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Diagnostic role of ovarian – adnexal reporting and data system magnetic resonance imaging scoring system for evaluation of indeterminate adnexal lesions

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Abstract

Introduction: Magnetic resonance imaging (MRI) plays an important role in distinguishing malignant from benign adnexal mass which are indistinguishable from ultrasonography.This can help in early diagnosis and treatment of indeterminate adnexal lesions.This study aims to evaluate the accuracy of ovarian adnexal reporting and data system (O-RADS) MRI score in distinguishing bening from malignant lesion when compared to histopathology which is the gold standard and evaluate MRI features suggesting malignancy in such lesions .

Method: This was a retrospective study of MRI pelvis carried out in patients with indeterminate adnexal lesions who had MRI pelvis done from 2018 to 2022 at Patan Hospital, Lalitpur, Nepal. Ethical approval was obtained from the institutional review committee of Patan Academy of Health Sciences. MRI diagnosis based on O-RADS MRI score was compared with histopathology diagnosis and sensitivity, specificity were calculated. Chi square test was used and p-value less than 0.05 was considered statistically significant.

Result: Among 175 patients, 135 had benign and 40 had malignant lesions. The sensitivity and specificity of MRI diagnosing indeterminate lesion was 92.5% and 91.85% respectively. Among malignancy, 92.5% had O-RADS MRI score of 4 and 5. Significant statistical association of O-RADS MRI score was found with histopathology diagnosed malignancy. MRI features of malignancy were multilocular, solid cystic lesion with contrast enhancement, septations and diffusion restriction. Malignancy was common in middle aged patients (41-60 y).

Conclusion: O-RADS MRI scoring is significantly associated with histopathology-proven adnexal malignancy and hence helps in accurately diagnosing indeterminate adnexal lesions and stratifying the risk of malignancy.

Keywords: adnexal lesion, magnetic resonance imaging (MRI), ovarian adnexal reporting and data system (O-RADS)

Introduction

Ovarian malignancy is the seventh leading cause of death in women with a median age for diagnosis of 50-79 years.[1] The incidence and mortality of ovarian carcinoma is more in western world compared to Asia.[2] In a study from Nepal, ovarian malignancy was found to be the fourth most common malignancy in female in Nepal.[3] Ovarian tumors present diversely and may escape detection until larger in size. Approximately 10% of adnexal lesions are indeterminate and are undiagnosed in ultrasonograms. Early diagnosis of ovarian malignancy is important to improve the survival rate.[4]

According to European society of gynaecological oncology the first line imaging for adnexal pathology is ultrasonography.[5] For Indeterminate adnexal lesions which are undiagnosed from ultrasonography, Magnetic Resonance Imaging (MRI) becomes reliable modality with its signal intensity and sequences like diffusion weight image (DWI) and dynamic contrast enhancement (DCE). MRI Scoring system was introduced for the risk strastification of indeterminate adnexal lesions. The ovarian adnexal reporting and data system magnetic resonance imaging (O-RADS MRI) score is based on previous Adnexal lesion (ADNEX) MRI scoring.[6] MRI findings for O-RADS scoring include locularity, lesions content, T2/DWI signal intensity, and contrast enhancement.[7]

MRI scoring for diagnosing malignancy is 93.5% sensitive and 96.6% specific.[8] With the help of an MRI scoring system, malignancy risk in indeterminate adnexal lesions can be determined hence avoiding unnecessary surgery. The aim of this study is to evaluate the accuracy of the O-RADS MRI scoring system in diagnosing indeterminate adnexal lesions.

Method

This was a retrospective study of patients with indeterminate adnexal mass who had an MRI pelvis done in the Department of Radiology and Imaging of Patan Hospital, Patan Academy of Health Sciences (PAHS), Lalitpur, Nepal. After getting the ethical approval from the Institutional Review Committee of PAHS, (Reference number: drs2208191671) retrospective analysis of 175 patients who underwent MRI for indeterminate adnexal lesions between May 2018 and June 2022 was done. MRI was done with a Philips ingenia machine with 1.5 Tesla strength. The electronically saved soft copy of MRI reports of the patients were searched and retrieved from the MRI section of the radiology department. Similarly soft copy of Histopathology reports of the patients were identified and retrieved from the Department of Pathology.

