



Anal and Perianal Masses: The Common, the Uncommon, and the Rare

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Indian J Radiol Imaging 2024;34:688–701.

Abstract

A variety of tumors involve the anal canal because the anal canal forms the transition between the digestive system and the skin, and this anatomical region is made of a variety of different cells and tissues. Magnetic resonance imaging (MRI) is the modality of choice for diagnosis and local staging of the anal canal and perianal neoplasms. In this pictorial review, we demonstrate the MRI anatomy of the anal canal and perianal region and display the imaging spectrum of tumors in the region along with an overview of its management. Imaging appearances of many tumorlike lesions that can cause diagnostic dilemmas are also demonstrated with pointers to differentiate between them.

Keywords

- ▶ anal
- ▶ perianal
- ▶ neoplasms
- ▶ cancer
- ▶ MRI

Introduction

The anal canal has a mixture of different coexisting types of cells and tissues, which predispose to the development of a wide variety of neoplasms. Squamous cell carcinomas (SCCs) are the most common anal canal carcinomas, accounting for 80% of all anal canal carcinomas.¹ The less common anal canal malignancies include adenocarcinoma and melanoma, which account for 15 and 4% cases, respectively. Lymphoma, neuroendocrine tumors (NETs), and mesenchymal neoplasms are even rarer in the anal canal. Tumors originating from the adjacent structures and organs can also secondarily involve the anal canal. These include lesions arising in the ischioanal fossa, vagina, vulva, urethra, and pelvic musculo-skeletal system.

The perianal region refers to the skin surrounding a perimeter of 5 cm around the anal verge.² Tumors of the perianal region are at least five times less common than tumors of the anal canal.¹ Any cancer occurring in the skin

elsewhere can occur in this region, with SCC being the most common. Less common neoplasms of perianal skin include verrucous carcinoma (VC), giant condyloma acuminatum (Buschke–Löwenstein tumor), basal cell carcinoma, Bowen's disease, and Paget's disease.

Although anal and perianal neoplasms can be clinically evaluated and biopsied easily, imaging with magnetic resonance imaging (MRI) is done to define the anatomical origin and the internal characteristics of the mass, and for staging.² Through this pictorial review, we demonstrate the anal canal and perianal anatomy on MRI and exhibit the imaging spectrum of tumors and tumorlike lesions in these regions. We also review the radiologist's role in staging and treatment planning of common neoplasms.

MR Imaging Technique

MR imaging performed with phased array coils provides excellent anatomical detail of the anal sphincters and the anatomical

article published online
March 23, 2024

DOI <https://doi.org/10.1055/s-0044-1781459>.
ISSN 0971-3026.

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boundaries of the pelvis. High-resolution (HR) T2-weighted imaging (T2WI) in three orthogonal planes are the key sequences for knowing the extent of the lesion and proper assessment of the anal sphincter complex.³ These are obtained with a slice thickness of 3 to 3.5 mm, with a small field of view (FOV) of 18 to 20 cm and high matrix (e.g., 320 × 256). Because of the forward tilt of the anal canal, the axial and coronal planes for HR imaging should be aligned orthogonal and parallel to the long axis of the anal canal, respectively (→ Fig. 1). Large FOV (covering the whole of the pelvis) T1 weighted imaging (T1WI), T1 fat-suppressed imaging, short tau inversion recovery (STIR) imaging, and diffusion weighted imaging (DWI) are other useful imaging sequences for disease characterization, determination of the extent of disease, and nodal spread. Intravenous gadolinium contrast may not be needed in most cases but can be used in selected cases to characterize uncommon lesions.

MRI Anatomy of Anal Region

The anal region includes the anal canal, anal verge (anus), and perianal skin (→ Fig. 1). The anal canal is the terminal part of the intestine that lies between the rectum above and the anal verge below.² The anorectal junction is at the superior limit of the puborectalis muscle, which forms a U-shaped sling around the superior portion of the anal canal. The anal verge is a band of squamous epithelial tissue that lacks hair follicles.² The anal canal has the following layers from inside-out: the mucosa, submucosa, and the sphincter muscles. An important landmark of the anal canal mucosa is the dentate line, which marks the junction of the endoderm-derived upper two-thirds and ectoderm-derived lower one-third of the anal canal.² The lining epithelium, the lymphatic and venous drainage, and nerve

supply above and below the dentate line are hence different. The lining epithelium in the lower third of the anal canal is nonkeratinized squamous epithelium, that in the upper one-third is the columnar epithelium, and the middle third is a mix of both and is hence called the transitional zone.² The difference in lymphatic drainage above and below the dentate line will be seen in nodal spread of anal canal tumors. Tumors above the dentate line drain into the perirectal and internal iliac nodes, whereas tumors below the dentate line and the anal margin drain into the inguinal and femoral lymph nodes.⁴

Deep to the anal canal mucosa is the submucosa followed by two muscular layers, namely, the internal anal sphincter (IAS) and the external anal sphincter (EAS). The IAS is an involuntary muscle that is the thickened extension of the circular smooth muscle layer of the rectum. On MRI, IAS appears homogenous and moderately hyperintense on T2WI.⁵ The EAS, which is a voluntary muscle, along with the puborectalis sling (PS), forms the outermost layer of the anal canal. The PS surrounds the upper third of the anal canal, while the EAS surrounds the lower two-thirds. According to the traditional description, EAS the is made of three muscle bundles, namely, deep, superficial, and subcutaneous bundles.² The deep bundle surrounds the middle two-thirds anal canal. The superficial bundle sweeps around and encircles the lower one-third of the anal canal. The subcutaneous bundle lies inferolateral to the IAS and beneath the anal verge. On MRI, the EAS complex has low signal intensity with “striated” appearance on T2WI. On HR T2WI, it may be possible to distinguish the three components of EAS. The dentate line, although not visible on MRI, is located at the level between the upper one-third and the lower two-thirds anal canal.^{5,6}

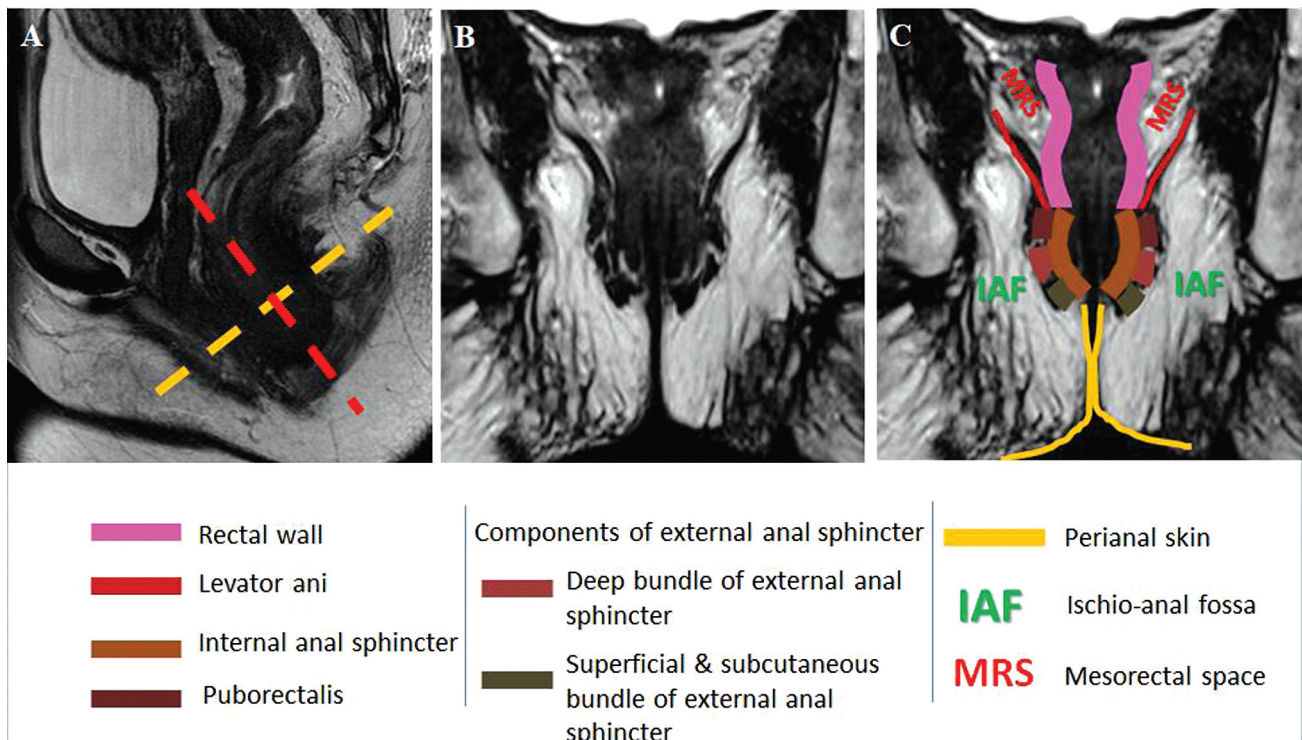


Fig. 1 (A) Sagittal image of the anal canal demonstrating the planes to obtain axial (yellow dashed line) and coronal (red dashed line) T2 high-resolution images of the anal canal. (B,C) Magnetic resonance imaging (MRI) of the anatomy of the anal canal in coronal plane.

