Adnexal Mass: Diagnostic Validity of MRI versus Calculated Risk of Malignancy Index

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Abstract: Objectives: To evaluate diagnostic validity of preoperative magnetic resonance (MR) imaging of women had adnexal masses in comparison to postoperative histopathological diagnosis of excised specimens. **Patients & Methods:** The study included 155 females; 104 premenopausal and 51 postmenopausal women and 37 women had cancer breast. All patients had full history taking, clinical examination, abdomino-pelvic ultrasonography and gave a venous blood sample for estimation of serum CA-125. Age, CA-125 serum levels, ultrasounds findings, and menopausal status of all the cases were recorded preoperatively for calculation of the modified risk of malignancy index (RMI) and RMI at 230 was considered as cutoff point for differentiation between benign and malignant adnexal mass. All patients underwent MR imaging for preoperative assessment and then underwent surgical exploration. Obtained specimens were sent for histopathological examination. **Results:** Histopathological examination of excised specimens defined malignancy in 20 specimens (12.9%), while the other 135 specimen were benign. Patients had malignancy showed significantly higher serum CA125 levels compared to those had benign lesions. Preoperative pelvic US was positive for malignancy in 54 patients (34.8%) and RMI defined 64 patients as having malignancy with a sensitivity, specificity, negative predictive value (NPV) and accuracy rates of diagnosis of malignancy of 88.2%, 64.5%, 97.8% and 67%, respectively. Preoperative MRI defined 35 patients as having malignancy with a sensitivity, specificity, NPV and accuracy rate of diagnosis of malignancy of 95%, 88.1%, 99.2% and 89%, respectively. Reliance on MRI for prediction of malignancy showed significantly higher difference compared to RMI. The ROC curve defined preoperative MRI as the more significantly specific predictor with AUC=0.916, followed by previous history of mastectomy (AUC=0.700) and lastly RMI (AUC=0.694). **Conclusion:** Preliminary evaluation of patients with adnexal mass could be assessed using the risk of malignancy index and the surgical decision should be assured using preoperative MRI and confirmed with histopathological examination of excised specimen. Malignant adnexal mass in women had mastectomy for cancer breast is not uncommon and must be searched for during follow-up.

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1.Introduction

Adnexal masses affect any age and despite the knowledge that adnexal masses affecting premenopausal women are mostly benign, no age group is immune against malignancy. Moreover, time factor is highly influencing the surgical outcome especially for malignant ovarian masses. Thus, a reliable method to differentiate a benign from a malignant adnexal mass would provide a basis for optimal preoperative planning and may also reduce the number of unnecessary laparotomies for benign disease **(Dodge *et al.*, 2012)**.

Ultrasonography is currently considered as the primary imaging modality for identifying and characterizing adnexal masses because of its widespread availability, relatively low cost, and high sensitivity in the detection of masses. Gray-scale and Doppler ultrasound examination of adnexal masses can be used to discriminate between benign and malignant tumors. However, sonography is limited by its decreased specificity for the diagnosis of benignity, which can vary from 60% to 95% and result in as many as 20% of adnexal masses being classified as indeterminate **(Guerriero *et al.*, 2007; Ghattamaneni *et al.*, 2009; Loubeyre *et al.*, 2012)**.

Diagnosis of indeterminate adnexal masses is still one of challenging confronting surgeons as their organ of origin may be uncertain and/or determining whether a clinically diagnosed adnexal mass is benign or malignant is frequently not possible until surgical exploration and histologic examination are performed. Consequently, it may not be possible to decide preoperatively whether conservative or radical surgery is appropriate **(Sohaib & Reznek, 2007; Fujii *et al.*, 2008; Lalwani & Dubinsky, 2013)**.

Breast cancer is the most common malignancy in women, with approximately 1,200,000 new cases diagnosed annually worldwide and is one of the leading causes of death among women. As a subsequence, there is a higher risk that these patients

may develop another primary malignant tumor, including that of the ovaries. The estimated risk of developing primary ovarian cancer is approximately double for all patients with prior breast cancer. Furthermore, metastatic breast cancer to the ovaries is also not uncommon and represents 6-27.8% of all ovarian malignant tumors **(Kim *et al.*, 2012; Pal *et al.*, 2013; Siegel *et al.*, 2013)**.

The current prospective study aimed to evaluate the diagnostic validity of preoperative MR imaging of women had adnexal masses in comparison to postoperative histopathological diagnosis of excised specimen.

2.Patients & Methods

The current study was conducted at Departments of General Surgery, Radiology and Pathology, Saudi German Hospital Madinah, KSA since Jan 2010 till Aug 2012. The study included all female patients presenting to Gynecology outpatient clinic with symptoms suggestive of the presence of an adnexal mass and those attending General surgery outpatient clinic with biopsy confirmed cancer breast and assigned for surgical interference. All patients had full history taking, clinical examination including abdominal and pelvic examination and then underwent abdomino-pelvic ultrasonographic examination.