The MRI findings of the lesions were then scored according to the O-RADS MR system by two MD radiologists. No lesion was scored 1. Unilocular cyst with simple, endometriotic, fat content, no solid tissue or T2/DWI hypointense nodule without enhancement was scored 2. Score 3 included unilocular proteinous or non-endometriotic lesions, Multilocular lesions without solid components, or T2/DWI hyperintense solid components with mild enhancement. Score 4 included the presence of solid tissue with an intermediate curve on DCE or enhancement less than myometrium. O-RADS score 5 included solid tissue (Excluding T2 dark/DWI dark) with high-risk DCE or more enhancement than myometrium and distant spread.[7] O-RADS MRI score of 1 was considered normal, 2 was considered almost certainly benign, 3 was considered low risk for malignancy, 4 was considered an intermediate risk for malignancy and 5 was considered as high risk for malignancy.[6] Obtained score and MRI final diagnosis were compared with histopathology findings.

All the patients that had undergone an MRI pelvis in the Radiology Department of Patan Hospital, Patan Academy of Health Sciences for indeterminate adnexal lesions were included. Patients whose final diagnosis could not be reached due to incomplete data, patients whose histopathology records could

not be retrieved, and patients whose surgery could not be performed due to various co-morbid conditions were excluded from this study.

The data were entered into MS Excel and imported into the IBM SPSS 20 software for statistical analysis. Chi-square test was applied to find out the association between the O-RADS score and histopathology-proven malignancy, the accuracy of MRI diagnosis with histopathological diagnosis, and specific MRI features found in malignancy.

Result

The total number of patients with indeterminate adnexal lesions, who had undergone surgery or histopathology diagnosis, was 175. Among them, 135(77.1%) patients had benign lesions and 40(22.9%) had malignant lesions, diagnosed by histopathology.

The mean and standard deviation of the age of the patients with indeterminate adnexal lesions was 38.5±14.34 for benign lesions and 44.53±15.70 for malignant lesions, Table 1.

Out of 135 benign adnexal lesions, 77(57.03%) were found in the young age group (up to 40 y), while 42(31.1%) were in the middle age group (41-60 y) and 16(11.8%) in old age group (>60 y). Among 40 malignant adnexal lesions, 21(52.5%) were in the middle age group, while 12(30%) were young and 7(17.5%) of the old age group. Benign lesions were more common in the young age group which is up to 40 y and with increasing age after 40 y, malignancy was more commonly found. The result was statistically significant for age with a p-value of 0.024 and age groups with a p-value of 0.011, Table 1.

Among 135 benign cases**,** 96(71.11%) were unilocular (95% CI: 62.96–78.09), 75(55.55%) had internal septations (95% CI: 47.14–63.67) and 111(82%) had clear fluids (95% CI: 74.91–87.75). These MRI features are statistically significant for benign lesions, Table 2. Similarly, among 40 malignant cases, 38(95%) adnexal lesions were multilocular (95% CI: 83.5–98.62), 39(97.5%) had solid components (Excluding T2/DWI hypointense solid component) (95% CI: 87.12–99.56), 40(100%) malignant lesions showed post-contrast enhancement and areas of clear cystic fluid within it (95% CI: 91.24–100), 30(75%) lesions had thick internal septations (95% CI: 59.81–85.81) and 37(92%) showed hyperintensity in DWI (Diffusion-weighted image) with ADC (Apparent Diffusion Coefficient) hypointensity (95% CI: 80.14–97.42) suggesting restricted diffusion. These MRI features were similarly statistically significant for malignant adnexal lesions, Table 2.

Out of 175 patients with indeterminate adnexal lesions, 135(77.14%) patients were histopathologically proven with benign lesions, and 40(22.85%) were proven with malignant lesions. But in our study, MRI had reported 127(72.57%) as benign and 78(44.57%) cases as malignant. MRI was found to be 92.5% sensitive and 91.8% specific in diagnosing adnexal malignancy and 91.8% sensitive and 92.5% specific in diagnosing benign adnexal lesions. A statistically significant association (p-value <0.001) between MRI diagnosis and histopathology diagnosis was found, Table 3.

Among 175 cases, 96(54.9%) were categorized under O-RADS MRI score 2 (Almost certainly benign), 31(17.7%) under the score 3 (low risk of malignancy), 36(20.6%) under the score 4 (Intermediate risk of malignancy) and 12(6.9%) were categorized under the score 5 (High risk of malignancy), Table 4.

