VOLUME - 13, ISSUE - 11, NOVEMBER - 2024 • PRINT ISSN No. 2277 - 8160 • DOI : 10.36106/gjra

Original Research Paper

Radiology

"DIAGNOSTIC EFFICACY OF OVARIAN-ADNEXAL REPORTING AND DATA SYSTEM (O-RADS) -ULTRASOUND TO DISTINGUISH BENIGN AND MALIGNANT ADNEXAL MASSES IN A TERTIARY CARE HOSPITAL"

Arige Raj Bharath Naidu	Senior Resident, Department Of Radio Diagnosis, Apollo Health City, Apollo Institute Of Medical Sciences & Research, Apollo Health City Campus, Road No.92, Jubilee Hills, Film Nagar, Hyderabad, Telangana 500090.
Mohd Abdul Rawoof*	Senior Resident, Department Of Radio Diagnosis, Apollo Institute Of Medical Sciences & Research, Apollo Health City Campus, Road No.92, Jubilee Hills, Film Nagar, Hyderabad, Telangana 500090. *Corresponding Author
Karanam Poorna Sasank	Senior Resident, Department Of Radio Diagnosis, Apollo Institute Of Medical Sciences & Research, Apollo Health City Campus, Road No.92, Jubilee Hills, Film Nagar, Hyderabad, Telangana 500090.
Peethamber Lokanandi	Assistant Professor, Department Of Radiodiagnosis, Gitam Institute Of Medical Sciences And Research, Visakhapatnam, Andhra Pradesh, India.
Syed Aamir Sohail	Senior Resident, Department Of Radiology , Esic Medical College Gulbarga Karnataka
Devesh Joshi	Registrar, Department Of Radio Diagnosis, Apollo Hospitals, Jubilee Hills, Hyderabad, Telangana State, India.
Bojanapally Preethi	Junior Resident, Department Of Radio Diagnosis, Apollo Hospitals, Jubilee Hills, Hyderabad, Telangana State, India.

ABSTRACT

Introduction: The ADNEXA is collective term for Ovary, Fallopian Tubes and Broad Ligaments. In general practice, adnexal lesions are routinely encountered, both benign and malignant1. Ultrasound is a rapid, relatively inexpensive and a non-invasive modality2 . Trans abdominal and trans vaginal ultrasound (grey scale and Doppler ultrasonography) are first modality of choice for evaluating adnexal masses1. Transabdominal ultrasonography is also useful to look for secondary changes like hydroureteronephrosis, peritoneal involvement and ascites3.Ultrasound diagnosis of solid vascular adnexal lesions and cystic adnexal lesions with solid components having good vascularity, with elevated serum markers can help in prompt referral to a gynaecologic oncologist 1. The ovarian - adnexal reporting and data system Ultrasound(O-RADS US) uses standard lexicon, incorporates all classes of risk and also management strategy for evaluation of ovarian and other adnexal masses4.It is relatively new and introduced in the year in 2018 by an International Multidisciplinary cavity, comprising clinicians and researchers from the fields of Radiology, Gynaecology, Pathology and Gynaecologic Oncology. **Aim/Purpose:** To evaluate the diagnostic efficacy of ORADS-US in differentiating benign and malignant adnexal lesions with histopathological correlation. **Material And Methods:** This was a retrospective and prospective analytical study conducted at Apollo hospital, Jubilee hills, Hyderabad. A USG Philips Affiniti 70 and 50 machines was used.Ultrasound reports of patients who were diagnosed with adnexal lesions will be retrieved from the medical records of the radiology department. Ca-125 and histopathological reports for those patients will be collected and interpreted. All patients referred to Radiology Department with clinical suspicion of adnexal masses lower abdominal pain will be screened. **Results:** A total of 55 patients with adnexal lesions were included and histopathological diagnosis was obtained in all cases, serving as the gold standard. The sensitivity, specificity, PPV, NPV, and accuracy of the O-RADS classification system were found to be 88.5%, 96.6%, 95.8%, 90.3%, and 92.7%, respectively. The sensitivity, specificity, PPV, NPV, and accuracy of the IOTA-SR classification system were 84.6%, 96.6%, 95.7%, 87.5%, and 90.9%, respectively. we found that 0-RADS compares favourably with IOTA-SR. Specifically, O-RADS showed slightly higher sensitivity and accuracy with similar specificity when compared to IOTA-SR. In our study, all the indeterminate lesions were considered malignant. CA-125 levels were found to be increased in most of the cases that were assigned O-RADS 4 and O-RADS 5 and later confirmed to be malignant on histopathology. Conversely, CA-125 levels were low in three cases that were assigned O-RADS 4 and O-RADS 5 but were proven to be malignant on histopathology. **Conclusion:** In conclusion, combining the serum levels of CA125 with ultrasound features may have a more significant diagnostic value in distinguishing benign from malignant ovarian lesions. Nevertheless, it cannot be solely relied upon as an indicator, as CA-125 levels may also be elevated in certain benign ovarian lesions. A comprehensive approach that considers both CA-125 and ultrasound findings is essential for accurate diagnosis and management.

KEYWORDS : USG, O-RADS, CA -125 Levels.

INTRODUCTION:

The adnexa are collective term for ovary, fallopian tubes and broad ligaments. In general practice, adnexal lesions are routinely encountered, both benign and malignant[1]. Common benign adnexal lesions include simple cyst, dermoid cyst, haemorrhagic cyst, endometrioma, hydrosalpinx, serous cystic tumour, mucinous cystadenoma, paraovarian cyst, thecoma, brenner tumour and peritoneal inclusion cyst. Malignant lesions include mucinous cystadenocarcinoma, serous cystadenocarcinoma, endometrioid carcinoma, granulosa cell tumour, clear cell cancer, dysgerminoma, sertoli Leydig cell tumour and poorly differentiated carcinoma.[5] Majority of the ovarian neoplasms are epithelial in origin.[6]

There is association of germ line mutations like BRCA1 and

BRCA 2 for ovarian malignancies.[7]

Role Of Ultrasound In Diagnosis Of Adnexal Pathology:

Ultrasound is a rapid, relatively inexpensive and a non-invasive modality[2].Trans abdominal and trans vaginal ultrasound (grey scale and Doppler ultrasonography) are first modality of choice for evaluating adnexal masses[1]. While trans vaginal ultrasound in most of the adnexal masses provides optimal visualization, in case of larger masses or those which are located superficially, transabdominal ultrasound is useful [8]. Transabdominal ultrasonography is also useful to look for secondary changes like hydroureteronephrosis, peritoneal involvement and ascites[3]. For classifying cystic lesions like simple cysts, haemorrhagic cysts, dermoids, endometriomas and lesions suspicious for malignancy, ultrasound is very useful. Majority of the simple cysts can be confidently diagnosed with the help of follow up imaging.

