

Role of MRI in Diagnosis of Uterine Adenomyosis

AMIRA T. SALEM, M.Sc.; ALYAA A. EL-NAGGAR, M.D. and MOHAMMED Kh. OMAR, M.D.

The Department of Diagnostic Radiology, Faculty of Medicine for Girls, Al-Azhar University, Cairo, Egypt

Abstract

Background: Adenomyosis is defined as the presence of ectopic endometrial glands and stroma within the myometrium. It is a disease of the inner myometrium and results from infiltration of the basal endometrium into the underlying myometrium. Magnetic Resonance Imaging (MRI) is the radiologic tool of choice for this condition. A thickness of the junctional zone of at least 12mm is the most frequent MRI criterion in establishing the presence of adenomyosis.

Adenomyosis can appear as a diffuse or focal form. Adenomyosis is often associated with hormone-dependent lesions such as leiomyoma, deep pelvic endometriosis and endometrial hyperplasia/polyps.

Aim of Study: In this study we illustrate the role of MRI in evaluation of uterine adenomyosis, its findings and associated conditions.

Patients and Methods: Thirty female patients were suspected to have uterine adenomyosis were enrolled for MRI using 1.5-T MR imaging unit. Patients were selected according to their age group (child bearing period), their clinical manifestations, then later MRI findings for each case, collection of data then statistical analysis was performed.

Results: MRI for Uterine Adenomyosis is considered an accurate noninvasive modality for diagnosis of adenomyosis and associated lesions. Diagnostic sensitivity, specificity and accuracy of diagnosis of MRI were 92.3%, 75% and 90% respectively in our study.

Conclusion: Our study revealed that MRI represents an accurate evaluation tool for adenomyosis allowing its diagnosis and detection of associated pathologies and can differentiate it from mimicking lesions noted at other imaging modalities and planning of appropriate treatment.

Key Words: Adenomyosis – Endometrial glands – Diagnostic imaging – Junctional Zone (JZ) – Pelvic MRI – Uterus – Women's imaging.

Introduction

UTERINE Adenomyosis was first described by Rokitansky in 1860 as “cystosarcoma adenoides uterinum” and was later defined by Von Recklinghausen in 1896. It is a common condition that predominantly affects women in the late reproductive years [1].

Uterine adenomyosis is a common benign uterine disease characterized by the presence of ectopic endometrial glands and stroma within the myometrium. This happens when the normal boundary between the endometrial basal layer and the myometrium is disrupted [2]. The presence of ectopic endometrial glands and stroma induces a hypertrophic and hyperplastic tissue [1].

It is asymptomatic in one third of cases, in the remaining being a cause of menorrhagia, dysmenorrhea, pelvic pain and uterine enlargement [3]. It is considered a significant factor of sterility in these patients, presumably by impairing uterine sperm transport [4]. The common symptoms include dysmenorrhea, menorrhagia, and abnormal uterine bleeding, but these do not allow diagnosis [5]. Adenomyosis can be a debilitating disease in women [2].

The mean frequency of adenomyosis at hysterectomy is between 20% and 30% [6]. Therefore, imaging plays an important role because establishment of the correct preoperative diagnosis is critical to avoid unnecessary intervention [5].

Hysterosalpingography no longer serves a major role in the diagnosis of adenomyosis [7]. This is more invasive imaging procedure has been largely supplanted by abdominal ultrasound followed by endovaginal ultrasound. The advantages of ultrasound are ease of use on a daily basis and diagnostic

performance when exploration is of good quality, however, MRI has evolved as the current imaging technique of choice in confirming suspected cases of adenomyosis [8].

Magnetic Resonance (MR) imaging is a highly accurate noninvasive modality for diagnosis of uterine adenomyosis, differentiation of adenomyosis from other gynecologic disorders, and planning of appropriate treatment [5].

Patients and Methods

This is a prospective study included 30 female patients referred from the Gynecology Department to the Radiology Department at Saudi German Hospital Aseer to perform MRI study during the period from March 2016 till September 2018.

Inclusion criteria:

- Female patients' complaints suggestive of having adenomyosis with their age between 25-50 years (child bearing period):
 - Chronic pelvic pain.
 - Infertility (mainly secondary).
 - Abnormal uterine bleeding.
- Female patients whose ultrasound examination was suggestive of having adenomyosis:
 - Bulky uterus, globular shape uterus.
 - Heterogeneous myometrium.
 - Asymmetrical myometrial wall thickness.
 - Myometrial cysts.
 - Thick junctional zone.

Cases with MRI findings suggestive of adenomyosis were included in the study.