All patients gave a venous blood sample collected under complete aseptic conditions from the antecubital vein, blood samples were centrifuged and serum was collected for estimation of serum CA-125 level in peripheral blood using immunoradiometric assay kits for CA-125 used the OC 125 antibody **(Kenemans *et al.*, 1993)**.

Age, CA-125 serum levels, ultrasounds findings, and menopausal status of all the cases were recorded preoperatively. The modified risk of malignancy index (RMI) for each woman was calculated using the product of the ultrasound score (U), the menopausal score (M), and the absolute value of serum CA-125 inserted in the following formula: RMI= U x M x serum CA-125. Five ultrasound features suggestive of malignancy were sought to derive U including multilocularity (more than bilocular), presence of solid areas, bilaterality, presence of ascites, and extraovarian tumors/evidence of metastases. U of 1 was given if none or one of these findings was detected and a score of 3 if two or more of these features were present. Postmenopausal status was defined as more than one year of amenorrhea, or age older than 50 years for women who had undergone hysterectomy; they scored M=3. All other patients who did not meet these criteria were defined in a premenopausal status which scored M=1. The absolute values of serum CA-125 was entered directly into the mentioned equation **(Tingulstad *et al.*, 1996; Bailey *et al.*, 2006)** and RMI at 230 was considered as cutoff point for differentiation between benign and malignant adnexal mass **(Obeidat *et al.*, 2004)**.

All enrolled patients underwent MR imaging for preoperative assessment. MR imaging was performed by using a 1.5-T MR imaging system (Magnetom Symphony; Siemens Medical Systems, Erlangen, Germany) with a body coil. Immediately before MR imaging, all patients were given 1 mg of intramuscular glucagon or 20 mg of scopolamine butylbromide. Unenhanced scans were obtained, and then patients were intravenously injected with gadolinium chelates, 0.1 mmol/kg provided that the patient has normal creatinine level.

T_2-weighted fast spin-echo images were obtained in the axial, sagittal and coronal planes; repetition time msec/echo time [effective] msec = 3090–5000/80–128, echo train length of nine. T1-weighted spin-echo images were obtained in the axial and sagittal planes; repetition time msec/echo time msec = 523–575/14–20. T1-weighted images with either chemical or frequency-selective fat suppression images were obtained in the axial and sagittal planes. After contrast administration, T1-weighted images with fat-suppression were obtained in the axial, sagittal and coronal planes. Other parameters included matrix size of 192–256 × 256–512, field of view of 330–480 mm and 4–5.7 mm section thickness with an intersection gap of 20 – 25 %.

All patients underwent surgical exploration and obtained specimens were sent for histopathological examination. The histopathological diagnosis was considered as the gold standard for defining the outcomes. Tumors were classified according to World Health Organization definitions **(Andersen *et al.*, 2003)** and malignant tumors were staged according to the criteria of the international Federation of Gynecology and Obstetrics **(Benedet *et al.*, 2000)**.

Statistical analysis

Obtained data were presented as mean±SD, ranges, numbers and ratios. Results were analyzed using Wilcoxon; ranked test for unrelated data (Z-test) and Chi-square test (X^2 test). Sensitivity & specificity of estimated parameters as predictors for vitality were evaluated using the receiver operating characteristic (ROC) curve analysis judged by the area under the curve (AUC) compared versus the null hypothesis that AUC=0.05. Statistical analysis was conducted using the SPSS (Version 15, 2006) for Windows statistical package. *P* value <0.05 was considered statistically significant.

3.Results

The study included 155 females fulfilling the inclusion criteria and assigned for exploratory laparotomy for adnexal mass. Mean age of enrolled patients was 43.6±11.9; range: 25-73 years. There were 104 premenopausal and adolescent women and 51 postmenopausal women. Thirty-seven patients had cancer breast and were assigned for Patty operation including mastectomy and axillary evacuation. Twenty-two patients had mastectomy were premenopausal, while 15 patients had mastectomy were postmenopausal. Patients' presenting symptoms were variable and in various combinations. Patients' preoperative clinical data are shown in table (1).

Surgical exploration was conducted successfully for all enrolled patients without intraoperative complications. Histopathological examination of excised specimens defined malignant adnexal lesions (Figs. 1-3) in 20 patients (12.9%), while the other 135 specimen were benign adnexal lesions. Seven postmenopausal women (13.7%) had malignant adnexal lesion, while 13 premenopausal women (12.5%) had malignant adnexal lesion. Eight patients had mastectomy had malignant adnexal mass, while the other 12 patients had malignant adnexal mass had no previous history of breast lesions, (Table 2).

Mean serum CA125 level of total enrolled patients was 101.6±106.7; range: 23-592 U/ml. Patients had benign lesions had mean CA125 of 65.9±30.7; range: 23-135 U/ml, while patients had malignant lesions had mean serum CA125 level of 342.7±124.3; range: 145-592 U/ml. patients had malignancy showed significantly (p<0.05) higher serum CA125 levels compared to those had benign lesions, (Fig. 4).

