Role of Ultrasound and MRI In diagnosis of pelvic endometriosis and adenomyosis

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Abstract

Background: Endometriosis is a condition where tissue similar to the lining of the uterus; the endometrial stroma and glands,endometriosis was further classified as endometriosis interna and endometriosis externa.Some patients with endometriosis being asymptomatic and others have disabling pelvic pain, infertility, or adnexal masses. **Methods:** Conducted on 20 Patients diagnosed clinically as endometriosis and/or adenomyosis and fulfilling the inclusion and exclusion criteria aiming to prove the ability of ultrasound and MRI to accurately diagnose ectopic endometrial lesions like endometriosis and adenomyosis. **Results:** MRI proved the true positive presence of endometriosis and/or adenomyosis in 15 out of 20 cases (75%). Pure endometriosis was actually diagnosed in 10 cases from all 15 true positive cases (66.6%), adenomyosis was diagnosed in 3 cases (20%), and mixed endometriosis and adenomyosis were diagnosed in 2 cases (13.4%). Associated MRI findings included uterine fibroids (26.6%), adhesions in (40%), and Hematosalpinx (20%) from all 15 true positive cases .
Key words: Ectopic Endometrium, Ultrasound, MRI and Intervention plan

Introduction:-

signal on both T1 and T2 weighted sequences interspersed within foci of hyperintensity brightness) noted on the T2 weighted scans representing small cystically dilatated glands or more acute sites of microhemorrhage (Tamai et al., 2006).

PATIENTS AND METHODS:-

Study design:This prospective study was performed aiming to determine the role of Ultrasound, MRI In diagnosis of pelvic endometriosis and adenomyosis

Study population:-

suggestive of having endometriosis and/or adenomyosis.

-Infertility (primary or secondary), Pelvic pain, Abnormal uterine bleeding.

-Bulky uterus:-Thick junctional zone, Heterogeneous myometrium, Complicated adnexal cyst

Exclusion criteria:

- Prepubertal and post-menopausal females.

MRI provides better diagnostic capability due to the increased soft tissue differentiation, allowable through higher spatial and contrast resolution it has high specificity for identifying endometriomas, which are characterized by high signal intensity on T1-weighted images and low signal intensity on T2-weighted images (Chamié et al., 2011). MRI can be used to classify adenomyosis based on the depth of penetration of the ectopic endometrium into the yometrium.The uterus will have a thickened junctional zone with diminished

The study was performed at the Gynecology Department to Radiology Department in Mansoura Hospitals for MRI evaluation. informed consents were given by all patients, the study wasconducted on 20 Patients diagnosed as clinically in endometriosis and/or adenomyosis .

Inclusion Criteria:

-Females in the childbearing period (18- 45 y), whose ultrasound examination was

Only cases with MRI findings suggestive of adenomyosis or endometriosis were included in the study.

- Patients with metallic pacemakers.
- Patients with scan disability by MRI or any imaging modalities, which do not reach our satisfaction results.

Methods

Ultrasound examination:

-The vaginal transducer isintroduced and maneuveredunder real-time monitoring to visualise the adnexae, then withdraw slightly angled towards the fornix to avoid unnecessary patient discomfort against the cervix.

-Transabdominal Scan is done sagitally in the midline immediately above the pubis. The probe is heeled to get the bladder over the fundus of the uterus and assess the uterus, vagina and cervix. The image is zoomed to assess and measure the endometrial thickness.

-Before a transvaginal sonogram is done, bladder is so empty, patients are relaxed on the bed with showing the TV probe and explainingthis superior accuracy procedure in improving complete diagnostic resolution without any speculum used. The probe is covered with a latex sheath and lubricatedwith sterile gel on the outside.

MR imaging

MR imaging was performedusing a 1.5-T MR imaging unit.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, vaginaand adnexa, images need to be taken in at least 3planes: axial, coronal and sagittal.

