Role of MRI in diagnosing Ovarian and Adnexal pathologies

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Abstract:
Background*: MRI is very useful tool to diagnose and characterize ovarian and adnexal pathology. MRI can also be helpful in establishing treatment protocol for patients. Diagnosis of ovarian and adnexal pathology requires multidisciplinary approach. It is based on physical examination, laboratory tests and imaging techniques. There are three types of tumors originated from ovary: epithelial, germ cell and sex cord-stromal tumors. Neoplasm of Ovary may be benign, borderline, or malignant. Image guided approach depend on morphological appearance. Based on that, adnexal masses classified into four main groups: unilocular cyst, multilocular cyst, cystic and solid, predominantly solid with objectives to document the use of MRI guided approach in diagnosing ovarian and adnexal pathologies.*
Materials and Methods*: A cross sectional observational study conducted with conveniently enrolled 30 participants after their written informed consent. Data were entered in MS excel spreadsheet and analyzed with SPSS V.20.*
Results*: Total 30 participants were enrolled for data analysis with mean age was 34.9±11.1 years with most of the patients belongs to lower(63.3%) class and 60% were married. Lower abdominal pain(60%) was most common symptoms followed by menstrual irregularity(40%). Current study reported Endometrioma (5 cases), Ovarian dermoid (5 cases), Ovarian malignancy (5 cases) and others.*
Conclusion*: Because of high contrast resolution and lack of ionizing radiation exposure, MRI has advantage to determine the site of origin of pelvic mass and detect local invasion.*
***Key Word:Ovary*, Adnexa, Magnetic resonance imaging**

I. Introduction

Ovarian and adnexal pathologies are common finding in daily clinical practice. Sometimes, it may be detected incidentally or identified in symptomatic patients. Diagnosis of ovarian and adnexal pathologies represents a diagnostic challenge. It is of great importance to plan adequate therapeutic procedures and may influence patient's management. Most of the adnexal pathologies are benign. The common ovarian lesions are physiological cysts, endometrioma, benign cystic teratoma. Small number of adnexal pathologies will be borderline tumors or invasive cancer. It is not advised to take a biopsy for confirming the nature of an adnexal mass if there is no peritoneal disease beyond the ovary. Biopsy caused the spillage of a potentially confined tumor and increase stage and risk for patient. Therefore, the clinical decision on how aggressively to manage the ovarian mass relies on the available clinical and image findings, rather than histology. Symptoms are also important at the time of presentation. Also, age, menopausal status of the patient and the presence of acute or chronic pain or fever may inform the interpretation of image findings. In premenopausal women with pain, a pregnancy test is indicated to rule out possible ectopic pregnancy. Ultrasonography (US), Computed Tomography (CT), and Magnetic Resonance Imaging (MRI) are currently used to evaluate ovarian tumors. (1,2)

Ultrasound is the first line imaging modality, allowing the characterization of most adnexal masses. MRI is indicated in the characterization of sonographically indeterminate masses, whereas CT is indicated for further staging of a suspected ovarian cancer on US. (2) Magnetic resonance (MR) imaging may provide useful information for the characterization of ovarian and adnexal pathologies as nonneoplastic or neoplastic. Therefore, radiologists plays a vital role in the multidisciplinary approach of ovarian mass. Although different pathological conditions may have similar radiologic manifestations, they should be aware of MR imaging features of ovarian and adnexal lesions that may orientate the differential diagnosis.

II. Material And Methods

This cross-sectionalprospective study was carried out on patients of Department of radiology atSurat Municipal Institute of Medical Education and Research Center, Surat, Gujaratfrom August 2022to January 2023. A total 30 adult female patients were enrolled in this study.

Study Design: Prospective cross-sectional study

Study Location: This was a tertiary care teaching hospital-based study done in Department of Radiology, at Surat Municipal Institute of Medical Education and Research Center, Surat, Gujarat.

Study Duration: August 2022to January 2023.

Sample size: 30 patients.

Sample size calculation: Sample size had not calculated. We had enrolled 30 patient who referred to radiology department for MRI purpose in mentioned period.

Subjects & selection method:Conveniently 30 patients were enrolled in this study who visited radiology department for MRI pelvis.

Study equipment: Philips Achieva 1.5 Tesla

Inclusion criteria:

1. Patient with lower abdominal pain.
2. Patient with menstrual irregularities.

Exclusion criteria:

1. Implanted Electric and Electronic Devices are a strict contraindication to the Magnetic Resonance Imaging, and particular:
2. Heart Pacemakers (Especially Older Types)
3. Insulin Pumps
4. Implanted Hearing Aids
5. Neurostimulators
6. Intracranial metal clips.

Procedure methodology

Patients were referred to radiology department by various other departments for imaging purpose. Present study had followed strict professional and ethical standards at each stage of research. All measures were undertaken to protect the confidentiality of the respondents. Present study had not asked anything which reveals personal identification. In case the respondents wanted to speak to the researchers after the study suitable measures were taken to protect their identity and ensured privacy and comfort, within the available setting. Their participation was strictly voluntary. Participants had freedom to withdraw themselves at any time in between if they wished to. All participants were informed about the background and purpose of the study Present study had conducted with 30 participants after their written informed consent based on our inclusion and exclusion criteria. Their primary data were collected by using Predesigned semi structural questionnaire, whichwas anonymous. After primary data collection, participants were undergoing MRI examination and findings were documented for further analysis. After data collection, all the data were entered in MS Excel spreadsheet and analyzed with the help of MS Excel. Qualitative data were explained with frequency and percentage.MRI was done using 1.5 tesla GE signal explorer machine including standard scan protocol. Ovarian and Adnexal pathologies were categorized as benign or malignant based on clinical details and imaging features.