Endometriomas, classic haemorrhagic cysts and dermoids have a low risk of cancer. Therefore, the patient can be assured of a benign process when the above-mentioned cystic lesions are diagnosed on ultrasound. Ultrasound diagnosis of solid vascular adnexal lesions and cystic adnexal lesions with solid components having good vascularity, with elevated serum markers can help in prompt referral to a gynaecologic oncologist[1].

Classification Systems For Adnexal Lesions:

For diagnosis of adnexal lesions, different classification systems were designed such as International Ovarian Tumour Analysis Simple rules (IOTA-SR), Gynecologic Imaging - Reporting and Data System(GI-RADS) and O-RADS[9].

The ovarian - adnexal reporting and data system Ultrasound(O-RADS US) uses standard lexicon, incorporates all classes of risk and also management strategy for evaluation of ovarian and other adnexal masses[4].

It is relatively new and introduced in the year in 2018 by an International Multidisciplinary cavity, comprising clinicians and researchers from the fields of Radiology, Gynaecology, Pathology and Gynaecologic Oncology.

O- Rads Classification

O- Rads 0 - an incomplete evaluation
O- Rads 1 - the physiologic category (normal premenopausal ovary)
O- Rads 2 - almost certainly benign category (<1% risk of malignancy)
O- Rads 3 - lesions with low risk of malignancy (1% to <10%)
O- Rads 4 - lesions with intermediate risk of malignancy (10% to <50%)
O- Rads 5 - lesions with high risk of malignancy (greater than equal to 50%).

Role Of Other Imaging Modalities And Ca-125 In Diagnosis Of Adnexal Lesions:

Computed tomography (CT) has lesser role than ultrasound or Magnetic resonance imaging (MRI) for ovarian lesion characterization. However, for comprehensive evaluation of lymphadenopathy or potential sites of peritoneal implants, it is the imaging modality of choice [3]. MRI can improve diagnostic certainty. For classifying subtype of ovarian neoplasm and to stage the disease, MRI is helpful[10]. MRI capability for providing a more specific diagnoses for sonographically indeterminate lesions reduces the level of suspicion and thus the number of surgeries performed for benign diagnoses in asymptomatic women.[11]

For the detection and management of ovarian cancer, tumour markers play an essential role. Extensive studies have been conducted on numerous cancer markers. For Screening and managing ovarian cancer, Cancer antigen 125 (CA-125) plays a significant role[5].Other tumour markers include HE 4, CA 19-9, CA 72-4, AFP, LDH and HCG. Some studies were conducted on combination of HE 4 and CA-125[12].

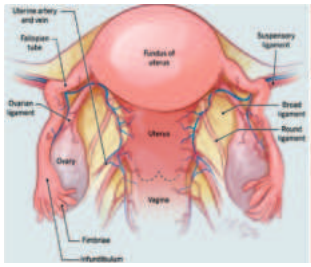
Rationale And Purpose Of This Study:

Adnexal pathologies are most commonly encountered in regular practice. Different classification systems for evaluation of adnexal masses like IOTA-SR and GI RADS are in place. Among all such classifications, the recent one is O-RADS. The purpose of this study is to validate O-RADS classification system to differentiate malignant and benign lesions in women who underwent surgical treatment. O-RADS classification system is based on the modality of ultrasonography, which is easily accessible, relatively inexpensive and non-invasive.

Validatation of O-RADS to differentiate benign from malignant adnexal lesions in Indian population is not well established in literature. Only few studies have been done, most of them in European and North American countries. In this study, we aim to assign each adnexal lesion diagnosed on ultrasound, a category based on O-RADS and compare with the final histopathological diagnosis to validate the O-RADS classification system.

Gross Anatomy Of Ovaries:

Ovaries are ovoid in shape and correspond to a volume of 1.2 to 9.4 cm3. They are anteriorly bounded by the broad ligament, mesovarium, and obliterated umbilical artery , Posteriorly by the ureter, internal iliac vessels, and suspensory ligament with ovarian vessels , Superiorly by the external iliac vessels, and inferiorly by the levator ani. Medially by the ovarian ligament attaching ovaries to the uterus, pararectal fossa, and rectouterine pouch. Laterally, they are bounded by the obturator vessels and nerves in the ovarian fossa, obturator internus and fascia, and parietal peritoneum of the pelvic wall.. Ovarian artery is the main artery supplying ovaries. Ovaries also have blood supply from ovarian branches of uterine artery. Right ovarian vein drains into inferior venacava; whereas left ovarian vein drains into left renal vein. Lymphatic drainage to para-aortic; iliac and inguinal lymph nodes. Sympathetic supply from T10 and T11 spinal segments via aorticorenal plexus and its branches. Parasympathetic supply from inferior hypogastric plexus. Sensory fibers accompany sympathetic nerves. There could be a variant anatomy; ovary in the ectopic location such as the inguinal canal or in the suprapelvic position. There could be absence or hypoplasia of both ovaries or supernumerary ovaries.



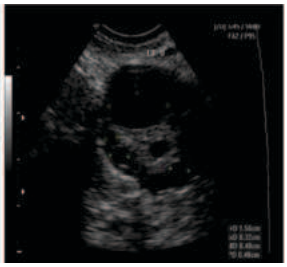


Figure 1 – Anatomy of Uterus and Ovaries
Figure 2 – Ultrasound image of normal ovary.

MATERIAL AND METHODS:

This was a Retrospective and prospective analytical study conducted at Apollo hospital, Jubilee hills, Hyderabad with Study duration of 12 months; from February 2022 - February 2023.. i.e Retrospective component: February 2022 to November 2022 and Prospective component: December 2022 to February 2023.

For Retrospective component of the study: Ultrasound

reports of patients who were diagnosed with adnexal lesions will be retrieved from the medical records of the radiology department. Ca-125 and histopathological reports for those patients will be collected and interpreted.

For Prospective component of the study: All patients referred to Radiology Department with clinical suspicion of adnexal masses lower abdominal pain will be screened. An informed consent and study proforma was obtained.