All 96 cases which were given an O-RADS score of 2 were histopathologically benign, among 31 cases with an O-RADs score of 3, 28(90.3%) were found to be benign and 3(9.7%) were malignant. Similarly, out of 36 cases that scored 4 in O-RADS, 11(30.6%) were found to be benign and 25(69.4%) were malignant. Out of 12 cases that scored 5 in O-RADS, all of them were found to be malignant. A statistically significant association was found between O-RADS MRI score categories with histopathological diagnosis of malignancy (p-value <0.001), Table 5.

Table 1. Age-wise distribution of benign and malignant pathology in patients with indeterminate adnexal lesion

Variables		Benign N(%)	Malignant N(%)	Total	p-value
Age	Mean±SD	38.5±14.34	44.53±15.70	39.88±14.83	0.024[a]
Age groups					
Young age group	≤40 y	77(57.03%)	12(30%)	89(50.85%)	
Middle age group	41-60 y	42 (31.1%)	21 (52.5%)	63(36.00%)	0.011[b]
Old age group	>60 y	16 (11.8%)	7 (17.5%)	23(13.14%)	
Total		135(100%)	40(100%)	175(100%)	

Note: a=Independent sample t-test, b=Pearson's chi-square test

Table 2. MRI findings of benign and malignant pathology in the patient with indeterminate adnexal lesion

Adnexal lesions MRI findings	N	%	95% CI
Benign lesion			
Unilocular lesion	96	71.11%	62.96–78.09
Multilocular lesion	37	27.74%	20.59–35.48
Internal septations	75	55.55%	47.14–63.67
Fat components	52	38.51%	30.74–46.94
Mucin content cyst	21	15.55%	10.41–22.62
Hemorrhagic component	25	18.51%	12.87–25.91
Clear fluid cyst	111	82%	74.91–87.75
Mural nodules (T2/DWI hypointense)	32	23.70%	17.32–31.54
Post-contrast enhancement of solid components	45	33.33%	25.94–41.65
Calcification	32	23.70%	17.32–31.54
Sub-total	135		
Malignant lesion			
Unilocular	2	5%	1.38–16.5
Multilocularity	38	95%	83.5–98.62
Solid component	39	97.5%	87.12–99.56
Internal septations	30	75%	59.81–85.81
Fat component	8	20%	10.5–34.76
Mucin content cyst	10	25%	14.19–40.19
Clear fluid cyst	40	100%	91.24–100
Hemorrhagic component	24	60%	44.6–73.65
Post-contrast enhancement of solid component	40	100%	91.24–100
Calcification	6	15%	7.06–29.07
Peritoneal, omental, or mesenteric nodularity	9	22.50%	12.32–37.5
Ascites	27	67.5%	52.02–79.92
DWI hyperintensity/ADC hypointensity	37	92%	80.14–97.42
Sub-total	40		

Table 3. Accuracy of MRI diagnosis with final histopathological diagnosis

Final Diagnosis	Histopathology Diagnosis	MRI Diagnosis	Sensitivity	Specificity	p-value (chi square test)
Benign lesions	135	127	91.85%	92.5%	<0.001
Malignant lesions	40	48	92.5%	91.85%	<0.001

Table 4. O-RADS scoring of the indeterminate adnexal lesions based on MRI findings

O-RADS MRI Score	Features of the lesion	N	%	Cumulative percent
1	No adnexal lesion	0	0	0
2	Almost certainly benign	96	54.9	54.9
3	Low risk of malignancy	31	17.7	72.6
4	Intermediate risk of malignancy	36	20.6	93.1
5	High risk of malignancy	12	6.9	100.0
Total		175	100	

Table 5. Association of O-RADS score with histopathologically proven malignancy

O-RADS MRI score	Number of cases	Histopathological finding		Fischer's exact test
		Benign N(%)	Malignant N(%)	
2	96	96(100.0%)	0(0.0%)	<0.001
3	31	28(90.3%)	3(9.7%)	
4	36	11(30.6%)	25(69.4%)	
5	12	0(0.0%)	12(100.0%)	