Statistical analysis

Data were entered in MS excel spread sheet after data collection. Data was analyzed using SPSS version 20. Quantitative data were explained with frequency and percentage and pie chart used.

III. Result

Total 30 participants were enrolled for data analysis. Mean age of the patients was 34.9±11.1 years with minimum 14 years and maximum 60 years. Most of the patients belongs to lower(63.3%) class and 33.7% belongs to middle socio-economic class. Out of total, 60% participants were married, and 40% participants were unmarried. In current study, lower abdominal pain (60%) was most common symptoms followed by menstrual irregularity (40%) and abdominal discomfort (33.3 %). (Table 1)

Current study reported Endometrioma (5 cases), Ovarian dermoid (5 cases), Ovarian malignancy (5 cases), cystadenoma (4 cases), ovarian simple cyst (4 cases), fibroid of broad ligament (2 cases), ovarian hemorrhagic cyst (2 cases), Tubo-ovarian mass (2 cases) and 1 case of Para ovarian cyst.(chart 1)

Table no 1 Socio-demographic profile and symptomatology

Age wise classification		
Age group	N	%
Less than or equal to 25 years	7	23.3%
26-40 years	14	46.7%
More than 40 years	9	30%
Minimum age-14 years, Maximum age-60 years with Mean ± SD – 34.9±11.1		
Socio economic classification		
Class	N	%
Lower	19	63.3%
Middle	11	36.7%
Marital status wise distribution		
Status	N	%
Married	18	60%
Unmarried	12	40%
Symptomatology of patients		
Symptoms	N	%
Lower abdominal pain	18	60%
Menstrual irregularity	12	40%
Abdominal discomfort	10	33.3%
Menorrhagia	7	23.3%
Fever	3	10%
Vomiting	2	6.7%

Chart 1 MRI finding wise distribution.
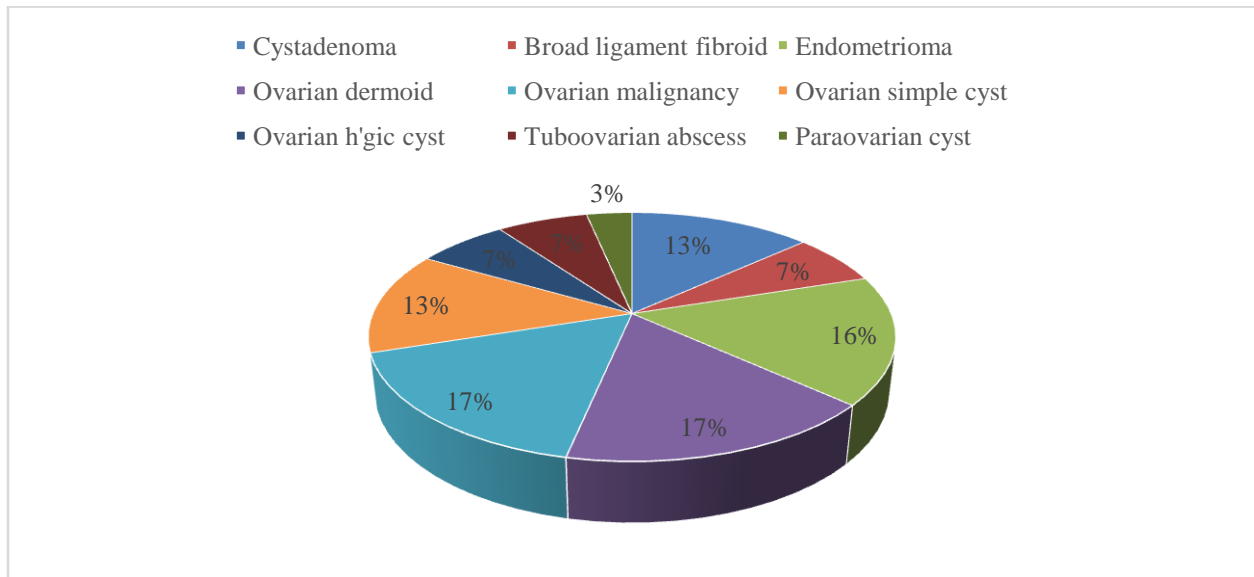
IV. Discussion

The most important step in evaluation of ovarian and adnexal pathology is to determine whether the pathology is benign or malignant. It has important role in treatment planning and to decide whether patient needs surgical approaches or conservative approaches.

Currently three modalities are used for diagnosing ovarian and adnexal pathologies like Ultrasonography (US), Computed Tomography (CT), and Magnetic Resonance Imaging (MRI). US is most commonly used and first-line imaging investigation for suspected adnexal masses helping in detection and characterization of ovarian tumors.(1) Morphological analysis of adnexal masses by US is usually accurate for identifying low risk or high risk lesions.(3) The most important morphological features for high risk ovarian masses are as follows.