The perianal skin, also known as the anal margin, is the hair-bearing skin surrounding the anal verge for a radius of 5 cm². The ischioanal fossa is a pyramid-shaped space situated on both sides of the anal sphincter complex with its base directed to the surface of the perineum and its apex directed anteromedially toward the pubic symphysis.² It is bounded superiorly by the levator ani muscle, medially by the EAS muscles, laterally by the obturator internus muscle and its fascia, and inferiorly by skin of the perineum.

Classification and Staging of Anal and Perianal Neoplasms

The World Health Organization (WHO) classifies tumors of the anal canal broadly into two categories: (1) benign epithelial tumors and precursors and (2) malignant epithelial tumors.⁷ They are further divided based on the histologic type. Perianal tumors are classified just like skin tumors elsewhere.

Staging of cancers arising from both the anal canal and perianal regions is based on the 8th edition of the American Joint Committee on Cancer (AJCC)/Union for International Cancer Control (UICC) TNM (tumor size, node involvement, and metastasis status) classification (►Table 1).^{8,9} The T stage is based on size of the lesion and not based on the depth of invasion. Regional lymph nodes for N staging include inguinal, mesorectal, superior rectal, internal iliac, and external iliac nodes.

Tumors Arising in the Anal Canal

Squamous Cell Carcinoma of the Anal Canal

SCC is the most common neoplasm of the anal canal, accounting for nearly 80% of all neoplasms.⁴ It can affect

adults of any age group but peaks in sixth decade of life.⁴ No gender predilection is seen. Human papillomavirus (HPV) infection (mainly HPV-16 and HPV-18 subtypes) and human immunodeficiency virus (HIV) infection remain the most common risk factors for anal SCC.⁴ Some of the other known risk factors include cervical dysplasia, autoimmune disorders, immune suppression in transplant recipients, cigarette smoking, and long-standing perianal fistulizing Crohn's disease. Typical imaging appearance of SCC is as an infiltrative, usually circumferentially spreading lesion in the anal canal and the lower rectum, which is intermediate on T2WI and mildly hypointense on T1WI, and shows restricted diffusion (►Fig. 2).⁶ Lymph node involvement, if present, is commonly seen at the inguinal, internal, and external iliac and mesorectal stations.^{4,8} Metastasis can occur to any organ, but the liver and lungs are most frequently involved.^{4,8}

Curative intent chemoradiotherapy (CRT) is the treatment of choice in most cases as it preserves the anal sphincter function.⁶ Following CRT, response assessment is done with MRI or fluorine-18 fluorodeoxyglucose positron emission tomography/computed tomography (FDG-PET/CT) 6 months after CRT.^{10,11} Complete response to CRT on MRI is indicated by loss of the bulk of the lesion with T2 hypointense signal without restricted diffusion replacing it, indicating post-treatment fibrosis (►Fig. 2). There may be increased T2 signal intensity if there is edema, inflammation, and necrosis following treatment, which can mimic residual tumor. Kochhar et al have described "tram track" sign on post-CRT MRI scans, which is defined as parallel linear low signal at the inner and outer margins of the internal sphincter at the site of the original tumor.¹⁰ This sign was present in more than half the patients studied at 6 months post-CRT and had a

Table 1 TNM staging of anal and perianal lesions according to the 8th edition of AJCC/UICC TNM classification

T category	T criteria
T0	No evidence of primary tumor
Tis	High-grade squamous intraepithelial lesion (previously termed carcinoma in situ, Bowen's disease, anal intraepithelial neoplasia II–III, high-grade anal intraepithelial neoplasia)
T1	Tumor ≤2 cm
T2	Tumor >2 cm but ≤5 cm
T3	Tumor >5 cm
T4	Tumor of any size invading adjacent organ(s), such as the vagina, urethra, or bladder
N category	N criteria
N0	No regional lymph node metastasis
N1	Metastasis in the inguinal, mesorectal, internal iliac, or external iliac nodes
N1a	Metastasis in the inguinal, mesorectal, or internal iliac lymph nodes
N1b	Metastasis in the external iliac lymph nodes
N1c	Metastasis in the external iliac with any N1a nodes
M category	M criteria
M0	No distant metastasis
M1	Distant metastasis

Abbreviations: AJCC, American Joint Committee on Cancer; TNM, tumor size, node involvement, and metastasis status; UICC, Union for International Cancer Control.

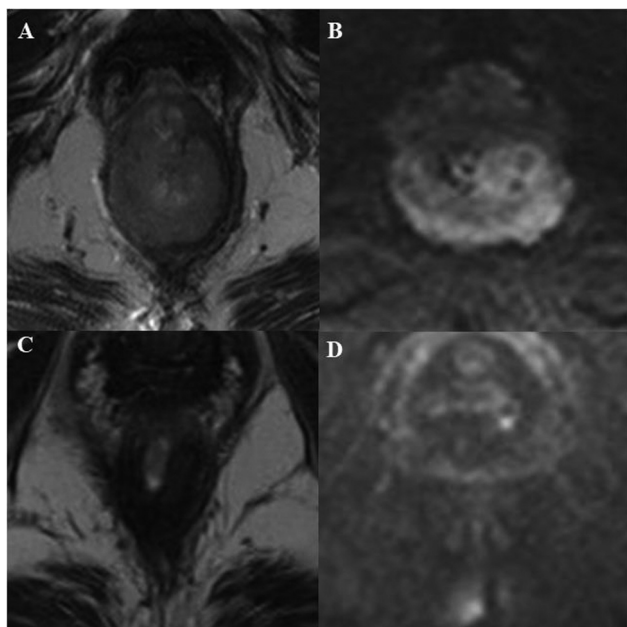


Fig. 2 Anal canal squamous cell carcinoma (SCC) before treatment (A,B) and posttreatment (C,D). (A) Axial T2-weighted image (T2WI) and (B) high *b*-value diffusion weighted imaging (DWI) show typical appearance of treatment naïve anal canal SCC, which is infiltrative, usually a circumferentially spreading lesion, which is intermediate on T2 and shows restricted diffusion. Postchemoradiotherapy (CRT) T2WIs in (C) axial and (D) high *b*-value DWI show complete response to CRT indicated by loss of bulk of lesion with T2 hypointensity signal without restricted diffusion.

negative predictive value for early local relapse of 83%. Absence of residual metabolic activity (complete metabolic response) at posttreatment FDG-PET/CT suggests low risk of recurrence and longer progression-free survival.¹¹ Salvage surgery as abdominoperineal resection is reserved for incomplete responders to CRT.⁶

Adenocarcinoma of Anal Canal

Anal adenocarcinoma accounts for around 15% of all anal canal cancers.¹² Like SCC, it affects an adult of any age group with no gender predilection.^{4,12} However, it has a lower peak age than SCC, occurring at the fifth decade of life.⁴ In the majority of the cases, they are rectal adenocarcinomas that extend to the anal canal. Adenocarcinomas arising from the anal gland are thought to be rare.² The differentiation between them is challenging, especially in large tumors where both anal and low rectal involvement is observed. The AJCC uses the anatomical location to differentiate between them. They recommend that if the epicenter of the tumor is located more than 2 cm proximal to the dentate line or proximal to the anorectal ring on digital examination, the tumor should be classified as rectal cancer. If the epicenter of the tumor is located ≤ 2 cm from the dentate line, the tumor should be classified as anal cancer.⁸ TNM staging of rectal adenocarcinoma extending into the anal canal is like rectal carcinoma, while adenocarcinoma arising from the anal gland is similar to anal SCC.⁸ The differentiation, however, has no relevant implication as their pathological characteristics and natural history are similar and hence they are

managed similarly.¹³ The European Society for Medical Oncology (ESMO) therefore includes all anorectal adenocarcinomas as low rectal cancer, if the distance from the anal verge to the lower margin of the tumor is less than 5 cm.¹⁴