Preoperative pelvic US was positive for malignancy in 54 (34.8%) patients and was negative in 101 (65.2%) patients. Calculation of RMI; considering cutoff point at 230, defined 64 patients as having malignancy and 91 patients as free of malignancy with a sensitivity rate of 88.2%, specificity rate of 64.5%, negative predictive value of 97.8% and accuracy rate of diagnosis of malignancy of 67%. On the other hand, preoperative MRI defined 35 patients as having malignancy (5-8) and 120 patients as free of malignancy giving a sensitivity rate of 95%, specificity rate of 88.1%, negative predictive value of 99.2% and accuracy rate of diagnosis of malignancy of 89%. Reliance on MRI for prediction of malignancy showed significantly higher (X^2=6.542, p<0.05) difference compared on reliance on RMI, (Fig. 9).

Verification of the diagnostic yield of preoperative MRI and RMI and previous history of mastectomy for the probability of presence of malignant adnexal mass using ROC curve defined preoperative MRI as the more significantly specific predictor with AUC=0.916. Moreover, previous history of mastectomy was significantly specific predictor for malignant adnexal mass with AUC=0.700 versus AUC=0.694 for RMI, (Table 3, Fig. 10).

Table (1): Patients' preoperative clinical data

Data			Findings
Number	Premenopausal		104 (67.1%)
	Postmenopausal		51 (32.9%)
	Total		155 (100%)
Age (years)	Premenopausal		36.2±4.2 (25-43)
	Postmenopausal		58.7±7.1 (45-73)
	Total		43.6±11.9 (25-73)
Presenting symptoms	No complaint		26 (16.8%)
	Pain as the sole symptom		96 (61.9%)
	Pain in association with	General manifestations	58 (37.4%)
		Menstrual irregularities	87 (56.1%)
		Vaginal bleeding	23 (14.8%)
		Gastrointestinal complaints	45 (29%)
		Palpable mass	29 (18.7%)

Data are presented mean±SD & Numbers; ranges & percentages are in parenthesis

Table (2): Patients' distribution according to histopathological results of excised adnexal mass among age and previous breast cancer categorization

		Benign	Malignant	Total
Previous mastectomy	Pre-menopausal	16 (10.3%)	6 (3.9%)	22 (14.2%)
	Postmenopausal	13 (8.4%)	2 (1.3%)	15 (9.7%)
No previous breast lesion	Pre-menopausal	77 (49.7%)	5 (3.2%)	82 (52.9%)
	Postmenopausal	29 (18.7%)	7 (4.5%)	36 (23.2%)
Total		135 (87.1%)	20 (12.9%)	155 (100%)

Table (3): ROC curve analysis of preoperative MRI and RMI and history or previous mastectomy as predictors for adnexal malignancy

	AUC	±Std Error	Significance	95% CI	
				Upper	Lower
MRI	0.916	±0.033	<0.001	0.851	0.980
Previous mastectomy	0.700	±0.076	=0.004	0.551	0.849
RMI	0.694	±0.062	=0.005	0.573	0.814

AUC: area under curve; Std error: standard error; CI: confidence interval; MRI: magnetic resonance imaging; RMI: risk of malignancy index

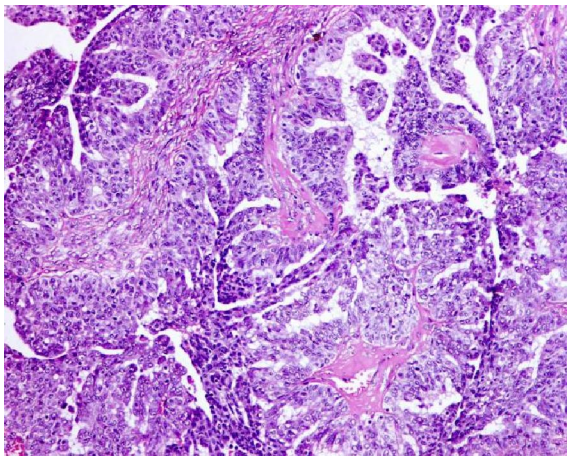

Fig. (1): Histopathological picture of excised specimen showing ovarian papillary serous carcinoma (H&E x100)

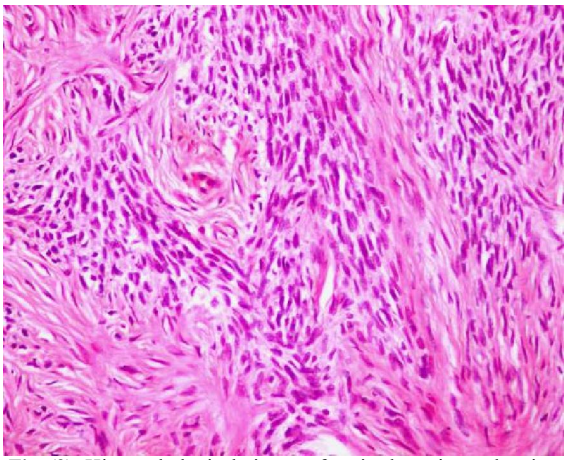

Fig. (3): Histopathological picture of excised specimen showing ovarian fibroma (H&E x200)