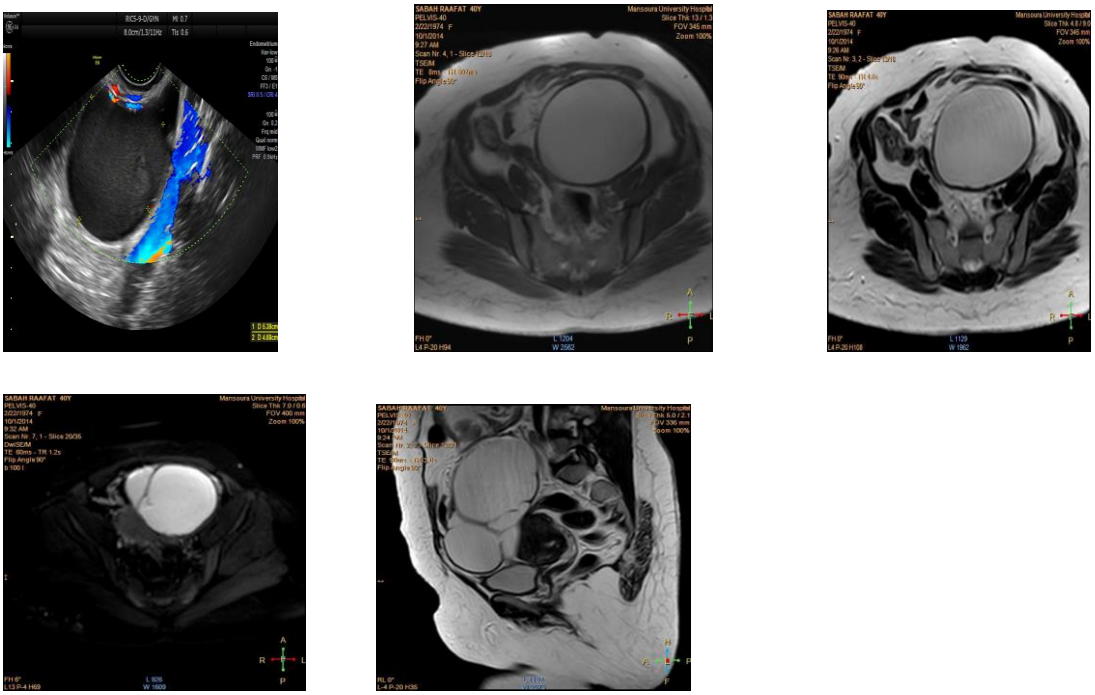
MR Imaging protocols

1. Axial and coronal 2D fast spin-echo T2-weighted (TR/TE, 2,500–4,000/80–90) spoiled dual gradient-echo sequences
2. Axial and coronal T1-weighted in- and out-of phase (120–200/2.3 and 4.6, 90° flip angle) sequences.
3. Sagittal fast spin-echo T2-weighted performed with a pelvic or torso phased-array coil.
4. Routinely fat suppressed T2-weighted fast spin echo images for excluding fat containing lesions. .
5. Parameters for 2D images included a section thickness of 5- 6 mm with an intersection gap of 0–1 mm; matrix size, 256 × 160–192; field of view, 20–24 cm2; number of signals acquired, 1 or 2.

MR Imaging analysis:

MR images were analyzed for the following:

- Presence of unilateral or bilateral ovarian cystic lesions with their signal intensitiesin the T1WIs, T2WIs and in the Fat suppression sequences.
- Presence of solid components and enhancement of the solid component if present.
- Presence of septations within the cyst.
- Presence of adhesions.
- Thickening of junctional zone.
- Focal or diffuse involvement of the junctional zone.
- Presence of associated other uterinepathologies.
- Screening the vesicouterine pouch, vesicovaginal septum,bladder, fallopian tubes, uterine ligaments, cul-de–sac,rectovaginal septum, and bowel for endometriotic implants



(Fig 1) ***40-year-old female patient presenting with menorrhagia and pelvic pain***

- TVUS shows a 5x4.5 cm well defined homogeneous, hypoechoic complex cystic focal lesion within the left ovary with diffusely low internal echoes
- Multi-septated left adnexal cystic mass lesion is seen. It is revealed reducing the vesicular cavity capacity and displacing it inferiorly .
- lesion presents high signal on T1 and intermediate signal on T2WIs with facilitated STIR WIs being of high signal intensity on this sequence

Pathology: Left endometrioma

a.

b.

C

d.

e.

