New Ultrasound Gynecological Reporting Data System (GIRADS) and Ovarian Reporting Data System (ORADS) for Distinguishing Adnexal Masses

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Abstract

Background: Adnexal masses are considered common gynaecologic clinical problems. Most lesions are benign necessitating conservative management and follow-up. Ovarian cancer is considered the most lethal gynaecological cancer in women. Annually, it is responsible for an estimated 152,000 deaths, and 239,000 new cases are recorded worldwide. In Egypt, it accounts for 4.1% of all cancers affecting women, considering it one of the most common diagnosed cancers among the Egyptian females [. Typic- ally, ovarian cancer presents at late stage when its 5-year survival rate is less than 30%. GI-RADS classification system for adnexal masses, in which GI-RADS 1 was considered definitely benign, GI-RADS 2 very probably benign, GI-RADS 3 probably benign, GI-RADS 4 probably malignant, and GI-RADS 5 very probably malignant. Findings suggestive of malignancy included thick pap- illary projections, thick septa, solid areas with/without ascites and vascularization within solid areas, papillary projections or central area of a solid tumour on colour or power Doppler assessment as defined according to the International Ovarian Tumour Analysis criteria(IOTA).

Keywords: febrile neutropenia, management

Introduction

Adnexal masses are considered common gynaecologic clinical problems. Most lesions are benign necessitating conservative management and follow-up. Ovarian cancer is considered the most lethal gynaecological cancer in women. Annually, it is responsible for an estimated 152,000 deaths, and 239,000 new cases are recorded worldwide. In Egypt, it accounts for 4.1% of all cancers affecting women, considering it one of the most common diagnosed cancers among the Egyptian females [. Typic- ally, ovarian cancer presents at late stage when its 5-year survival rate is less than 30% (**1).**

Adnexal masses are identified primarily by ultrasound. However, since the ultrasound is operator-dependent and the diagnosis of adnexal masses has been usually left to the examiners' impression, many scoring systems, re- gression models, and neural networks have been suggested for better diagnosis (**2).**

In 2009, Amor and colleagues proposed the Gynaecol- ogy Imaging Reporting and Data System, to enhance the communication between radiologists and clinicians. This classification is based on summarized standardized report of ultrasound findings which could provide an estimated risk of malignancy for the examined adnexal mass (**3).**

Accurate pre-operative assessment of women with ad- nexal masses is crucial for ovarian reserve in case of non- malignant pathologies particularly in young fertile women. Also, the precise determination of the characteristics of the adnexal masses is important in cases when laparos- copy replaces laparotomy because aseptic oncologic methods have to be followed to prevent rupture of ad- nexal malignant masses. Further, pre-operative suspi- cion of ovarian cancer enables the examiners to do another imaging modality for proper characterization and staging of the lesions as well as improvement of survival rates (**4).**

We assessed the morphological and colour Doppler find- ings of the lesions. The morphological criteria included the site of the lesion, size, the echopattern, the presence of associated solid component, and the

presence of septa or papillary projections. The colour Doppler was used to de- tect the vascularity, high or low, and vessel arrangement, central or peripheral. Absent or mild peripheral vascular- ity was considered benign; however, abnormal central vas- cularity of the solid component was considered suspicious lesions **(5).**

We used GI-RADS classification system for adnexal masses, in which GI-RADS 1 was considered definitely benign, GI-RADS 2 very probably benign, GI-RADS 3 probably benign, GI-RADS 4 probably malignant, and GI-RADS 5 very probably malignant (**6).**

Findings suggestive of malignancy included thick pap- illary projections, thick septa, solid areas with/without ascites and vascularization within solid areas, papillary projections or central area of a solid tumour on colour or power Doppler assessment as defined according to the International Ovarian Tumour Analysis criteria(IOTA) **(7).**

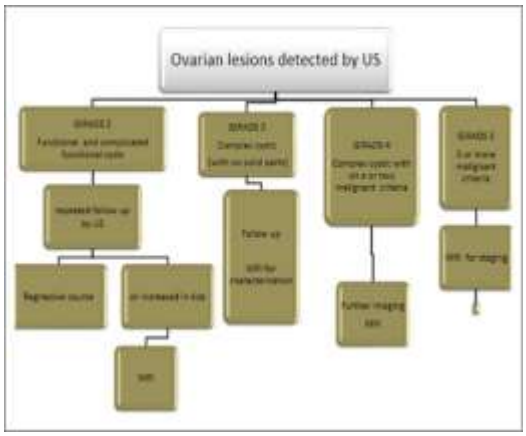

Fig. 1 Suggested algorithm for the

Figure 1: Suggested algorithm for the diagnosis of ovarian lesions **(8)**

Reporting of the precise diagnosis of adnexal masses is an important issue in clinical practice, as inaccurate diagnosis might lead to unnecessary examinations and surgeries, and appropriate diagnosis improves the com- munication between the medical team and leads to bet- ter outcome **(9).**