Exclusion criteria:

- Pre pubertal and post-menopausal females.
- Patients with metallic pace-makers or metallic prosthesis for treatment of aneurysms specifically at the brain.
- Claustrophobic patients that can not complete MRI examination.

All cases were subjected to the following:

- 1- Verbal consent: Taken from the patient.
- 2- Full history taking with a special emphasis on:
 - I- Age.
 - II- Parity.

III- Menstrual history.

IV- Past history of gynecological operations such as CS, D & C or hysteroscopy.

V- Past history of gynecological troubles for example post partum complications / endometritis.

3- *Ultrasound examination:* Most of patients underwent preliminary pelvic ultrasound examination. The examination was performed using GE logic 9 ultrasound machine or/and Philips EPIQ 7 G machine. Trans-abdominal and trans-vaginal approaches using C1-6 (trans abdominal) and C10-3V (trans vaginal) transducers respectively were performed.

4- *MR imaging:* Examination of the patients at their late proliferative phase.

NB: Females at their menstruation postponed to be done later at late proliferative phase to avoid physiologic changes on junctional zone and uterine contractions.

- Administration of hyosine before study which is helpful in preventing uterine contractions.
- MR imaging was performed using 1.5-T MR imaging unit (Ingenia S, Philips medical system) or/and (Magnetom Symphony, Semen's medical system).
- All the patients were imaged in the supine position using pelvic phased-array coil.

MR Imaging planes:

- For optimal evaluation of the uterine corpus, cervix, vagina and adnexa, images need to be taken in at least 3 planes: Axial, coronal and sagittal.
- We started with a sagittal T2 localizer which is used as a guide for obtaining images in the axial and coronal planes.
- Axial and coronal planes are angled parallel with the main organ (uterine) axis.

Imaging sequences:

- 1- The uterus is best visualized on T2 weighted images, sagittal, axial and coronal because of the uterine geometry and importance of showing the endometrium and relationship of any abnormality to the endometrium that better appear at this sequence.
- 2- An axial T1 weighted sequence is useful as a general pelvic screening sequence for masses.

If hemorrhagic cystic area at the myometrium is suspected or even associated endometriosis.

- 3- Fat suppression sequences either STIR or T2 SPAIR were performed. Hyper intense cysts appeared in T1 and/or T2 will be still bright (not suppressed) in cases of hemorrhagic content differentiating it from cysts with fat content.
- 4- We use contrast when in doubt about the nature of a uterine nodule or to characterize associated findings, such as an adnexal mass.

MR imaging analysis:

MR images were analyzed for the following:

- Thickening of the uterine junctional zone.
- Diffuse or focal involvement of the junctional zone.
- Presence of myometrial cysts.
- Presence of myometrial focal lesions and their signal intensities.
- Signal intensity of found myometrial cysts in the T1WIs, T2WIs and in the fat suppression sequences or at post contrast sequences.
- Appearance of endometrium and if there are signs associated to adenomyosis e.g. hyper intense linear striations/invaginations extending from endometrium to myometrium with/out pseudo widening of the endometrium or even associated endometrial pathology.
- Presence of associated uterine pathology.
- Screening the vesico uterine pouch, vesico vaginal septum, urinary bladder, fallopian tubes, uterine ligaments, cul-de-sac, recto vaginal septum, and bowel for endometriotic implants that can be associated with the uterine adenomyosis.

5- Statistical analysis:

Data were checked, entered and analyzed using computer programs Microsoft Excel 2010 and statistical program for social science, Version 15 (SPSS Inc., Chicago, Illinois, USA).

Results

MR proved the presence of adenomyosis (true positive cases) in 24 out of 30 cases (80%):

- The main presenting symptom in MRI proved uterine adenomyosis patients was chronic pelvic pain not responding to medical treatment, relatively decreased by NSAID and relapse again

(14/24 cases) 58.3%. Patients complaining from abnormal uterine bleeding were (6/24 cases) 25%, whether patients complaining of infertility (4/24 cases) 16.7%. Based on the preliminary ultrasound study findings, patients with bulky uterus, heterogeneous myometrium, asymmetrical uterine walls thickness, thick junctional zone and/or myometrial cysts were sent for further MRI assessment.

- Patients at pre menopausal period (40-50 years) were (20/24 cases) 83.3%, this relation noted significant.
- Positive past history of uterine surgical procedure in our adenomyosis cases were noted significant accounting 75% (18/24 cases).
- Patients had positive history of surgical procedures (18/24 cases); 50% of them (9/18 cases) had history of D & C, 38.9% (7/18 cases) had history of CS and 11.1% (2/18 cases) had history of myomectomy.