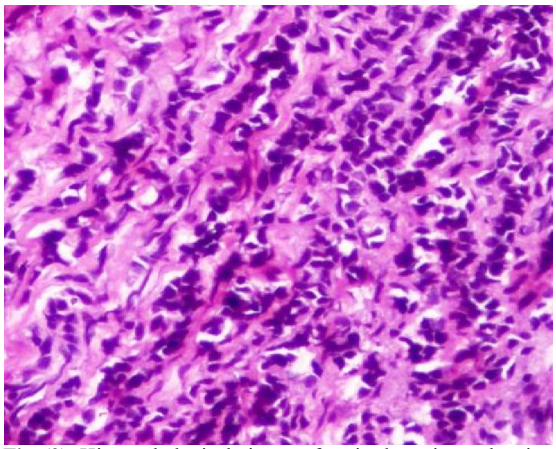

Fig. (2): Histopathological picture of excised specimen showing ovarian metastatic lobular carcinoma (H&E x200)

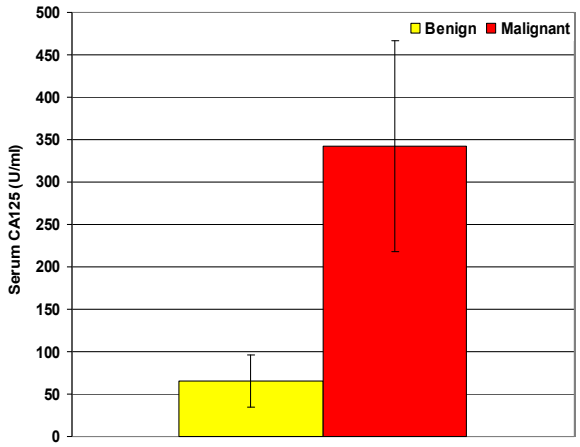

Fig. (4): Mean (±SD) serum CA125 levels of studied patients categorized according to result of histopathological examination of excised specimens

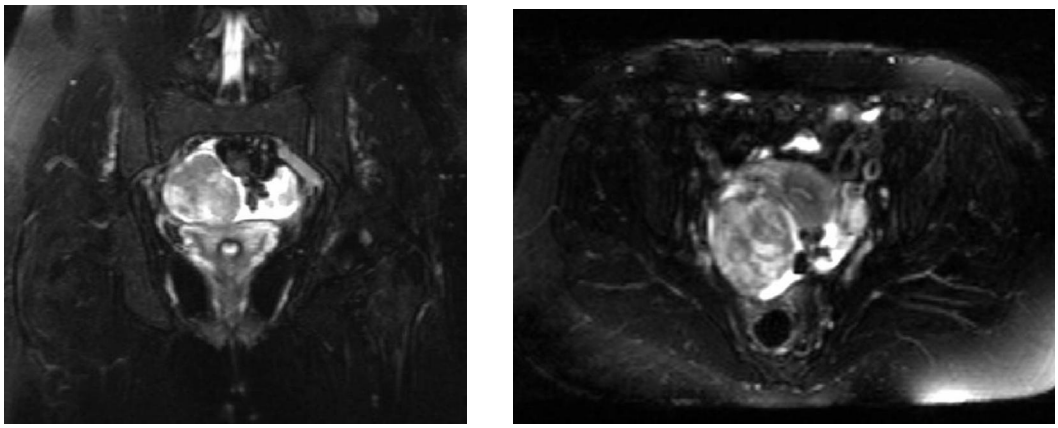

Fig. (5): MRI of the pelvis showing right adnexal mixed solid and cystic mass with heterogeneous signal intensity and free pelvic fluid; Metastatic ductal breast carcinoma (Top: Coronal view; Bottom: Axial view)