Adenocarcinomas can be mucinous and nonmucinous.¹⁵ Nonmucinous adenocarcinomas are the common subtype. They cannot be distinguished from SCCs of the anal canal and appear as an infiltrative, circumferentially spreading T2 intermediate lesion in the rectum and anal canal, and show restricted diffusion.¹⁵ Mucinous adenocarcinomas are the less common subtype with worst prognosis and are defined as tumors with extracellular mucin greater than 50% of tumor volume. On MRI, mucinous tumors are characteristically T2 hyperintense lesions that show facilitated diffusion. Following contrast, it will show a lacelike peripheral contrast enhancement (**►Fig. 3**).¹⁵ Mucin has low attenuation at CT and usually will be false negative on PET examinations (**►Fig. 3**). Mesorectal lymph node involvement is very common for adenocarcinomas, while inguinal, internal, and external iliac node involvements are less common.⁴ Metastasis to the liver and lungs are most frequently observed.⁴

Imaging in restaging of adenocarcinomas with MRI is error prone because of difficulties in distinguishing residual cellular from acellular mucin and persistent tumor bulk despite potential treatment response.¹⁶ Nonmucinous tumors can develop acellular mucin following neoadjuvant CRT, which is a good prognostic sign and indicates response.¹⁷

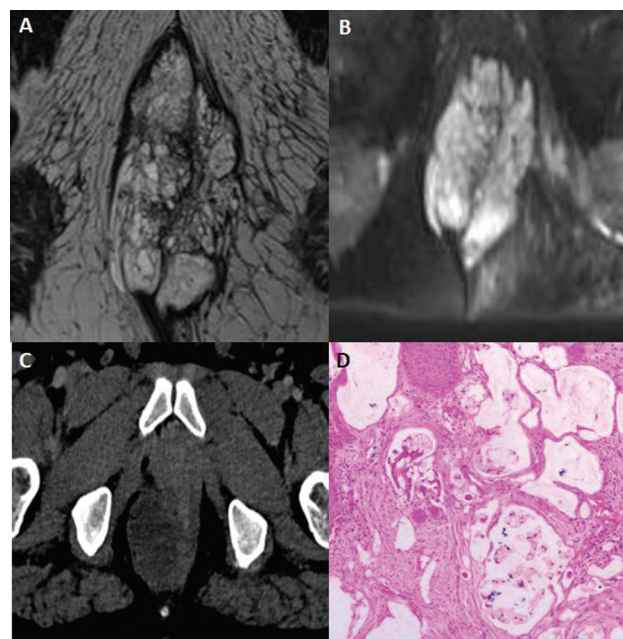


Fig. 3 Mucinous adenocarcinoma of anal canal. (A) T2-weighted image (T2WI) and (B) short tau inversion recovery (STIR) image in axial plane show T2/STIR markedly hyperintense lobulated mass in the anal canal. (C) Axial computed tomography (CT) image through the anal canal done for planning radiotherapy (RT) shows the low attenuation of mucin. (D) Hematoxylin and eosin–stained histology microphotograph, of original magnification 40x, shows mucin lakes within the specimen.

Table 2 MRI low rectal cancer staging system (mrLR)

MRI stage	Anatomical definition
mrLR1	Tumor confined to the bowel wall and does not extend through full thickness
mrLR2	Tumor replaces the muscle coat but do not extend to the intersphincteric plane
mrLR3	Tumor invades the intersphincteric space
mrLR4	Tumor invades the external anal sphincter

Abbreviations: MRI, magnetic resonance imaging.

The standard of care for nonmetastatic anorectal adenocarcinoma is neoadjuvant long-course CRT followed by surgical resection.¹⁷ Various abdominoperineal excision (APE) techniques are used for resection of low rectal/anal adenocarcinoma. They include standard APE, intersphincteric APE, and extralevator APE.^{18,19} The technique is chosen, depending on the accurate assessment of the anal sphincter involvement using an MRI-based low rectal cancer staging system (→ **Table 2**).^{2,5}

Anal Melanoma

Anal melanoma is rare, comprising less than 1% of all melanomas and 4% of anal malignancies.²⁰ It commonly occurs in the elderly and has a slight female predominance. The lesion can be sessile or polypoidal in nature. Patients present with nonspecific symptoms of rectal bleeding, anal lump, and tenesmus.²¹ On clinical examination, polypoidal melanoma of anal canal can be easily mistaken as a thrombosed hemorrhoid and often diagnosed only after pathologic examination of hemorrhoidectomy specimens. Around 70% of anal melanomas are pigmented and hence are called melanocytic melanomas, and the remaining are amelanotic melanomas.²⁰

The imaging features of anal melanomas depend on the melanin content and the presence or absence of hemorrhage. Melanocytic melanomas demonstrate T1 and T2 shortening (→ **Fig. 4**), which is seen as T1 hyperintensity and T2 hypointensity, respectively, whereas amelanotic melanomas do not show substantial T1 or T2 shortening.²⁰ Most lesions show a homogenous enhancement pattern. The management of non-metastatic disease is surgical, either with APE or wide local excision, followed by adjuvant chemotherapy, immunotherapy, radiation therapy, or a combination of these.²²

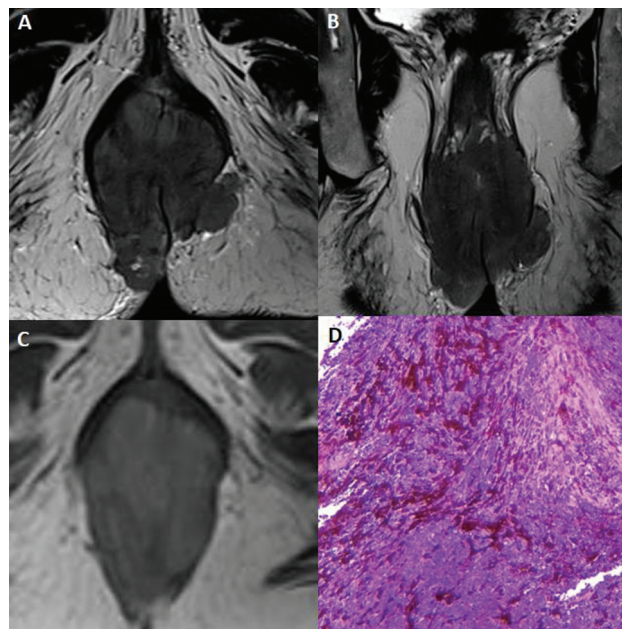


Fig. 4 Anal melanoma. T2-weighted image (T2WI) in (A) axial and (B) coronal planes and (C) T1WI in axial plane show a T2 intermediate and T1 hyperintense lesion in the anal canal infiltrating the sphincter. (D) Hematoxylin and eosin–stained histology microphotograph, of original magnification 40x, shows melanin containing tumor cells.

Anal Neuroendocrine Neoplasms

Neuroendocrine neoplasms, formerly known as carcinoid tumors, are rare in the anal canal, occurring in individuals older than 50 years.²³ The new WHO classification of 2022 (→ **Table 3**) classifies them into NETs, if they are well differentiated, and as neuroendocrine carcinoma (NEC), if they are poorly differentiated.²⁴ They are further subclassified based on the number of mitoses, Ki-67 proliferation index, and cytomorphology. NETs, being well differentiated, have low cellular atypia and express neuroendocrine markers including chromogranin, synaptophysin, and hormones, while NECs with marked cellular atypia, frequent necrosis, and high proliferative activity will have variable and usually low sensitivity and specificity for the common neuroendocrine markers.²⁴ NECs can also have a coexisting conventional carcinoma (i.e., adenocarcinoma or SCC) in them. NETs of the anorectum are usually clinically asymptomatic unless metastatic, while NECs present with signs and symptoms of an aggressive neoplasm and often disseminated.²³

Table 3 The WHO classification (2022) of neuroendocrine neoplasm

Type	Classification	Diagnostic criteria
Well-differentiated neuroendocrine tumor (NET)	NET, grade 1	<2 mitoses/2 mm ² and/or Ki67 < 3%
	NET, grade 2	2–20 mitoses/2 mm ² and/or Ki67 3–20%
	NET, grade 3	>20 mitoses/2 mm ² and/or Ki67 > 20%
Poorly differentiated neuroendocrine carcinoma (NEC)	Small cell NEC	>20 mitoses/2 mm ² and/or Ki67 > 20% (often >70%), and small cell cytology
	Large cell NEC	>20 mitoses/2 mm ² and/or Ki67 > 20% (often >70%), and large cell cytology

On MRI, the lesions can be of varied morphology, from small submucosal nodule to large polypoidal ulcerating mass.²⁵ No specific MRI characteristics are present to differentiate them from other common cancers of the anal canal. Functional imaging with 68-Gallium DOTA peptide (DOTA-TOC, DOTATATE, DOTANOC) PET scan is used to stage NETs as they show high avidity.²⁵ NECs are commonly nonavid on 68 - Gallium DOTA PET imaging and hence FDG-PET/CT is the preferred modality for staging.

