



THE PRESACRAL ENIGMA: UNRAVELLING MASS LESIONS ON MRI

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ABSTRACT

Background: Presacral (retrorectal) masses comprise a rare and heterogeneous group of lesions arising from congenital, neurogenic, osseous, and miscellaneous origins. Owing to the complex anatomy of the presacral space and overlapping clinical presentations, imaging plays a pivotal role in diagnosis and surgical planning. Magnetic resonance imaging (MRI) is considered the modality of choice because of its superior soft tissue characterization and multiplanar capability. In this study, we present the spectrum of presacral masses evaluated and diagnosed with MRI in a tertiary care hospital. We have highlighted the characteristic MR imaging findings and differential diagnostic considerations in presacral masses. **Methods:** We conducted a retrospective review of patients diagnosed with presacral masses at a tertiary care centre. Clinical presentation, imaging findings, and histopathological correlation where available were analysed. MRI characteristics including lesion morphology, signal intensity, diffusion restriction, enhancement pattern, sacral involvement, and communication with the spinal canal were evaluated. **Results:** The spectrum of histologically and radiologically distinct presacral lesions detected on MRI in the current study were- Currarino triad, pre-sacral schwannoma, anterior sacral meningocele, sacrococcygeal teratoma, and epidermoid cyst. MRI accurately characterized lesion composition and extent in all cases. **Conclusion:** Presacral masses demonstrate a wide spectrum of imaging appearances. MRI serves as the primary imaging modality for accurate lesion characterization, as well as for assessment of any associated spinal anomalies MRI findings assist in appropriate surgical planning if a pattern-based MRI approach is adopted, by facilitating the narrowing of differential diagnosis.

KEYWORDS : Presacral Masses; MRI Pelvis; Currarino Syndrome; Anterior Sacral Meningocele; Schwannoma; Epidermoid Cyst; Sacrococcygeal Teratoma

INTRODUCTION

The presacral space is a potential anatomical space located between the rectum anteriorly and the sacrum posteriorly. Superiorly, it is bounded by the peritoneal reflection and inferiorly by the levator ani and coccygeus muscles. Presacral masses are uncommon and often present a diagnostic challenge because of nonspecific clinical manifestations such as pain, constipation, lower urinary tract symptoms, or incidental detection on imaging. (1) Owing to the presence of embryologic remnants from multiple tissue origins, a wide variety of congenital, neurogenic, osseous, inflammatory, and infective lesions may occur in the presacral space. Accurate radiological diagnosis is essential for narrowing the differential diagnosis, guiding surgical planning, and preventing complications such as inadvertent biopsy of meningoceles. (3)

Presacral masses are broadly classified into congenital, neurogenic, osseous, inflammatory, and neoplastic etiologies. Congenital lesions constitute the largest subgroup and include developmental cysts such as epidermoid cysts, dermoid cysts, tailgut cysts, anterior sacral meningoceles, and teratomas. Certain syndrome associations include the Currarino triad where the triad of anorectal malformation, sacral defect, and presacral mass, should also be recognized because of their characteristic imaging appearance and associated spinal anomalies. (2) Neurogenic tumours such as schwannomas and neurofibromas are important entities to be considered in the differential diagnosis in presacral masses.

Magnetic resonance imaging (MRI) is considered the imaging modality of choice for evaluation of presacral masses because of its superior soft tissue contrast resolution and multiplanar imaging capability. MRI accurately delineates lesion extent, internal composition, sacral involvement, neural foramina extension, and any communication with the spinal canal. Diffusion-weighted imaging and post-contrast sequences further aid in characterization of mass. Imaging features of Currarino triad were a combination of sacral anomalies with the presacral mass. Presacral schwannoma is

seen in relation with the sacral nerve showing extension into the neural foramina. An anterior sacral meningocele demonstrates cerebrospinal fluid intensity mass communicating with thecal sac. The sacrococcygeal teratomas are cystic masses with solid components demonstrating heterogeneity due to calcification, teeth and other ectodermal tissues. Presacral epidermoids are well marginated, unilocular cystic masses showing diffusion restriction. MRI was seen to be particularly useful in evaluating sacral dysgenesis, intraspinal extension of presacral mass, as well as its relationship to adjacent pelvic structures.

