Role of Endosonography and Magnetic Resonance Imaging for Assessment of Adnexal Lesions in Childbearing Period

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Abstract:

Background: Adnexal masses represent a diagnostic dilemma. They can be encountered in females at any age. Imaging has essential role in their diagnosis and subsequent management. Ultrasonography (USG) is the initial imaging study of choice in the evaluation of adnexal lesions. USG and magnetic resonance imaging (MRI) are best in the assessment of adnexal mass lesions. **Aim**: To determine the role of endosonography and conventional MRI for assessment and differentiation of various adnexal lesions in childbearing period females. **Subjects and Methods:** We prospectively studied 50 women in childbearing period (age from 15 to 50 years) with adnexal lesions either symptomatic or accidently diagnosed. All patients were subjected to ultrasound (both transabdominal and transvaginal ultrasonography (TVUS) and MRI examination. The agreement between these modalities final diagnosis was calculated. The sensitivity and specificity of these modalities to correctly distinguish benign and malignant pathologies were calculated. **Result:** Most commonly affected age group was 26-35 years. The major presenting complaints were lower abdominal pain and lump in the lower abdomen. In our study, most common origin of adnexal lesions was from ovaries. MRI has sensitivity of 100% and specificity of 97.9 % while USG has sensitivity of 80% and specificity of 95.1% in diagnosis of adnexal lesions. **Conclusion**: Conventional MRI is superior to ultrasound in identification and characterization of adnexal masses. Combined endosonography and conventional MRI are sufficient for accurate diagnosis of most adnexal lesions in females in childbearing period. This will definitely obviate further costly functional MRI, also unnecessary gynaecological interventions and surgeries, and subsequently preserve fertility in such age group.

Keywords: Adnexal lesions, childbearing period, transvaginal ultrasound, MRI.

Introduction

Adnexal lesions are frequently encountered gynaecological problem either symptomatic or asymptomatic. They vary with different age groups. In childbearing period, physiologic follicular cysts and corpus luteum cysts are the most common adnexal masses, but the possibility of ectopic pregnancy must always be suspected. Other masses in this age group include polycystic ovaries and benign neoplasms (1).

Malignant neoplasms are uncommon in younger women but become more frequent with increasing age. In postmenopausal women with adnexal masses, both primary and secondary neoplasms must be considered. Of them, malignant epithelial ovarian tumors are associated with the highest mortality of all gynaecological cancers (2).

Ovarian germ cell tumors (OGCTs) arise primarily in young women between 10 and 30 years of age and represent 70 percent of ovarian neoplasms in this age group. They are derived from primordial germ cells of the ovary. They may be benign or malignant. These neoplasms comprise approximately 20 to 25 percent of ovarian neoplasms overall, but account for only an approximate 5 percent of all malignant ovarian neoplasms. Cystic teratoma is the most common (95%) benign germ cell tumor (3).

Proper management depends on proper preoperative assessment, with the help of clinical examination, laboratory tests and different imaging modalities. Ultrasonography with Doppler is the first imaging modality in the evaluation of adnexal masses. It is an important tool for differential diagnosis of adnexal lesions and characterization of their nature either benign or malignant. Ultrasound permits evaluation of pelvic organs in addition to Doppler blood flow mapping with no need for contrast. USG is less invasive and less expensive modality, so it is a preferred technique for imaging the female pelvis with avoiding radiation. Therefore, ultrasound imaging should be the first imaging technique used in women with pelvic symptoms (4).

Transvaginal ultrasonography is considered the preferred method for the evaluation of pelvic masses and the early diagnosis of adnexal lesions. It remains the first-choice modality in patients with a suspicious

isolated ovarian mass with fewer artifacts and does not require distended bladder for visualization (5).

Magnetic Resonance Imaging (MRI) is considered as a reliable tool for imaging of the sonographically indeterminate adnexal mass to specify the nature and characteristics of the mass. A sonographically indeterminate adnexal mass is defined as one has complexity that cannot be confidently placed into either the benign or malignant category or one for which the site of origin, from the ovary, uterus, or another pelvic structure (6).