(a) solid/cystic or solid lesions with a maximum diameter greater than 4 cm;

(b) the presence of irregular, nonfatty, solid vascularized areas greater than 28mm in diameter (4);

(c) the presence of papillary projection (vegetation) and thick wall and septa greater than 3mm in a cystic lesion. (5)

Color Doppler helps in the diagnosis of vascularized components within the mass.(6) Sometimes, an adnexal mass is defined as indeterminate on ultrasonography when it cannot be confidently placed into either the benign or malignant category, even after thorough interrogation including Doppler assessment, or for which the site of origin, from the ovary, uterus or another pelvic structure, remains to be established.(7) Computerized tomography scan is most commonly performed in preoperative evaluation of a suspected ovarian malignancy. But it exposes patients to radiation is its major drawback. When US findings are nondiagnostic or indecisive, MRI can be a valuable problem-solving tool. It is an adjunctive modality for evaluating adnexal lesions and useful for surgical planning information. (8) MRI is very useful in providing accurate information about hemorrhage, fat, and collagen. (7) It is also used to identify different types of tissue contained in pelvic masses, distinguishing benign from malignant ovarian tumors, with an overall accuracy of 88% to 93%. (9)

Cystadenoma

Cystadenomas are true cystic epithelial ovarian neoplasm. Serous cystadenomas are more common and account for around 25% of benign ovarian neoplasm. Cases occurs between 20 and 50 years old, bilaterally in 12–23% of cases. The lining of the cyst may be flat or may have small papillary projections. The typical MRI appearance of serous cystadenoma is mostly unilocular cyst with a thin wall. The presence of blood can vary to heterogeneous signal intensity. Mucinous cystadenomas are account for approximately 41% of benign ovarian neoplasms. In contrast to serous tumors, it is rarely seen (2%−5%) as bilateral. Mucinous cystadenomas are multilocular cysts, larger than serous, containing gelatinous material or fluid of various viscosities. The loculi of the tumors often show various signal intensities on both T1- and T2-weighted images ("stained-glass appearance"). Presence of thick wall or septa suggestive of borderline lesions while the presence of solid components suggests carcinoma. (10)
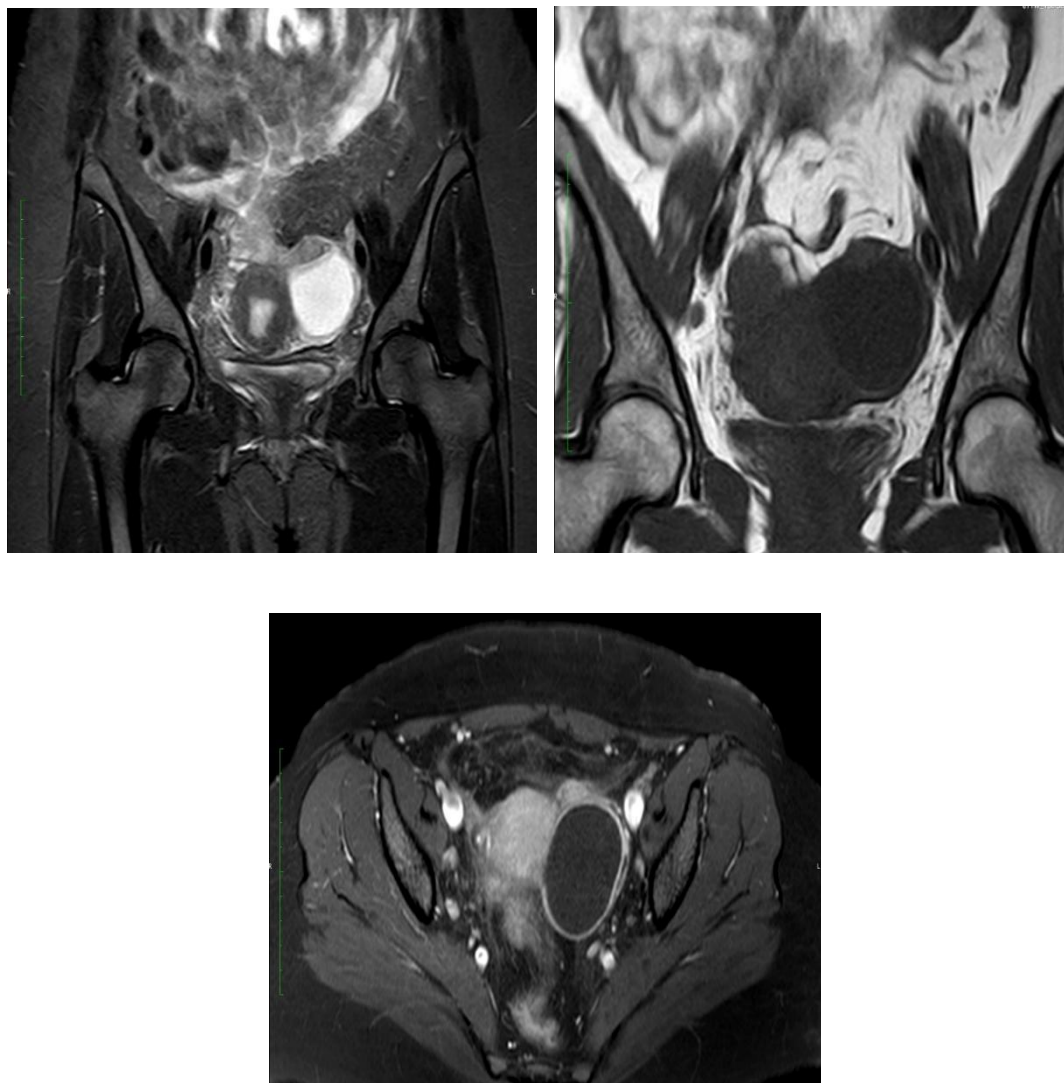
Case 1:A well-defined cystic lesion with few thin internal septations noted in left ovary, which appears hypointense on T1, hyperintense on T2/STIR with post contrast peripheral enhancement.
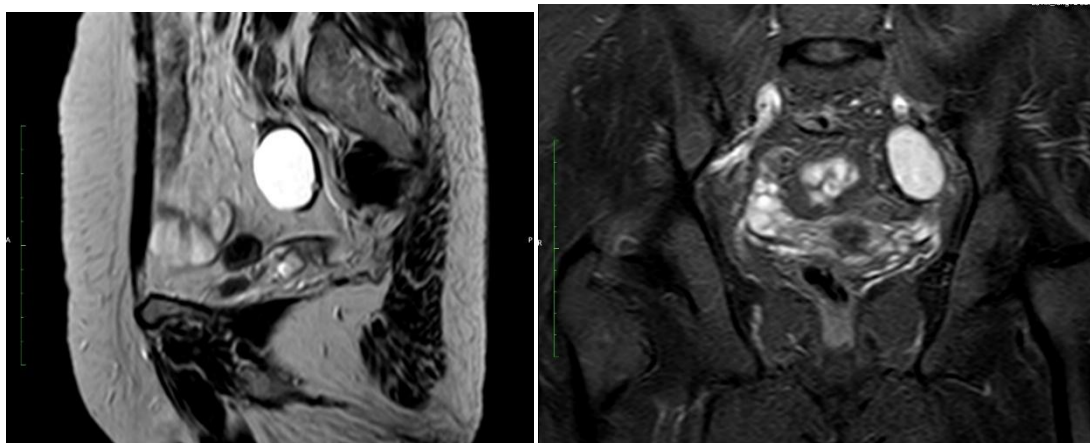
Endometrioma