Inclusion Criteria:

1) Patients aged > 18 years.
2) Patients clinically suspected to have lower abdominal pain/adnexal lesions and undergo ultrasound imaging.
3) Presence of non-physiologic adnexal lesion.

Exclusion Criteria:

1) Patients with inadequate follow up
2) Patients who have increased genetic risk for ovarian malignancy.
3) Pregnant women.
4) Patients who come for follow up after undergoing surgical treatment for known adnexal pathology.
5) Unable to categorize due to absence of colour doppler images in the retrospective study.

1. Study Definitions:

Ovarian-adnexal Reporting And Data System -ultrasound

O- Rads Us 0 : An incomplete evaluation

O- Rads Us 1 : Physiologic category

- ovarian follicle (<3 cm)
- corpus luteum (<3 cm)

O- Rads Us 2 : Almost certainly benign category (<1% risk of malignancy)

Simple cyst 3-5 cm

- premenopausal: no follow-up
- postmenopausal: 1-year follow-up

Simple cyst 5-10 cm

- **premenopausal:** 8-12 week follow-up
- **postmenopausal:** 1-year follow-up

Unilocular cyst with smooth margins <3 cm

- **premenopausal:** no follow-up
- **postmenopausal:** 1-year follow up if referring to ultrasound specialist or MRI management by a gynecologist

Unilocular cyst with smooth margins 3-10 cm

- **premenopausal:** 8-12 week follow-up
- **postmenopausal:** refer to ultrasound specialist or MRI; management by a gynecologist

Lesions with "classical ultrasound characteristics" of the following but may have specific recommendations and measure < 10 cm:

- Typical hemorrhagic cyst
- Dermoid cyst
- Endometrioma
- Paraovarian cyst
- Peritoneal inclusion cyst
- Hydrosalpinx.

O- Rads Us 3:

Low Risk Of Malignancy (1% To <10%) - needs a referral to ultrasound specialist or gynecologist with a view to MRI

- Unilocular>10 cm (simple or non-simple)
- Lesions looking like typical dermoids, endometriomas, or hemorrhagic cysts
- >10 cm
- Solid smooth lesion of any with color score 1
- Multilocular cyst <10 cm smooth inner wall with color score 1-3

O- Rads Us 4

Lesions with an intermediate risk of malignancy (10% to <50%) - needs ultrasound specialist review or MRI as well as management by a gynecologist with gynecological oncology support or solely by a gynecological oncologist

- Unilocular cyst with a solid component, any size, 1-3 papillary projections, any color score
- Multilocular cyst with solid component, any size, color score 1-3
- Multilocular cyst without solid component
- >10 cm, smooth inner wall with color score 1-3
- any size smooth inner wall with color score of 4
- any size with an irregular inner wall or irregular septations of any color score
- solid smooth lesion of any with color score 2-3.

O- Rads Us 5:

Lesions with a high risk of malignancy (≥50%) - needs a referral to a gynecological oncologist

- presence of ascites / peritoneal nodularity
- unilocular cyst with 4 or more papillary projections
- multilocular cyst with a solid component
- solid lesion - some criteria apply - color score 4
- solid irregular lesion of any size.

Color scoring (CS) indicator

- CS1: no flow
- CS2: minimal flow
- CS3: moderate flow
- CS4: strong flow. [20]

Iota Ultrasound Rules For Ovarian Masses:

Benign features : If an ovarian lesion has at least one of these features and no malignant features it can be confidently considered benign :

- Unilocular cyst
- Smooth multilocular tumor <10 cm
- Solid components <7 mm in diameter
- Presence of acoustic shadows
- No detectable doppler signal.

Malignant Features: If an ovarian lesion has at least one of these features and no benign features it can be confidently considered malignant :

- Irregular solid tumor
- Irregular multilocular solid mass >10 cm in diameter
- ≥4 papillary structures
- Ascites
- High doppler signal (color score 4). [13]

2. Study Procedure:

Retrospective Study Component :

Ultrasound reports of patients who were diagnosed with adnexal lesions will be retrieved from the medical records of the radiology department for the period February 2022 to November 2022. The medical records of each patient meeting the study criteria will be retrieved and ultrasound images will be collected. Lesions will be assigned category based on O-RADS and IOTA classification systems. Ca-125 and histopathological reports for those patients will be collected and interpreted. Data will be collected for each included patient and study proforma will be completed.

Prospective Study Component :

All patients referred to Radiology Department with clinical suspicion of adnexal masses lower abdominal pain will be screened. Among these patients, those who satisfy the study inclusion criteria will be informed about the study and after obtaining an informed consent, a study proforma will be

completed for every patient included in this study.

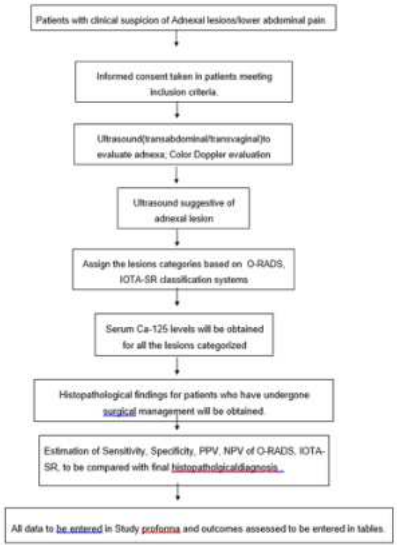
3. Study Imaging Protocol:

Prospective patients will be subjected to USG in Philips Affiniti 70 and 50 machines (Best, Netherlands). Trans abdominal/ Trans vaginal sonography will be performed.

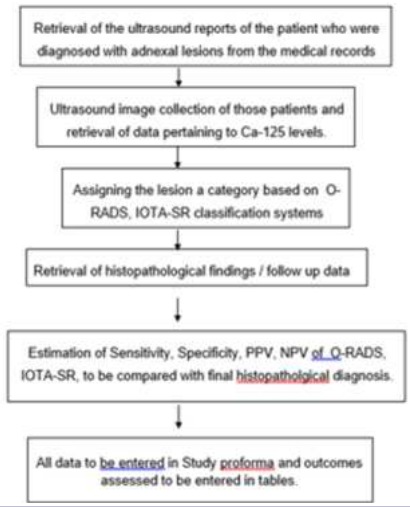
Colour Doppler will be used to assess vascularity of the lesions. Retrospective patients could have already undergone imaging in the same machines in our institute.