Magnetic resonance imaging has an important role in diagnosis of adnexal lesions and tumor staging. If a lesion cannot be adequately classified by US, conventional and contrast enhanced MR imaging can help to determine certain morphological features of the adnexal mass. MRI can distinguish fat, blood and fibrous content based on the signal characteristics of adnexal masses. Benign lesions have characteristic findings including high signal intensity on T1-weighted images and low signal intensity on T2- weighted images. Certain morphologic features are characteristic to malignant lesions including the presence of solid and cystic areas within

a mass, necrosis within a solid lesion, septations, ascites, peritoneal disease, lymphadenopathy and bilateral lesions (7).

Patients and Methods

Type of the study and time frame: This study was a prospective observational study carried out on fifty female patients presented clinically by manifestations suggestive of adnexal lesions or seen incidentally by Transabdominal Ultrasound examination and referred to Radiology Department at Benha University Hospital for performing ultrasound both transabdominal and transvaginal ultrasonography (TVUS), color Doppler assessment and magnetic resonance imaging (MRI).This study was conducted during the period from December 2019 to December 2020.

Ethical committee approval for this study: was obtained from the ethical committee of Benha faculty of medicine and approval from institutional review board was also taken before starting our study.

Inclusion criteria:

All patients were proved to have adnexal mass with diameter more than 3cm that is

variable inconsistency. Age range between (15-50years)

Exclusion criteria:

Patients having any prosthetic heart valve implant, any pacemaker implant, aortic stent graft, cochlear implant or any metallic orthopedic implants (Any electrically, magnetically or mechanically activated implants), any joint replacement surgery and claustrophobic patients. Virgin females also were excluded.

An informed verbal consent from all participants was taken and confidentiality of information was assured. The title and objectives of the study were explained to the patients to ensure their cooperation.

All patients had been subjected to clinical assessment: including complete history taking and clinical examination.

All Patients included in the study were subjected to the following examinations.

Trans-abdominal ultrasound examination (done for all patients) using gray scale ultrasound machine (Toshiba Xario 200) with 3.5 MHz convex probe. The examination was done with full urinary bladder in supine position in both longitudinal and transverse.

Transvaginal ultrasound examination (done for all patients):

 (TVUS) was done using ultrasound machine (Toshiba Xario 200) with 6 MHz transvaginal probe. The patients were asked to evacuate their bladders. After explanation of the TVUS technique, the examination was done. The end of the probe was covered by gel, inserted into a condom and finally recoated with gel then gently inserted into the vagina. The patients were placed in dorsal position with their buttocks were elevated by pillow, then examined in both antero-posterior and transverse pelvic planes for assessment of the uterus, then the probe was rotated side by side for better visualization of the ovaries (Different scan planes are achieved by a combination of rotation and angulation of the probe). *Transverse scan:* follow the fundus of the uterus to the area of the cornu to image the ovaries to measure the long axis. The localization of the ovary was facilitated by the presence of the ovarian follicles and the ovaries were visualized adjacent to the internal iliac vessels. Color imaging may be used to identify vascular structures from the ovary. *Longitudinal scan:* rotate the transducer 90 degrees once the sagittal plane of ovary is obtained, Measure the width and depth. Angulation and tilting the

transducer to the right or to the left directed the sound beam to visualize the ovary. Measurement of the Doppler indices was taken from the intraovarian arteries.

MRI examination (done for all patients):

MRI was performed on (TOSHIBA VINTAGE 1.5-T) MR imaging unit. All the patients were imaged in the supine position using pelvic phased-array coil to improve the image quality.

Patient preparation: patients asked to fast for at least 3 hours before MR imaging and received Intravenous antispasmodic drug immediately before MR imaging to reduce bowel peristalsis. The sequences used in this study were: axial T1, axial T2 (TR= , sagittal T2 , axial T1 post contrast , coronal T2 and coronal T1 fat suppressed. Post contrast images were done after IV injection of Gadolinium at a dose of 0.1 mmol/kg of body weight that was used for the recognition of enhancement of the solid component, the tumor wall, septations and vegetations.

MR Image Analysis:

The MR imaging features were then correlated with the surgical and pathologic findings. The imaging features documented include the number of adnexal masses per patient, origin (ovarian or extraovarian), shape, size, and content of lesion (solid only, mainly solid, solid–cystic, mainly cystic, and cystic only). If a wall could be identified, its thickness, character, and enhancement were noted. If septa were present in the lesion, the number, thickness, character, and enhancement of the septa were recorded. Any vegetation appearing on the wall or the septum of the lesion was measured and noted. In addition, we documented the presence of a hemorrhage or fat. We determined that a hemorrhage was present if signal intensity was high on T1-weighted spin-echo and fat-suppressed T1-weighted MR sequences. We determined that fat was present if the lesion showed high signal on T1-weighted MR images that lost signal on the fat-suppressed T1-weighted MR images.