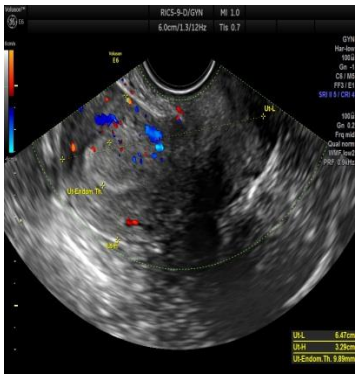
(Fig 2) ***45 years old women presented by dysmenorrhea***

(a) Trans-abdominal US, (b) Trans-vaginal US, (c) sagittal T2WI, (d) axial T2WI + FS, (e) axial T1WI

Imaging findings:

- By using Transabdominal and harmonizing Transvaginal US show enlarged uterus with circumferential asymmetrical myometrial thickening and minute scattered anechoic lesions seen in the outer layer of uterine myometrium
- MR appearance of enlarged bulky uterus
- Ill-defined lesion seen in the anterior and posterior myometrium with iso-intense signal to the uterus in T1 WI and low-signal-intensity with multiple small high-signal-intensity areas representing ectopic endometrial tissues and small cysts in T2- WI.

Pathology: Diffuse adenomyosis.



a.

b.

c

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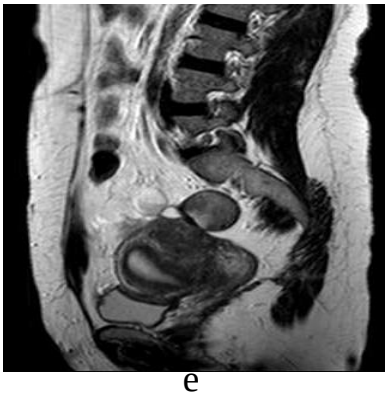

e

(Fig 3) ***30 years old women presented by menorrhagia***

Figure : (a, b , c) pelvic US, (d , e) axial and sagittal T2WI

imaging findings:

- Normal both adnexal regions with preserved parenchymal echo pattern and vasculature .
- Non gravid bulky uterus with asymmetrical myometrial thickening .
- A 2 x 1.4 cm well defined hyperechoic anterior uterine myometrial solid focal mass with mild vascularity and subtle displacing of endometrial stripe .
- Minute few anterior myometrial hypoechoic cysts .
- The mass displays iso to hyper signal intensity on T2 weighted images associated with asymmetrical focal thickening of the junctional zone.

Pathology: Focal adenomyosis.

Results and discussion:-

Endometriosis is defined as tissues like the endometrium which occur outside the uterine cavity **(Choudhary et al., 2009).** Historically, endometriosis was classified as endometriosis interna and endometriosis externa. Endometriosis interna referred to endometrial tissue within the myometrium, and endometriosis externa referred to endometrial tissue within all other sites. Now, the term adenomyosis has replaced endometriosis interna and endometriosis externa is simply called endometriosis (**Woodward et al., 2001).** Ultrasonographic protocol is typically the first and most commonly used imaging technique for the assessment of patients with infertility and/or pelvic symptoms. Transvaginal sonography should always be performed for perfect diagnosis however, with TVUS alone it may be hard to distinguish between myometrial or subendometrial lesions and endometrial lesions, both of which can cause abnormal bleeding. As well the ultrasound limitation lies in its reduced sensitivity for endometriotic plaques **(Choudhary et al., 2009).** In case of endometriosis MR imaging provides better diagnostic facility due to the improved soft tissue differentiation, allowable through higher contrast and spatial resolution. It has high specificity for recognizing endometriomas, which are characterized by hyper signal intensity on T1-WIs and hypo signal intensity on T2-WIs **(Chamié et al., 2011).** This study evaluated 20 patients with 22 pathologies suspected to have endometriosis and / or adenomyosis, their ages ranging from 18 to 45 years. **In patients with endometriosis** the core presenting symptom was infertility either primary or secondary (6 out of 14 cases) 42.8%, which is more or less consistent with the study by **Kuligowska et al** who reported that in infertile women **;** the endometriosis rate is much higher, between 20% and 50% of this population **(Kuligowska et al., 2005).**