Findings in cases diagnosed as adenomyosis on MRI study:

This included 24 patients out of 30 (80%) proven to be adenomyosis (true positive):

- On MRI examination diffuse adenomyosis cases were 18 out of 24 cases (75%) and in 6 out of 24 cases (25%) were focal.
- MRI signs that diagnose uterine adenomyosis (Chart 1).
- The most frequent sign to diagnose uterine adenomyosis was increased thickness of junctional zone 12mm or above found in 20 cases (83.3%), this sign may be alone or with other signs.
- 2 cases (8.3%) showed JZ thickness 9 and 10mm both have another criteria as JZ thickness/total myometrial thickness ratio at same level noted 69% and 55% for each of two cases respectively.
- 10 cases (41.7%) showed myometrial cysts.
- 2 cases (8.3%) showed ill defined hypo intense mass lesion with punctate hyper intense foci in T2 WIs (adenomyoma).
- 2 cases (8.3%) showed striation extending from endometrium to myometrium.
- Presence of myometrial cysts noted at 10 cases (41.6%), at which 9 cases of diffuse adenomyosis cases and 1 case from focal adenomyosis cases. Average size of the cysts is 3mm, but we have two cases of relatively large size, one case meas-

ured about 16mm and other case has large cyst measured about 3.5cm.

- Seven cases showed iso to low signal intensity on T1-weighted images whereas on T2-weighted images showed high signal intensity.
- Two cases showed high signal intensity on T2-weighted images and appeared of relative high signal intensity on T1-weighted images suggesting hemorrhagic content.
- One appeared hyper intense in T1-weighted image, of high signal intensity on T2 weighted image has hypo intense component noted also at fat suppression image suggesting aging hemorrhagic content.
- All cases of myometrial cysts were not suppressed on fat suppression sequences and showed no obvious contrast enhancement on post contrast sequences in its cystic components, but walls of two cases has relatively large sizes showed enhancement of their walls at post contrast sequences (Table 1).
- Associated conditions in MRI findings revealed uterine fibroids in 11/24 cases (45.83%) and ovarian endometriosis in 2/24 cases (8.3%).

Sensitivity, specificity, Positive Predictive Value (PPV), Negative Predictive Value (NPV) and accuracy:

- MRI study performed for all 30 patients, their results were compared to histopathological examination (Table 2).

False positive results: Included one case diagnosed by MRI as mild diffuse adenomyosis in the form of junctional zone thickness about 9mm involving about 45% of total myometrial thickness at that level. This case was negative for adenomyosis after biopsy.

False negative results: Missed two cases with clinical symptoms, ultrasound findings suggestive of adenomyosis. Although MRI findings were negative for adenomyosis (thickness of JZ measured 9mm for each case but not fulfilling other criteria), examination after biopsy showed early adenomyosis.

True negative results: Included 3 cases who were suspected to have adenomyosis, however both MRI and biopsy were negative.

The sensitivity, specificity, Positive Predictive Value (PPV), Negative Predictive Value (NPV) and accuracy of MRI in diagnosing adenomyosis were calculated and illustrated in (Table 3).

Table (1): MRI signal patterns of Myometrial cysts.

MRI signal pattern	No of patients	Percentage
• Iso to low T1, high T2 WIs	7	(70%)
• High T1, high T2 WIs	2	(20%)
• High T1, high T2 WIs with hypointense component	1	(10%)
Total	10	(100%)

Table (2): Results of MRI examination compared to histopathology.

True positive 24	False positive 1	
False negative 2	True negative 3	
26	4	Total 30

Table (3): Sensitivity, specificity, PPV, NPV and accuracy of MRI.

Sensitivity	92.3%
Specificity	75%
PPV	96%
NPV	60%
Accuracy	90%

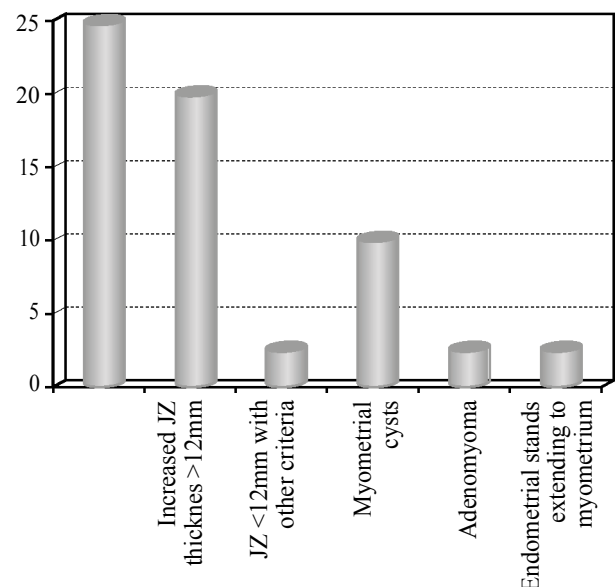


Chart (1): MRI diagnostic signs of uterine adenomyosis.