It occursbecause of extrauterine implantation of endometrial epithelium. In US, typical appearance is a complex cystic ovarian mass with homogenous low-level internal echoes and thick wall which is usually hypovascular at color Doppler evaluation. Sensitivity of US is 90.4% in diagnosing endometrioma is as high as MRI sensitivity (90%). Although, MRI is usually performed after the US. It is because other foci of endometriosis located in the pelvis and sub-pelvic spaces which can be associated and for excluding malignant degeneration. (11,12) It is also helpful in differentiating endometrioma from endometrioid adenocarcinoma and clear-cell adenocarcinoma that can develop within endometrial cysts, with an incidence of 0.6–1.0%. (13) In cases of endometrioma, MRI demonstrates solid components in the cystic wall clearly enhancing in postcontrast images. Subtraction images of precontrast and postcontrast sequences are useful when the enhancement evaluation is difficult due to the hyperintensity of endometrial cysts. Endometrioma appears on MRI images as high intensity on T1-weighted images and relatively low intensity lesions on T2-weighted images ("shading" effect) manifesting as gradual loss of signal of dependent layering contents. (14) MRI has been reported to have a sensitivity of 68–90% and specificity of 83–98% for the diagnosis of endometrial cysts. (15)
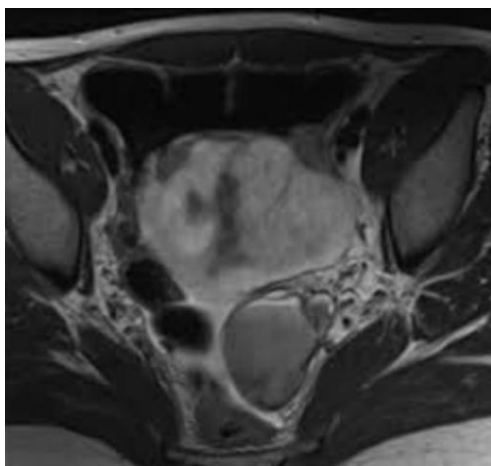
Case 2 : left ovarian cystic lesion showing T2 Shading – suggest left ovarian Endometrioma.

Ovarian cyst(simple and hemorrhagic)

It is most seen among women of reproductive age group. Physiological ovarian cysts constitute most adnexal masses. Ovarian follicles and follicular cysts share the same imaging features of thin-walled lesions with watery contents. According to definition, the term cyst should be reserved only to those larger than 3cm in size. (16) Because of its high prevalence in premenopausal age, cysts ranging from 3 to 5 cm do not require further follow-up, unless they are symptomatic. (16) Ovarian cysts includes either follicular cysts or corpus luteum cysts. The latter derive from failure of regression or hemorrhage into the corpus luteum. Corpus luteum and corpus luteum cysts have characteristics of a well-vascularized thicker wall that may be crenulated and often contain blood products. Thus, they display a lacelike appearance in US and not watery contents but signal intensity of blood products on MRI (high SI on T1-weighted imaging and FS T1-weighted imaging orhemosiderin). It occurs most commonly in one side and regresses in a 2–3-month interval.