In our study 6 cases had bilateral endometriomas (42.8%) with 83% sensitivity and 98% specificity diagnosed by transvaginal examination. Nearly the equivalent results were reported by **Woodward et al;** that bilateral endometriomas are often seen in 50% of cases (**Woodward et al., 2001).** As the cystic signal pattern of MRI , the sensitivity had increased up to 90% as compared to preliminary US examination with same the high specificity in both studies. we found that 6 cases (6 out of 14) 42.8% showed increased signal intense on T1& intermediate signal intense on T2WIs, and 2 cases (2 out of 14) 14.2% showed high signal intense on T1& low signal intense on T2WIs which is compatible with the study by **Choudhary et al.** who reported that the characteristic endometrioma shows shading, which is defined as a range of low T2 signal intensities and a corresponding high T1 signal intensity. This shading reveals the chronic nature of the endometrioma owing to repeated hemorrhagic episodes of hemorrhage accumulating over months and years with very high concentrations of protein, iron, and intracellular met-hemoglobin **(Choudhary et al., 2009).** In our study 3 cases (3 out of 14cases) 21.4% had hematosalpinx with 81% sensitivity and 78% specificity by transvaginal US study and 95% sensitivity and 89%

specificity by harmonizing MRI, while **Choudhary et al.** reported hematosalpinx in 30% of cases **(Choudhary et al., 2009). Choudhary et al**. reported that involvement of the uterine ligaments, stages, to fibrosis and adhesions causing obliteration of Douglas pouch **(Choudhary et al., 2009),**which is consistent with our study where adhesions were found in 6 cases (6 out of 14 cases) 42.8%. **Bazot et al.**reported that adenomyosis was demonstrated in 79% of the patients with endometriosis with 82.5% sensitivity and 84.5% specificity by pelvic ultrasound exam in comparison with 77.5% sensitivity and 92.5% specificity by combined MRI. That is because common aetiological factors like abnormal migration and metaplasia implicated in the pathogenesis of both endometriosis and adenomyosis **(Bazot et al., 2007).** Whereas in our study combined adenomyosis and endometriosis were found in only 2 cases (2 out of 14 cases) 14.2%.This dissimilarity may be due to the limited number of research cases.

Associated uterine fibroids were seen in 2 cases (2 out of 14 cases) 14.28% with 83% sensitivity and 90% specificity by transvaginal US study in comparison with 100% sensitivity and 91% specificity by matching MRI. **Uimari et al.**reported that 26% of patients with indicative endometriosis also had fibroids and this was suggested to be owing to hormone dependency and changes in intrauterine pressure during cyclic periods resulting in increased retrograde menstrual flow **(Uimari et al., 2011).** In our study MR imaging showed high accuracy in detecting endometriotic implants which were encountered in one case with rectovaginal endometriosis, compatible with the study particularly the uterosacral ligaments, with ectopic endometriotic nodules leads to thickening and, in later

by **Chamié et al.** who reported that MRI demonstrated high accuracy 90.2% in showing deep pelvic endometriosis in the retro cervical space **(Chamié et al.,2010). As for the patients with adenomyosis**, all our cases were multiparous with age ranging between 25 and 45 years, which is more or less consistent with the study by **Kuligowska et al.** who reported that adenomyosis most generally (70%–80% of cases) affects parous women aged 30–50 years **(Kuligowska et al., 2005).**

Four cases out of eight cases (50%) presented with abnormal uterine bleeding, whereas two cases (2 out of 8) presented with dysmenorrhea (25%) and another two cases presented with infertility (25%), which is nearly consistent with the study by **Tamai et al.** who reported that (70%) of adenomyotic women have symptoms as dysmenorrhea, menorrhagia and abnormal bleeding (**Tamai et al., 2005).** On MRI examination two patients (2out of 8) 25% had diffuse thickening of the innermost layer of myometrium with 86% sensitivity and 100% specificity in comparison with 80% sensitivity and 50-90% specificity by TVUS, whereas another two patients had focal adenomyoma (2 out of 8) 25% which is consistent with **Takeuchi and Matsuzaki** who reported that adenomyosis may affect diffusely the uterine myometrium causing a diffusely enlarged uterus, or it may be localized as an adenomyoma **(Takeuchi and Matsuzaki, 2011).** In the two patients who had diffuse adenomyosis, the thickness of junctional zone ranged between 14 up to 23mm with

79% sensitivity and 68% specificity by pelvic US study in comparison with 95% sensitivity and 94% specificity by combined MRI. These results are compatible with the study by **Champaneria et al.** Who reported that in adenomyosis, the width of junctional zone is more than 12 mm in absolute terms with consistent with the study by **Imaoka et al.** who reported that MRI is a highly precise modality for discriminating between leiomyomas and adenomyosis in cases of enlarged uterus, with a reported accuracy of 99% **(Imaoka et al., 2003).** Two other patients had associated endometriosis (25%) which is compatible with the study by **Tamai et al.** who reported that patients with adenomyosis often have associated disorders, most commonly endometriosis and leiomyoma **(Tamai et al., 2005).** MRI was performed for all 20 patients (with 22 pathologies) who were refereed from the Gynecology Department to Radiology Department in Mansoura and results were a junctional zone: myometrial thickness ratio of >40% **(Champaneria et al., 2010).**

