outcome. This may reduce the potential for incomplete therapy, subsequent reintervention, and resultant sphincter dysfunction.

ETIOLOGY AND MANAGEMENT OF ANORECTAL SEPSIS AND FISTULA

An anal fistula consists of an external opening, an internal opening and a communicating tract with varying degrees of inflammation. It may be radial or circumferential and have associated secondary tracts. The most well-known classification system of fistula-in-ano is that proposed by Parks.⁷ This is an anatomically based system dividing fistulae into four groups according to the relationship of the primary tract to the sphincter complex. In his series, the most common tract was intersphincteric (45%), followed by transsphincteric (30%), suprasphincteric (20%), and extrasphincteric (5%). Simple fistulae may be treated by fistulotomy whereas complex fistulae require staged management, which may include seton insertion, advancement flaps, fecal diversion, proctectomy, or medical therapies once the sepsis has resolved.

Many surgeons now consider perianal sepsis and fistula-in-ano, acute and chronic manifestations of the same disease process. The majority of anorectal sepsis is secondary to cryptoglandular infection that arises from anal glands located at the level of the dentate line, extending into the intersphincteric space. Failure of this suppurative process to discharge into the anal canal may give rise to anorectal sepsis with an ensuing fistulous tract. Other causes of fistula-in-ano include anal canal cancer, tuberculosis, HIV, diverticulitis, and Crohn's disease. The initial management of anorectal sepsis is primarily drainage. Premature closure of the overlying skin predisposes to recurrence. Large ischiorectal or deep anal space abscesses may require the placement of a mushroom catheter that permits adequate drainage allowing the underlying cavity to heal by secondary intention. Many surgeons do not look for a fistulous tract at the time of drainage because of the potential for creation of an iatrogenic tract in the presence of extensive inflammation and infection. Once the underlying sepsis has resolved, EUA may be performed to search for an associated tract.

Unfortunately despite management under optimal conditions, fistula recurrence occurs, mostly related to undiagnosed sepsis and complex fistulous tracts. Also, ~10% of patients will have misclassification of their fistula on EUA that influences subsequent outcome. The potential to convert a simple fistula to a more complex situation by overenthusiastic probing of tracts when the internal opening is not obvious needs to be borne in mind when dealing with anal fistulae. There is an increasing appreciation that EUA alone has limitations in assessing patients with severe perianal fistulous disease. Failure to identify secondary fistulous tracts at the time of the initial surgery is one of the most common reasons for failure. MRI performed by an experienced radiologist will act as an important aid to the surgeon facilitating eradication of sepsis and identification of factors associated with recurrence. The combination of the two modalities offers the best approach to the identification and correct classification of fistula-in-ano that dictates the resulting surgical strategy.

MAGNETIC RESONANCE IMAGING TECHNIQUE

MRI uses magnetic fields and radio frequency energy to create images of soft tissue without the use of ionizing radiation. This is an important consideration, especially in young patients who, over the course of treatment and surveillance, will require multiple imaging sessions. The technique can create images in any plane, although typically a combination of straight axial, sagittal, and coronal plane images is sufficient to adequately define the anatomy.⁸ This ability to obtain multiplanar imaging and excellent differentiation of soft tissues makes MRI ideal for the assessment of anorectal disease. The radiological images obtained correlate well with the clinically defined anatomy. An additional advantage is that no patient preparation is required. In a typical MRI study of the perianal region for fistula, multiple sequences are employed. At our institution, traditional T2-weighted imaging is obtained in axial, sagittal and coronal planes. Short tau inversion recovery (STIR) imaging, which is sensitive to fluid but has low fat signal, is obtained in the axial plane. Precontrast T1-weighted imaging without and with elimination of the fat signal is also obtained in multiple planes. Subsequently, after gadolinium contrast administration, T1-weighted imaging is repeated in multiple planes.

Some centers have combined the use of an anal endoluminal coil with a surface coil to improve the quality of images. The anal endoluminal coil has a smaller diameter than a more traditional rectal coil making it more tolerable for the patient when inserted into the anal canal. It has excellent resolution for the internal and external anal sphincters and thus is ideal in patients with cryptoglandular disease. The nature of the coil limits its

sensitivity and beyond a certain radius, the definition is significantly reduced. Thus, in these cases, an external coil is used to obtain signal originating more distant from the endoluminal coil. This includes signal from fistula tracts outside the sphincter complex. This external system consists of four or more coils collecting image data over a wider anatomic region. Despite their potential usefulness, their use is very limited because anal endoluminal coils are not generally commercially available.