MATERIALS AND METHODS

Study Design and Patient Selection

This retrospective observational study was conducted in the Department of Radiodiagnosis at a tertiary care centre. MRI was performed in 3 T Siemens Magnetom machine. The MRI features of presacral masses were assessed. Histopathology records of all patients diagnosed on MRI with presacral masses were reviewed.

Inclusion Criteria

Patients with:

1. Imaging evidence of a presacral/retrorectal mass on MRI.
2. Adequate MRI imaging available for review.
3. Histopathological diagnosis or characteristic radiological diagnosis where applicable.

Exclusion Criteria

1. Patients with incomplete imaging data.
2. Postoperative recurrent lesions with inadequate baseline imaging.
3. Lesions not centred in the presacral space.

Imaging Technique

MRI examinations were performed using a 3T MRI scanner. The imaging protocol included multiplanar sequences comprising:

- T1-weighted images
- T2-weighted images

- Short tau inversion recovery (STIR) sequences
- Diffusion-weighted imaging (DWI) with apparent diffusion coefficient (ADC) mapping
- Post-contrast T1-weighted fat-suppressed sequences following intravenous gadolinium administration wherever indicated

Image Analysis

All MRI studies were retrospectively reviewed by radiologists with experience in abdominal and neuroradiology imaging. The following imaging parameters were evaluated:

1. Lesion location and extent
2. Size and morphology
3. Signal characteristics on T1- and T2-weighted images
4. Presence of cystic, solid, fatty, or haemorrhagic components
5. Diffusion restriction
6. Neural foramina extension of the mass or communication with the spinal canal
7. Relationship with adjacent pelvic structures.

Case 1 – Currarino Triad with Presacral Cystic Teratoma (Fig: 1 a,b,c,d)

A patient with history of anal stenosis who had undergone a limited posterior sagittal anorectoplasty (PSARP), underwent MRI evaluation specifically for assessment of any associated presacral pathology. MRI revealed a well-circumscribed encapsulated multilocular cystic lesion in the presacral region extending from the (S2) level to the tip of coccyx, measuring approximately $2.7 \times 2.1 \times 3.1$ cm (transverse $\times$ antero-posterior $\times$ craniocaudal dimensions). Few areas of T1 and T2 hyperintensity were identified within the mass, with suppression on TIRM FS sequences, suggestive of intralesional macroscopic fat. The lesion caused anterior displacement of the rectum without infiltration into it. The fat planes with adjacent pelvic structures were preserved. Sacrococcygeal anomalies were detected in the form of fused S3–S5 vertebrae and kyphotic curvature involving the S3–coccygeal region. The conus medullaris was seen terminating at the level of the L2 vertebral body, and a syrinx was noted within the distal spinal cord extending over a length of 2.7 cm. No neural foramina extension or communication with the dural sac was seen. There was no destruction of sacrum or coccyx.

Additional anomaly detected on coronal MR images was a horseshoe kidney with mild hydronephrosis. Changes of anorectoplasty with sigmoidostomy stoma were present with mural thickening at the anorectal junction. Large and small bowel loops were dilated with air-fluid levels. There was no pelvic lymphadenopathy. Based on the constellation of anorectal malformation, sacral anomaly, and presacral cystic solid mass, imaging findings were consistent with Currarino triad with presacral cystic teratoma (Altman type IV).

Case 2 – Currarino Triad with Ruptured Anterior Sacral Meningocele (Fig:2 a, b, c)

In an 8-year-old female child, MRI revealed a midline anterior sacral defect extending from S2 to S5 with defective formation of the left halves of S2–S5 vertebrae and spina bifida involving the posterior elements of S1 and S2 vertebrae. A multiloculated anterior sacral mass measuring $2.2 \times 2.4 \times 1.9$ cm was seen herniating through the vertebral defect into the presacral region, containing CSF. The location and association with vertebral dysplasia was typical of anterior meningocele. Leptomeningeal enhancement and thickening of cauda equina nerve roots suggested superadded intraspinal intradural spread of infection.