In our study two patients had associated uterine fibroids which were demonstrated as well-circumscribed low signal intense masses on T2WIs images (2 out of 8) 25% and this is compared to histopathological assessment**.** ***False positive*** results included one case diagnosed by MR imaging as endometriotic cyst but post-operative pathological examination depicted a hemorrhagic cyst. ***False negative*** results missed one case with clinical symptoms and sonographic findings impressive of adenomyosis. While MRI findings were negative for adenomyosis, biopsy revealed early adenomyosis.

True negative results included 3 cases who were suspected clinically and by sonographic evaluation to have adenomyosis; but both MRI and biopsy were negative.

MRI final diagnoses:

This study included 15***true positive cases*** with 18 pathologies. Ten (66.6%) patients were diagnosed as pure endometriosis, three patients (20%) as pure adenomyosis and two patients (13.3%) had both adenomyosis and endometriosis. In our study The ***Sensitivity, Specificity, positive predictive value (PPV), negative predictive value (NPV) and accuracy*** of MRI in diagnosing endometriosis and adenomyosis were 94%, 75%, 95%, 70%, 93.5% respectively. These results are more or less compatible with the study by **Choudhary et al.** who demonstrated that MRI yielded an overall sensitivity, specificity, and accuracy of 90%, 98%, and 96%, respectively, for diagnosing endometriomas and in distinguishing between them and other gynecological masses (**Choudhary et al., 2009).** In a different study, **Stamatopouloset al.** reported that MRI has highly accurate in diagnosis of adenomyosis.MRI demonstrated sensitivity of 46.1%, specificity of 99.1%, positive predictive value (PPV) of 92.3%, and negative predictive value (NPV) of 88.5% **(Stamatopouloset al., 2012). Summary** Endometriosis is a condition where ectopic tissues similar to the normal lining tissues of the uterus; the endometrial stroma and glands, is found elsewhere in the body. This study entails evaluation of 20 female patients who were suspected to have

endometriosis and/or adenomyosis, for MRI assessment. Their ages were ranging between 18 and 45 years. Their leading (40% of all cases), and irregular vaginal bleeding (25% of all cases). MRI proved the true positive presence of endometriosis and/or adenomyosis in 15 out of 20 cases (75%). Pure endometriosis was actually diagnosed in 10 cases from all 15 true positive cases (66.6%), adenomyosis was diagnosed in 3 cases (20%), and mixed endometriosis and adenomyosis were diagnosed in 2 cases (13.4%).

Associated MRI findings included uterine fibroids (26.6%), adhesions in (40%), and Hematosalpinx (20%) from all 15 true positive cases . MRI was performed for all 20 patients (with 22 pathologies) and results were compared to istopath-ological assessment. False positive results included one case diagnosed by MR imaging as endometriotic cyst but post-operative pathological examination depicted a hemorrhagic cyst. False negative results missed one case with clinical symptoms and sonographic findings impressive of adenomyosis. While MRI findings were negative for adenomyosis, biopsy revealed early adenomyosis.True negative results included 3 cases who were suspected clinically and by sonographic evaluation to have adenomyosis; but both MRI and biopsy were negative.The diagnostic sensitivity, specificity and accuracy of diagnosis of MRI were 95.2%, 75% and 92% respectively.

complaints were infertility (35% of all cases), pelvic pain

Conclusion

With the development of recent radiological technologies, new MR imaging sequences are being used. Of these, is the diffusion weighted images (DWI), susceptibility-weighted imaging (SWI), MR spectroscopy (MRS), cine MRI, and high-resolution MR imaging at 3 T which can improve the specificity of MRI and therefore increasing the radiologist's self-confidence in image interpretation which will finally be reflected on the patients' outcome and prognosis. Both endometriosis and adenomyosis are common causes of infertility, bleeding and pelvic pain between females; MRI can detect both separately or combined with each other Finally, both endometriosis and adenomyosis are common causes of infertility, abnormal bleeding, and pelvic pain between females; MRI can detect both separately or combined with each other.

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