The quality of images is improved when the sphincter muscles and the pelvic floor complex relax and the use of antispasmodics may help reduce motion artifact. In addition, the use of gadolinium enhancement may allow one to distinguish persistent sepsis from burnt-out fistulous tracts.⁹

The correlation of MRI with surgical findings and ensuing outcomes has been confirmed in several studies.^{6,10} Its clinical usefulness is particularly seen in patients with perianal Crohn's disease who often have extensive primary and secondary fistulous tracts that may give rise to the so-called watering-can perineum. MRI is also useful in the identification of pelvic sepsis and extrasphincteric fistulas, which may be iatrogenic or secondary to rectal neoplasm, inflammatory bowel disease, or diverticulitis. The surgical management of such cases may necessitate an abdominal approach. Imaging may also provide critical information on sphincter integrity, which is an important consideration particularly in female patients and those with anterior fistula tracts.

The cylindrical layers of the anal canal are identifiable on MRI. On T2-weighted images, the internal anal sphincter (IAS) appears as a hyperintense layer. In contrast, the external anal sphincter is hypointense (Fig. 1). The fistula itself appears as a relatively high signal intensity tract, which is thought to represent the true lumen with granulation tissue. Surrounding this is the relatively low intensity signal of the tract wall containing fibrotic tissue (Fig. 2).¹¹ The presence of

inflammatory edema, although identifiable, is much harder to recognize. In fact, although the anatomic details of the anal anatomy are better seen on T2-weighted images, postcontrast T1-weighted images are typically much better for visualization of the actual fistulous tracts. Active inflammation usually enhances significantly and can be readily identified (Fig. 3).

Morris et al, using MRI characteristics classified fistula-in-ano into five grades (Table 1). It is an extension of Parks classification to MRI findings and includes secondary fistulous tracts and associated abscesses. They found excellent correlation with ensuing surgical findings.¹² It was particularly advantageous in identifying occult intersphincteric sepsis (Fig. 4). It was also predictive of which patients may require secondary surgeries, which is an important consideration when counseling patients undergoing surgery for anorectal sepsis or fistula-in-ano.

MAGNETIC RESONANCE IMAGING AND ANOVAGINAL FISTULA

The presence of an anovaginal fistula with gas and feces per vagina can be extremely debilitating for the patient. The condition may initially present with recurrent vaginal infections or a foul odor. It is most often seen following an obstetric injury. It may also arise secondary to anorectal procedures, pelvic floor surgery, Crohn's disease, trauma, radiation injury, and anorectal malignancy. In addition to a fistula, these patients often have an associated sphincter defect.¹³ This makes preoperative imaging and definition of anatomy critical to the surgical outcome.

The multiplanar images and high spatial resolution of the anal canal, anovaginal septum and surrounding tissues, provided by MRI makes it ideal for preoperative imaging.¹⁴ Dwarkasing et al demonstrated its accuracy in identifying additional abnormalities such as abscesses within the anovaginal septum and secondary perianal fistula tracts. Although only 20 patients were imaged, it identified all internal anal canal openings and 95% of vaginal openings.¹⁵ On T2-weighted images the anovaginal fistula appears as a predominantly high-signal intensity linear abnormality. Its negative predictive value is important in the management of patients referred with symptoms of anovaginal fistula, which cannot be located clinically.

MAGNETIC RESONANCE IMAGING IN THE ASSESSMENT OF MEDICAL AND SURGICAL THERAPIES

More recently, MRI has been used to monitor the response of fistulous tracts to medical treatments. MRI demonstrates that skin healing may not be an appropriate determinant of outcome in patients with fistulous

Figure 1 Axial T2-weighted image at the level of the anal canal demonstrating mildly hyperintense internal sphincter (arrow), hypointense external sphincter (arrowhead), and levator ani muscle (L).

Figure 2 (A) Axial T2-weighted image at the level of the anal canal demonstrating a hyperintense translevator fistula (arrow). Also demonstrated are external sphincter (e), internal sphincter (i) and levator ani (L). (B) Axial short tau inversion recovery (STIR) image in the same patient showing a transsphincteric component (arrow). (C) Sagittal T1-weighted postcontrast image in the same patient demonstrates hyperenhancement along a contiguous fistulous tract to the skin (arrow).¹⁸

disease. Van Asche et al reported that despite apparent healing on clinical examination, fistulous tracts persist in patients with Crohn's disease treated with infliximab (chimeric monoclonal antibody to tumor necrosis factor- α) therapy. Eleven of 18 patients demonstrated clinical response evidenced by the absence of any further drainage from the fistula but 8 patients had evidence of persistent tracts and residual inflammation on MRI, raising the clinical concern about the durability of the long-term response.¹⁶

Fibrin glue has been proposed as an alternative to surgery in patients with fistula-in-ano. Enthusiasts for its use believe that it reduces the incidence of sphincter damage, has minimal side effects, and will not affect anal

canal function.¹⁷ It may also be performed on an out-patient basis without need for an anesthetic. Some centers have used MRI to ensure complete obliteration of the tract at the time of fibrin glue instillation. However, results have been variable.¹⁸