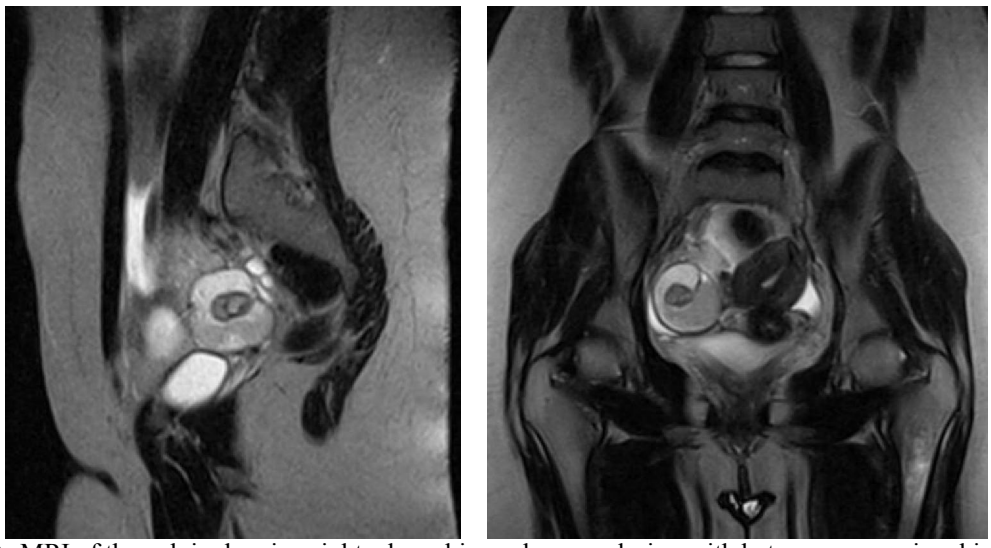

Fig. (6): MRI of the pelvis showing right adnexal irregular mass lesion with heterogeneous signal intensity; Metastatic lobular breast carcinoma (Top: Sagittal view; Bottom: Coronal view)

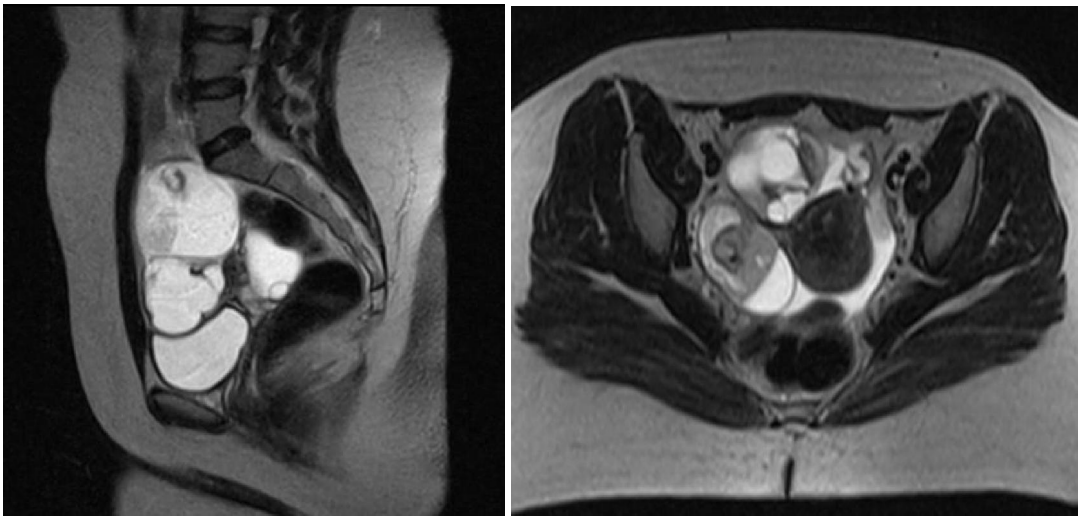

Fig. (7): MRI of the pelvis showing right adnexal mixed solid and cystic mass with heterogeneous signal intensity; Papillary serous carcinoma (Top: Sagittal view; Bottom: Axial view)

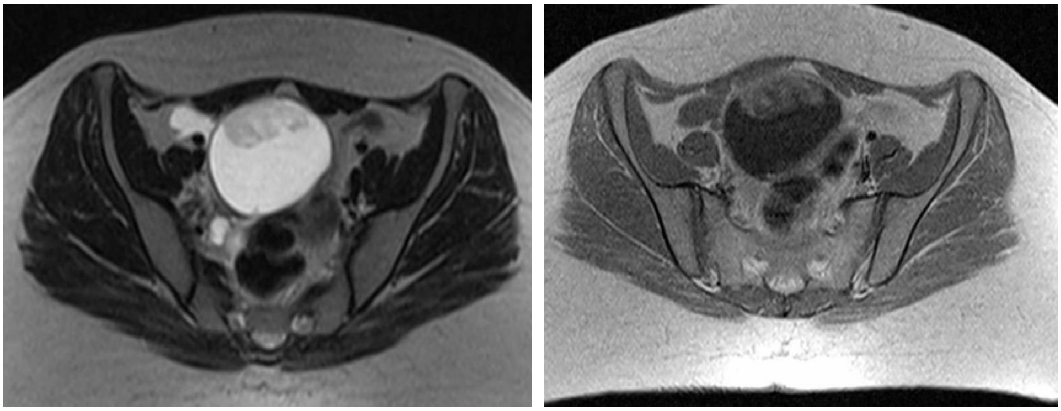

Fig. (8): MRI (Axial view) of the pelvis showing right adnexal cystic mass lesion with solid irregular mural component; Borderline papillary serous tumor

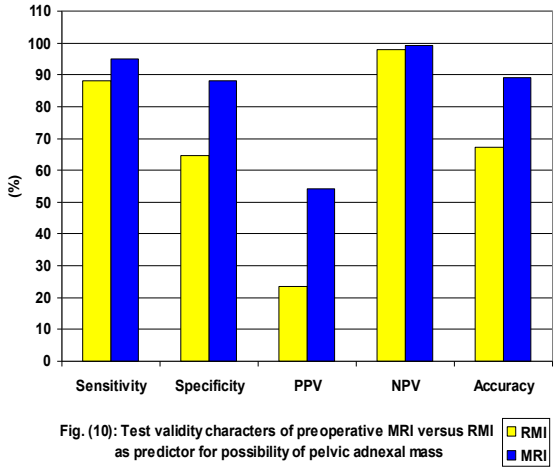

Fig. (10): Test validity characters of preoperative MRI versus RMI as predictor for possibility of pelvic adnexal mass