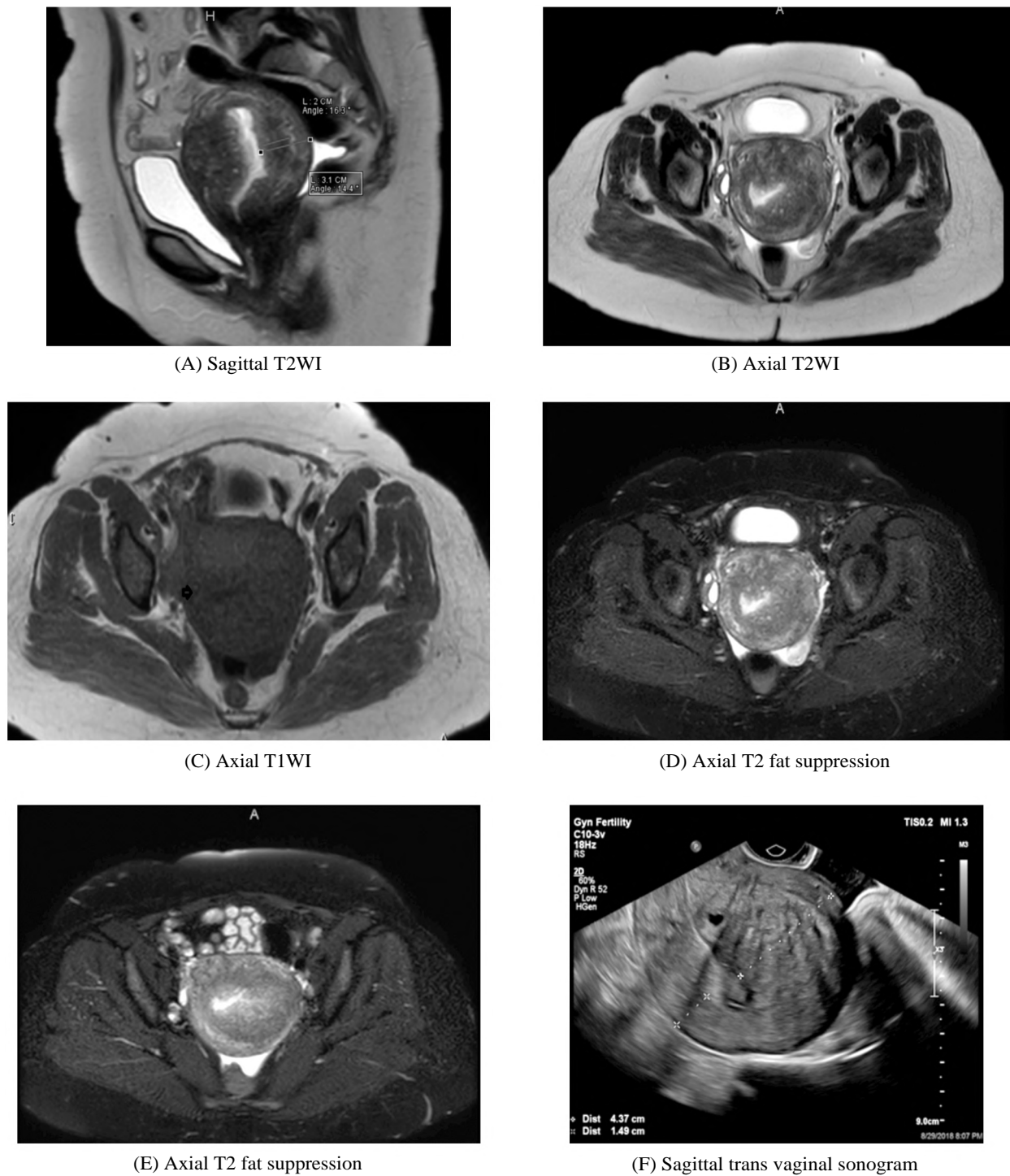
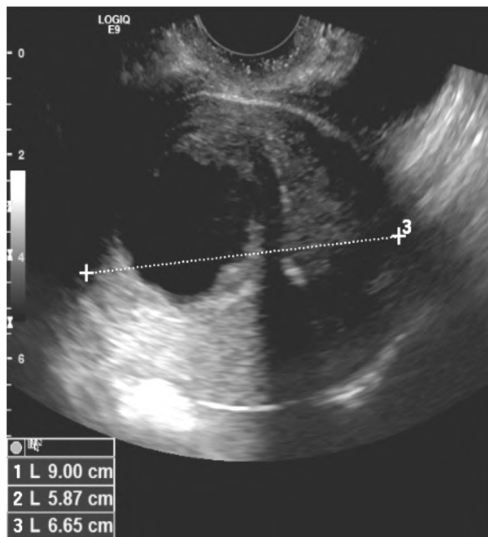
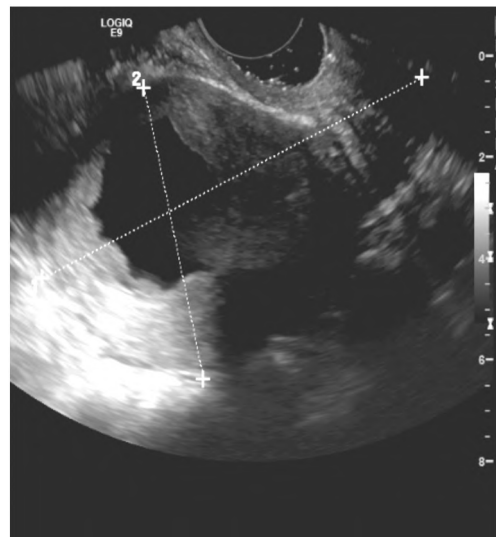