The examination required filling of the urinary bladder (ideal 1–2 cm above the uterine fundus). Images were ob- tained in sagittal and transverse planes (oblique image may be needed). To view the adnexa, we moved the trans- ducer from side to side. Transvaginal sonography (TVS) using a 4–8-MHz endoluminal probe after emptying the urinary bladder to minimize discomfort and to bring the uterus and ovaries into the focal zone was performed. The probe was disinfected, ultrasound (US) gel was applied to the transducer head, and a condom was used. Anteropos- terior and transverse pelvic planes were done. Colour and power Doppler were done for all cases to detect the vascu- larity of the lesions and to differentiate between suspicious solid component and benign lesions **(10).**

Ovarian Reporting Data System (ORADS)

Clinical presentation and pertinent laboratory analysis often determine the appropriate imaging differential diagnostic considerations in evaluating anyone with ovaries presenting with pelvic symptoms. In patients with a positive pregnancy test, sonography is the modality of choice to evaluate the pregnancy and any complications. Sonography is also the modality of choice for evaluating patients who present with pelvic pain or a mass but are not pregnant. Pelvic sonography is the preferred imaging modality when an obstetrical or gynecologic etiology is suspected under American College of Radiology (ACR) Appropriateness Criteria **(11).**

Sonography is useful in evaluating for the presence of an adnexal mass as well as for mass characterization. For example, the sonographic appearance of a retracting clot and/or a reticular pattern without Doppler flow/vascularity is diagnostic of a hemorrhagic cyst. Most adnexal cysts are benign and are easily characterized by ultrasound. However, evaluation of indeterminate adnexal masses by an ultrasound expert is highly valuable. Published data supports the use of pattern recognition by an experienced ultrasound examiner as a highly accurate method of discriminating between benign and malignant adnexal

masses without the need for MRI. In particularly challenging cases, contrast-enhanced MRI may be helpful in differentiating between benign and malignant ovarian masses **(12).**

Ultrasound Imaging

In evaluating any pelvic mass, the first step is to determine if the mass is arising from the ovaries, the uterus, or another location. Once the anatomical origin is determined, imaging may be extremely helpful in establishing an accurate diagnosis. If the mass is of ovarian origin, for example, identifying its nature—cystic, solid, or complex—and ascertaining the presence of any fat or calcium in the mass will helps narrow the differential diagnoses **(13).**

Ultrasound is also invaluable for determining the cystic or solid nature of adnexal masses. Although a comprehensive discussion of all adnexal masses is beyond the scope of this pictorial review. In 2019, the Society of Radiologists in Ultrasound (SRU) updated its 2010 consensus statement on the management of asymptomatic ovarian and adnexal cysts **(14).**

More recently, the ACR convened a consensus panel on risk stratification of ovarian-adnexal masses and management using an O-RADS^{TM} classification system. This system is more comprehensive than the SRU system in that it not only makes recommendations for classifying simple cysts, but also includes recommendations for risk stratifying more complex adnexal cysts. The O-RADS system also provides a lexicon of ultrasound descriptors to characterize, and ultimately classify, adnexal masses **(15).**

For simple ovarian cysts in the premenopausal patient, the ACR recommends that 5-10 cm cysts be followed for 8-12 weeks to confirm their functional nature and to reassess for wall abnormalities. In postmenopausal females, simple cysts > 1 cm should be described but do not require follow-up imaging unless they are > 3 cm in size. The ACR O-RADS committee recommends a 1-year follow-up for 3-10 cm cysts in postmenopausal females. The complete review of this most recent SRU update and the O-RADS committee can be found in references 2 and 3 **(16).**

While other guidelines in the literature are used for ultrasound evaluation of ovarian masses, the O-RADS system has been selected for review for multiple reasons. First, it provides an evidence-based standard lexicon for the use of terms that give a consistent diagnosis. Risk stratification is based upon the application of descriptors that are most predictive of malignancy from a large database, including pathology correlation with the International Ovarian Tumor Analysis (IOTA) group ultrasound rules for ovarian masses **(17).**

This system goes well beyond the SRU classification of simple cysts and considers other features of adnexal masses and corresponding management recommendations. In addition, it is ultrasound-based, providing risk stratification and management based on imaging appearance of cysts. Descriptors of appearance include pure cysts, multilocular cysts, and multilocular cysts with solid components or solid masses. O-RADS considers diameter of the mass, presence of acoustic shadowing, unilocular versus multilocular cysts, cystic masses with papillary projection or solid component/solid mass appearance, and scoring of mass vascularity.[3] Color flow is graded as follows: **(18)**

1. no flow;
2. minimal flow;
3. moderate flow; and
4. very strong flow.

Germ Cell Tumors

Dermoid cysts and teratomas are classified as germ cell tumors, account for 15-20% of all ovarian neoplasms and are rarely malignant. Teratomas may be mature or immature. Dermoid cysts are mature cystic teratomas that may have components from 3 germ-cell layers that predominantly include mature ectoderm elements **(19).**

Ultrasound and CT features of dermoids include cystic components, fatty elements, hair, and/or calcifications. Thus, a hyperechoic component with acoustic shadowing in a predominantly cystic mass on ultrasound is highly predictive of a dermoid cyst. These cysts can also demonstrate a variety of other sonographic features, including a hyperechoic component with acoustic shadowing, hyperechoic lines and

dots, or floating echogenic spherical structures. A Rokitansky nodule is a solid mass of sebaceous material projecting into the lumen of the mass. Most cases require no further evaluation upon identification of classic ultrasound or CT features of O-RADS 2 lesions **(20).**