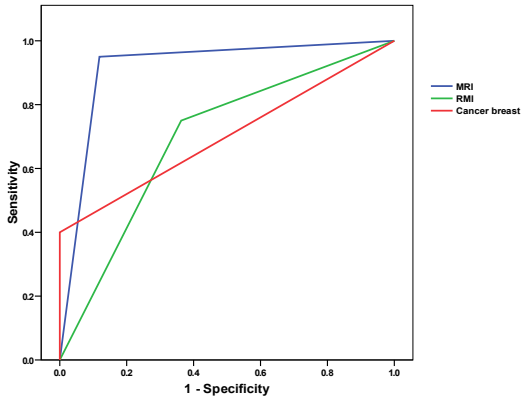

Fig. (10): ROC curve analysis of evaluated parameters as predictors for adnexal malignancy

4.Discussion

The current study reported a frequency of malignant adnexal mass in patients had previous mastectomy of 21.6%. This figure indicated the necessity of follow-up of patients had mastectomy for metastatic or synchronous, metachronous cancers especially that had hormonal basis. In support of this co-incidence; **Abahssain *et al.* (2010),** described a case of 47 year-old women who was treated with surgery, chemotherapy, radiotherapy and tamoxifen for stage III estrogen receptor positive breast carcinoma and 10 months after stopping tamoxifen, a stage Ic granulosa cell tumor of the ovary was diagnosed. **Mekić-Abazović *et al.* (2011)** presents a case of endometrial cancer in a breast cancer patient treated with tamoxifen with elevated values of CA125 and CA153 tumor markers; additional diagnostic analyses showed a "de novo" endometrial cancer rather than metastatic breast cancer. **Akhavan *et al.* (2012)** described a case of adenosarcoma of uterus in a 69-year-old woman with a history of breast cancer and 10 years tamoxifen therapy. **Tuncer *et al.* (2012)** collectively concluded that although an adnexal mass in a woman with breast cancer is most commonly a benign ovarian cyst, the overall risk of ovarian malignancy is increased with breast cancer and an adnexal mass with complex architecture detected by ultrasonography and high CA 125 level were the strongest risk factors associated with increased risk of malignancy

In trial for evaluation of the predictors for the possibility of having malignant adnexal mass; risk of malignancy index (RMI) depending on serum CA125 level and presence of ultrasonographic data suggestive of malignancy and if the patient was pre- or post-menopausal was evaluated versus histopathological examination of the excised specimen as a gold standard for comparison; RMI showed a sensitivity, specificity and negative predictive value for presence of adnexal malignancy of 88.2%, 64.5% and 97.8%, respectively and showed an AUC equals 0.649 which was significantly higher compared to the null hypothesis (p=0.005). In hand with these data, **Valentini *et al.* (2011)** reported an AUC of 0.68 on the training set and an AUC of 0.65 on the test set of RMI at cutoff point of 200, with a sensitivity of 64%, a specificity of 55% on the test set.

van den Akker *et al.* (2011) also, reported a sensitivity of 76%, specificity of 82%, positive and negative predictive values of 45% and 95%, and an accuracy of 81% for RMI for discrimination between benign and malignant lesions. **Terzić *et al.* (2011)** showed a positive correlation between both histopathological categories and RMI categories and at cut off value of 200, RMI showed a sensitivity of 83.33%, specificity of 94.12%, positive predictive value of 89.29% and negative predictive value of 90.57% and concluded that RMI is very reliable in differentiation of benign from malignant adnexal masses. **Ashrafgangooei & Rezaeezadeh (2011)**, found that RMI identified malignant cases more accurately than any individual criterion in diagnosing ovarian cancer and using a cut-off level of 238 to indicate malignancy, the RMI showed a sensitivity of 89.5%, a specificity of 96.2%, a PPV of 77.3%, a NPV of 98.4% and an accuracy of 95.4% and concluded that RMI is a simple, easily applicable method in the primary evaluation of patients with adnexal masses of high risk of malignancy. **Terzić *et al.* (2013)** found RMI consisting of ultrasound parameters and laboratory analyses to be good discriminating factors among malignant, benignant and borderline tumors

MRI showed significantly higher AUC, compared to the null hypothesis, for differentiation between benign and malignant adnexal masses with significantly higher test validity characters compared to RMI and previous history of cancer breast.