Case 3 :T2/STIR hyperintense cystic lesion noted in left ovary – suggests left ovarian simple cyst.

Ovarian dermoid

Ultrasound features of dermoid sometimes may overlap with those of other entities, such as endometriomas or ovarian carcinomas. CT scan or MRI is performed in suspected dermoid, as they allow a specific diagnosis. Both of these techniques help in identification of fat is the pivotal. On MRI, the fatty component will demonstrate high SI on both T1- and T2-weighted imaging, with the lipid-laden cyst fluid demonstrating a similar high SI on T1-weighted imaging and intermediate SI on T2-weighted imaging. Chemical shift artifact is observed at the fat-fluid interface in dermoid cysts as bright or dark bands along the frequency-encoding gradient on T2-weighted imaging. Use of FS T1-weighted imaging enables dermoid cysts (which drop the SI) to be distinguished from hemorrhagic lesions or endometriomas which retain high SI. In lipid poor dermoid chemical shift imaging techniques may assist in defining the correct diagnosis. Due to their very slow growth, surveillance is a treatment option in dermoid smaller than 5 cm in size. (17)
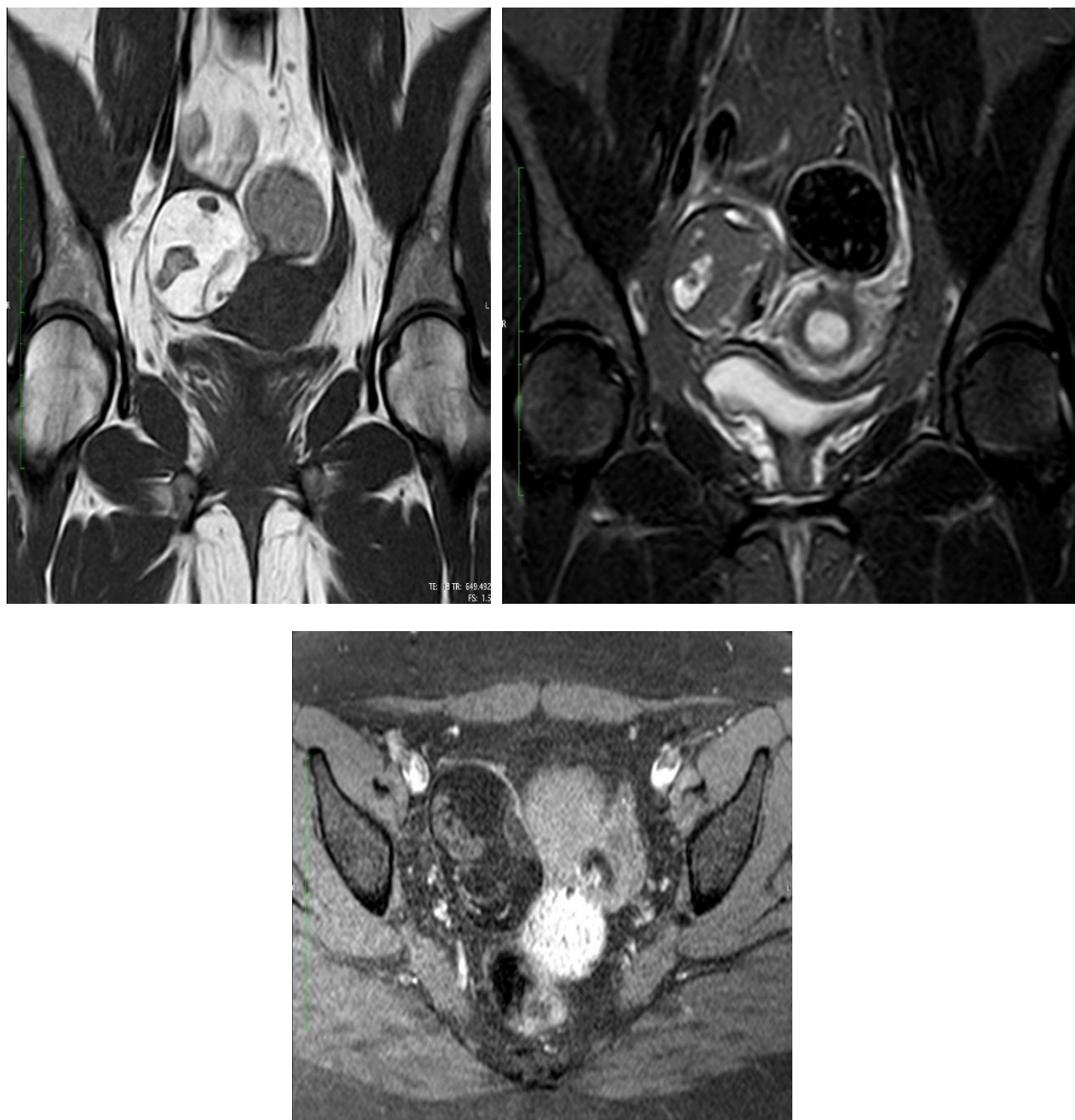
Case 4 : A well-defined lesion, likely arising from right adnexal region extending upto midline. The lesion appears predominantly hyperintense with few internal hypo intensity on T1/T2 and corresponding predominant iso-intensity with few internal hyperintensity on STIR images. There is suppression of T1 hyperintensity on fat suppressed sequences. The lesion is not visualized separately from right ovary.