4. Study Statistical Analysis Plan:

- All study data from the study proforma sheets will be entered into master chart MS excel sheet.
- All the qualitative parameters like will be represented with frequencies and percentages.
- All the quantitative parameters like age, CA125 (U/ml), etc., will be presented with mean, median and standard deviation.
- Chi-Square test for measure of association to find the association between qualitative parameters we will use
- Diagnostic statistics such as Sensitivity, Specificity, PPV, NPV, Accuracy will be obtained for O-RADS, IOTA SR and CA125 and compared with the final histopathology diagnosis.
- The data will be entered using M.S. Office and the analysis will be performed by using SPSS 19.0v. P value less than 0.05 will be considered as significant.
- All the information derived from the data will be represented with relevant graphs.



5. Study Flow Chart-prospective Study:(figure :3)



6. Study Flow Chart-retrospective Study: (figure :4)

RESULTS:

A total of 55 patients included in the study,

Age Distribution Among Study Population

Most of the patients in the study belong to the age group of <= 40 years (50.9%). followed by 51 years and above (27.3%) and 41-50 years (21.8%).

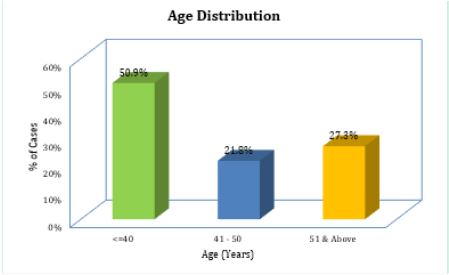


Fig 5: Age distribution among study population:

Table 1: Percentage of subjects assigned with each O-RADS category

O-RADS	No. of Subjects	Percentage
O-RADS 2	20	36.4%
O-RADS 3	11	20.0%
O-RADS 4	11	20.0%
O-RADS 5	13	23.6%
Total	55	

Out of 55 patients included in the study, the number of subjects categorized under O-RADS 2, O-RADS 3, O-RADS 4, and O-RADS 5 were 20 (36.4%), 11 (20%), 11 (20%), and 13 (23.6%), respectively.

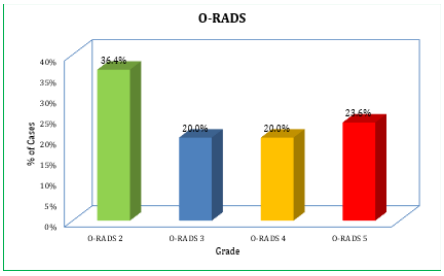


Fig 6: Percentage of subjects assigned with each O-RADS category

Table 2: Percentage of subjects assigned with each IOTA category

IOTA	No. of Subjects	Percentage
Benign	32	58.2%
Inconclusive	9	16.4%
Malignant	14	25.5%
Total	55	

Out of 55 patients included in the study, 32 subjects (58.2%) were classified under the benign category, 14 subjects (25.5%) under the malignant category, and 9 subjects (16.4%) under the inconclusive category according to the IOTA-SR classification.

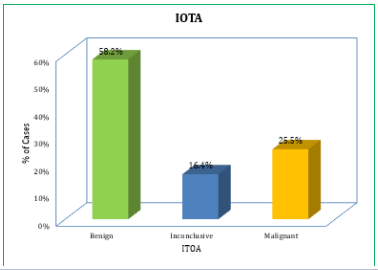


Fig 7: Percentage of subjects assigned with each IOTA category

Table 3: Percentage of study population Vs Histopathology diagnosis

Histopathology	No. of Subjects	Percentage
Benign	29	52.7%
Malignant	26	47.3%
Total	55	

It was observed that out of 55 subjects with adnexal lesions, 29 lesions (52.7%) were diagnosed as benign and 26 lesions (47.3%) were diagnosed as malignant on histopathology.

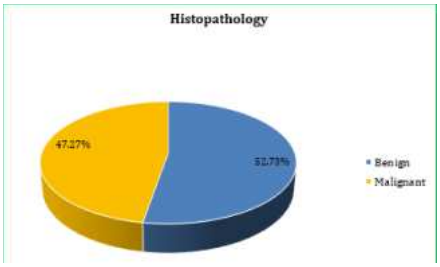


Fig 8: Percentage of study population Vs Histopathology diagnosis

Table 4: Age group Vs Histopathology

Age (Years)	Histopathology		Total
	Benign	Malignant	
<=40	26	2	28
41 - 50	2	10	12
51 & Above	1	14	15
Total	29	26	55
P Value	<0.001		
(Chi-Square test)			

In this study, the majority of the lesions diagnosed as benign on histopathology were in the age group <=40 years (89.7%), with the other age groups of 41-50 years and 51 and above years accounting for 6.9% and 3.4%, respectively. For lesions diagnosed as malignant on histopathology, the majority of the subjects were in the age group of 51 years and above (53.8%), with the other age groups of <=40 years and 41-50 years accounting for 7.7% and 6.9%, respectively. The trends were significant with a p-value of less than 0.001.

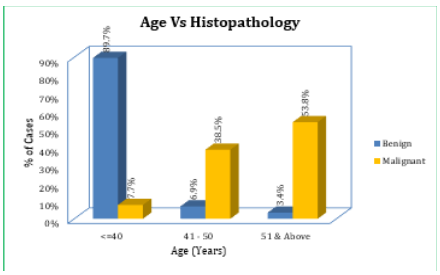


Fig 9: Age group Vs Histopathology

Table 5: Parameter Vs Histopathology

Parameter	Histopathology		P Value (Chi-Square test)
	Benign	Malignant	
Simple	2	0	0.173
Classic Lesions	20	1	<0.001
Unilocular	4	4	0.867
Multilocular	3	10	0.014
Solid Component	0	9	0.001
Solid Lesion	0	11	<0.001
Papillary Projection	0	5	0.013
Acoustic Shadows	10	1	0.005
Ascites	0	4	0.028

In the study, when different variables/parameters and the final histopathological diagnosis were compared, the trends were significant with a p-value of less than 0.001 in cases of classic lesions, where out of 21 cases, 20 cases were histopathologically proven to be benign, and all solid lesions in this study were proven to be malignant on histopathology.