The patients were followed up to correlate the findings with clinical outcome or histopathological findings. Among 50 cases, 18 cases underwent further interventions and tissue sampling was subjected to histopathological examination.

Statistical Analysis:

Data entry, processing and statistical analysis was carried out using MedCalc ver. 18.2.1 (MedCalc, Ostend, Belgium). Tests of significance (Kruskal-Wallis,

Wilcoxon's, Chi square, logistic regression analysis, and Spearman's correlation) were used. Data were presented and suitable analysis was done according to the type of data (parametric and non-parametric) obtained for each variable. P values less than 0.05 (5%) was considered to be statistically significant. Descriptive statistics: Mean, Standard deviation (± SD) and range for parametric numerical data, while Median and Inter-quartile range (IQR) for non-parametric numerical data. Frequency and percentage of non-numerical data. Analytical statistics: Kruskal-Wallis test was used to assess the statistical significance of the difference of a non-parametric variable between more than two study groups.

Results

This study included (50) patients which are referred to Radiology Department at Benha University Hospital with their ages ranged from 15 years to 50 years old, the mean age was (30 ± 4.23 years.). Distribution of the studied sample according to age is shown in (table 1)

The patients presented clinically by different complaints but the main and most common complaint was pelvic pain in 40% of patients, pain and abdominal swelling in 36%, menstrual abnormalities in 10%. Still

two patients (4%) had asymptomatic adnexal lesions. Distribution of studied sample according to patient's symptoms and mode of injury is shown in (table 2) and (figure 1)

Distribution of laterality of adnexal masses: Masses on right side were 25 cases (50%), on left side were 15 cases (30%) and 10cases (20%) were bilateral. This is shown in (table 3)

Origins of the adnexal lesions, on USG were 62% from ovary, 7% from fallopian tube, 1% broad ligament and 11% inconclusive. On MRI 72% were from ovary, 7 % from fallopian tube, 2% from uterus , one case 2% from the sigmoid colon. This is shown in (table 4)

Sonographic echo pattern of the studied cases: the cystic lesions were the most common found lesions. Different sonographic patterns are shown in (table 5).

On USG 43 (86%) were reported as benign and 7 cases (14%) were reported as malignant. On MRI, 44 (88%) were reported as benign and 6 cases (12%) were reported as malignant. Sensitivity and specificity of USG and MRI are shown in (table 6).

CASE No.1; Female patient aged 49 years old complaining of abdominal pain and distention

with previous history of gastric (GIST) with final diagnosis with bilateral Krukenberg tumors of ovaries with ascites (Figure 2).

CASE No.2; Female patient aged 27 years old, married, complaining of acute pelvic pain & fever. Final diagnosis with right tubo-ovarian abscess (Figure 3).

Table (1): The age distribution among the studied group.

Age in years	Number of cases	Percentage
15-25	13	26%
26-35	27	54 %
36-45	8	16 %
46-50	2	4 %

Table (2): The frequency of different complaints in the studied patients with different adnexal.

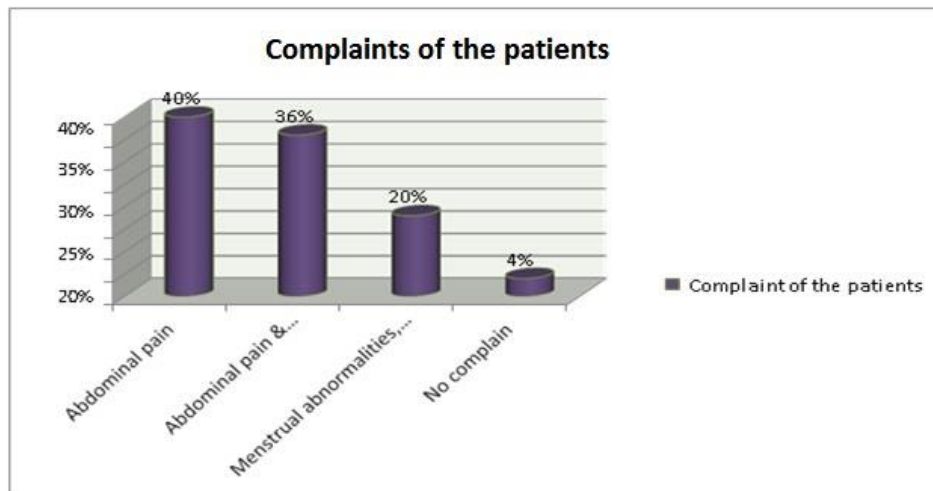|	No of patients (n=50)	Percentage (100%)
Abdominal pain	20	40%
Abdominal pain &enlargement	18	36%
Menstrual abnormalities, vaginal bleeding, infertility	10	20%
No complain	2	4%