A complex perianal fistulous tract was seen on axial and coronal MR images, with external perineal openings at the 7 o'clock and 3 o'clock positions communicating with the cystic presacral mass. Multiple secondary ramifications of the

perianal fistula tract with ischiorectal abscesses were present. The urinary bladder was elongated with the pinecone appearance suggestive of neurogenic bladder. The uterus and vagina were seen to be hypoplastic. MR imaging findings were consistent with Currarino triad with ruptured anterior sacral meningocele leading to perianal fistula and abscess formation.

Case 3 – Sacrococcygeal Teratoma (Fig:3 a,b)

In a 1-year 2-month-old female child with markedly elevated AFP levels, MRI revealed a large well-defined predominantly solid presacral mass with few cystic components, measuring $6.0 \times 6.7 \times 6.8$ cm in AP $\times$ transverse $\times$ craniocaudal dimensions. The solid component appeared heterogeneously isointense on T1 and heterogeneously hyperintense on T2, with areas of blooming on GRE suggestive of haemorrhage. Heterogeneous enhancement of the solid component was seen. Cystic components with a fluid-fluid level within one cyst were noted. No intralesional fat or calcification was present. Superior extension of the mass into the sacral spinal canal was noted.

Posterior extension of the mass to the skin and subcutaneous tissues and inferior extension into the gluteal region was seen with focal loss of fat planes with the gluteus maximus muscle. Enhancement of muscle fibres with gadolinium contrast administered indicates inflammatory reaction.

The mass caused anterior displacement and compression of the rectum, anal canal, urinary bladder, urethra, and uterus without invasion into any of the pelvic organs.

In a child with markedly elevated AFP levels, MRI enabled the diagnosis of sacrococcygeal teratoma (Altman type III) – malignant (immature), which was subsequently confirmed on histopathology.

Case 4 – Schwannoma (Fig:4 a,b,c)

A 30-year-old male with complaints of lower abdominal pain for 1 year, MRI revealed a large well-defined presacral solid–cystic mass (in relation to S1 to S5 vertebrae) measuring $9.6 \times 8 \times 11.8$ cm was detected on MRI. The mass caused anterior displacement of the rectum. Widening of the right S1–S2 neural foramina with extension of the mass along the right S1 nerve root was identified. The mass demonstrated isointense signal on T1W images, with hyperintense signal on T2W images with restricted diffusion and intense heterogeneous gadolinium enhancement. The right S2 nerve root appeared bulky and T2 hyperintense without enhancement. MRI imaging features were suggestive of spinal S1 nerve sheath tumour and further histopathology on resection of the mass proved it to be schwannoma.

Case 5 – Anterior Sacral Meningocele (Fig:5 a to d)

A 28-year-old female with lower abdominal pain for 2 years underwent MRI pelvis. Absence of distal sacral segments, consistent with partial type II sacral agenesis was identified. There was a low-lying spinal cord extending till S1 vertebra and was tethered to the dura. A large presacral cystic lesion, hypointense on T1 and hyperintense on T2 images with few internal septations, with complete signal suppression on FLAIR images, measuring $7.9 \times 8 \times 6.5$ cm was detected. The mass was communicating with the thecal sac through the sacral defect, features characteristic of an anterior sacral meningocele. The mass was seen abutting the right ovary and causing anterior displacement of the rectum. Mild free fluid was present in the pouch of Douglas.

Findings were consistent with type II sacral agenesis with anterior sacral meningocele.

Case 6 – Epidermoid Cyst (Fig:6 a,b,c)

In a 51-year-old female patient with history of abdominal pain

and polyuria for 8 months, MRI of the abdomen and pelvis showed a well-defined encapsulated presacral mass, with T1 isointense signal, heterogeneously hyperintense on T2W/TIRM images, measuring $9.5 \times 9 \times 11.7$ cm, extending from S1 vertebral level to level of coccyx, displacing the rectum and urinary bladder anteriorly. It demonstrated restricted diffusion, appearing hyperintense on DWI with corresponding hypointense signal on ADC. No enhancing components were seen in the mass. No neural foraminal extension or bony involvement was present. Imaging features are typical of a presacral epidermoid cyst. Ultrasound pelvis confirmed the pseudo testis appearance typical of an epidermoid cyst.