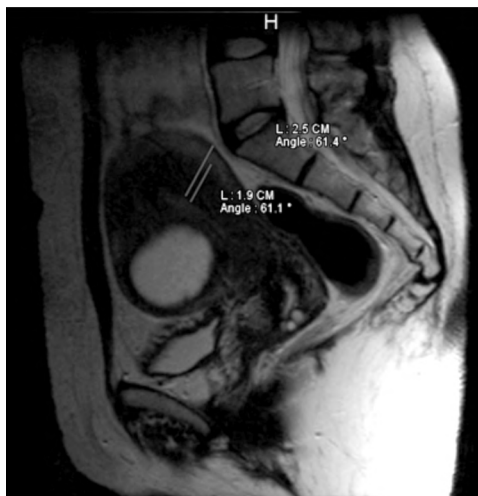
Fig. (1): Female patient 49 years old, presented by lower abdominal pain not responding to medical treatment, had clinical ultrasound features suggesting uterine adenomyosis, image (F) that showed revealed bulky RUV uterus with globular contour, heterogeneous texture, asymmetrical wall thickness, small myometrial cyst as well as anterior wall heterogeneous ill defined area mimicking myoma, MRI was done (A-E) showed bulky RUV uterus of globular shape (A), significant increase of JZ and JZ/myometrial thickness ratio (measures) with, multiple hyper intense myometrial small or micro cysts (A, B) not suppressed on T2 fat suppression image (D) and few of the cyst noted hyper intense in T1 WI black arrow (C). Ill defined anterior wall hypo intense lesion has hyper intense micro cysts with protrusion of the lesion with its microcysts into the endometrium (A, B, D). Hyper intense striations extending from the endometrium to myometrium (E) with endometrial invagination at lower posterior wall (arrow) (A).