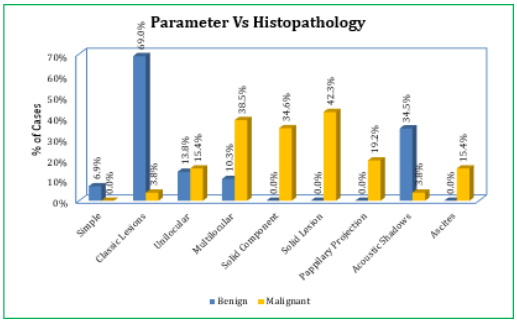


Fig 10: Parameter Vs Histopathology

Table 6: Colour score Vs Histopathology

Colour Score	Histopathology		Total
	Benign	Malignant	
Score 1	28	10	38
Score 2	1	3	4
Score 3	0	5	5
Score 4	0	8	8
Total	29	26	55
P Value	<0.001		
(Chi-Square test)			

In the study, when the color score and the final histopathological diagnosis were compared, all lesions with color scores 3 and 4 were proven to be malignant. Out of the 38 lesions assigned a color score of 1, 28 lesions were proven to be benign. The trends were significant with a p-value of less than 0.001.

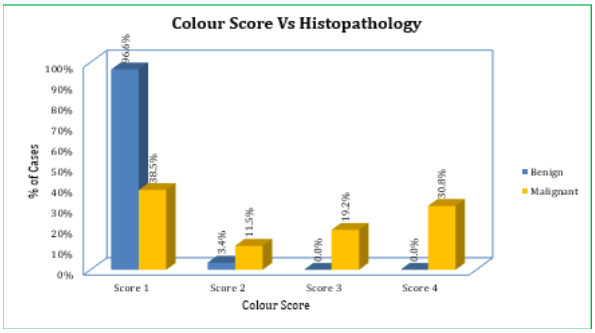


Fig 11: Colour score Vs Histopathology

Table 7: O-RADS categories Vs Histopathology

O-RADS	Histopathology		Total
	Benign	Malignant	
O-RADS 2	20	0	20
O-RADS 3	8	3	11
O-RADS 4	1	10	11
O-RADS 5	0	13	13
Total	29	26	55
P Value	<0.001		
(Chi-Square test)			

Out of the total 29 lesions that were benign on histopathology, O RADS 2 was assigned to 20 lesions. Out of the total 26 lesions that were malignant on histopathology, O RADS 5 was assigned to 13 lesions, and O RADS 4 was assigned to 10 lesions. It was observed that all the 20 lesions assigned to the O RADS 2 category were benign, and all the lesions assigned to the O RADS 5 category were malignant. The trends were significant with a p-value of less than 0.001.

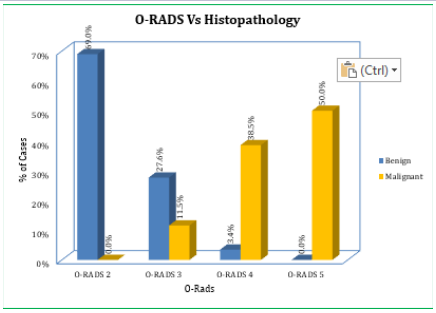


Fig 12: O-RADS categories Vs Histopathology

Table 8: O-RADS Vs Histopathology

O-RADS	Histopathology		Total
	Benign	Malignant	
Benign	28	3	31
Malignant	1	23	24
Total	29	26	55
Sensitivity	88.5%		
Specificity	96.6%		
PPV	95.8%		
NPV	90.3%		
Accuracy	92.7%		

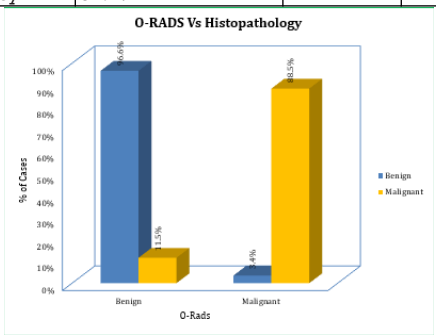


Fig 13: O-RADS Vs Histopathology

Table 9: IOTA Vs Histopathology

IOTA	Histopathology		Total
	Benign	Malignant	
Benign	28	4	32
Inconclusive	1	8	9
Malignant	0	14	14
Total	29	26	55
P Value	<0.001		
(Chi-Square test)			

Under IOTA simple rules, out of 32 lesions assigned to the benign category, 28 lesions were proven to be benign, and 4 lesions were proven to be malignant. Out of 14 lesions assigned to the malignant category, all the lesions were proven to be malignant. Out of 9 lesions assigned to the inconclusive category, 8 lesions were proven to be malignant, and 1 lesion was benign. The trends were significant with a p-value of less than 0.001.

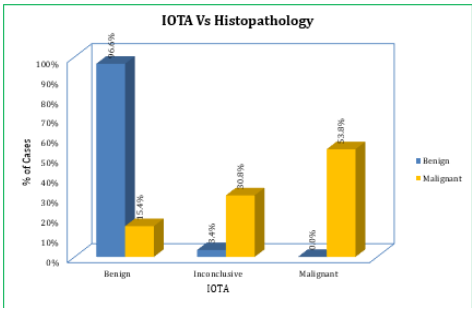


Fig 14: IOTA Vs Histopathology

Table 10: IOTA Vs Histopathology considering inconclusive lesions as malignant

IOTA	Histopathology		Total
	Benign	Malignant	
Benign	28	4	32
Malignant	1	22	23
Total	29	26	55
Sensitivity	84.6%		
Specificity	96.6%		
PPV	95.7%		
NPV	87.5%		
Accuracy	90.9%		

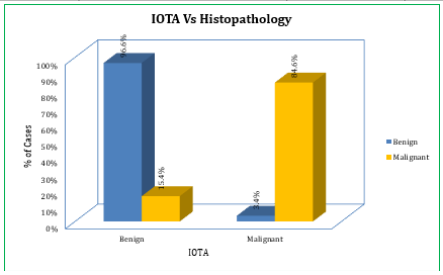


Fig 15: IOTA Vs Histopathology considering inconclusive lesions as malignant

Table 11: Area under the curve CA 125

Area Under the Curve CA 125				
Area	Std. Error[a]	Asymptotic Sig.[b]	Asymptotic 95% Confidence Interval	
			Lower Bound	Upper Bound
.946	.027	.000	.892	.999
Cut off Value	69			
Sensitivity	80.8%			
Specificity	96.6%			

The cut off value for CA-125 came out to be 69. Area under the curve 0.946 with a standard error of 0.027. Sensitivity and specificity were 80.8% and 96.6%.