DISCUSSION

A structured MRI approach is essential for evaluation of presacral masses as summarized in Table 1. A pattern-based approach significantly narrows the differential diagnoses enabling accurate diagnosis and guiding appropriate surgical management.

Germ cell tumours can occur in the presacral region, with sacrococcygeal teratomas being the most common congenital tumours in fetuses and newborns, occurring in approximately 1 in 35,000–40,000 live births. (4, 5) They may rarely be present in older children or adults. MRI typically demonstrates a predominantly cystic heterogeneous mass due to presence of tissues of ectodermal, mesodermal and endodermal origin (6). Elevated AFP levels in sacrococcygeal tumors raise the suspicion of malignant transformation of these otherwise benign tumors. MRI demonstrates features critical for surgical planning i.e., excellent delineation of tumour extent into the sacral spinal canal, or soft tissues, as well as displacement of adjacent pelvic organs.

Germ cell tumours are often associated with certain syndromes. Currarino syndrome is a rare congenital disorder characterized by the triad of anorectal malformation, sacral dysgenesis, and a presacral mass. It results from abnormal development of the caudal cell mass during embryogenesis. It has been described as a Complete (Classical) Type (characterized by the presence of all three features of the Currarino triad—an abnormality of the sacrum, a presacral mass, and an anorectal malformation) and an Incomplete Type in which only one or two of the 3 characteristic features are present. The presacral mass associated with Currarino syndrome can be anterior sacral meningocele, germ cell tumour, or developmental cysts. (7, 9) Mature teratomas contain fat, teeth, calcification while enhancing solid component is present in immature teratomas. The prevalent classification system for sacrococcygeal teratomas is the Altman classification (8) and the four categories are:-

Type I - Predominantly extra pelvic/external tumour with a minimal intrapelvic component.

Type II - Predominantly extra pelvic/external tumour with a significant intrapelvic component.

Type III - Predominantly intrapelvic tumour with a smaller extra pelvic/external component.

Type IV - Entirely intrapelvic tumour with no external component.

The osseous sacral abnormalities associated with this syndrome are partial sacral agenesis, the hemi-sacrum appearing scimitar or sickle shaped, sacral mal-segmentation or sacrococcygeal dysgenesis with variable involvement of coccyx. (9)

Anterior sacral meningocele is a rare form of spinal dysraphism in which the meninges herniate through a sacral defect into the presacral space. Anterior sacral meningocele can be a feature of Currarino triad with the meninges herniating through the dysplastic sacrum. (9) A large CSF-intensity mass ventral to the vertebra, communicating with the thecal sac can be identified on MRI, features consistent with

anterior sacral meningocele. The cord may be low lying and may even be tethered at the sacrum thecal level. Biopsy of these lesions is contraindicated due to risk of introducing infection into the thecal sac, resulting in meningitis and chance of CSF leak from the puncture site into the presacral pelvic soft tissues. (10) Additionally, abnormal embryologic development of the hindgut, neuroaxis, and surrounding mesodermal structures, can give rise to cysts that coexist with the sacral abnormalities and the presacral mass. Anorectal malformations are often associated with the Currarino syndrome. (9) MRI identified sacral agenesis associated with sac of meninges herniating through the sacral vertebral defect in 2 patients in this study. MRI enabled demonstration of communication between the ventrally herniated thecal sac and a fistulous tract to the skin, indicating contained rupture.