Discussion

In our present study, we included 175 cases who had indeterminate adnexal lesions which could not be confidently distinguished as benign or malignant through ultrasonography, MRI showed a sensitivity and specificity of 92.5% and 91.8% respectively in diagnosing those lesions. This finding is similar to a study conducted in a hospital at the University of Pennsylvania, for the correlation of MRI diagnosis with histopathology diagnosis of indeterminate adnexal lesions, in which MRI diagnosis was 95% specific and 94.1% sensitive.[9] Similarly in another study conducted at the University of Baghdad among 30 patients the diagnostic accuracy of MRI for ovarian malignancy was 90.9% sensitive and 75% specific which is similar to our study.[10] The similarities of these findings and accuracy of MRI in diagnosing indeterminate adnexal lesions could be due to well characterization of the lesion by the signal intensity of the solid components, fluid content , and functional sequences of MRI like DWI and DCE pattern of the solid components which makes diagnostic accuracy of MRI superior to ultrasonogram.

In our study, lesions with higher O-RADS scores which are MRI O-RADS scores 4 and 5 were commonly found to be malignant, 25(69.4%) lesions scored 4, and 12(100%) lesions scored 5 were confirmed malignant by histopathology. In a study conducted in India in 2021 for the diagnostic performance of O-RADS MRI scoring the malignancy rate was 91.7% for the lesions that scored O-RADS 5.[11] Similarly in another study conducted at the University of Los Andes, Colombia, the frequency of malignancy was 3.1% for O-RADS 3, 34.9% for O-RADS 4 and 77.6% for O-RADS 5 which showed increasing malignancy rate with increasing O-RADS score.[12] Aggressive adnexal lesions which included enhancing solid components and distant spread were scored as O-RADS 4 and O-RADS 5, this could be the reason for the similarities of our findings to other studies.[6] In our study 3(9.7%) malignancy rate was found in lesions with O-RADS 3 which is contrary to a study conducted in Turkey among 332 patients where only 1.2% malignancy was detected for the lesions with O-RADS MRI score 3. This could be due to the inclusion of post-contrast enhancing solid components in category 3 and due to the limited availability of dynamic contrast enhancement (DCE) studies.[13]

In our study, O-RADS score 2 had 0% malignancy which is similar to a study conducted in 2018 among 237 patients in South America where 0% malignancy was found in ADNEX MRI score 2.[14] O-RADS MRI

scoring was an evolution of ADNEX MRI scoring system with similar scores as 1 having no lesion, Score 2 as definitely benign and highest Score 5 as highly suspicious malignant mass. ADNEX MRI scoring was renamed by the American College of Radiology with some changes such as performing visual analysis of enhancement where the time-intensity curve of dynamic contrast enhancement (DCE) is not feasible, lack of this element in ADNEX MR scoring has limited its use on larger scales.[6]

In our study the rate of malignancy in lesions scored 3, 4, and 5 were 9.7%, 64.9%, and 100% respectively, which is similar to another study conducted in Japan among a population of 663 where adnexal mass was scored from 1 to 5 according to ADNEX MR scoring system in which the malignancy rate with the score 2, 3, 4 and 5 were 1.9%, 12.8%, 62.6%, and 87.4% respectively.[15] Similarities of these findings may be due to the common benign MRI findings like unilocular lesions without enhancing solid components included up to score 3 and common malignant MRI findings likely multilocular lesions with enhancing solid components included in score 4 and 5 in both the scoring systems.[6]

In our study 40(22.8%) adnexal lesions were diagnosed as malignant by histopathology. Regarding MRI findings among those lesions, 39(97.5%) lesions were solid cystic with post contrast enhancement, 24(60%) lesions with hemorrhagic component, 27(67.5%) lesions with ascites, and 9(22.5%) lesions with peritoneal, omental, or mesenteric deposits. This is supported by another study conducted in 2000 at the University of California, whereby the MRI features associated with malignancy was solid lesion and post-contrast enhancement. The detection rate of malignancy was 94% in the post-contrast MRI study.[16] Similarly in 2017 among 84 patients a study was conducted at Babylon University for the accuracy of MRI in diagnosing the adnexal malignancy which was 95% while sensitivity was 93.75%. The MRI features of malignancy were solid cystic lesions in 81.2% with post-contrast enhancement.[17] In advanced ovarian malignancy ascites are commonly encountered.[18] In our study 27(67.5%) of malignant cases had ascites which is almost similar to another study conducted in America among 125 patients where 73% of malignancy had ascites.[19] In our study hemorrhagic component was only in 25(18.5%) benign lesions and 60% in malignant lesions which was contrary to a study conducted among 155 patients in England for characterization of adnexal mass in MRI where hemorrhagic component (44.4%) was more common in benign lesions than the malignant lesion. This might be due to the variation of MRI features at the time of the presentation of the patient. Hemorrhagic components alone in the lack of other MRI features cannot indicate malignancy.[20]