Fig. 1: Different complaints in the studied patients with different adnexal lesions

Table (3): Distribution of adnexal mass in relation to site.

	number	
Right	**25**	**(50%)**
Left	**15**	**(30%)**
Bilateral	**10**	**(20%)**

Table (4): Anatomical distribution of the lesions on USG and MRI.

Origin of the lesion	On USG	On MRI
	No of patients (%)	No of patients (%)
Ovary	31(62%)	39 (78 %)
Fallopian tube	7(14%)	7(14 %)
Broad ligament	1(2%)	1(2 %)
Uterus	-	2(4 %)
Inconclusive	11(22%)	-
others	-	1(2%)
Total	50	50

Table (5): Sonographic echo pattern of the studied cases.

Sono-graphic picture	Hydro salp-inx	Ectopi cpregn -ancy	TO A	PC O	Sol id	Cystic (n=24)			Complex (n=8)	
						Septa - tion	Veg eta- tion	No septa/ vegetation	Predomi- nantly cystic	Predomi- nantly solid
Number of lesions	3	4	3	5	5	2	5	17	3	5
Percentage	6%	8%	6%	10%	10%	4%	10%	34%	6%	10%
Fisher's Exact Test P-value	0.817					<0.001*			0.461	

Non-significant >0.05 significant <0.05* high significant <0.001*

Table (6): Sensitivity and specificity of USG and MRI.

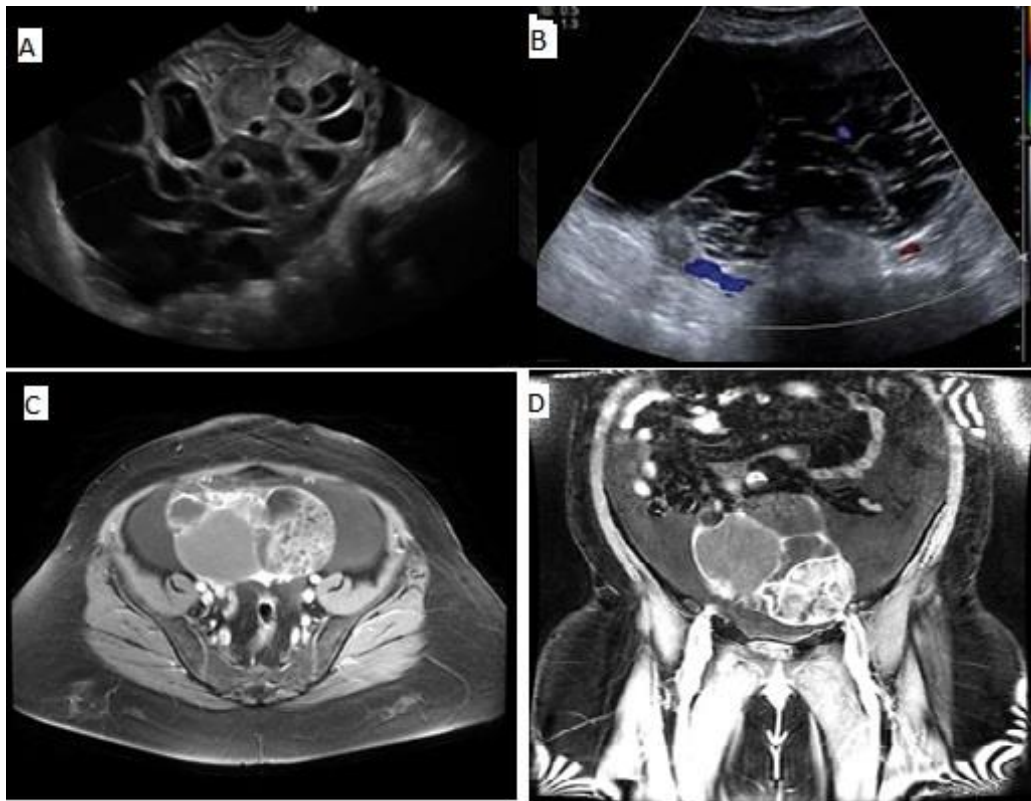| Variable	USG	MRI
Sensitivity	80%	100%
Specificity	95.1%	97.9%
Positive predictive value	66%	83%
Negative predictive value	97%	100%