A small proportion of presacral masses are Schwannomas. A recent systematic review comprising 570 surgically managed retrorectal tumours identified 54 cases of schwannoma (9.5%), with schwannomas representing the most frequently reported benign neurogenic tumour in the study cohort. (11) These benign peripheral nerve sheath tumours arise from Schwann cells located in the peripheral nerves and nerve roots of the presacral and pelvic regions. The typical MR appearance is of a well-circumscribed, solid homogeneously enhancing mass with tiny cysts. (12) The absence of foraminal destruction and presence of a well-encapsulated presacral solid-cystic enhancing prevertebral mass in relation to the neural foramen, supports the diagnosis of a schwannoma. Recognition of nerve root involvement is important as it differentiates schwannoma from other presacral tumours. MRI demonstrated a well-encapsulated presacral solid-cystic mass in one patient (Fig 4a and 4b)

Dermoid cysts, epidermoid cysts and neurenteric cysts are congenital developmental lesions that can be found in presacral space. These benign lesions are derived from embryological remnants. (13) A large presacral cystic mass with classic diffusion restriction distinguishes an epidermoid from other cystic presacral lesions such as tailgut cysts, dermoid, and mature teratoma.

Imaging Approach and Differential Diagnosis: Table 1:

Suggestive Diagnosis	Key Imaging Clue in MRI
Germ cell tumors (Teratoma) / Dermoid	Macroscopic fat signal
Epidermoid cyst	Marked restriction on DWI/ADC
Schwannoma	Foraminal widening or dumbbell-shaped extension
Anterior sacral meningocele	CSF-equivalent signal with communication through sacral defect
Tailgut cyst	Multiloculated retrorectal cystic mass
Chordoma / Schwannoma / other neoplasm	Enhancing solid component
Chordoma / aggressive neoplasm	Bone erosion or destructive sacral involvement

Conclusion and Clinical Relevance

Accurate preoperative characterization of cystic mass in the presacral region is essential for adequate surgical management due to availability of the choice of surgical approaches. MRI findings directly influence surgical planning in pre-sacral masses. Intraspinous extension and communication with the spinal canal indicates neurogenic origin, presence of ectodermal elements in the mass suggests germ cell tumors, purely cystic masses are usually epidermoid or dermoid, while malignant masses demonstrate a substantial enhancing component and bone destruction. MRI is the best modality for incidental identification of presacral masses and their further characterization.

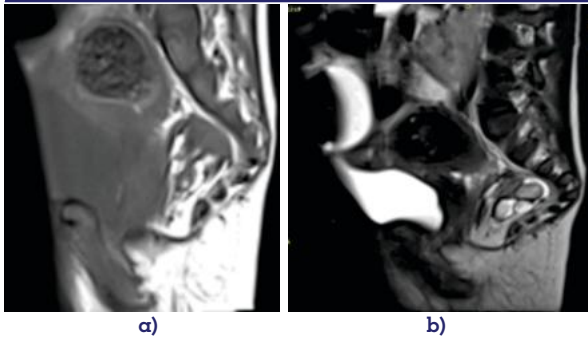
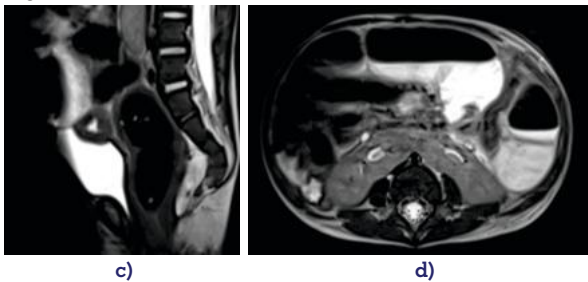


Fig 1: Pre sacral teratoma: a) T1WI sagittal image shows a well-circumscribed encapsulated lesion in the presacral region measuring $2.7 \times 2.1 \times 3.1$ cm with areas of T1 hyperintensity suggestive of fatty component within the lesion. b) T2WI sagittal image shows a multilocular lesion in the presacral region



c) T2WI sagittal image shows excessive anterior curvature of lower sacrum with fused vertebrae. d) T2WI axial image at L2 vertebral level shows the Horseshoe kidney with isthmus at L2 level and dilated bowel loops with air fluid level.