ACCURACY OF MAGNETIC RESONANCE IMAGING

Fistulography was the traditional technique used to define fistula anatomy. However its reliability was unpredictable and very often it failed to define the extent of primary tracts or secondary extensions. In addition, it gave no information on the relationship of tracts to the

Figure 3 (A) Coronal T2-weighted image demonstrating the low signal fibers portion of a fistulous tract extending to the perianal skin (arrow). (B) Coronal T1-weighted postcontrast image at the same level demonstrates hyperenhancement in the same region, representing inflammation.

sphincter complex or pelvic floor. Its limited value was confirmed by Kuijpers HC et al, who reported that it was accurate in only 16% of cases.¹⁹ In addition, false-positive results occurred in 10% causing the surgeon to search for nonexistent tracts, increasing the potential for iatrogenic injury.

Thus, the ensuing development of endoanal ultrasonography (EAUS) was met with enthusiasm. Its potential to identify the relationship of the fistula tract to the sphincter complex was a significant advance. The addition of agents such as hydrogen peroxide was reported to increase diagnostic accuracy.²⁰ However, the technique was noted to be associated with a significant learning curve, interobserver bias, and it had poor resolution beyond the anal canal.

The ability of MRI to differentiate soft tissues, identify tracts outside the anal canal, and orientate the images obtained to the surgically relevant plane was a major advance.²¹ Subsequent studies compared the accuracy of EAUS with MRI. Maier et al reported a

sensitivity of 60% for EUAS compared with 84% for whole-body MRI, replicating the results of previous studies by Hussain et al and Lunniss et al.^{22–24} In addition, there was a higher false-positive rate for EAUS with the authors suggesting that there seems to be little place for EAUS in the preoperative assessment of fistula-in-ano with MRI being the imaging modality of choice.

LIMITATIONS OF MAGNETIC RESONANCE IMAGING

The use of MRI requires a radiologist with additional experience in pelvic anatomy. The inter- and intra-observer agreement among expert radiologists is excellent, but outside the field, the quality of information provided is substandard.²⁵ Failure to align MRI images with the anal canal axis is a common error. In acute anorectal sepsis or painful fistulous disease, it may not be possible to use endoluminal

Table 1 Magnetic Resonance Imaging Classification of Fistula-in-Ano

Grade 1: A simple linear intersphincteric fistula, without involvement of the ischioanal or ischiorectal fossa. The tract is confined by the external sphincter and has no extensions.
Grade 2: An intersphincteric fistula with an abscess or secondary tract, but bounded by the external sphincter. These secondary tracts may be of the horseshoe variety crossing the midline or may extend up the intersphincteric plane without crossing the midline.
Grade 3: A transsphincteric fistula crossing both the internal and external sphincters, and the ischiorectal fossa before opening onto the skin.
Grade 4: A transsphincteric fistula with an associated abscess in the ischioanal or ischiorectal fossa.
Grade 5: Perianal fistulous disease extending above the levator ani muscle. This includes extrasphincteric fistula and suprasphincteric fistula, which originates in the intersphincteric space before piercing the levator ani and traveling downwards in the ischiorectal fossa.

Figure 4 (A) Axial T1-weighted postcontrast image demonstrating a small intersphincteric abscess (arrowhead). (B,C) Subsequent levels demonstrating a contiguous horseshoe-shaped fistula extending around the rectum (arrows).

coils. In addition, patients with severe Crohn's disease may have associated stenosis. In managing patients with fistulous tracts the internal opening and its relationship with the dentate line influences whether one will perform a primary fistulotomy or a staged procedure. However, a limitation of MRI is that it is unable to identify the dentate line. The use of MRI also adds a considerable cost component to the patient's care. In addition, some patients have relative or absolute contraindications to MRI including those with specific implanted devices such as pacemakers and certain cerebral aneurysm clips. Imaging will also be limited in patients who cannot receive intravenous contrast due to renal insufficiency.

CONCLUSIONS

MRI has an important role in the management of complex perianal disease. The cost involved and expertise required may not justify its use in simple fistula-in-ano. However, the presence of Crohn's fistulae or recurrent disease despite adequate surgical management requires appropriate imaging to delineate anatomy and relationship of tracts to the sphincter complex. Preoperative MRI can dictate the surgical procedure of choice and is an important determinant of outcome. It may alert the general surgeon to the presence of significant disease requiring specialist management given the associated risk of incontinence. It also plays a critical role in assessing

the response of fistulous tracts to the milieu of new medical therapies.