Figure (2): Krukenberg tumors of ovaries. (A)Transvaginal US scan reveals complex (solid &cystic) adnexal masses bilateral not separable from both ovaries measuring(7x4cm)and(4x5cm) (B)Color Doppler US scan shows increased vascularity, peripheral and central color flow (C)Axial T1 MR weighted image (D)Coronal T2 weighted.
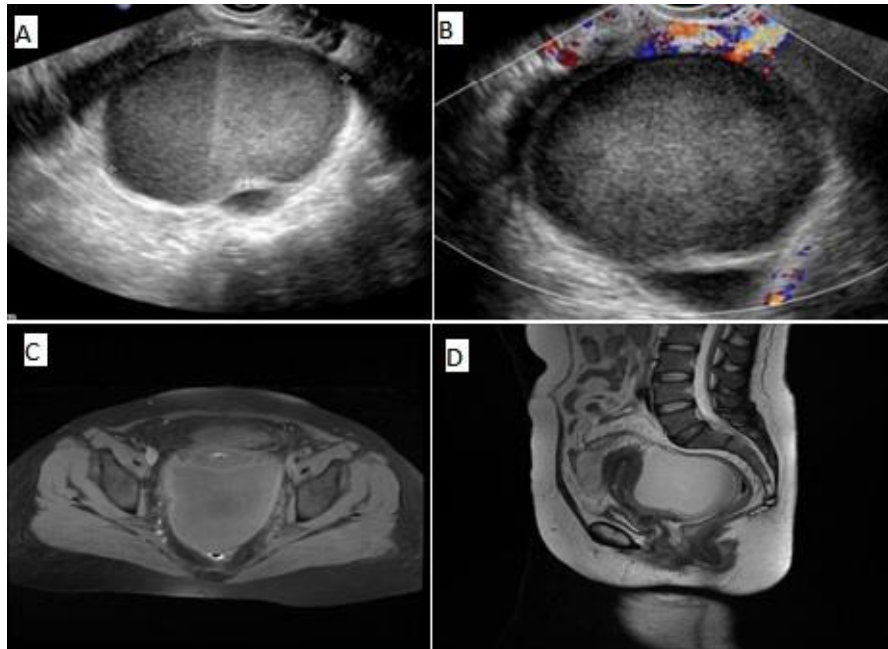
Figure (3): Right tubo-ovarian abscess. (A) Transvaginal US scan reveals right complex adnexal lesion with a dilated tube of ipsilateral side, measuring about (4.5x4cm).(B) Color Doppler US scan shows peripheral vascularity. (C)Axial T1 MR weighted image shows a well-defined multilocular right adnexal cystic lesion, measuring about (4x3 cm). It displays high signal intensity of the inner walls. (D)   Sagittal T2 weighted image shows that the contents   of   cavities   have   high   signal   intensity   with   thick   irregular   wall.

Discussion

Adnexal lesions are frequently encountered gynecological problem either symptomatic or asymptomatic. Their nature varies with different age groups. Proper evaluation of adnexal lesions represents the road map to the management plan of these lesions either conservatively with follow up or gynecological surgeries and interventions. Particularly in the reproductive age group, there are no specific clinical or laboratory findings that definitely prove or rule out malignant nature of a lesion. Hence, USG

both transabdominal, TVUS and MRI have become very useful imaging modalities for the assessment of various adnexal lesions in women (8).

The present study was conducted on 50 female patients with adnexal masses which were studied by USG and MRI modalities. Among 50 cases, 18 cases underwent more invasive interventions with tissue sampling that was subjected to histopathological

examination. The remaining cases were managed conservatively.