Endometriomas

Endometriomas and hemorrhagic cysts may appear similar on sonography. However, hemorrhagic cysts may have characteristics of a retracting clot and/or reticular pattern of internal echoes. According to the recent O-RADS classification, masses with this characteristic pattern of a hemorrhagic ovarian cyst and < 5 cm without internal flow require no follow-up imaging. However, follow-up at 8-12 weeks is recommended for masses > 5 cm. Alternatively, endometriomas usually appear with ground glass, homogeneous, low-level, internal echoes with no solid components on ultrasound. Follow-up at 12 weeks is recommended in these cases **(21).**

Peritoneal Inclusion Cysts

One mimic of a surface epithelial neoplasm is a benign entity called a peritoneal inclusion cyst, which may be mistaken for a complex cystic ovarian mass. Peritoneal inclusion cysts represent fluid "trapped" within the peritoneal adhesions in patients with previous history of abdominal or pelvic surgery, Crohn disease, or prior pelvic inflammatory process. These "cysts" are not spherical, but they may be oblong with more acute angulations at their margins, as the fluid is interposed between different surfaces within the pelvis. History is helpful in such cases. There should be no mural nodularity. They need only be evaluated with ultrasound or, if detected with CT, they require no further evaluation **(22).**

Hydrosalpinx

Diagnostic ultrasound features of hydrosalpinx include visualization of a tubular structure with septations, or an S-shaped cystic mass separate from the ovary or uterus. Depending on transducer angulation, this adnexal mass may appear as a more rounded cystic structure. When seen in cross-section, the longitudinal folds produce a characteristic "cogwheel" appearance **(23).**

O-RADS 4 and 5 Lesions

Worrisome ultrasound features of O-RADS 4 and 5 lesions include the presence of multilocular cysts, solid components within the lesion, papillary projections, large size, and higher color flow grades. These features can be present in solid lesions such as sex cord tumors or ovarian metastases, Of these lesions, the most worrisome are surface epithelial neoplasms. These tumors constitute approximately 90% of all malignant ovarian tumors and include serous or mucinous cyst adenocarcinomas. Serous neoplasms have a higher frequency of malignancy than do mucinous neoplasms **(24).**

An unusual type of surface epithelial tumor with concerning features is the borderline tumor. These tumors are typically diagnosed pathologically after surgery. They occur in younger patients and have a 10-year survival rate as high as 95% **(25).**

Ultrasound plays a significant role in diagnosing ovarian and adnexal pathology. It is usually the screening modality of choice in these cases and may be useful in establishing a specific diagnosis in the nonpregnant patient. The SRU and ACR O-RADS^{TM} guidelines may be helpful in classifying simple ovarian cysts and other adnexal masses. In more problematic cases, consultation with an ultrasound expert and the addition of MRI may be warranted **(26).**

The accurate characterization of ovarian and other adnexal masses is essential for optimal patient management. Conservative and less aggressive management is more appropriate for lesions that are likely benign. On the other hand, when malignancy is suspected, patients should be referred to a gynecologic oncologist because this is known to result in better outcomes. The ultimate goal is to optimize ovarian cancer outcomes while minimizing unnecessary surgical procedures in patients at low risk of malignancy **(27).**

Consideration should be given to minimizing surgical morbidity and maintaining hormonal competency for patients at low risk for malignancy. A recent study of patients with asymptomatic tumors classified as benign by using US supports the use of expectant management as a valid option, which may reduce the number of surgical complications while minimizing health care costs. A consensus report by a

multidisciplinary panel of experts regarding management of adnexal masses published in 2017 also concluded that surgical procedures for benign lesions may be avoided with improvement in the preoperative assessment of these lesions **(28).**

Published studies, as well as expert consensus, support the use of pattern recognition by an experienced US examiner as the most accurate US method of discriminating between benign and malignant adnexal lesions. However, the level of expertise of practitioners who perform and interpret sonograms varies widely. Recognizing this offers an opportunity to improve risk stratification by establishing standardized and evidence-based risk assessment algorithms **(29).**

The American College of Obstetricians and Gynecologists recommendations now encourage more detailed use of US risk assessment by all practitioners, incorporating an elevated score on a formal risk assessment test that includes one of the US-based risk classification systems developed by the International Ovarian Tumor Analysis (IOTA) group. The IOTA group has developed evidence-based terms and definitions used in the Simple Rules classification system and Assessment of Different Neoplasias in the Adnexa (ADNEX) model to differentiate benign from malignant adnexal masses (**30).**

The IOTA Simple Rules are unable to classify all adnexal masses as either benign or malignant because another diagnostic method (such as evaluation by an expert US examiner) is required to categorize inconclusive masses in about 20% of patient cases, limiting its usefulness. However, the 10 US features referred to when applying the IOTA Simple Rules have now been incorporated in a mathematical model to calculate the likelihood of malignancy (**31).**

The preferred IOTA group mathematical model, the IOTA ADNEX model, calculates the likelihood not only of an adnexal mass being simply benign or malignant but also the likelihood of a mass being borderline malignant, a stage I primary invasive malignancy, a stage II–IV primary invasive malignancy, or a metastasis in the ovary from another primary tumor **(32).**