Surgery (endoscopic or open) remains the cornerstone of treatment of a localized neuroendocrine neoplasm. However, many patients develop metastases and require a multidisciplinary approach for optimal management.^{23,26} Chemotherapy is also recommended along with surgery, especially in cases of metastatic NET and in NEC.²³

Lymphoma

Primary anorectal lymphomas account for only 3% of all gastrointestinal lymphomas and only approximately 0.1% of all anal malignancies.¹⁶ HIV infection is a well-known risk factor due to the interplay between poor immune response and infection by oncologic viruses, especially Epstein-Barr virus (EBV) infection. The most common histologic subtype is diffuse large B-cell non-Hodgkin's lymphoma.¹⁶

At MRI, anal lymphoma usually appears as isointense on T1WI and intermediate signal on T2WI, solid mass causing focal and/or circumferential thickening of the anal canal (**Fig. 5**).²⁷ They also show restricted diffusion on DWI and mild postcontrast enhancement. FDG-PET/CT will show avid uptake and is the preferred modality for staging.

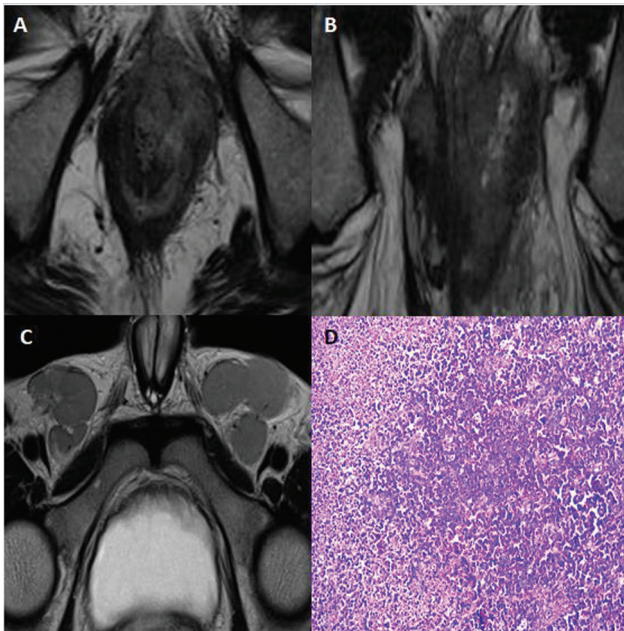


Fig. 5 A human immunodeficiency virus (HIV) positive man with anal lymphoma. T2-weighted image (T2WI) in (A) axial and (B) coronal planes through the anal canal show an infiltrative T2 mildly hyperintense mass in the anal canal. (C) T2WI in axial plane through the inguinal level shows bilaterally disproportionately large homogenous inguinal nodes. (D) Hematoxylin and eosin-stained histology microphotograph, of original magnification 100x, shows a tumor with plasmablastic cells suggestive of plasmablastic lymphoma.

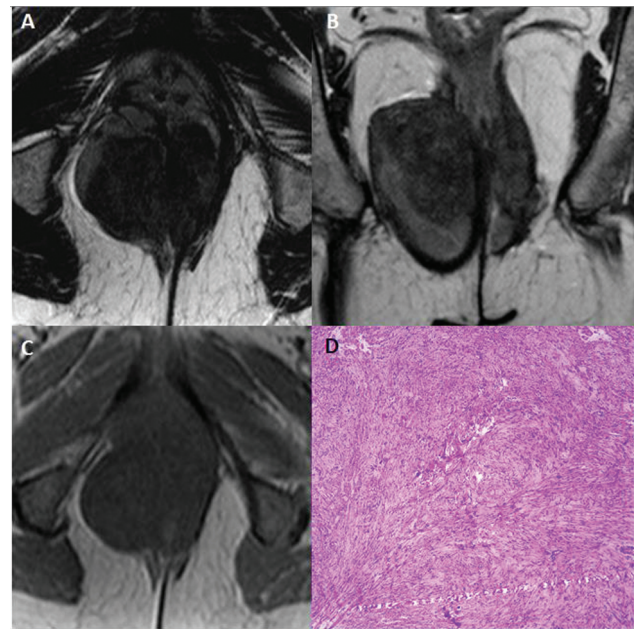


Fig. 6 Anal leiomyoma. T2-weighted image (T2WI) in (A) axial and (B) coronal planes and (C) T1WI in axial plane show an exophytic growing smooth margined T2 hypointense and T1 isointense lesion extending into the right ischioanal fossa. (D) Hematoxylin and eosin-stained histology microphotograph, of original magnification 40x, shows well-differentiated smooth muscle cells with red fibrillar cytoplasm showing no nuclear atypia.

The treatment for anal lymphoma is not without confusion due to its rarity.^{28,29} Medical management with chemotherapy is considered the primary treatment for most cases.

Smooth Muscle Neoplasms

Common benign smooth muscle tumors include leiomyomas and myofibromas, while leiomyosarcomas (LMS) are malignant tumors.^{21,30} They originate from the muscularis mucosae or muscularis propria. These lesions, being submucosal in origin, show a submucosal bulge with normal overlying mucosa, unless the lesion is large and/or malignant.³¹

Both leiomyoma and myofibroma appear as smooth margined and well-defined T2 mildly hypointense and T1 isointense lesions, which usually grow exophytically (**Fig. 6**).^{21,31} Myofibromas demonstrate intense postcontrast enhancement, whereas leiomyomas show mild to moderate homogenous enhancement. LMS, like leiomyomas, are exophytically growing lesions that are T1 isointense, but with irregular margins, heterogeneous on T2WI, and demonstrate a heterogeneous enhancement (**Fig. 7**).²¹

Surgical excision is the treatment of choice for benign lesions.³² The mainstay treatment of LMS is surgery; however, neoadjuvant radiotherapy and adjuvant chemotherapy are recommended as they decrease local and distant recurrence and improve survival.²¹

Gastrointestinal Stromal Tumor

Anal gastrointestinal stromal tumors (GISTs) are rare (accounting for 5–10% of all GISTs), but are one of the most common

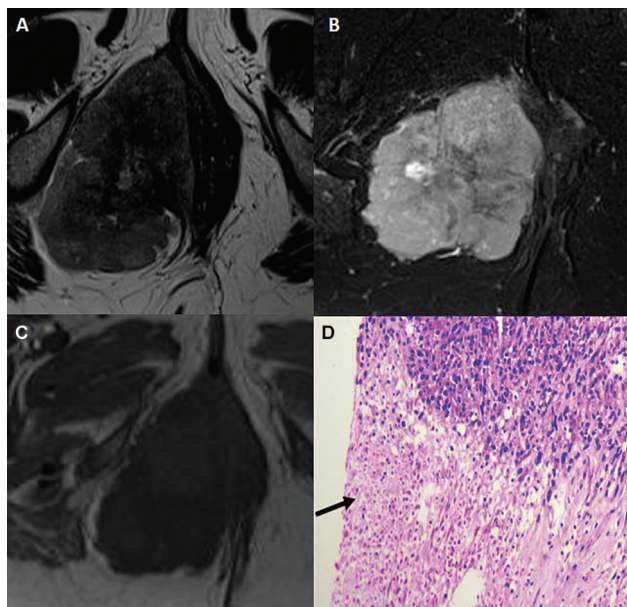


Fig. 7 Anal leiomyosarcoma. (A) T2-weighted image (T2WI), (B) short tau inversion recovery (STIR), and (C) T1-weighted image (T1WI) in axial planes show as lobulated exophytic growing lesion with irregular margins with T2 heterogeneous signal due to necrosis. (D) Hematoxylin and eosin–stained histology microphotograph, of original magnification 40x, shows smooth muscle cells with a prominent nuclear atypia (arrow).

mesenchymal tumors of the anal canal.³³ These tumors arise from the interstitial cells of Cajal in the myenteric plexus. The biologic behavior of these tumors is variable with the majority presenting with local disease only and less than 20% of patients develop distant metastases.³³ Aggressive lesions are usually greater than 5 cm in size, while lesions of size 2 to 5 cm have an intermediate risk profile and lesions less than 2 cm seem to remain consistently free of metastases.

On MRI, a GIST appears as a large smoothly marginated T1 iso- to hypointense and T2 hyperintense mass from the anal canal with a large exophytic component (►Fig. 8).³³ Following contrast administration, larger tumors show central necrosis. Lymph node metastases are generally absent.