In the present study, most commonly affected age group was 25-35 years and the mean age was 30 years. The mean age group in another study was 29 years (9). This mean age is also consistent with another study done by different group; they observed that the mean age was 30 years (10). This was expected as our study included females in childbearing period, in which transvaginal ultrasound examination can be performed.

In the current study, most common presenting symptom is lower abdominal pain representing 40% with pain and swelling in 36%, menstrual abnormalities in 20%. Still there were two asymptomatic patients (4%) diagnosed accidentally while undergoing examination for another cause. Our findings are similar to a report that showed that the initial compliant was abdominal pain in 77.5% cases, vaginal bleeding in 20% of the patients and 12.5% of their patients were asymptomatic (11). Also consistent with another study that found the most common presenting complaints of patients with adnexal masses were lower abdominal pain in 88% cases and lump in the lower abdomen in 32%

cases (10). There was a study with higher frequency of abdominal pain and reported that the most frequently presenting symptom was lower abdominal pain in 98% cases. However, their study was based on various adnexal masses presenting with acute symptoms (9).

Regarding anatomical site of adnexal masses, in our study maximum number of cases (78%) was seen arising from the ovaries. In our study only one broad ligament fibroids were included and most of the pathologies are ovarian with lower number of pathologies in fallopian tube and extra ovarian. This is consistent with other study, where maximum number of cases (80%) was seen arising from the ovaries (12). A study done by different group demonstrated that ovarian masses were found to be most common (56%) of all the adnexal masses where they included significant number of leiomyomas in their study (13).

In our study, most adnexal lesions were benign in nature. We had only six malignant cases (12%).This is much lower than recent study reporting that malignancy can reach 25% (12).This is explained by the older age group included in such study. The risk of malignancy increases with advancing age of

the patients and malignant lesions are more common in the postmenopausal age group which is out the scope of our study (14).

In the present study, we found that MR imaging in the detection and characterization of adnexal masses had a sensitivity of 100% and specificity of 97.9% which signifies that MR imaging is highly accurate in the characterization of adnexal mass lesions. This is in agreement with a study that showed that accuracy of MR imaging in the detection and characterization of adnexal mass lesions was reported to have a sensitivity of 95% and specificity of 88% (15). Also our results are consistent with a different study that observed that the MRI sensitivity and specificity for detecting malignancy were 98% and 93%, respectively (16) which is comparable with our findings

Our study showed USG has overall sensitivity of 80% and specificity of 95.1%.The sensitivity of gray scale USG in adnexal masses in a study was 92.5% (17). This is a comparable to 80% in the present study. Our results are also consistent with another study which reported that overall TVUS sensitivity for all pathological adnexal entities was 80.8% (18). Overall MRI sensitivity of MRI for all pathological

entities was 94.6%. Our results are in agreement with another report, that demonstrated that TVUS of the benign ovarian lesion had high overall sensitivity (89-100%) and specificity (73-83%), while TVUS of dermoid cyst and endometrioma ware 100% (19).

To characterize adnexal masses first step is site, tissue of origin and second step is tissue characterization and both are well delineated by MRI. Unenhanced T1- and T2-weighted imaging is important for accurate tissue characterization. MRI offers supplemental diagnostic information in cases of a suboptimal or equivocal ultrasound examination and in patients in whom there is discrepancy between sonographic findings and physical examination. MRI has high sensitivity and specificity which will help in staging of cancers, patient selection for treatment, and detection of disease recurrence.

Still our study has some limitations. The sample size was relatively small. This explains that our study did not include less common but not rare adnexal lesions i.e ovarian edema, ovarian torsion and inflammatory ileocecal masses as a mimic of adnexal lesion. In addition, only 36% of our patients had histopathological

examination of their lesions which is considered the definite diagnostic test. As the remaining patients were treated conservatively with regular follow up with either regressive or stable lesions. This supported the radiological diagnosis with MRI and TVUS examination. Also the number of malignant lesions only 6 cases (12%), this was attributed to specific age group included in our study.

Conclusion

Conventional MRI is superior to ultrasound in identification and characterization of adnexal masses. Combined endosonography and conventional MRI are sufficient in accurate diagnosis of most adnexal lesions in females in childbearing period. This will definitely obviate further costly functional MRI, also unnecessary gynaecological interventions and surgeries. This subsequently preserves females' fertility in such age group.

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