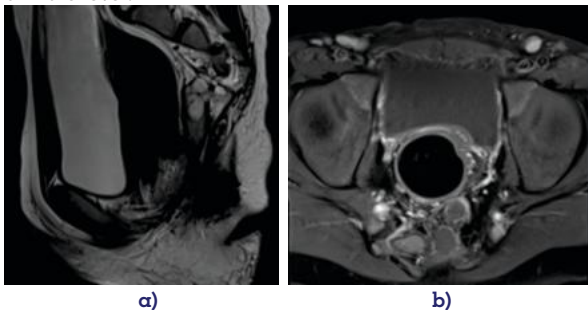
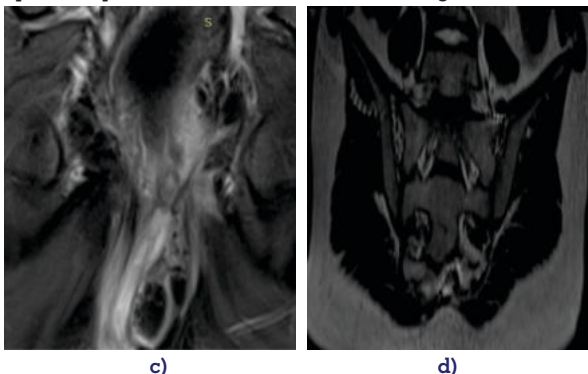


Fig 2: Ruptured presacral anterior meningocele a) T2WI sagittal image shows a multiloculated anterior sacral meningocele measuring $2.2 \times 2.4 \times 1.9$ cm seen in the presacral region, it also shows an elongated urinary bladder and dilated rectum secondary to anal stenosis b) T1WI axial post-contrast image shows peripheral enhancement of the cystic components suggesting an infected anterior meningocele.



c) T1 post-contrast coronal image shows a linear enhancing fistulous tract in the perianal region, d) T2WI coronal image revealed a midline anterior sacral defect with defective formation of the left halves of S2-S5 vertebrae

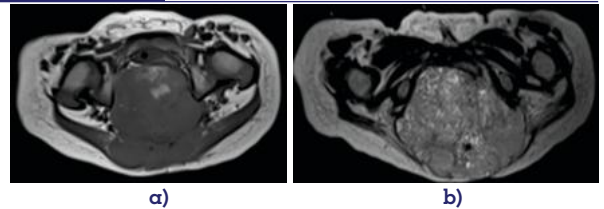
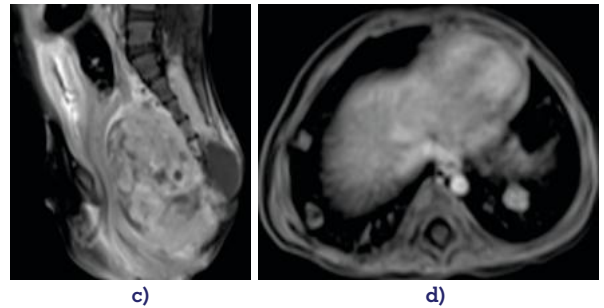


Fig 3: Immature Sacrococcygeal Teratoma, a) and b) T1WI and T2WI images show a large well-defined solid presacral mass with few cystic components, measuring $6.0 \times 6.7 \times 6.8$ cm (AP $\times$ Tra $\times$ CC), with a small external component in the sacrococcygeal region. It appears heterogeneously isointense on T1WI and heterogeneously hyperintense on T2WI, with few areas of T1 hyperintensity suggestive of haemorrhage.



c) T1WI post contrast sagittal image shows heterogeneous enhancement of the lesion. d) T1WI post-contrast axial image of lower chest shows multiple variable sized heterogeneously enhancing subpleural nodules in the bilateral basal segments, suggestive of metastatic deposits.