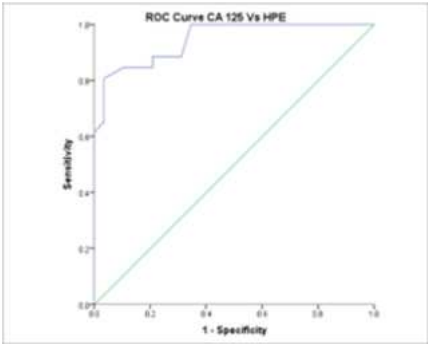


Fig 16: ROC Curve CA 125 Vs HPE.

Illustrations:

Illustration-1

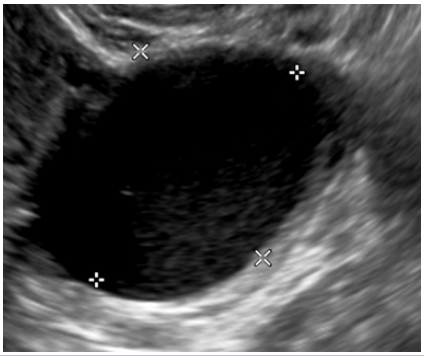


Fig 17: 36-year-old woman presented with dysmenorrhea and back pain, ultrasound image demonstrating a unilocular cyst containing low level homogeneous internal echoes in left ovary. The lesion was assigned 0-RADS 2 category. Under IOTA-SR, classified as B5. Histopathology proved to be endometrioma, which is a benign lesion.

Illustration-2

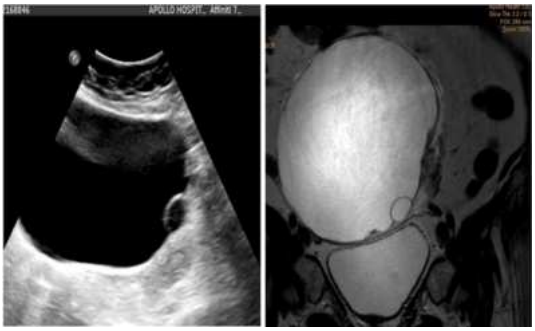


Fig 18: 42-year-old woman presented with feeling of fullness in her abdomen, ultrasound image demonstrating a well-defined cystic lesion with few peripheral loculations in the pelvis. The lesion was in the midline .No solid components.. No demonstrable vascularity. The lesion was assigned 0-RADS 3 category. Under IOTA-SR, classified as B5. Intraoperative findings revealed torsion of the cyst. Histopathology proved to be serous cystadenoma.

Illustration-3

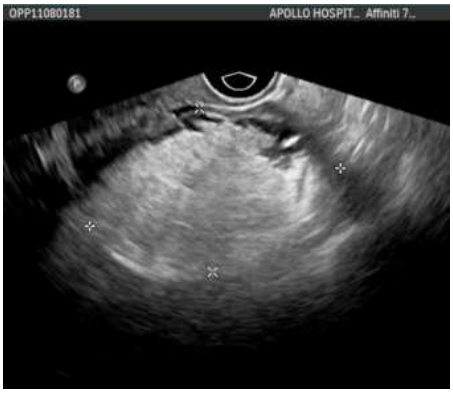


Fig 19: 34-year-old woman presented with feeling of fullness in her abdomen, ultrasound image demonstrating a well-defined cystic lesion measuring 68 x 40 mm, with diffusely hyperechoic internal component showing acoustic shadowing. The lesion is abutting right ovarian tissue. The lesion was assigned 0-RADS 2 category. Under IOTA-SR, classified as B4 B5. Histopathology proved to be dermoid.

Illustration-4

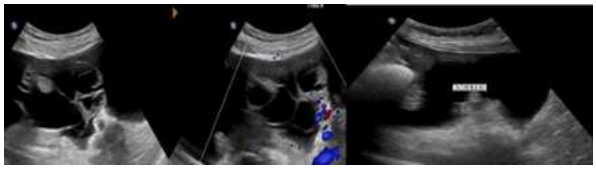


Fig 20: 60 year-old woman presented with abdominal distension, ultrasound image demonstrating multilocular cystic lesion with internal solid components and papillary projections. Color uptake was noted within the solid components. Color score score was given as 3. Moderate ascites was noted. The lesion was assigned 0-RADS 5 category. Under IOTA-SR, classified as M2 M4. Histopathology diagnosis was serous cystadenocarcinoma.

Illustration-5

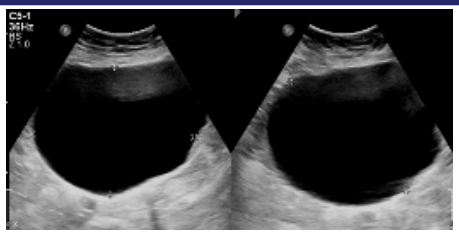


Fig 21: 38 year-old woman presented with lower abdominal pain, ultrasound image demonstrating unilocular cystic lesion in right adnexa. No internal solid component/papillary projections noted. The lesion was assigned 0-RADS 3 category. Under IOTA-SR, classified as B1. Histopathology diagnosis was serous cystadenoma.

Illustration-6

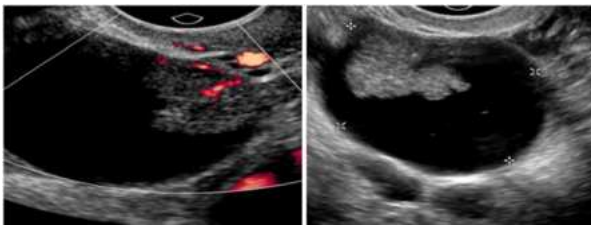


Fig 22: 42 year-old woman presented with lower abdominal pain and fullness, ultrasound image demonstrating unilocular lesion with internal lobulated solid component and few papillary projections in left adnexa. Color uptake was noted with the solid component. The lesion was assigned 0-RADS 4 category. Under IOTA-SR, classified as indeterminate. Histopathology diagnosis was seromucinous tumor with features of malignancy.

Illustration-7

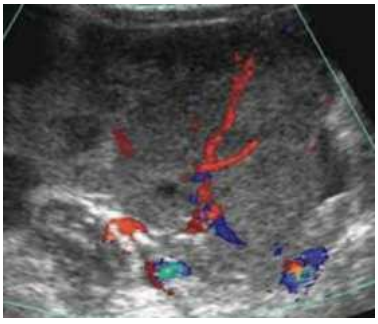


Fig 23:55 year-old woman presented with lower abdominal pain and fullness, ultrasound image demonstrating irregular solid lesion with colour score of 4 in the right adnexa. Ovaries are not distinctly visualised. The lesion was assigned 0-RADS 5 category. Under IOTA-SR, classified as M1M5 . Histopathology proved to be endometrioid carcinoma

DISCUSSION

This was a hospital-based study to evaluate the diagnostic efficacy of O-RADS-US in distinguishing benign and malignant adnexal masses. In our study, 55 patients with adnexal lesions were included, and histopathological diagnosis was obtained in all cases, serving as the gold standard.