These data supported that previously reported in literature evaluated the diagnostic yield and value of preoperative MR imaging of patients with sonographically indeterminate adnexal lesions; ***Yamashita et al. (1997)*** found contrast-enhanced MRI allowed discrimination between benign and malignant ovarian lesions, ***Grab et al. (2000)*** found MRI improved diagnostic specificity to 84%, ***Funt & Hann (2002)*** found that MRI lead to an exact diagnosis or a narrow differential and obviate the need for surgery or otherwise change management, ***Hauth et al. (2005)*** reported that MRI can distinguish between benign and malignant ovarian tumors with high sensitivity and specificity and is capable of characterizing many adnexal masses and ***Adusumilli et al. (2006)*** found the sensitivity of MRI for identifying malignancy was 100% and its specificity for benignity was 94% with excellent agreement between MRI and the final diagnosis for determining the origin, tissue content and tissue characteristics of a mass.

Moreover, **Chilla *et al.* (2011)** reported that inclusion of MRI in the diagnostic algorithm of the indeterminate adnexal mass allows better differentiation of ovarian lesions resulting in a change of therapeutic decision-making with net cost savings. **Boldyreva & Briukhanov (2012)** found the benefit of MRI is that information images of the basic structures of the small pelvis can be obtained in patients with a marked commissural process after hysterectomy in the absence of limitations in large mass sizes. **Valentini *et al.* (2012)** documented that MRI should be considered at least in urgent, if not in emergent, care given the wide range of female pelvic disorders that can be correctly assessed thanks to the excellent soft-tissue contrast, high spatial resolution and ability to depict blood products and it should be preferred in women of reproductive age because of the absence of radiation exposure.

It could be concluded that preliminary evaluation of patients with adnexal mass could be assessed using the risk of malignancy index and the surgical decision should be assured using preoperative MRI and confirmed with histopathological examination of excised specimen. Malignant adnexal mass in women had mastectomy for cancer breast is not uncommon event and must be searched for during follow-up of these patients.

References

1. Abahssain H, Kairouani M, Gherman R, M'rabti H, Errihani H: Granulosa cell tumor of the ovary and antecedent of adjuvant tamoxifen use for breast cancer. World J Surg Oncol. 2010; 8:67.
2. Adusumilli S, Hussain HK, Caoili EM, Weadock WJ, Murray JP, Johnson TD, Chen Q, Desjardins B: MRI of sonographically indeterminate adnexal masses. AJR Am J Roentgenol. 2006; 187(3):732-40.
3. Akhavan A, Akhavan Tafti M, Aghili F, Navabii H: Uterine adenosarcoma in a patient with history of breast cancer and long-term tamoxifen consumption. BMJ Case Rep. 2012; 2012
4. Andersen ES, Knudsen A, Rix P: Risk of malignancy index in the preoperative evaluation of patients with adnexal masses. Gynecol Oncol., 2003; 90: 109-12.
5. Ashrafgangooei T, Rezaeezadeh M: Risk of malignancy index in preoperative evaluation of pelvic masses. Asian Pac J Cancer Prev. 2011;12(7):1727-30.
6. Bailey J, Tailor A, Naik R: A risk of malignancy index for referral of ovarian cancer cases to tertiary center: does it identify the correct cases. Int J Gynecol Cancer, 2006; 166: 30-4.
7. Benedet JL, Hacker NF, Ngan HYS: Staging classifications and clinical practice guidelines of gynaecologic cancers. Int J Gynecol Obstet., 2000; 70: 207-312.
8. Boldyreva OG, Briukhanov AV: The capacities of ultrasound study and magnetic resonance imaging of small pelvic masses after hysterectomy. Vestn Rentgenol Radiol. 2012;(4):42-9.