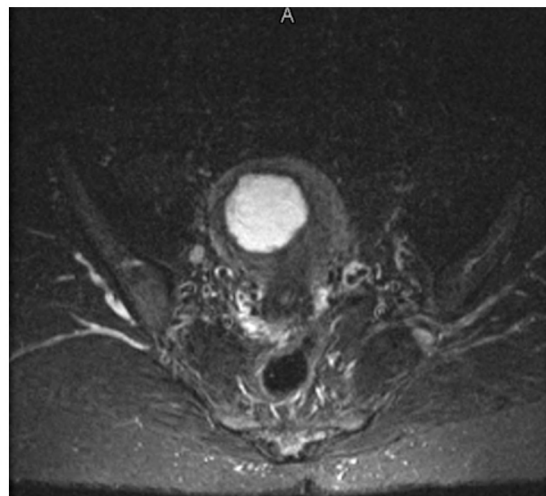
(A) Axial trans vaginal sonogram



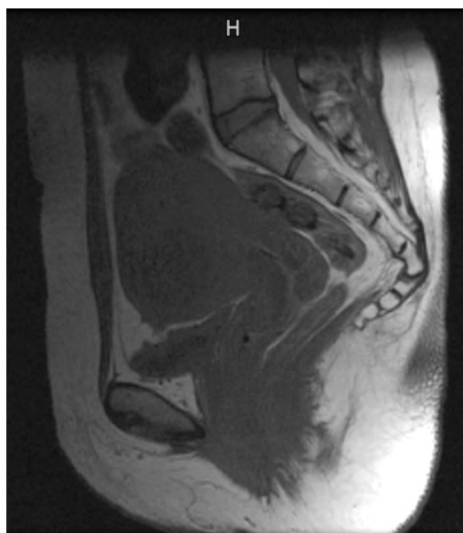
(B) Sagittal trans vaginal sonogram



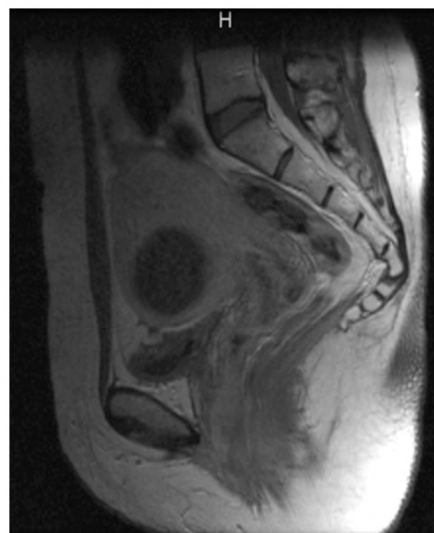
(C) Sagittal T2WI



(D) Axial T2 fat suppression



(E) Sagittal T1WI without contrast



(F) Sagittal T1 post contrast WI

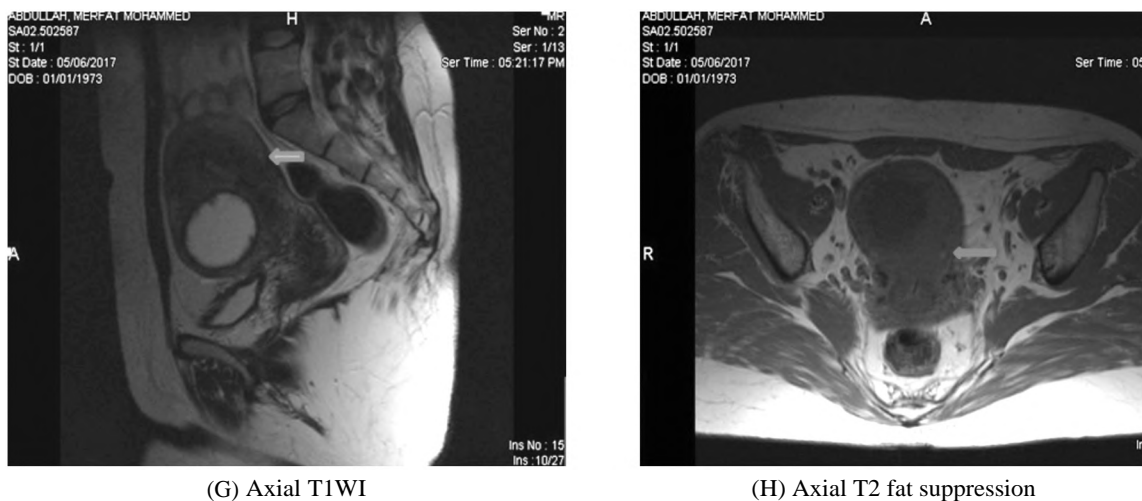


Fig. (2): Female patient 36 years old, presented by abnormal uterine bleeding following short period of missed menses, history of previous 3 CS, Pelvis ultrasound (TVS) was done showed bulky uterus has anterior wall uterine cyst (A,B) was first suspected to be abnormal gestational sac cause of its position near to endometrium but B-HCG was negative at two subsequent lab results, MRI pelvis was done and revealed uterine adenomyosis (C-F) sagittal T2 WI showed bulky uterus with increased JZ thickness in comparison to total myometrial thickness at same level (measures), hyper intense anterior wall myometrial cyst seen within ill defined thickened JZ with hypo intense wall (arrow) noted within mid anterior portion of JZ (C), cyst noted hypo to iso intense in T1WIs (E,H) cyst take no enhancement at post contrast sequences but its wall take enhancement as well adjacent JZ and myometrium (F). Notice hyper intense focus at posterior wall noted at sagittal T2WI and axial non contrast T1WI (arrows at Fig. 2G,H).