The youngest patient in the study was 26 years old, while the eldest was 65 years.

The primary objective of the study was to calculate the sensitivity, specificity, positive predictive value, negative predictive value, and accuracy of the O-RADS classification system in distinguishing benign from malignant lesions. The sensitivity, specificity, PPV, NPV, and accuracy of the O-RADS classification system were found to be 88.5%, 96.6%, 95.8%,

90.3%, and 92.7%, respectively.

In the study conducted by **Pelayo, M et al**[14] **,** the sensitivity was reported as 90.2%, which is similar to the sensitivity achieved in our study.

In our study, all the 20 lesions assigned to O RADS 2 category were benign on histopathology. This is in concordance with the study conducted by **Hack K et al** [5] where the proportion of malignancy for O-RADS 2 was 0% (0 out of 100). Similarly, the study conducted by **Basha MAA et al**[9] **,** showed a percentage of malignancy in O-RADS 2 as 0.4%, while the study conducted by **Cao L et al**[2], showed a low malignancy risk of less than 1% for O-RADS 2.

100% of O-RADS category 2 lesions were found to be benign, as confirmed by surgical excision, supporting the safety of the stratified management paradigms in O-RADS.

Table 12:

	Sensitivity	Specificity
Cao L et al[2]	98.7 %	83.2 %
Hack K et al[5]	99 %	70 %
Vara J et al[15]	97 %	77 %

Most of the studies showed a sensitivity of 70 to 99 % and specificity of 60 to 95 %. Our study was in concordance with most of the studies.

One of the secondary objectives of our study was to calculate the sensitivity, specificity, positive predictive value (PPV), negative predictive value (NPV), and accuracy of the IOTA-SR classification system in distinguishing benign from malignant lesions. The sensitivity, specificity, PPV, NPV, and accuracy of the IOTA-SR classification system were 84.6%, 96.6%, 95.7%, 87.5%, and 90.9%, respectively. These results are in agreement with the study conducted by **Auekitrungrueng R et al**[16]**.** where the sensitivity and specificity were reported as 83.8% and 92%.

In the study conducted by **Garg S et al**[17], the sensitivity for the detection of malignancy in cases where IOTA simple rules were applicable was 91.66%, and the specificity was 84.84%.

Table 13:

	Sensitivity	Specificity
Pelayo, M et al[14]	87.8 %	69.7 %
Garg S et al[17]	91.6 %	84.8 %
Auekitrungrueng R et al[16]	83.8 %	92 %

In our study, the sensitivity was found to be similar to that of most previous studies. However, the specificity in our study was higher when compared to the majority of the studies.

Comparison of the sensitivity, specificity, Positive predictive value, Negative predictive value and accuracy of O-RADS and IOTA-SR classification systems is another secondary objective of our study.

Our study-
Table :14

	Sensitivity	Specificity
0-RADS -US	88.5 %	96.6 %
IOTA	84.6 %	96.6 %

Other studies-
Basha MAA et al[9]
Table :15

	Sensitivity	Specificity
0-RADS -US	96.6 %	92.8 %
IOTA	92.1 %	93.2 %

Hiett, A.K et al [18]
Table :16

	Sensitivity	Specificity
0-RADS –US	100 %	46.4 %
IOTA	95.6 %	79.1 %

Xie WT et al [19]
Table :17

	Sensitivity	Specificity
0-RADS -US	94.42 %	66.3 %
IOTA	94.42 %	71.74 %

Most of the studies showed that 0-RADS compares favorably with IOTA-SR. For instance, in the study by **Basha MAA**[9] ,it was demonstrated that 0-RADS had significantly higher sensitivity for malignancy than IOTA. However, in the study by Xie **Xie WT et al (2022)**[19] **,** their findings showed that IOTA-SR was more effective than 0-RADS.

- In our study, we found that 0-RADS compares favorably with IOTA-SR. Specifically, O-RADS showed slightly higher sensitivity and accuracy with similar specificity when compared to IOTA-SR. However, one main drawback of the IOTA classification system that we observed was its tendency to assign indeterminate or inconclusive categories for a few lesions. In our study, all the indeterminate lesions were considered malignant.
- Another secondary objective of our study was to determine whether CA-125, in combination with 0-RADS, can be useful in differentiating benign from malignant lesions. To establish this, we determined the best cut-off value for CA-125 using a receiver operating characteristic curve (ROC), and the optimal cut-off reference value was found to be 69 U/ml. The sensitivity and specificity for this combined approach were 80.8% and 96.6%, respectively.
- CA-125 levels were found to be increased in most of the cases that were assigned O-RADS 4 and O-RADS 5 and later confirmed to be malignant on histopathology. Conversely, CA-125 levels were low in three cases that were assigned O-RADS 4 and O-RADS 5 but were proven to be malignant on histopathology. However, it is worth noting that CA-125 levels can also be increased in some benign lesions, such as endometriosis.
- In conclusion, combining the serum levels of CA125 with ultrasound features may have a more significant diagnostic value in distinguishing benign from malignant ovarian lesions. Nevertheless, it cannot be solely relied upon as an indicator, as CA-125 levels may also be elevated in certain benign ovarian lesions. A comprehensive approach that considers both CA-125 and ultrasound findings is essential for accurate diagnosis and management.

Limitations of our study with recommendations for further study

- A larger sample size could have allowed for a more comprehensive evaluation of the modalities across a broader population and a wider spectrum of diseases.
- A critical limiting factor in the examination of ovarian masses is the radiologist's experience, which may influence the diagnostic performance of ultrasound. To address this concern in future studies, each imaging study should be independently analysed by two observers who are blind to the final histological diagnosis. Additionally, conducting statistical analysis of interobserver variation and agreement would be beneficial.
- Certain women were excluded from the study, including those with incomplete evaluations (O-RADS 0), normal ovaries (O-RADS 1), insufficient follow-up data, and poor image quality. This omission might have led to a selection bias, potentially resulting in fewer benign adnexal lesions being represented in the study. To address this concern and validate the findings, a large multicenter randomized controlled trial is necessary.
- Since histopathology was considered the gold standard in

our study, only women who underwent surgery were included. Notably, lesions classified as O-RADS 2 and O-RADS 3, which were advised for follow-up, were not included in the study. This limitation could be overcome by conducting a study over a more extended duration to include these cases.