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REFERENCES

- Buchanan GN, Halligan S, Williams AB, et al. Magnetic resonance imaging for primary fistula-in-ano. *Br J Surg* 2003; 90:877-881
- Schaefer O, Lohrmann C, Langer M. Assessment of anal fistulas with high-resolution subtraction MR-fistulography: comparison with surgical findings. *J Magn Reson Imaging* 2004;19:91-98
- Spencer JA, Chapple K, Wilson D, Ward J, Windsor AC, Ambrose NS. Outcome after surgery for perianal fistula: predictive value of MR imaging. *AJR Am J Roentgenol* 1998; 171:403-406
- Halligan S, Stoker J. Imaging of fistula in ano. *Radiology* 2006;239:18-33
- Berman L, Israel GM, McCarthy SM, Weinreb JC, Longo WE. Utility of magnetic resonance imaging in anorectal disease. *World J Gastroenterol* 2007;13:3153-3158
- Chapple KS, Spencer JA, Windsor AC, Wilson D, Ward J, Ambrose NS. Prognostic value of magnetic resonance imaging in the management of fistula-in-ano. *Dis Colon Rectum* 2000;43:511-516
- Parks AG, Gordon PH, Hardcastle JD. A classification of fistula-in-ano. *Br J Surg* 1976;63:1-12
- Bartram C, Buchanan G. Imaging anal fistula. *Radiol Clin North Am* 2003;41:443-457
- Zbar AP, deSouza NM, Puni R, Kmiet WA. Comparison of endoanal magnetic resonance imaging with surgical findings in perirectal sepsis. *Br J Surg* 1998;85:111-114
- Haggett PJ, Moore NR, Shearman JD, Travis SP, Jewell DP, Mortensen NJ. Pelvic and perineal complications of Crohn's disease: assessment using magnetic resonance imaging. *Gut* 1995;36:407-410
- Dwarkasing S, Hussain SM, Krestin GP. Magnetic resonance imaging of perianal fistulas. *Semin Ultrasound CT MR* 2005;26:247-258
- Morris J, Spencer JA, Ambrose NS. MR imaging classification of perianal fistulas and its implications for patient management. *Radiographics* 2000;20:623-637
- Hull T. Rectovaginal fistula. In: Fazio V, Church J, Delaney C, eds. *Current Therapy in Colon and Rectal Surgery*. 2nd ed. Philadelphia: Elsevier, Mosby; 2005:35-40
- Stoker J, Rociu E, Schouten WR, Lameris JS. Anovaginal and rectovaginal fistulas: endoluminal sonography versus endoluminal MR imaging. *AJR Am J Roentgenol* 2002;178: 737-741
- Dwarkasing S, Hussain SM, Hop WC, Krestin GP. Anovaginal fistulas: evaluation with endoanal MR imaging. *Radiology* 2004;231:123-128
- Van Assche G, Vanbeckevoort D, Bielen D, et al. Magnetic resonance imaging of the effects of infliximab on perianal fistulizing Crohn's disease. *Am J Gastroenterol* 2003;98:332-339
- Buchanan GN, Sibbons P, Osborn M, et al. Pilot study: fibrin sealant in anal fistula model. *Dis Colon Rectum* 2005; 48:532-539
- Buchanan GN, Bartram CI, Phillips RK, et al. Efficacy of fibrin sealant in the management of complex anal fistula: a prospective trial. *Dis Colon Rectum* 2003;46:1167-1174
- Kuijpers HC, Schulpen T. Fistulography for fistula-in-ano. Is it useful? *Dis Colon Rectum* 1985;28:103-104
- Poen AC, Felt-Bersma RJ, Eijssbouts QA, Cuesta MA, Meuwissen SG. Hydrogen peroxide-enhanced transanal ultrasound in the assessment of fistula-in-ano. *Dis Colon Rectum* 1998;41:1147-1152
- Halligan S, Buchanan G. MR imaging of fistula-in-ano. *Eur J Radiol* 2003;47:98-107
- Maier AG, Funovics MA, Kreuzer SH, et al. Evaluation of perianal sepsis: Comparison of anal ultrasonography and magnetic resonance imaging. *J Magn Reson Imaging* 2001; 14:254-260
- Hussain SM, Stoker J, Schouten WR, Hop WC, Lameris JS. Fistula in ano: endoanal sonography versus endoanal MR imaging in classification. *Radiology* 1996;200:475-481
- Lunniss PJ, Barker PG, Sultan AH, et al. Magnetic resonance imaging of fistula-in-ano. *Dis Colon Rectum* 1994; 37:708-718
- Buchanan GN, Halligan S, Taylor S, et al. MRI of fistula-in-ano: inter- and intraobserver agreement and effects of directed education. *AJR Am J Roentgenol* 2004;183:135-140