Discussion

Uterine adenomyosis is a common benign uterine disease characterized by the presence of ectopic endometrial glands and stroma within the myometrium. This happens when the normal boundary between the endometrial basal layer and the myometrium is disrupted [2]. The presence of ectopic endometrial glands and stroma induces a hypertrophic and hyperplastic tissue [1]. The aetiology of adenomyosis is still not fully understood and various theories have been proposed. Exposure to oestrogen, parity, and prior uterine surgery, are known risk factors. The most consensual theories propose that adenomyosis results from invagination of the endometrial basalis layer into the myometrium or from embryologically misplaced pluripotent Müllerian remnants [6].

The common symptoms include dysmenorrhea, menorrhagia, and abnormal uterine bleeding, but these do not allow diagnosis [5].

The purpose of imaging is to make the diagnosis, to determine the extent of spread (focal or diffuse, adenomyoma), and to check whether there is any associated disease, in particular endometriosis [3].

Pelvic MRI is superior to trans vaginal sonography in terms of specificity and sensitivity for

both focal and diffuse adenomyosis according to many studies [4,9,10].

Our study included a total of 30 female patients suspected to have uterine adenomyosis who underwent Pelvic MRI.

In our study, all patients were subjected to clinical assessment and most of them to preliminary ultrasound assessment. At MRI examination we used sagittal, axial and coronal T2WI, Axial T1WI, Axial T2-SPAIR, and Axial T1 fat suppression. We use contrast when in doubt about the nature of uterine lesion or to assess other associated finding such as adnexal mass. These sequences were also used by Agostinho, et al. [7,11].

In our study 24 out of 30 cases were proven to have uterine adenomyosis compared to histopathological assessment (true positive cases), false positive results included one case diagnosed by MRI as mild diffuse adenomyosis but was negative for adenomyosis after biopsy. False negative results missed two cases with clinical symptoms and ultrasound findings suggestive of adenomyosis although MRI findings were negative for adenomyosis, examination after biopsy showed early adenomyosis. True negative results included 3 cases who were suspected to have adenomyosis; however both MRI and biopsy were negative for adenomyosis. The diagnostic sensitivity, specificity and

accuracy of diagnosis of MRI were 92.3%, 75% and 90% respectively. Novellas et al., [8] revealed that the diagnostic accuracy of MRI in uterine adenomyosis is 85% both of us revealed that MRI is an accurate modality in diagnosing uterine adenomyosis. In Marc and Emile study [12], TVS versus MRI in diagnosis of uterine adenomyosis and their results suggest that MRI is more useful than TVS in the diagnosis of adenomyosis with MRI sensitivity 77% and specificity 89%, they recommend further studies to determine the performance of direct signs (cystic component) and indirect signs (characteristics of junctional zone) to avoid misdiagnosis of adenomyosis (done in our study).

In our study, uterine adenomyosis was common in the peri menopausal females 40-50 years (83.3% of true positive cases), Novellas et al., [8] mentioned that adenomyosis referentially affects women between 40-50 years old this relation was noted significant.

In our study the diagnosed and proven cases of adenomyosis 24/30 cases all of them were multi para in agreement with Templeman et al., [13], both of us revealed significant correlation between parity as a risk factor and uterine adenomyosis.

In our study 18/24 (75%) cases were exposed to prior uterine surgery, about 50% of them underwent CS, Riggs et al., [14] revealed that exposure to prior uterine surgery specially CS is a risk factor for the development of adenomyosis uteri.

In our study 18/24 (75%) were diffuse form and 6/24 (25%) were focal form, Bedaiwy A. Mohamed, and Falcone T, in general gynecology, 2007 mentioned same percentage that diffuse adenomyosis is found in approximately two thirds of cases, and focal adenomyosis is found in one third [15].

Regarding Larsen, et al., the most frequent finding for the diagnosis of adenomyosis is thickening of the junctional zone, with a thickness exceeding 12mm being highly predictive of the diagnosis [16]. In our study increased junctional zone thickness exceeding 12mm were found in 20/24 cases (83.3%) which can be alone as a diagnostic sign or accompanied by other signs.

We have two cases of JZ thickness 9 and 10mm, they have another additional criterion which is the JZ thickness/myometrial thickness measured 45 and 55% respectively. According to Gordts et al., a maximal junctional zone thickness to myometrium thickness ratio over 40% such as a relative thick-

ening of the junctional zone in a localised area can diagnose cases of junctional zone thickness between 8 and 12mm as adenomyosis.