Although the predictive value of these rules and models is high (and has been externally validated and in common usage in Europe), their acceptance has been limited in clinical practice in the United States and Canada to date. This may be related to the preference for a so-called pattern recognition approach rather than a mathematical model (ADNEX), as well as the absence of more detailed guidance in the evaluation of many lesions that are almost certainly benign **(33).**

Other ovarian mass characterization and management systems have been proposed, including the Society of Radiologists in Ultrasound consensus statement; the University of Kentucky morphology index ; and the Gynecologic Imaging Reporting and Data System, or GI-RAD. The Society of Radiologists in Ultrasound consensus statement, popular in North America, is helpful in determining which cystic lesions require follow-up, further imaging, or a surgical procedure. However, the statement does not include standardized terminology and definitions, and does not recommend management for higher-risk lesions **(34).**

GI-RADS also does not provide objective criteria for all lesions. The morphology index by the University of Kentucky group defines objective morphology terms which, when combined with tumor volume, demonstrates good prediction of malignancy in ovarian tumors from an ovarian cancer screening population, but it has not been validated outside a single institution and is without widespread acceptance. This leaves an opportunity to create a universally recognized reporting tool based on common terminology, as well as a management system for all categories of risk **(35).**

The Ovarian-Adnexal Reporting and Data System (O-RADS) lexicon for US was published in 2018, providing a standardized lexicon that includes all pertinent descriptors and definitions of the characteristic US appearance of normal ovaries and ovarian or other adnexal lesions. The lexicon is based on consensus of the committee. Taking into consideration supporting evidence for the performance of different terminology used in the literature for the classification of a mass as benign or malignant, the committee members agreed on terms similar to those used in the IOTA models. We have now tested the descriptors used in the O-RADS lexicon on the large data set from phases 1–3 of the IOTA study to assign a risk of malignancy to each of them **(36).**

Those terms that were found to be useful in assigning risk of malignancy have been placed in a condensed lexicon table to facilitate risk stratification. Finally, with the use of other evidence-based supporting studies

in the literature that offer additional guidance differentiating management schemes in a variety of almost certainly benign lesions that include simple cysts, hemorrhagic cysts, dermoid cysts, endometriomas, paraovarian cysts, peritoneal inclusion cysts, hydrosalpinges, and O-RADS US working group consensus, we offer guidelines for management in the different risk categories **(37).**

The proposed guidelines are a collaborative, multidisciplinary, international approach incorporating both the common European and North American approaches. The guidelines include all risk categories with their attendant management strategies, which have not been included within any of the prior systems **(38).**

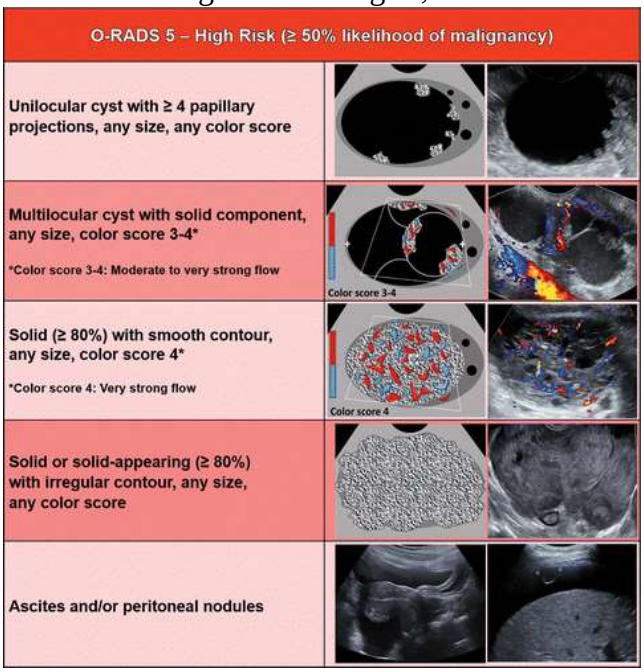

Figure 2: Image shows Ovarian-Adnexal Reporting and Data System (O-RADS) US category 5, high risk of malignancy **(39)**

Management

The O-RADS US classification system should aid the health care provider in deciding which lesions require no follow-up or conservative follow-up, often with the aid of a US specialist or the performance of a MRI study for optimal characterization, versus lesions that mandate consultation with a gynecologist or gynecologic oncologist. General agreement of committee members based on the literature and expert opinion was achieved through discussion during multiple conference calls following e-mail distributions in determining management strategies in each category. These are described in detail below **(40).**

- ✓ **O-RADS 0, Incomplete Evaluation**

Generally, a repeat US is recommended, although an alternate imaging study such as MRI may be appropriate in selected cases.

- ✓ **O-RADS 1, Normal Ovary**

No additional imaging or imaging follow-up is necessary.