Surgery is the definitive curative treatment.³⁴ Imatinib mesylate, a tyrosine kinase inhibitor, is routinely used for unresectable tumors as neoadjuvant or salvage therapy.³⁴

Malignancy Associated with Fistula-in-Ano

Malignancies associated with fistula-in-ano are rare. It can be due to a malignancy presenting as fistula-in-ano (malignancy first and fistula later) or malignancy developing within a chronic fistula (fistula first and malignancy later).³⁵ The former type is thought to be more common and occurs when the tumor blocks the opening of the anal gland resulting in formation of a perianal abscess and fistula.³⁵ The second type, where malignancy develops within a chronic fistula, is very rare with only a few reports in the literature. In 1934, Rosser et al³⁵ proposed the following three criteria to diagnose this entity: (1) the fistula should antedate the carcinoma by a minimum of 10 years, (2) the tumor should be the only tumor in the anorectum, and (3)

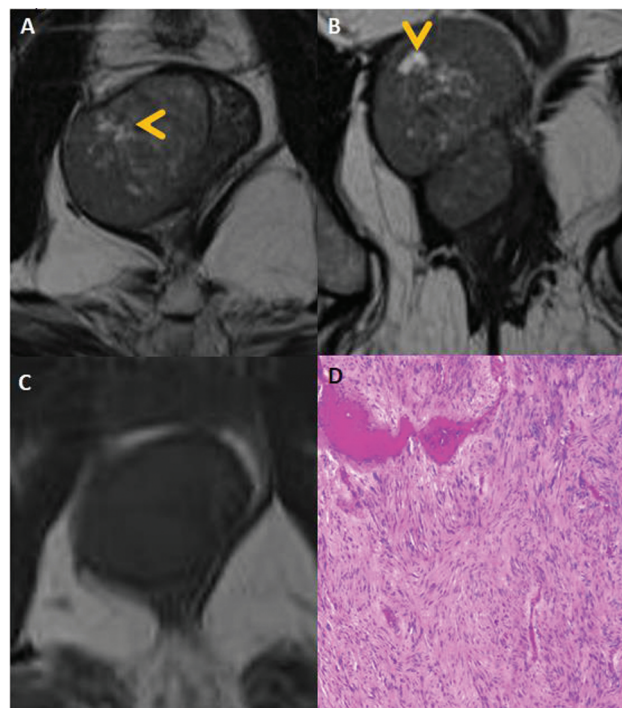


Fig. 8 Anal gastrointestinal stromal tumor (GIST). T2-weighted image (T2WI) in (A) axial and (B) coronal planes and (C) T1WI in axial plane through the anal canal show exophytic growing smoothly marginated T1 isointense and T2 heterogeneous mass from the anal canal. The heterogeneity on T2 is due to multiple necrotic foci within the tumor (yellow arrowheads in A and B). (D) Hematoxylin and eosin–stained histology microphotograph, of original magnification 40x, shows bland spindle cells with elongated nuclei typical of spindle type of GIST.

the internal opening of the fistula should not be into the lesion. Tumors arising from such nonhealing fistulas are either adenocarcinomas or SCCs.³⁶

MRI can easily identify cases of malignancy presenting as fistula-in-ano (►Fig. 9). However, diagnosing malignancy developing within a fistula is challenging by imaging and has demonstrated low sensitivity unless in advanced stages.³⁶ The presence of focal wall thickening as T2 intermediate signal nodularity or enhancing soft tissue within a chronic fistula is suspicious for malignant transformation of a fistula (►Fig. 9). The management guidelines for a malignancy developing in a fistula has not been established, and many times radical resection combined with chemo radiation is generally practiced.^{36,37}

Tumors Secondarily Involving anal Canal

Mesenchymal Tumors from Ischioanal Fossa

Mesenchymal tumors rarely can develop in the ischioanal fossa, arising from vascular, neural, muscular, fibrous, and fatty elements.³⁸ ►Table 4 shows a simple classification of the ischioanal fossa tumors based on tissue of origin. Among them aggressive angiofibroma is the most common primary tumor of ischioanal fossa and is discussed below. Lipomas and well-differentiated liposarcomas have predominant fatty components and can be diagnosed easily on imaging.³⁸

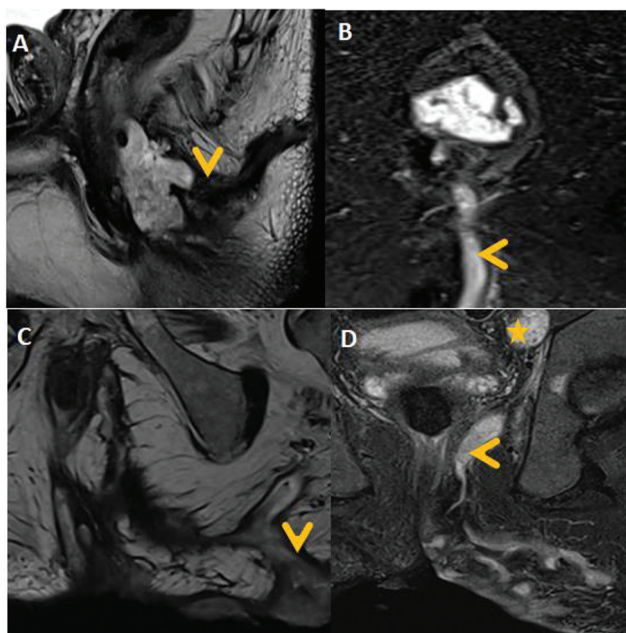


Fig. 9 Malignancy associated with fistula-in-ano. T2-weighted image (T2WI) in (A) sagittal plane and (B) short tau inversion recovery (STIR) axial image through the anal canal show a T2/STIR markedly hyperintense lobulated mass in the anal canal with a high trans-sphincteric fistula-in-ano (arrowheads in A and B). The presence of a lesion at the internal opening of the fistula favors this to be a case of a fistula developing due to anal malignancy (malignancy presenting as a fistula-in-ano). Companion images of a case of malignancy developing in chronic fistula, which is seen on (C) T2 image and (D) STIR image as a complex trans-sphincteric fistula with multifocal areas of nodular soft tissue within its wall (yellow arrowheads in C and D). A heterogeneous enlarged mesorectal node is also seen (yellow star in C).

Most other tumors have nonspecific MRI features and may need biopsy for a definitive diagnosis.³⁸

Aggressive Angiomyxoma

An aggressive angiomyxoma, although rare, is the most common tumor of the ischioanal fossa and has a predilection for females of reproductive age.³⁸ These tumors present as a painless mass that can sometimes cause local pressure on adjacent structures. They spread in multiple compartments without invading adjacent organs.³⁹

MRI features are very typical (–Fig. 10) and include iso- to hypointense signal intensity relative to the muscle on T1WI, and a characteristic “laminated” pattern on T2WI due to high signal intensity background myxoid stroma with low signal intensity parallel lines representing collagen fibrils. The lesion shows a heterogeneous postcontrast enhancement.⁹

The treatment of choice is wide surgical resection; however, due to infiltrative growth and poor circumscription, it is difficult to excise this tumor completely, resulting in high risk of local recurrences.³⁹

Developmental Cysts

Congenital cysts, which can occur in the ischioanal fossa, include tailgut cyst, epidermoid cyst, and dermoid cysts. Differentiation among them may be possible based on imaging.⁴⁰

Table 4 A simple classification of ischioanal fossa tumors based on tissue of origin

Benign
<ul style="list-style-type: none"> • Vascular: <ul style="list-style-type: none"> - Aggressive angiomyxoma, hemangioma • Neural: <ul style="list-style-type: none"> - Plexiform neurofibroma, schwannoma • Adipocytic: <ul style="list-style-type: none"> - Lipoma • Muscle and fibrous tumors: <ul style="list-style-type: none"> - Solitary fibrous tumor • Congenital and developmental cysts: <ul style="list-style-type: none"> - Tailgut cyst - Epidermal cyst - Dermoid cyst
Malignant
<ul style="list-style-type: none"> • Vascular: <ul style="list-style-type: none"> - Angiosarcoma • Neural: <ul style="list-style-type: none"> - Malignant granular cell tumor - Malignant peripheral nerve sheath tumor • Adipocytic: <ul style="list-style-type: none"> - Liposarcoma • Muscle and fibrous tumors: <ul style="list-style-type: none"> - Leiomyosarcoma - Rhabdomyosarcoma - Malignant PEComa - Undifferentiated pleomorphic sarcoma, etc. • Secondary neoplasms: <ul style="list-style-type: none"> - Metastatic - Direct tumor extension from the anal canal, vagina, vulva, urethra, and pelvic musculoskeletal system

Abbreviations: PEComa, perivascular epithelioid cell tumor.