From the MRI findings of our study, the solid portion of 37(92%) malignant lesions showed hyperintensity in the DWI sequence and hypointensity in ADC sequences suggesting restricted diffusion which is similar to a study conducted among 39 malignant adnexal lesions in Japan.[21] These findings are supported by another study conducted in 2017 in China for DWI parameters in benign and malignant ovarian tumors where DWI showed high signal intensity in the solid component of 93.1% of malignant lesions and mixed signal intensity in 9.82%.[22] Similarities of these findings are due to the presence of hypo-intense DWI (Dark DWI) solid component given O-RADS MRI score 2 which is almost certainly benign, while lesion with solid tissue excluding dark DWI (hypo-intense DWI) or hyper-intense DWI restricted solid component falls under O-RADS MRI score of 3, 4 or 5 suggesting suspicious malignancy.[7] Unilocular cystic adnexal lesions fall under the category of O-RADS MRI 2 and 3 which is almost certainly benign or low risk of malignancy.[7] In our study MRI features of benign lesions were most commonly unilocular, 96(71.1%) lesions were found unilocular in this study which is almost similar to another study done at the University of Kentucky among 3,200 women where no patient with unilocular cyst developed ovarian cancer and 69% resolved spontaneously.[23] This might be due to low complexity of

unilocular cystic lesions and less chance of development of thick septations and solid areas for malignant transformation.[23]

Among 175 cases in our study, 135(77.1%) cases had benign adnexal lesions while 40(22.9%) had malignant lesions. In a study conducted in Pakistan Lahore, among 110 patients, 72% of the adnexal lesions were found to be benign while the rest were malignant.[24] This is almost similar to our study. In another study conducted in Nepal, there were 135(83.9%) benign adnexal lesions and 26(16.1%) malignant adnexal lesions.[25] Also, another study in Nepal Medical College showed the incidence of benign adnexal lesions at 90.5% while malignant adnexal lesions at 9.5%.[26] These similarities of benign lesions being more common than malignant adnexal lesions may be due to the study group commonly being a young and middle-aged group. Contrary to our study only 59.2% was benign in a study conducted among 855 cases in Karachi, Pakistan.[27] This contrary may be due to the study including all the ovarian neoplasms while our study included only indeterminate adnexal lesions and variation in study sample size.

In our study, the benign lesions were more commonly found in young age groups which is up to 40 years while beyond 40 years of age, malignancy was common. The middle-aged group (41-60 y) showed a maximum number of malignancies in our study. These findings are supported by a study conducted in Gujarat, India where malignant neoplasm was common after the 5th decade and benign neoplasm was 68% common in the 3rd to 5th decade.[28] Similarly, in a study conducted in Sri Lanka, the incidence of the adnexal lesion was most common in 20-60 years of age which was 86.6% and most benign lesions (49.8%) were found before 40 years while 77% of malignant ovarian tumors were more common in age groups above 40 years.[29] On the contrary, in a study conducted in Dhaka, Bangladesh among 539 patients the mean age for the presentation of benign ovarian lesions was 34 years while the mean age for the presentation of the malignant ovarian lesion was 40 years, but in our study mean age for malignant lesions was 44.5 years.[30] This may be due to the variation in study group size and presentation of different age groups for MRI.

Histologically, in our study most common tumor was a surface epithelial tumor which was 96(54.8%), followed by germ cell ovarian tumor which was 37(65%). Similarly, in a study among 162 cases conducted in India for histopathology spectrum for ovarian tumors, the most common ovarian tumors were surface epithelial tumors which were 77.7% followed by germ cell tumors (18.5%) and sex cord-stromal tumors (3.8%).[31] Surface epithelial tumor is the commonest form of all ovarian tumors representing 60-70%, they can either be benign or malignant. Their malignant form represents >90% of ovarian cancers.[32]

Conclusion

O-RADS MRI scoring is significantly associated with histopathology-proven adnexal malignancy. Hence it helps in accurately diagnosing indeterminate adnexal lesions and stratifying the risk of malignancy in such lesions.

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Conflict of Interest

None

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Author Contribution

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