- ✓ **O-RADS 2, Almost Certainly Benign (<1% Risk of Malignancy)**

Generally, either no follow-up or surveillance is the recommendation for lesions that are almost certainly benign. Further characterization by a US specialist or performance of an MRI study, as well as management by a gynecologist, may be advised in some subgroups **(41).**

- ✓ **Simple Cysts**

The simple cyst is a subset of unilocular cysts with a smooth thin wall, acoustic enhancement, and no internal elements (thus anechoic), as stated in the O-RADS US lexicon. Although simple cysts are not a separate category in the IOTA group data, there is strong support for a benign etiology in the literature. In a

recent nested case-controlled study by Smith-Bindman et al of 72 093 women who underwent pelvic sonography from 1997 to 2008, no simple cysts were diagnosed as cancer in women younger than 50 years (0 of 12 957 cysts), and only a single simple cyst was ultimately diagnosed as a malignancy in women over 50 years (one of 2349 simple cysts) at 3 years following US. Other large populations of patients with simple cysts have also been studied with similar findings, albeit predominantly in the ovarian cancer screening populations in postmenopausal women (**42).**

The committee agreed that no additional management is required for simple cysts less than or equal to 5 cm in diameter in premenopausal patients, and those less than or equal to 3 cm should be considered physiologic (consistent with normal physiology, ie, follicles). Because of the challenge of performing a consistently high-quality study in larger cysts and keeping in mind that the vast majority of these cysts are functional, the committee agreed that it is reasonable in the premenopausal patient to recommend a follow-up in 8–12 weeks for cysts greater than 5 cm but less than 10 cm to confirm its functional nature or to reassess for cyst wall abnormalities (more easily missed in cysts approaching 10 cm) **(43).**

In general, the proliferative phase is the optimal time for reevaluation, allowing involution of functional cysts to occur following menstruation. If the cyst persists or enlarges, then management by a gynecologist is suggested. At times, larger cysts may be incompletely evaluated by transvaginal US, and in these cases, it is important to perform a transabdominal examination or to indicate an incomplete evaluation due to size, location, or both, thus reverting to category 0 **(44).**

Because data confirm only the rare occurrence of malignancy in the sonographically demonstrated postmenopausal simple cyst, no further management is suggested in cysts up to 3 cm. For cysts greater than 3 cm but less than 10 cm, at least 1-year follow-up showing stability or decrease in size is recommended with consideration of annual follow-up for up to 5 years, if stable. If the cyst enlarges, then management by a gynecologist is suggested. However, there is currently a paucity of evidence for defining the optimal duration or time interval for surveillance **(45).**

- ✓ **Classic Benign Lesions and Associated Descriptors**

Once again, when certain classic benign features cited in the literature are encountered, one should use them to make a specific diagnosis. Trying to use other, more generic descriptors may lead to an incorrect diagnosis and inappropriate management. If these almost certainly benign lesions are not classic, then some may fall into risk categories that would require further characterization by referral to a US specialist or by performance of an MRI study. However, through this process, the correct diagnosis should be reached and these patients not overtreated. An example would be in the setting of a hydrosalpinx that may demonstrate the presence of what appears to be a complete septation or endosalpingeal fold misinterpreted as a solid component (**46).**

Hemorrhagic cysts.—Typical hemorrhagic cysts in the premenopausal age group that are less than or equal to 5 cm require no further management. When greater than 5 cm but less than 10 cm, follow-up in 8–12 weeks is recommended. If the cyst persists or enlarges, then referral for additional expertise to a US specialist or gynecologist, or the recommendation of an MRI study, is suggested. Hemorrhagic cysts should not occur in the postmenopausal population. Thus, when typical hemorrhagic cysts less than 10 cm in size are encountered in the postmenopausal age group, further evaluation by a US specialist, referral to a gynecologist, or performance of an MRI study is suggested **(47).**

Dermoid cysts and endometriomas. —Typical dermoid cysts and endometriomas that are less than 10 cm are managed similarly. In the premenopausal patient, an optional initial follow-up at 8–12 weeks may be helpful based on the confidence in the diagnosis and, if not removed surgically, annual US surveillance should be considered. These patients are usually under the care of a gynecologist. In the postmenopausal group, patients with a confident diagnosis of a dermoid cyst or endometrioma may be considered for annual US follow-up when not surgically excised **(48).**

However, in postmenopausal patients, the risk of malignancy and the risk of malignant transformation (ie, clear cell and endometroid carcinomas) are higher in endometriomas, so this risk should be considered when deciding management. If there is changing morphology or a developing vascular component within the lesion, then referral to a US specialist or performance of an MRI study is recommended in the

premenopausal age group and direct referral to MRI is recommended in the postmenopausal group. Similar to surveillance of postmenopausal simple and nonsimple smooth cysts, the optimal duration or interval of timing for surveillance has not been established **(49).**

Extraovarian cysts.—these include the paraovarian cysts, typical peritoneal inclusion cysts, and the typical hydrosalpinges of any size. Generally, no further follow-up is needed for simple paraovarian cysts with an optional follow-up at 1 year in the postmenopausal age group based on confidence in the diagnosis. If not simple, then the cyst should be managed according to O-RADS US ovarian cyst criteria. Management by a gynecologist is recommended for typical peritoneal inclusion cysts or hydrosalpinges **(50).**