Tailgut cysts are usually multicystic lesions with the locules having variable intensity due to the presence of mucin and blood (–Fig. 11).⁴⁰ The signal intensity of mucinous fluid is variable and depends on protein concentration. As protein concentration increases, T1 signal intensity changes from hypointense to hyperintense, while T2 signal intensity shows inverse trend from hyperintense to hypointense signals. Tailgut cysts can be complicated by infection and on rare occasions by malignant transformation. Malignant transformation is suspected when there is focal irregular wall thickening with enhancement.⁴⁰

Epidermoid and dermoid cysts are often unilocular cysts lined by a stratified squamous epithelium.⁴⁰ Epidermoid cysts contain a mixture of desquamated debris, cholesterol, keratin, and water, but it lacks the skin appendages such as sweat glands, hair follicles, and sebaceous glands, which are seen in dermoid cysts. On MRI, epidermoid cysts are unilocular thin-walled cysts with low signal intensity on T1WI and high signal intensity on T2WI, and may contain multiple T2 hypointense debris representing aggregates of keratin (–Fig. 11).³⁸ Dermoid cysts are similar to epidermoid cysts except that they can have fat components within. Loss of signal intensity in these cysts on out-phase images as opposed to in-phase images confirms their fatty nature.⁴⁰

These cysts, if symptomatic, may need surgical excision.

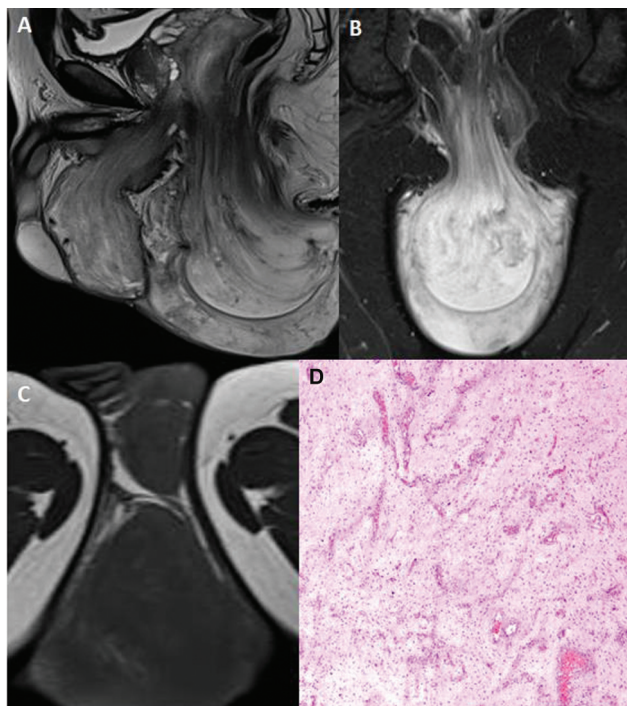


Fig. 10 Aggressive angiomyxoma. T2-weighted image (T2WI) in (A) sagittal plane, (B) short tau inversion recovery (STIR) image in coronal plane, and (C) T1 image in axial plane show T2/STIR markedly hyperintense lobulated mass in the anal and perianal region with a characteristic laminated appearance. The lesion is hypointense on T1WI. (D) Hematoxylin and eosin-stained histology microphotograph, of original magnification 40x, shows myxoid stroma with scattered stellate to spindle cells.

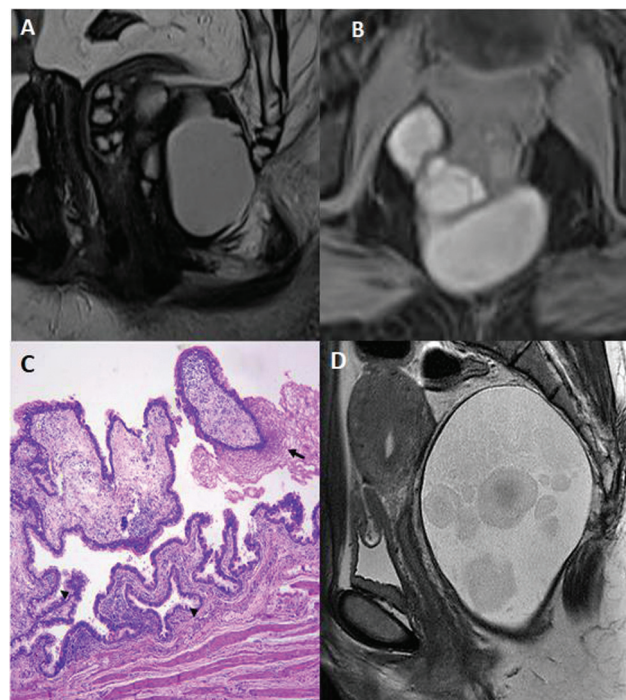


Fig. 11 Developmental cysts. (A) Tailgut cysts are multiloculated cysts in the retro-anal location, best demonstrated on T2 image. (B) The high protein content within the cyst can be seen as T1 fat-suppressed sequence (T1FS) hyperintensity. (C) Hematoxylin and eosin-stained histology microphotograph, of original magnification 40x, showing tailgut cyst lined by a columnar epithelium (arrowhead) and squamous epithelium (arrow). (D) Epidermoid cysts are unilocular on T2 images with the presence of T2 hypointense spheres within it representing keratin debris.

Secondary Neoplasms from Adjacent Structures

Secondary tumors arising in the vagina, vulva, urethra, and pelvic musculoskeletal system can involve the anal canal. Cancer of the vagina, if it involves the mucosa of the anorectum, is considered T4 according to the eighth edition of the TNM (2018) classification and stage IVa on the International Federation of Gynecology and Obstetrics (FIGO) staging.⁸ Vulvar cancer with extension to the anal canal is T2 according to the eighth edition of the TNM (2018) staging and stage II according to FIGO stage.⁸ Urethral cancer (in both males and females) if fixed or invading the sphincter of the anal canal is T4 according to the eighth edition of the TNM (2018) staging.⁸

Perianal Neoplasms

Bowen's Disease

Bowen's disease is an intraepithelial SCC that occurs most frequently on the face, hands, and trunk, and less commonly in the perianal region.⁴¹ In the perianal region, it probably represents severe anal intraepithelial neoplasia (AIN) and is associated with HPV-16 and HPV-18 infections.⁴⁰ Like anal canal SCCs, Bowen's disease is much more common in patients with HIV.⁴¹ In 2 to 6% of cases, the disease progresses to an invasive SCC. Bowen's disease has the highest incidence during the sixth and seventh decades of life.⁴¹ Common

symptoms include itching, burning, and occasionally bleeding, and on examination, the lesion appears as a well-defined erythematous, scaly plaque.⁴¹ Diagnosis is made by obtaining several full-thickness biopsy from the central portion and edges of the lesion. Imaging is generally not done. The treatment of choice is wide local excision.⁴¹

Perianal Paget's Disease

Perianal Paget's disease is quite an uncommon intraepithelial adenocarcinoma arising from the dermal apocrine sweat glands and can be associated with underlying apocrine or eccrine carcinoma, colorectal adenocarcinoma, and anal carcinoma in 38 to 69% of patients.⁴¹ It is most commonly found in older patients, averaging 66 years, and shows a preponderance for women. The lesions are erythematous and crusty, eczematoid, or scaly appearing, and present with nonspecific symptoms like pain, bleeding, and itching.⁴¹ Diagnosis is made with full-thickness biopsies of the affected skin. FDG-PET/CT or MRI is done before treatment to exclude associated underlying malignancy.⁴¹ If the disease appears to be locally confined on preoperative workup and is noninvasive on biopsy, wide local excision is the treatment of choice. When the tumor is invasive or located close to the anal canal, and sufficient surgical margin cannot be achieved, a combined modality treatment with chemoradiation may be needed.⁴¹ If underlying

malignancy is identified, it will also require appropriate treatment.