Para ovarian cyst

Para ovarian cyst are remnants of wolffian duct in the mesosalpinx that do not arise from the ovary. They account for ~10-20% of adnexal masses. Often seen located close to the ipsilateral round ligament and are often of homogeneous signal intensity. They typically occur in women at the ages of 20-40 years old. Most of the cases are asymptomatic and sometimes patients present with pelvic pain. It can be diagnosed with Ultrasonography as well as MRI. In uncomplicated case, MRI signal characteristics follow that of fluid. On T1 it appears hypointense and can be hyperintense if complicated by hemorrhage and on T2 it appears as hyperintense. (10)
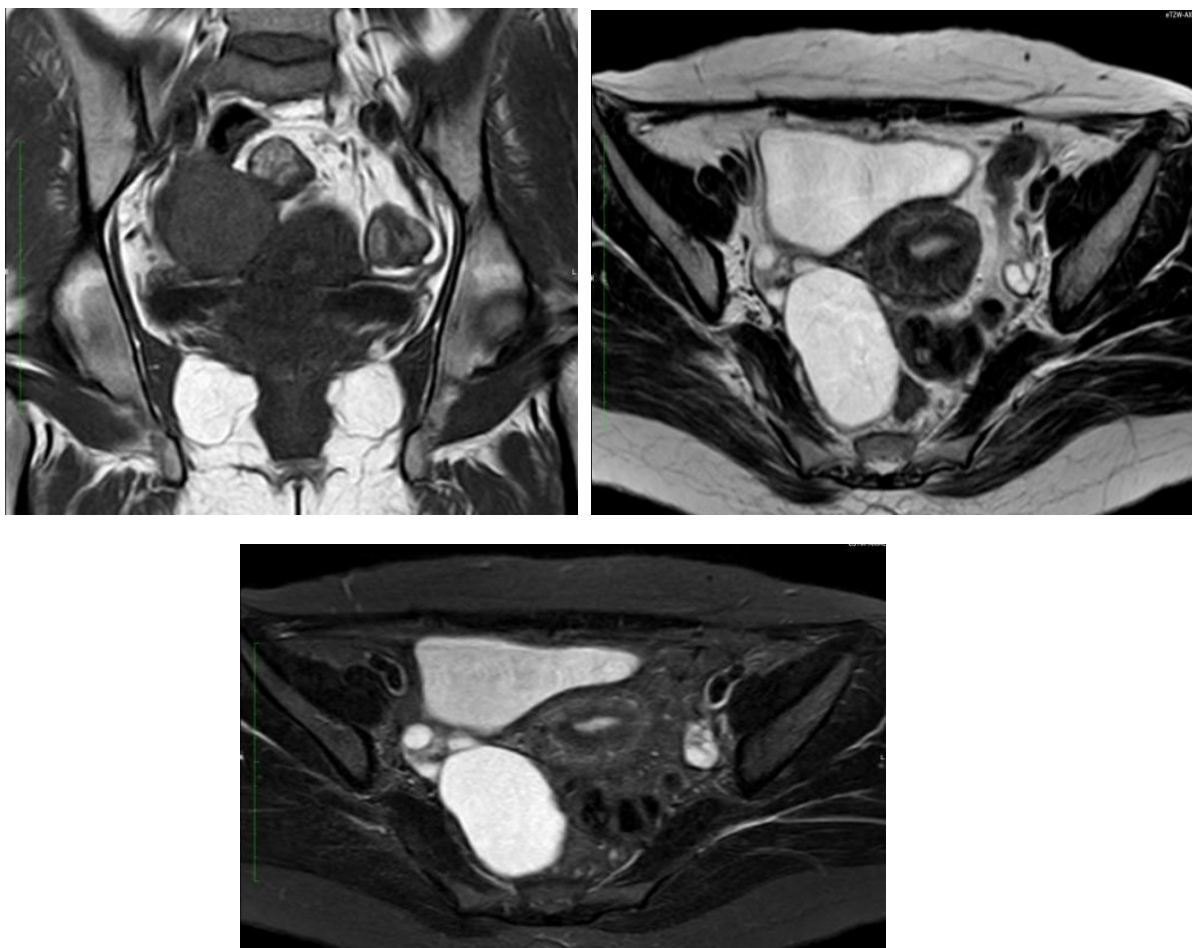
Case 5 : A well-defined T1 hypointense and T2/STIR hyperintense signal intensity cystic lesion noted in right adnexa which is seems separately from right ovary – suggest Para ovarian cyst .