- ✓ **Nonsimple Unilocular Smooth Cysts**

Unilocular cysts with smooth inner margins that are not simple and do not fall into any of the categories of classic benign lesions require no management in the premenopausal age group when less than or equal to 3 cm. A follow-up US in 8–12 weeks, in the proliferative phase if possible, is recommended for cysts greater than 3 cm and less than 10 cm. If the cyst persists or enlarges, then referral to a US specialist or performance of an MRI study should be considered for further characterization **(51).**

In the postmenopausal age group, although follow-up in 1 year is an option if the cyst is less than or equal to 3 cm, additional characterization of the fluid and inner margins of the cyst may be accomplished by a US specialist or an MRI study and should be considered for these cysts irrespective of the size. Management by a gynecologist is suggested for the larger premenopausal cysts greater than 3 cm and all postmenopausal nonsimple unilocular smooth cysts **(52).**

O-RADS 3 (1% to <10% Risk of Malignancy)

The vast majority of O-RADS 3 lesions (>90%) are benign and the committee agreed that there is no need for consultation with a gynecologic oncologist. Patients with this group of lesions should be managed by a general gynecologist, although it is important that optimal imaging evaluation be performed. Thus, consultation with a US specialist or performance of an MRI examination to minimize the risk of overlooking more suspicious features is encouraged by the O-RADS US management scheme **(53).**

O-RADS 4 (10% to <50% Risk of Malignancy)

Category 4 US findings (intermediate-risk lesions) warrant either consultation with gynecologic oncology prior to removal or referral for management. Menopausal status, US specialist evaluation, MRI characterization, and serum biomarkers (most commonly, CA-125) may play a role in deciding which of these lesions should be referred for management by a gynecologic oncologist. If a surgical procedure is to be performed by a general gynecologist, then it is recommended that the facility has the "necessary support and consultative services to optimize patient outcomes" **(54).**

O-RADS 5 (50%–100% Risk of Malignancy)

The system states that category 5 US findings (high-risk lesions) should be directly referred to a gynecologic oncologist for management. Although serum markers do play a role in evaluation, the O-RADS US committee purposely did not advocate for their routine use in the assessment based on lesion category, and they are not included in our risk stratification system. The committee felt that tumor marker evaluation should be individualized for each patient. For example, an elevated level of CA-125 in a premenopausal patient with an intermediate-risk lesion and a clinical scenario highly suspicious for endometriosis may unnecessarily elevate the concern for malignancy **(55).**

Likewise, a normal level of CA-125 may provide false reassurance in a postmenopausal woman with an intermediate- or high-risk category 4 or 5 lesion. Serum CA-125 levels are optional in the ADNEX model because they do not improve the overall model performance to distinguish between benign and malignant lesions. However, CA-125 improves subclassification of malignant lesions (eg, stage 2–4 invasive malignancies vs metastatic lesions). The committee also emphasizes that the O-RADS classification is not a substitute for performing a thorough history and physical examination and assessing the patient's need for additional testing. Although no classification system can completely encompass all aspects of the management of each patient with an adnexal lesion, O-RADS US more clearly defines referral criteria when compared with what has been previously published **(56).**

Conflicts of Interest: The authors declare no conflict of interest.