Squamous Cell Carcinoma of Perianal Skin

Perianal SCCs are at least five times less common than cancers of the anal canal and have a more favorable prognosis as they are typically well differentiated, slow growing, and without distant metastases.⁴¹ The risk factors for perianal SCC are the same as for SCCs of the anal canal.⁴¹ Most patients present after the fifth decade with an approximately equal male-to-female predominance.⁴¹ Symptoms of perianal SCC are nonspecific and include bleeding, pain, discharge, and pruritus. On examination, they are usually hard, raised, and ulcerated skin lesions with rolled, everted edges.⁴¹ The anal canal can become involved late in the disease, although the sphincter complex is rarely invaded. A VC is a rare histologic subtype of SCC characterized by highly differentiated squamous cells and appears as a large locally aggressive tumor with a cauliflowerlike appearance.⁴² It is often associated and confused with a giant condyloma acuminatum (GCA), also called Buschke–Löwenstein tumor due to similar clinical and imaging appearance. A GCA has been linked to HPV, whereas a VC is negative for HPV.⁴² On histological evaluation, VCs have no koilocytic atypia, whereas GCAs have koilocytic atypia.⁴² On the other hand, distinguishing VCs from conventional SCCs is also important because, although large and in some cases locally aggressive, VCs are often amenable to wide local resection since nodal metastases are extremely rare. However, there are published reports showing that VCs and conventional SCCs can coexist in the same lesion.⁴¹

Any patient with a suspicious lesion needs biopsy for definitive diagnosis. Pretreatment evaluation should include a full staging workup with imaging.⁴¹ MRI of the pelvis can demonstrate the extent of lesion, anal canal involvement, and regional nodes (→Fig. 12). VCs on MRI appear as T2 hyperintense cauliflowerlike lesion from the perianal skin (→Fig. 13).⁴³

Perianal SCCs are generally treated as skin cancers with wide local excision.⁴¹ Lesions involving the anal canal needs combined modality of chemoradiation as initial treatment approach followed by salvage surgery if recurrent or residual disease is present.⁴¹ VCs are also treated with wide local excision; however, high recurrence rates (as high as 66%) after excision have prompted the use of neoadjuvant or adjuvant chemoradiation therapy.⁴¹

Tumorlike Lesions

Prolapsed Hemorrhoids

Hemorrhoids are vascular cushions surrounding the anastomoses between the superior rectal artery and the superior, middle, and inferior rectal veins.⁴⁴ Internal hemorrhoids arise above the dentate line and external hemorrhoids arise below the dentate line. External hemorrhoids are innervated by somatic nerves and cause pain, whereas internal hemorrhoids are innervated by visceral nerve fibers and are painless. Most hemorrhoids are a combined type of internal and

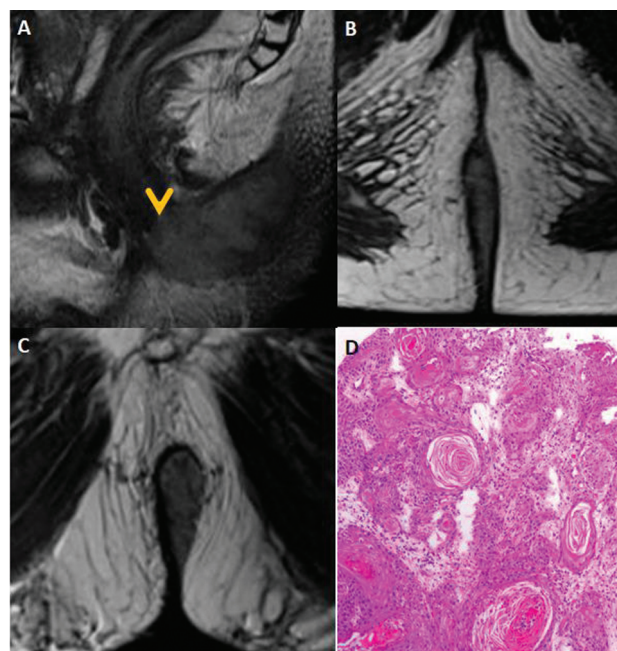


Fig. 12 Perianal squamous cell carcinoma (SCC). T2-weighted image (T2WI) in (A) sagittal, (B) axial, and (C) coronal planes show T2 intermediate signal thickening in the posterior perianal skin, which reaches up to the anal verge (arrowhead in A). The diagnosis was done by biopsy and magnetic resonance imaging (MRI) was done as part of staging workup to evaluate anal canal involvement and to look for regional nodes. (D) Hematoxylin and eosin–stained histology microphotograph, of original magnification 40x, shows marked keratinization and minimal nuclear pleomorphism in a well-differentiated SCC.

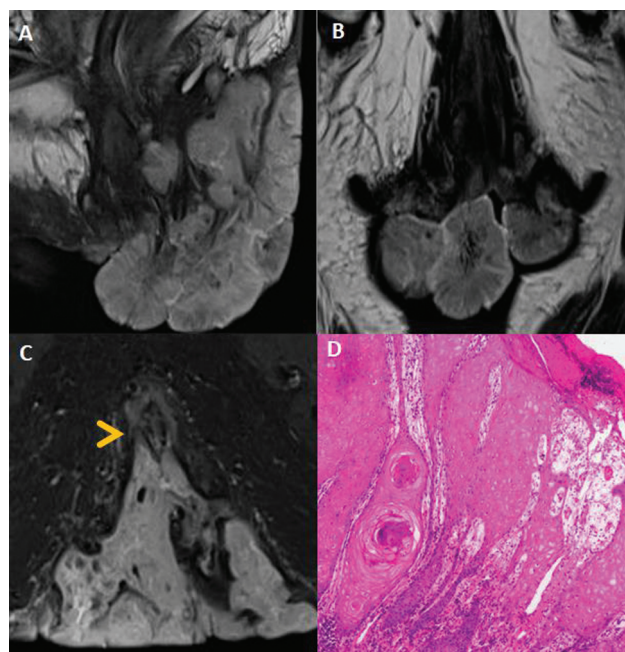


Fig. 13 Verrucous carcinoma at perianal region. T2-weighted image (T2WI) in (A) sagittal and (B) coronal planes and (C) short tau inversion recovery (STIR) image in axial plane shows a cauliflower like T2/STIR hyperintense mass in the perianal region with infiltration of the superficial and subcutaneous bundles of external anal sphincter (arrowhead). (D) Hematoxylin and eosin–stained histology microphotograph, of original magnification 40x, shows massive hyperkeratosis and parakeratosis.

external hemorrhoids.⁴⁴ Hemorrhoidal disease is commonly diagnosed on clinical examination but can also be seen on MRI. On T2WI, hemorrhoids are seen as moderately hyperintense polypoidal lesion. They may also show increased signal on T1WI (→ Fig. 14).⁴⁵

Vascular Malformations

Rectal bleeding is the most common presentation in vascular malformation (VM) and can mimic neoplasms. Colonoscopy in such cases may reveal nodular submucosal tumorlike lesion in the anorectum with normal or edematous overlying

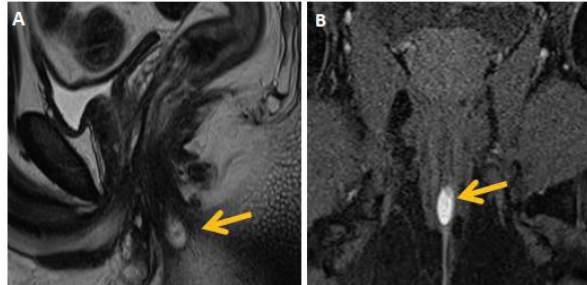
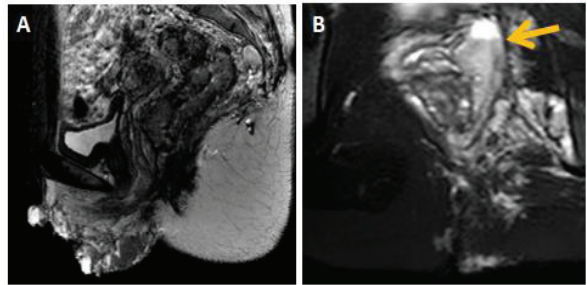
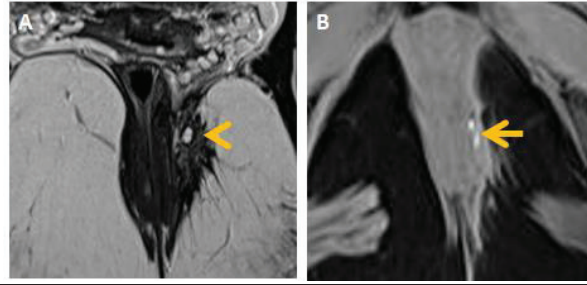
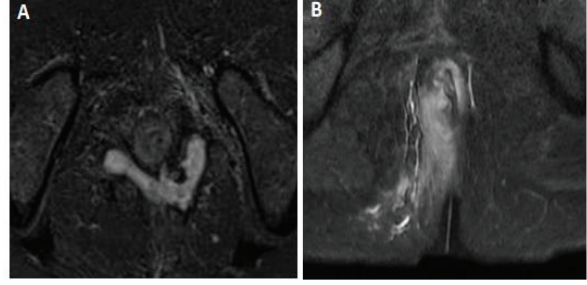
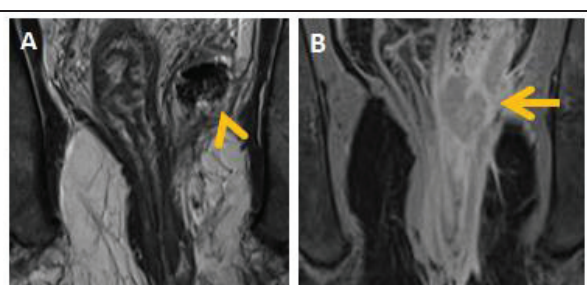
Tumour like lesions	Typical findings with representative MR images	
Prolapsed Haemorrhoids	<ul style="list-style-type: none"> - Small polypoidal lesion. - Variable signal in T2 images (arrow in A) and if acutely thrombosed can be hyper intense on fat suppressed T1WI (arrow in B). 	
Vascular malformations (VM)	<ul style="list-style-type: none"> - Low flow VM is seen as cluster of cystic spaces on T2 images (A) and STIR images (B). There may be presence of fluid debris levels within the cysts (arrow in B). - High flow VM contains tortuous signal voids. - No restricted diffusion. 	
Endometriosis	<ul style="list-style-type: none"> - Endometriotic plaques are generally hypo intense on T2 images (A), however will contain small T2 hyper intense (arrowhead in A) and T1 hyper intense foci (arrow in B) within. 	
Infections	<ul style="list-style-type: none"> - Typical perianal fistula has well-defined fluid contained tracts best identified on T2 fat suppressed image (A). - Perianal fistula in immunosuppressed has extensive anal and perianal edema and rarely has defined fistula tracts (B). - Other infections generally show nonspecific edema. 	
Inflammatory phlegmon	<ul style="list-style-type: none"> - Inflammatory phlegmon can mimic malignancy arising in chronic fistula. - T2 image (A) shows supralevator abscess with air foci (arrow head in A) associated with perianal fistula. Partial treatment of the same lead to formation phlegmon appearing as solid enhancing area (arrow) in post contrast T1 image (B). 	