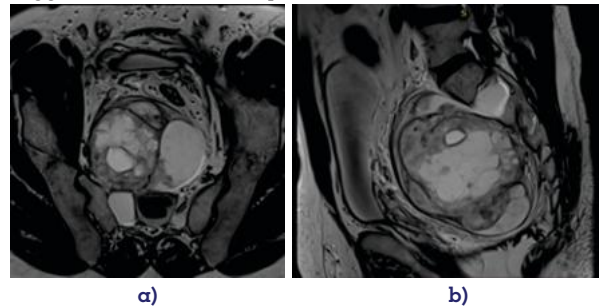
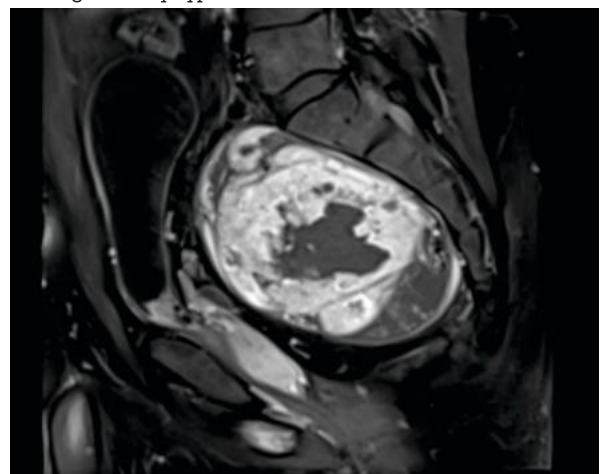


Fig 4: Schwannoma, a) and b) T2WI axial and sagittal images show a large well-defined presacral solid-cystic mass measuring $9.6 \times 8 \times 11.8$ cm extending from S1 to S5 with extension along the right S1 nerve root causing widening of the right S1-S2 neural foramen. The lesion appears T2 heterogeneously hyperintense.



c) T1WI post-contrast sagittal image shows heterogeneous enhancement of the lesion.

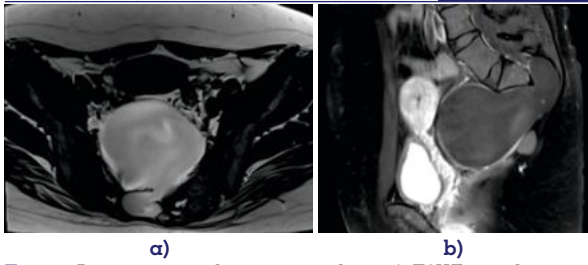


Fig 5: Anterior sacral meningocele: a) T2WI axial image shows a large presacral cystic lesion measuring $7.9 \times 8 \times 6.5$ cm, hyperintense on T2WI seen communicating with the thecal sac through a sacral defect, consistent with anterior sacral meningocele. b) T1WI post-contrast sagittal image shows no evidence of contrast enhancement of the sac.

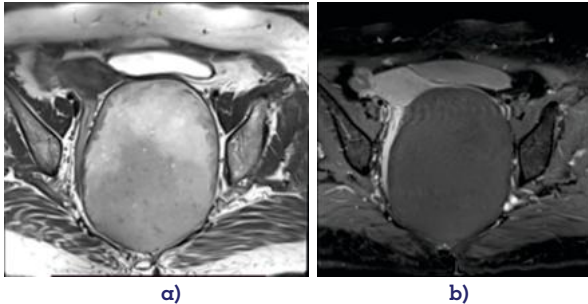
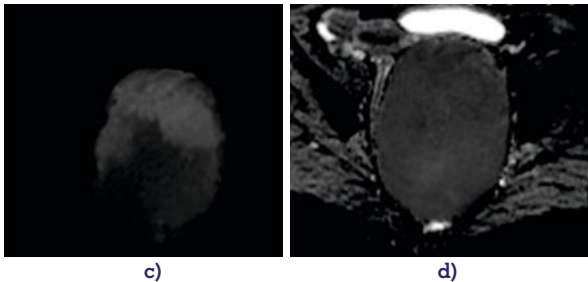


Fig 6: Presacral epidermoid cyst: a) T2WI axial image shows a well-defined encapsulated presacral mass measuring $9.5 \times 9 \times 11.7$ cm appearing T2 heterogeneously hyperintense. b) T1WI axial post-contrast image shows no evidence of enhancement.



c) and d) DWI and ADC images show Diffusion restriction in its anterior aspect of the cyst.

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