9. Chilla B, Hauser N, Singer G, Trippel M, Froehlich JM, Kubik-Huch RA: Indeterminate adnexal masses at ultrasound: effect of MRI imaging findings on diagnostic thinking and therapeutic decisions. Eur Radiol. 2011; 21(6):1301-10.
10. Dodge JE, Covens AL, Lacchetti C, Elit LM, Le T, Devries-Aboud M, Fung-Kee-Fung M; Gynecology Cancer Disease Site Group: Management of a suspicious adnexal mass: a clinical practice guideline. Curr Oncol. 2012;19(4):e244-57.
11. Fujii S, Kakite S, Nishihara K, Kanasaki Y, Harada T, Kigawa J, Kaminou T, Ogawa T: Diagnostic accuracy of diffusion-weighted imaging in differentiating benign from malignant ovarian lesions. J Magn Reson Imaging. 2008; 28(5):1149-56.
12. Funt SA, Hann LE: Detection and characterization of adnexal masses. Radiol Clin North Am. 2002; 40(3):591-608.
13. Ghattamaneni S, Bhuskute NM, Weston MJ, Spencer JA: Discriminative MRI features of fallopian tube masses. Clin Radiol. 2009; 64(8):815-31.
14. Grab D, Flock F, Stöhr I, Nussle K, Rieber A, Fenchel S, Brambs HJ, Reske SN, Kreienberg R: Classification of asymptomatic adnexal masses by ultrasound, magnetic resonance imaging, and positron emission tomography. Gynecol Oncol. 2000; 77(3):454-9.
15. Guerriero S, Ajossa S, Piras S, Gerada M, Floris S, Garau N, Minerba L, Paoletti AM, Melis GB: Three-dimensional quantification of tumor vascularity as a tertiary test after B-mode and power Doppler evaluation for detection of ovarian cancer. J Ultrasound Med. 2007; 26(10):1271-8.
16. Hauth EA, Wolfgarten B, Kimmig R, Forsting M: MR imaging of the pelvis in characterization of adnexal masses. Zentralbl Gynakol. 2005; 127(6):373-9.
17. Kenemans P, van Kamp GJ, Oehr P, Verstraeten RA: Heterologous double-determinant immunoradiometric assay CA 125 II: reliable secondgeneration immunoassay for determining CA 125 in serum. Clin Chem. 1993; 39: 2509–13.
18. Kim K, Cho SY, Park SI, Kang HJ, Kim BJ, Kim MH, Choi SC, Ryu SY, Lee ED: Risk of metastatic ovarian involvement in nongynecologic malignancies. Int J Gynecol Cancer. 2012; 22(1):3-8.
19. Lalwani N, Dubinsky TJ: Clinically suspected adnexal mass. Ultrasound Q. 2013; 29(1):87-8.
20. Loubeyre P, Patel S, Copercini M, Petignat P, Dallenbach P, Dubuisson JB: Role of sonography in the diagnostic workup of ovarian and adnexal masses except in pregnancy and during ovarian stimulation. J Clin Ultrasound. 2012; 40(7):424-32.
21. Mekić-Abazović A, Beculić H, Musić M, Fajkić A, Dervisević S: Endometrial cancer associated with an increase of CA153 and CA125 in tamoxifen treated patients with breast cancer. Med Glas (Zenica). 2011; 8(1):68-71.
22. Obeidat BR, Amarin A, Latimer JA: Risk of malignancy index in the preoperative evaluation of pelvic masses. Int J Gynecol., 2004; 85: 255-8.
23. Pal T, Cragun D, Lewis C, Doty A, Rodriguez M, Radford C, Thompson Z, Kim J, Vadaparampil ST: A Statewide Survey of Practitioners to Assess Knowledge and Clinical Practices Regarding Hereditary Breast and Ovarian Cancer. Genet Test Mol Biomarkers. 2013; Epub ahead of print.
24. Siegel R, Naishadham D, Jemal A: Cancer statistics, 2013. CA Cancer J Clin. 2013; 63(1):11-30.
25. Sohaib SA, Reznek RH: MR imaging in ovarian cancer. Cancer Imaging. 2007; 7 Spec No A:S119-29.
26. Tingulstad S, Hagen B, Skjeldestad FE: Evaluation of a risk of malignancy index based on serum CA125, ultrasound findings and menopausal status in the preoperative diagnosis of pelvic masses. Br J Obstet Gynaecol., 1996; 103: 826-31.
27. Tuncer ZS, Boyraz G, Selcuk I, Sahin N, Kaynaroğlu V, Ozışık Y: Adnexal masses in women with breast cancer. Aust N Z J Obstet Gynaecol. 2012; 52(3):266-9.
28. Valentini AL, Ameye L, Savelli L, Fruscio R, Leone FP, Czekierdowski A, Lissoni AA, Fischerova D, Guerriero S, Van Holsbeke C, Van Huffel S, Timmerman D: Adnexal masses difficult to classify as benign or malignant using subjective assessment of gray-scale and Doppler ultrasound findings: logistic regression models do not help. Ultrasound Obstet Gynecol. 2011; 38(4):456-65.
29. Valentini AL, Gui B, Basilico R, Di Molfetta IV, Miccò M, Bonomo L: Magnetic resonance imaging in women with pelvic pain from gynaecological causes: a pictorial review. Radiol Med. 2012; 117(4):575-92.
30. van den Akker PA, Zusterzeel PL, Aalders AL, Snijders MP, Samlal RA, Vollebergh JH, Kluivers KB, Massuger LF: External validation of the adapted Risk of Malignancy Index incorporating tumor size in the preoperative evaluation of adnexal masses. Eur J Obstet Gynecol Reprod Biol. 2011; 159(2):422-5.
31. Terzić M, Dotlić J, Ladjević IL, Atanacković J, Ladjević N: Evaluation of the risk malignancy index diagnostic value in patients with adnexal masses. Vojnosanit Pregl. 2011; 68(7):589-93.
32. Terzić M, Dotlić J, Likić I, Ladjević IL, Brndusić N, Arsenović N, Maricić S, Mihailović T, Andrijasević S: Current diagnostic approach to patients with adnexal masses: which tools are relevant in routine praxis? Chin J Cancer Res. 2013; 25(1):55-62.
33. Yamashita Y, Hatanaka Y, Torashima M, Takahashi M, Miyazaki K, Okamura H: Characterization of sonographically indeterminate ovarian tumors with MR imaging. A logistic regression analysis. Acta Radiol. 1997; 38(4 Pt 1):572-7.