Ovarian malignancy

Overall, borderline tumors account for approximately 15% of all ovarian tumors. The most common ovarian malignant lesions include invasive epithelial ovarian cancer and metastases. Metastasis constitutes 15% of malignant ovarian masses and mostly originated from breast and the GI tract cancer. In contrast to sex cord-stromal tumors (granulosa cell and Sertoli-Leydig cell tumors) and malignant germ cell tumors are rare tumors, mostly found in young age. They are now considered as precursor lesions that gradually progress to different subtypes of epithelial ovarian cancer type II. Serous high-grade ovarian cancer, the most common ovarian cancer, shares features of tubal and primary peritoneal cancer. It seems that it develops rapidly and is characterized by rapid dissemination into the peritoneal cavity and usually presents with tumor dissemination outside the pelvis and ascites at diagnosis. (18)

Chances of malignancy increases with the presence of septations, mural nodules, and papillary projections. MRI features suspicious for malignancy include mass 4 cm, cystic lesion with solid component, irregular wall thickness of 3 mm or more, septal thickness of 3 mm or more, presence of papillary projections or nodules, and presence of solid mass with necrosis and early, bright contrast enhancement.(19,20,21) In addition to this, ancillary criteria for suspected malignancy include direct local tissue invasion, peritoneal deposits, enlarged lymph nodes, and ascites. (20)(22)
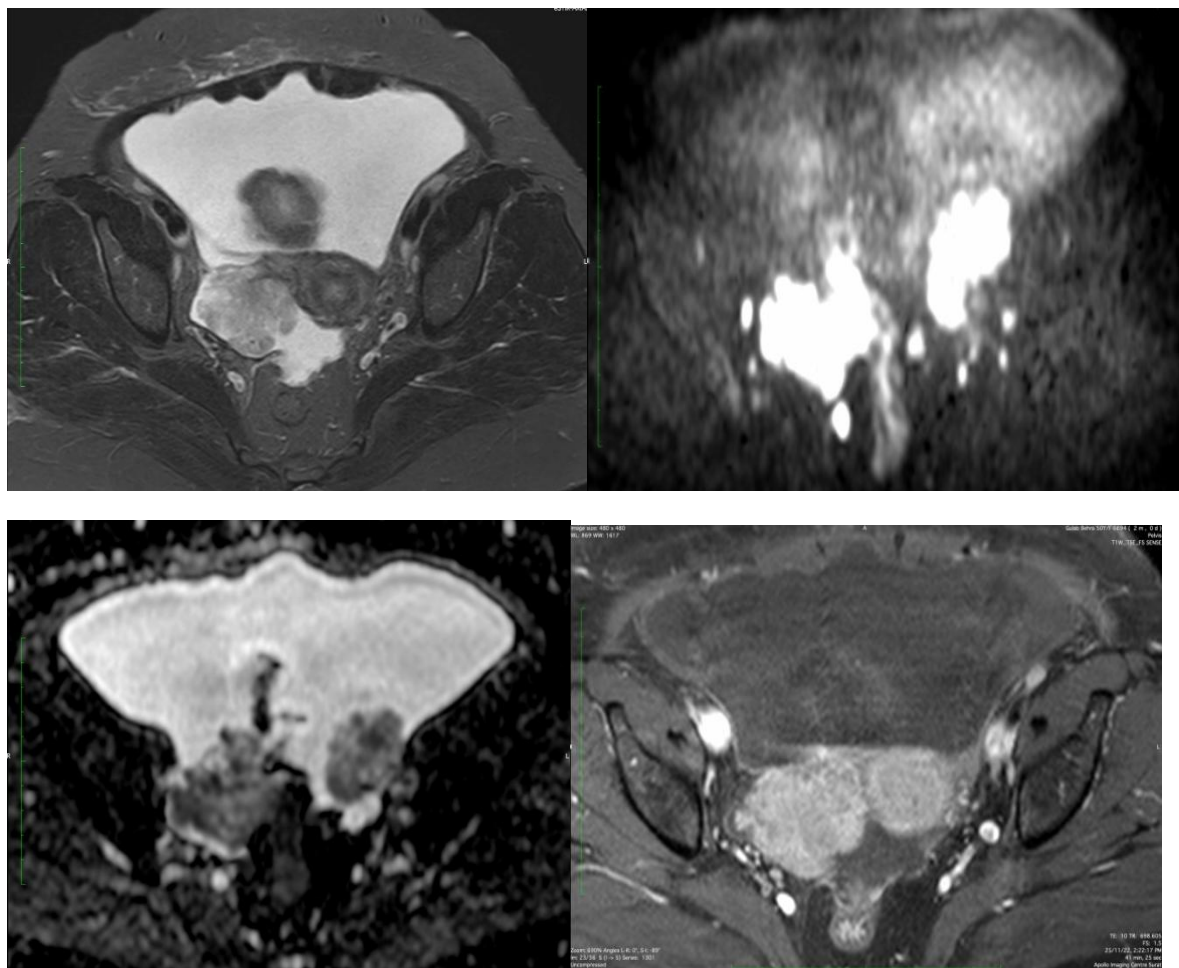
Case 6: A Multinodular enhancing solid lesions noted involving the right and left adnexal regions ,both ovary not visualized separately from the lesions. Bilateral solid lesion shows marked restricted diffusion.The lesion on the right side is in close proximity abutting the sigmoid colon without any significant luminal narrowing. Poor fat plane differentiation with serosal surface of the uterus.Gross ascites with nodular omental thickening noted.