In our study 10/24 case (41.7%) have myometrial cysts most of them of mean size 3mm. According to Bazot et al., [4] and Tamai K, et al., 2006 [18] the presence of these cysts, although almost pathognomonic of adenomyosis, is detected on MRI in only about half of the cases. This referred to decreased spatial resolution of MRI to detect small lesions according to Kataoka et al., study on MRI of the female pelvis at 3T compared to 1.5T [19].

In our study most of cases (7/10) of myometrial cyst (70%) are hyper intense in T2WIs and hypo to iso intense in T1WIs. Three cases out of 10 cases of myometrial cysts noted of hyper intense signal at T1 (hemorrhagic foci). Novellas et al., illustrated that this hemorrhagic content is not found routinely because it appears that the endometrial cells of adenomyosis are less dependent on circulating hormone levels [8].

In our study uterine fibroids noted at 45.8% of cases of uterine adenomyosis, according to a study adenomyosis coexisted with leiomyomas in 35% to 55% of cases [20], another mentioned that leiomyomas are present in almost 50% of cases involving adenomyosis of the uterus [8] denoting considered association.

In our study two cases (8.3%) were associated with ovarian endometriosis. Charles et al., study found 5.7% of uterine adenomyosis cases associated with endometriosis [21]. Another author found that one third of young women with clinically suspected, deep infiltrating endometriosis had MRI features of uterine adenomyosis [16].

Conclusion:

MRI is an accurate, noninvasive radiological modality to diagnose and evaluate uterine adenomyosis that may be missed or not confirmed by ultrasound. It can diagnose it separately or associated with other conditions.

Conflicts of interest:

There are no conflicts of interest.

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دور الرنين المغناطيسي فى تشخيص عضال الرحم الغدى

يعد عضال الرحم الغدى مرضا شائعا فى الرحم يتميز بوجود غدد بطانة الرحم والسدى داخل عضل الرحم. يحدث هذا نتيجة لإضطراب الحدود الطبيعية بين طبقة قاعدية بطانة الرحم وعضل الرحم المجاور.

وإن بعض المريضات اللاتي يعانين من مرض الرحم الغدى لا يشتكون أية أعراض، وعند وجود الأعراض فإنها غالبا تشمل عسر الطمث، ألم الجماع، وآلم الحوض المزمن، وغزارة النزيف الرحمى (الطمث)، ويعتبر كذلك عاملا مهما للعقم فى هؤلاء المرضى.

الرحم الغدى قد يكون منتشرًا بعضل الرحم بأكمله وهذا هو الأكثر شيوعًا أو قد يوجد على هيئة عقدة غدية ناتجة من تجمع عدة خلايا من بطانة الرحم داخل عضل الرحم. وقد يترافق هذا المرض مع أمراض أخرى، مثل الورم العضىلى الأملس، الأورام الحميدة لبطانة الرحم وبطانة الرحم المهاجرة.

وإنه ليوجد صعوبة فى التشخيص عن طريق الأعراض الإكلينيكية وحدها بسبب شيوعها فى العديد من الأمراض وقد يصحح مرضا موهنا عند النساء، لذلك كان من الضرورى إستخدام طرائق التصوير المختلفة للوصول للتشخيص الصحيح قبل إجراء أى تدخل جراحى.

يعد الرنين المغناطيسى طريقة تصوير دقيقة غير غازية للتشخيص وقد تكون أكثر فائدة من أجهزة الأشعة التلفزيونية فى تمييز العقدة الغدية بالرحم من الورم العضىلى الأملس، والتي ربما تكون أهم فرق سريريا مما يساعد على التخطيط المناسب للعلاج.

وقد إشتملت دراستنا على عدد ٣٠ حالة من الإناث واللاتي كن يتشتهبن بإصابتهم بعضال الرحم الغدى إكلينيكيًا أو بسبب وجود نتائج محتملة لوجود العضال بهن عن طريق تصوير أرحامهن بإستخدام الموجات فوق الصوتية.

تم عمل أشعة الرنين المغناطيسى للحالات وتجميع البيانات وتحليلها إحصائيا وقد إستنتجنا من دراستنا أن التصوير بالرنين المغناطيسى يمكنه تشخيص الحالات الرحم الغدى بنسبة دقة تصل إلى تسعين بالمائة، ويمكنه تشخيصه فى حالة وجوده منفردا أو مصاحبا لأمراض أخرى مثل الورم الليفى الأملس لعضلة الرحم حيث أنه يستطيع التفرقة بينهما.