Fig. 14 Tumorlike lesions.

mucosa.⁴⁶ They can also be divided into high- and low-flow lesions.⁴⁶ High-flow lesions should have an arterial component. MRI can help in diagnosing VM and help in defining its extent.⁴⁶ Low-flow malformations have cluster of cystic spaces with or without fluid debris layer (→ Fig. 14), whereas high-flow malformations contain signal voids. On dynamic

postcontrast MRI, high-flow lesions show rapid filling, whereas low-flow lesions show late filling. Calcification and phleboliths can be mistaken as flow void; however, they appear as focal signal void and are not tortuous as flow void. In case of doubt in differentiating them on MRI, a noncontrast CT can be done to identify calcification.

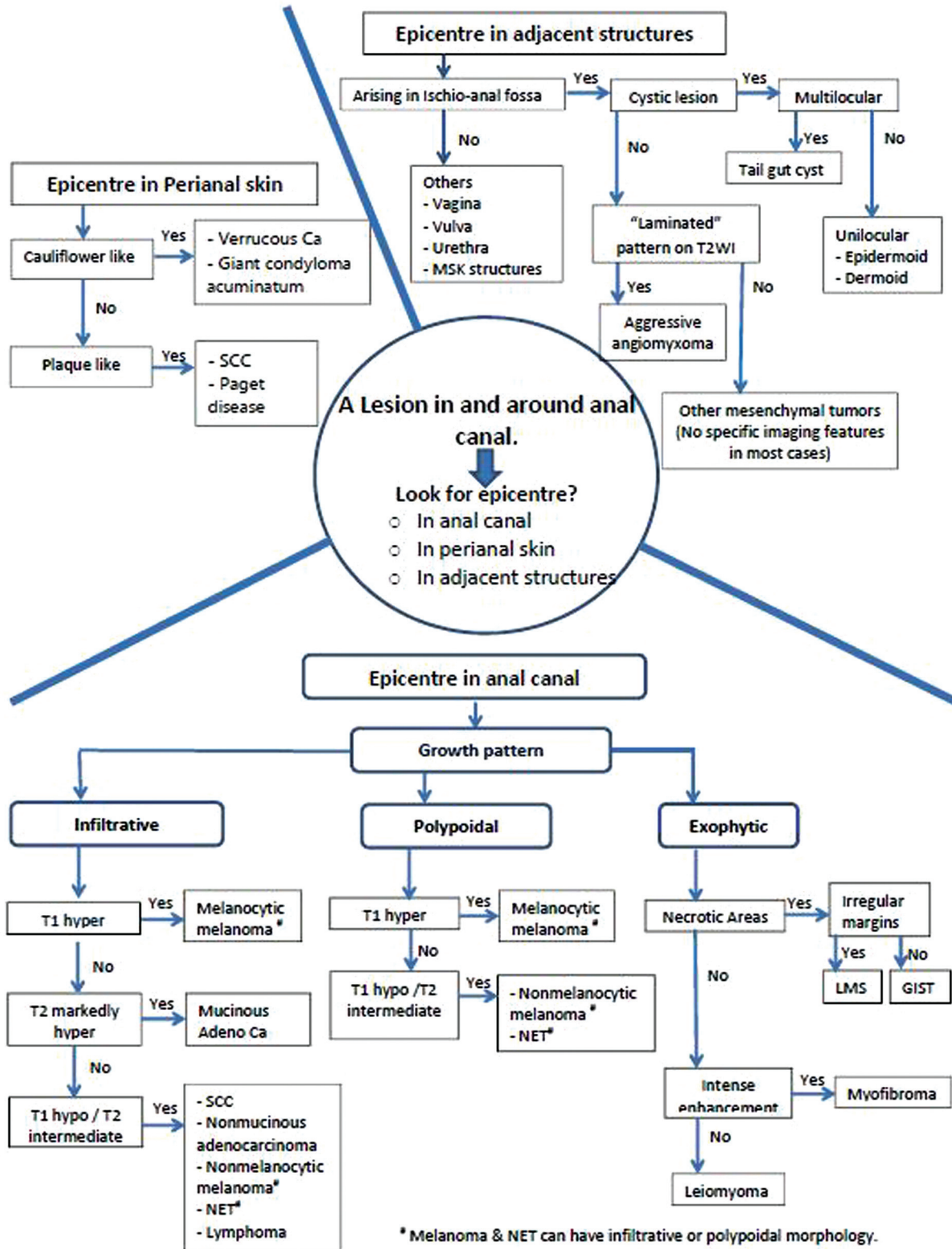


Fig. 15 Diagnostic algorithm for an imaging-based diagnosis of lesions in and around the anal canal.

Endometriosis

Perianal endometriosis is extremely rare. It usually occurs in childbearing women following obstetric or gynecological procedures most commonly following delivery at episiotomy scar.⁴⁷ A patient typically presents with cyclical pain. Many times, the diagnosis may not be made on physical examination, and MRI may be needed.⁴⁸ On MRI (►Fig. 14), endometriosis manifests as a nodular or plaque-like lesion with intermediate signal intensity on T1WI and low signal intensity on T2WI. Small T2 and T1 hyperintense foci corresponding to endometrial glands and hemorrhagic foci are almost always recognized within the endometriotic lesions.⁴⁸

Infections

A typical fistula-in-ano is mostly an idiopathic process thought to be caused by obstruction of anal glands and its diagnosis via an MRI is straightforward due to the presence of well-defined fluid contained tracts. Perianal infection in immunosuppressed patients with hematological malignancy is atypical on MRI as they have extensive anal and perianal edema and rarely have defined fistula tracts, creating confusing imaging appearance (►Fig. 14).³²

Common infections of the anorectum include nonsexually transmitted infections due to *Escherichia coli*, *Shigella* spp., *Campylobacter* spp., and *Clostridium difficile*, and sexually transmitted infections due to *Neisseria gonorrhoeae*, *Chlamydia trachomatis*, *Treponema pallidum*, and herpes simplex virus (HSV).⁴⁹ Most of these infections do not need imaging for diagnosis and if done may show nonspecific anorectal inflammation.

Inflammatory Phlegmon

A fistula-in-ano is commonly complicated by abscesses and ramifications. Atypical findings of solid enhancing mass-like lesions with no fluid component can represent inflammatory phlegmon in partly treated fistulas and can mimic a malignancy developing in chronic fistulas (►Fig. 14).⁵⁰ If differentiating them is not possible on imaging, tissue sampling needs to be done to confirm the difference.

Clues to Differential Diagnosis and Algorithmic Approach

A stepwise algorithmic approach to diagnose anal and perianal lesions based on imaging is highlighted in ►Fig. 15.

Conclusion

In this article, we showed a plethora of pathological conditions in the anal and perianal region. MRI is the modality of choice for assessing the extent of anal and perianal lesions. Some tumors have characteristic imaging findings that may permit accurate diagnosis; however, tissue sampling is often needed to confirm the diagnosis. Accurate diagnosis needs good knowledge of anal and perianal anatomy as well as knowledge of the spectrum of imaging findings of common and uncommon neoplasms.

Note

A part of this article including images were presented as electronic poster with the same title during the 33rd Annual Meeting and Postgraduate Course of European Society of Gastrointestinal and Abdominal Radiology (ESGAR), 2022, and was selected as a recommended poster.

Funding

None.

Conflict of Interest

None declared.

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