Broad ligament fibroid

Broad ligament fibroids represent a diagnostic challenge on imaging. It appears adnexal in location. Sometimes, they may be confused with ovarian tumors or may have an alternative histological diagnosis following myomectomy. Suspected broad ligament fibroid was also reported as a pelvic schwannoma at histology. The broad ligament is the most common extrauterine site for leiomyoma but with low incidence rate. (22)
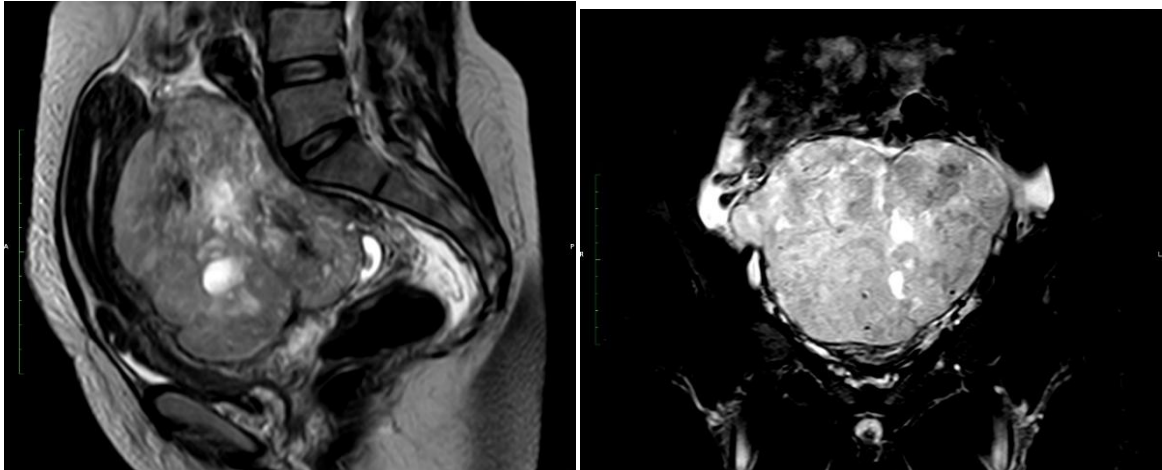
Case 7:Well defined fairly large sized lobulated T2/ STIR heterogeneously hyperintense lesions noted involving bilateral parametrium which show heterogenous enhancement on post contrast images – suggest bilateral broad ligament fibroids.

Tubo-ovarian abscess

Tubo-ovarian abscess are one of the most common late complications of pelvic inflammatory disease.Patientscommonly present with a combination of fever, elevated inflammatory markers, lower abdominopelvic pain, and vaginal discharge. Fever and leukocytosis may be absent sometimes. MRIcan be useful especially when sonography is indecisive or if the gas content is difficult to be differentiated from bowel gas.It typically seen as thick-walled fluid-filled pelvic mass(es). On T1: abscess contents typically hypointense and on T2: abscess contents typically heterogeneous signal or hyper-intense
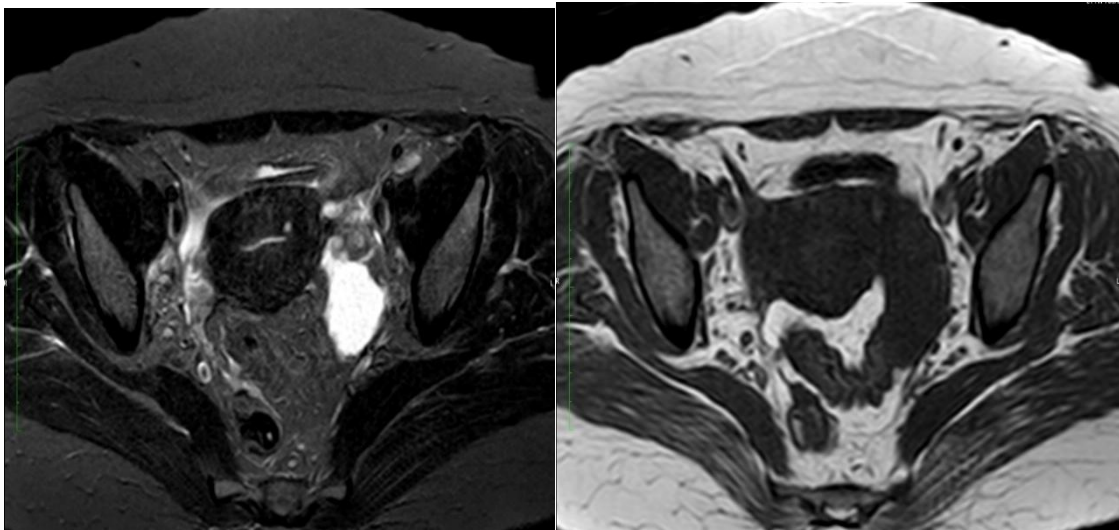
Case 8 : A well defined altered signal intensity lesion noted in left adnexa appearing hypointense on T1W and hyperintense on T2W & STIR images. There is possible ovarian tissue/ solid nodular component within lesion. It shows few internal septations.

V. Conclusion

MRI is an excellent investigation to evaluate the ovarian and adnexal pathologies due to its high spatial resolution, excellent tissue contrast, and multiplanar imaging capability. It is also very good modality for the tumor staging and follow‐ up of the cases. Certain key imaging features of ovarian or adnexal pathologies on MRI are helpful in the specific diagnosis or narrow down the differential diagnosis. MRI is useful for characterization of ovarian masses when US results are indeterminate or equivocal, especially when tumor markers are normal or in young patients when conservative surgery is suggestive.

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