References

1. **Watanabe E, Tanaka K, Takeda N, et al. (2017) S**urgical technique to prevent spillage of cyst fluid during operation for cystic ovarian tumors. Pediatr Surg Int. 29:645–649
2. **Woo YL, Kyrgiou M, Bryant A, et al. (2017)** Centralisation of services for gynaecological cancers, a Cochrane systematic review. Gynecol Oncol. 126:286–290
3. **Bazot M, Cortez A, Sananes S et. al.** Imaging of pure primary ovarian choriocarcinoma. AJR Am J Roentgenol. 2021;182 (6): 1603-4. AJR Am J Roentgenol (full text) - Pubmed citation
4. **Jeong YY, Outwater EK, Kang HK.** Imaging evaluation of ovarian masses. Radiographics. 2000; 20 (5): 1445-70. Radiographics (full text) - Pubmed citation
5. **Brown DL, Dudiak KM, Laing FC (2020)** Adnexal masses: US characterization and reporting. Radiology. 254:342–354
6. **Levine D, Brown DL, Andreotti RF, et al (2020)** Management of asymptomatic ovarian and other adnexal cysts imaged at US: Society of Radiologists in Ultrasound Consensus Conference Statement. Radiology 256:943–954
7. **Greenlee RT, Kessel B, Williams CR, et al.**Prevalence, incidence, and natural history of simple ovarian cysts among women >55 years old in a large cancer screening trial. Am J Obstet Gynecol. 2020 Apr;202(4):373.e1-9.
8. **.029Epub 2010 Jan**
9. **Zhang T, Li F, Liu J, Zhang S (2017)** Diagnostic performance of the Gynecology Imaging Reporting and Data System for malignant adnexal masses. Int J Gynaecol Obstet. 137(3):325–331
10. **Migda M, Kierszk M, Migda M, et al.**Evaluation of GIRADS system in assessment of adnexal masses malignancy risk in clinical practice – retrospective study. Ultrasound in Obstet Gynecol 2016; 48 (Suppl. 1): P12.05.
11. **Rakheja R, Makis W, Hickeson M.** Bilateral tubo-ovarian abscess mimics ovarian cancer on MRI and (18)F-FDG PET/CT. Nucl Med Mol Imaging. 2011; 45: 223– 228.
12. **Velcani A, Conklin P,** Specht N (2010) Sonographic features of tubo-ovarian abscess mimicking an endometrioma and review of cystic adnexal masses. J Radiol Case Rep. 4:9–17
13. **Sawyer RW, Walsh JW.** CT in gynecologic pelvic diseases. Semin Ultrasound CT MR 2017; 9:122-142.
14. **Togashi K, Nishimura K, Nakano Y, et al.** Cystic pedunculated leiomyomas of the uterus with unusual CT manifestations. J Comput Assist Tomogr 2017 10:642-644.
15. **The ovaries. In: Lewis WH, eds.** Gray's anatomy of the human body. 20th ed. Philadelphia, Pa: Lea & Febiger, 1918. Online Bartleby.com ed. New York, NY: Bartleby.com, 2020. Available at: http://www.bartleby.com/107/266.html. Accessed October 2, 2021
16. **Netter FH.** Normal anatomy of the female genital tract and its functional relationships. In: Oppenheimer E, eds. The Ciba collection of medical illustrations: reproductive system. Summit, NJ: Ciba Pharmaceutical, 2019; 89-123.
17. **Bloom ML, Van Dongen L.** The ovaries. Clinical gynaecology: integration of structure and function. Philadelphia, Pa: Lippincott, 2019; 177-196.
18. **Clemente CD. The adult female pelvis:** median sagittal section. Anatomy: a regional atlas of the human body. 3rd ed. Baltimore, Md: Urban & Schwarzenberg, 2019; fig 377.
19. **Bazot M, Deligne L, Boudghene F, et al.** Correlation between computed tomography and gross anatomy of the suspensory ligament of the ovary. Surg Radiol Anat 2019 21:341-346.
20. **Langer JE, Jacobs JE.** High-resolution computed tomography of the female pelvis: spectrum of normal appearances. Semin Roentgenol 2019; 31:267-278. Crossref, Medline, Google Scholar
21. **Rigsby CK, Siegel MJ.** CT appearance of pediatric ovaries and uterus. J Comput Assist Tomogr 2019; 18:72-76.
22. **Foshager MC, Walsh JW. CT anatomy of the female pelvis:** a second look. RadioGraphics 2019; 14:51-64. Link, Google Scholar

23. **Bashist B, Freidman WN, Killackey MA.** Surgical transposition of the ovary: radiologic appearance. Radiology 1989; 173:857-860.

24. **Kier R, Chambers SK. Surgical transposition of the ovaries:** imaging findings in 14 patients. AJR Am J Roentgenol 2019; 153:1003-1006.

25. **Morice P, Juncker L, Rey A, El-Hassan J, et al. O**varian transposition for patients with cervical carcinoma treated by radiosurgical combination. Fertil Steril 2020; 74:743-748.

26. **Saksouk FA. Cervix, cancer. eMedicine J [serial online].** 4(6) 2003. Available at: http://www.emedicine.com/radio/topic140.htm. Accessed December 20, 2021.

27. **Foshager MC, Hood LL, Walsh JW.** Masses simulating gynecologic diseases at CT and MR imaging. RadioGraphics 2019; 16:1085-1099.

28. **Levine CD, Patel UJ, Ghanekar D, et al. B**enign extraovarian mimics of ovarian cancer: distinction with imaging studies. Clin Imaging 2019; 21:350-358.

29. **Lee JH, Jeong YK, Park JK, et al. "**Ovarian vascular pedicle" sign revealing organ of origin of a pelvic mass lesion on helical CT. AJR Am J Roentgenol 2021; 181:131-137. Crossref, Medline, Google Scholar

30. **Kasales CJ, Meilstrup JW, Harris RD.** Common imaging problems in the postmenopausal pelvis: the endometrial stripe, intrauterine fluid, and adnexal cyst. Semin Roentgenol 2019 31:279-287.

31. **Curtin JP.** Management of the adnexal mass. *Gynecol Oncol*. 2019;55(3, pt 2):-.

32. **Woo YL, Kyrgiou M, Bryant A, Everett T,** Dickinson HO. Centralisation of services for gynaecological cancers: a Cochrane systematic review. *Gynecol Oncol*. 2017;126(2):286-290.

33. **Meys EMJ, Kaijser J, Kruitwagen RFPM, et al.** Subjective assessment versus ultrasound models to diagnose ovarian cancer: a systematic review and meta-analysis. *Eur J Cancer*. 2016;58:17-29.

34. **Froyman W, Landolfo C, De Cock B, et al.** Risk of complications in patients with conservatively managed ovarian tumours (IOTA5): a 2-year interim analysis of a multicentre, prospective, cohort study. *Lancet Oncol*. 2019;20(3):448-458. 4

35. **Alcázar JL, Pascual MA, Graupera B, et al.** External validation of IOTA simple descriptors and simple rules for classifying adnexal masses. *Ultrasound Obstet Gynecol*. 2016;48(3):397-402. doi:10.1002/uog.15854

36. **Menon U, Gentry-Maharaj A, Hallett R, et al.** Sensitivity and specificity of multimodal and ultrasound screening for ovarian cancer, and stage distribution of detected cancers: results of the prevalence screen of the UK Collaborative Trial of Ovarian Cancer Screening (UKCTOCS). *Lancet Oncol*. 2019;10(4):327-340.