- Another limitation of our study is that we only utilized CA125 among all other tumor markers. Future studies should consider incorporating a broader panel of tumor markers to enhance the comprehensiveness and accuracy of the analysis.

Financial Support And Sponsorship: Nil.
Conflicts Of Interest: There are No conflicts of interest.

REFERENCES:

1. Sadowski EA, Rockall AG, Maturen KE, Robbins JB, Thomassin-Naggara I. Adnexal lesions: Imaging strategies for ultrasound and MR imaging. DiagnInterv Imaging. 2019;100(10):635-646.
2. Cao L, Wei M, Liu Y, Fu J, Zhang H, Huang J, et al. Validation of American College of Radiology Ovarian-Adnexal Reporting and Data System Ultrasound (O-RADS US): analysis on 1054 adnexal masses. Gynecol Oncol.2021.
3. Choi JI, Park SB, Han BH, et al. Imaging features of complex solid and multicystic ovarian lesions: proposed algorithm for differential diagnosis. Clin Imaging. 2016;40(1):46-56.
4. Andreotti RF, Timmerman D, Benacerraf BR, Bennett GL, Bourne T, Brown DL, et al. Ovarian-adnexal reporting lexicon for ultrasound: a white paper of the ACR ovarian-adnexal reporting and data system committee. J Am CollRadiol. 2018;15(10):1415–29.
5. Hack K, Gandhi N, Bouchard-Fortier G, et al. External Validation of O-RADS US Risk Stratification and Management System. Radiology. 2022;304(1):114-120.
6. Morgan R.J., Armstrong D.K., Alvarez R.D., Bakkum-Gamez J.N., Behbakht K., Chen L.M., Copeland L., Crispens M.A., De Rosa M., Dorigo O., et al. Ovarian cancer, version 1.2016: Clinical practice guidelines in oncology. JNCCN J. Natl. Compr. Cancer Netw. 2016;14:1134–1163. Doi: 10.6004/jnccn.2016.0122.
7. Alsop K., Fereday S., Meldrum C., defazio A., Emmanuel C., George J., Dobrovic A., Birrer M.J., Webb P.M., Stewart C., et al. BRCA mutation frequency and patterns of treatment response in BRCA mutation-positive women with ovarian cancer: A report from the Australian ovarian cancer study group. J. Clin. Oncol. 2012;30:2654–2663.
8. Brown DL, Dudiak KM, Laing FC. Adnexal masses: US characterization and reporting. Radiology. 2010;254(2):342-354.
9. Basha MAA, Metwally MI, Gamil SA, Khater HM, Aly SA, El Sammak AA,et al. Comparison of O-RADS, GI-RADS, and IOTA simple rules regarding malignancy rate, validity, and reliability for diagnosis of adnexal masses. EurRadiol. 2021;31(2):674–84.
10. Sadowski EA, Maturen KE, Rockall A, et al. Ovary: MRI characterisation and O-RADS MRI. Br J Radiol. 2021;94(1125):20210157.
11. Sadowski EA, Thomassin-Naggara I, Rockall A, Maturen KE, Forstner R, Jha P, Nougaret S, Siegelman ES, Reinhold C. O-RADS MRI Risk Stratification System: Guide for Assessing Adnexal Lesions from the ACR O-RADS Committee. Radiology. 2022 Apr;303(1):35-47.
12. Van Gorp T, Cadron I, Despierre E, Daemen A, Leunen K, Amant F, Timmerman D, De Moor B, Vergote I. HE4 and CA125 as a diagnostic test in ovarian cancer: prospective validation of the Risk of Ovarian Malignancy Algorithm. Br J Cancer. 2011 Mar 1;104(5):863-70. doi: 10.1038/sj.bjc.6606092. Epub 2011 Feb 8. PMID: 21304524; PMCID: PMC3048204.
13. Kulkarni AM, Mehravaran S, Lee SY. IOTA Simple Rules: Review of 10 Points for Evaluation of Adnexal Masses. Radiographics. 2022;42(1):E29-E30.
14. Pelayo, M.; Pelayo-Delgado, I.; Sancho-Sauco, J.; Sanchez-Zurdo, J.; Abarca-Martinez, L.; Corraliza-Galán, V.; Martin-Gromaz, C.; Pablos-Antona, M.J.; Zurita-Calvo, J.; Alcázar, J.L et al. Comparison of Ultrasound Scores in Differentiating between Benign and Malignant Adnexal Masses. Diagnostics 2023, 13, 1307.
15. Vara J, Manzour N, Chacón E, López-Picazo A, Linares M, Pascual MÁ, Guerriero S, Alcázar JL. Ovarian Adnexal Reporting Data System (O-RADS) for Classifying Adnexal Masses: A Systematic Review and Meta-Analysis. Cancers (Basel). 2022 Jun 27;14(13):3151.
16. Auekitrungrueng r, tinnangwattana d, tantipalakorn c, charoenratana c, lerthiranwong t, wanapirak c, et al. Comparison of the diagnostic accuracy of international ovarian tumor analysis simple rules and the risk of malignancy index to discriminate between benign and malignant adnexal masses. Int j gynaecol obstet. 2019;146(3):364–9.
17. Garg s, kaur a, mohi jk, sibia pk, kaur n. Evaluation of iota simple ultrasound rules to distinguish benign and malignant ovarian tumours. J clindiagn res. 2017;11(8):tc06–9.
18. Hiett, A.K., Sonek, J.D., Guy, M. and Reid, T.J et al . (2022), Performance of IOTA Simple Rules, Simple Rules risk assessment, ADNEX model and O-RADS in differentiating between benign and malignant adnexal lesions in North American women. Ultrasound Obstet Gynecol, 59: 668-676.
19. Xie WT, Wang YQ, Xiang ZS, et al. Efficacy of IOTA simple rules, O-RADS, and CA125 to distinguish benign and malignant adnexal masses. J Ovarian Res. 2022;15(1):15. Published Jan 2022.
20. Trachowski LM, Jha P, Chawla TP, et al. O-RADS for Ultrasound: A User's Guide, From the AJR Special Series on Radiology Reporting and Data Systems. AJR Am J Roentgenol. 2021;216(5):1150-1165.