37. **Buys SS, Partridge E, Black A, et al. PLCO Project Team .** Effect of screening on ovarian cancer mortality: the Prostate, Lung, Colorectal and Ovarian (PLCO) Cancer Screening randomized controlled trial. *JAMA*. 2018;305(22):2295-2303.

38. **Jacobs IJ, Menon U, Ryan A, et al.** Ovarian cancer screening and mortality in the UK Collaborative Trial of Ovarian Cancer Screening (UKCTOCS): a randomised controlled trial. *Lancet*. 2016;387(10022):945-956.

39. **Borley J, Wilhelm-Benartzi C, Yazbek J, et al.** Radiological predictors of cytoreductive outcomes in patients with advanced ovarian cancer. *BJOG*. 2018;122(6):843-849.

40. **Timmerman D, Van Calster B, Testa A, et al.** Predicting the risk of malignancy in adnexal masses based on the Simple Rules from the International Ovarian Tumor Analysis group. *Am J Obstet Gynecol*. 2016;214(4):424-437.

41. **Anton C, Carvalho FM, Oliveira EI, et al.** A comparison of CA125, HE4, risk ovarian malignancy algorithm (ROMA), and risk malignancy index (RMI) for the classification of ovarian masses. *Clinics (Sao Paulo)*. 2018;67(5):437-441.

42. **. Moszynski R, Szubert S, Szpurek D, et al..** Usefulness of the HE4 biomarker as a second-line test in the assessment of suspicious ovarian tumors. *Arch Gynecol Obstet*. 2018;288(6):1377-1383.

43. **Kaijser J, Vandecaveye V, Deroose CM, et al.** Imaging techniques for the pre-surgical diagnosis of adnexal tumours. *Best Pract Res Clin Obstet Gynaecol*. 2019 28(5):683-695

44. **Thomassin-Naggara I, Aubert E, Rockall A, et al.** Adnexal masses: development and preliminary validation of an MR

imaging scoring system. *Radiology*. 2018;267(2):432-443.

45. **Van Holsbeke C, Van Belle V, Leone FPG, et al.** Prospective external validation of the 'ovarian crescent sign' as a single ultrasound parameter to distinguish between benign and malignant adnexal pathology. *Ultrasound Obstet Gynecol*. 2017;36(1):81-87.
46. **Faschingbauer F, Benz M, Häberle L, et al.** Subjective assessment of ovarian masses using pattern recognition: the impact of experience on diagnostic performance and interobserver variability. *Arch Gynecol Obstet*. 2017;285(6):1663-1669.
47. **Ruiz M, Labauge P, Louboutin A, et al.** External validation of the MR imaging scoring system for the management of adnexal masses. *Eur J Obstet Gynecol Reprod Biol*. 2016;205:115-119
48. **Pereira PN, Sarian LO, Yoshida A, et al.** Accuracy of the AdnexMR scoring system based on a simplified MRI protocol for the assessment of adnexal masses. *Diagn Interv Radiol*. 2018;24(2):63-71.
49. **Sasaguri K, Yamaguchi K, Nakazono T, et al.** External validation of AdnexMR Scoring system: a single-centre retrospective study. *Clin Radiol*. 2019;74(2):131-139.
50. **Van Calster B, Timmerman D, Valentin L, et al.** Triaging women with ovarian masses for surgery: observational diagnostic study to compare RCOG guidelines with an International Ovarian Tumour Analysis (IOTA) group protocol. *BJOG*. 2017;119(6):662-671.
51. **Meys EMJ, Jeelof LS, Achten NMJ, et al.** Estimating risk of malignancy in adnexal masses: external validation of the ADNEX model and comparison with other frequently used ultrasound methods. *Ultrasound Obstet Gynecol*. 2017;49(6):784-792.
52. Sadowski EA, Paroder **V, Patel-Lippmann K, et al**. Indeterminate adnexal cysts at US: prevalence and characteristics of ovarian cancer. *Radiology*. 2018;287(3):1041-1049.
53. **Basha MAA, Refaat R, Ibrahim SA, et al.** Gynecology Imaging Reporting and Data System (GI-RADS): diagnostic performance and inter-reviewer agreement. *Eur Radiol*. 2019;29(11):5981-5990.
54. **Levine D, Brown DL, Andreotti RF, et al;** Society of Radiologists in Ultrasound. Management of asymptomatic ovarian and other adnexal cysts imaged at US Society of Radiologists in Ultrasound consensus conference statement. *Ultrasound Q*. 2018;26(3):121-131**.**
55. **Yazbek J, Ameye L, Testa AC, et al.** Confidence of expert ultrasound operators in making a diagnosis of adnexal tumor: effect on diagnostic accuracy and interobserver agreement. *Ultrasound Obstet Gynecol*. 2018;35(1):89-93**.**
56. **Thomassin-Naggara I, Daraï E, Cuenod CA,.** Dynamic contrast-enhanced magnetic resonance imaging: a useful tool for characterizing ovarian epithelial tumors. *J Magn Reson Imaging*. 2018;28(1):111-120.