ORIGINAL ARTICLE CLINICAL PRACTICE MANAGEMENT

Ovarian-Adnexal Reporting Lexicon for Ultrasound: A White Paper of the ACR Ovarian-Adnexal Reporting and Data System Committee

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Abstract

Ultrasound is the most commonly used imaging technique for the evaluation of ovarian and other adnexal lesions. The interpretation of sonographic findings is variable because of inconsistency in descriptor terminology used among reporting clinicians. The use of vague terms that are inconsistently applied can lead to significant differences in interpretation and subsequent management strategies. A committee was formed under the direction of the ACR initially to create a standardized lexicon for ovarian lesions with the goal of improving the quality and communication of imaging reports between ultrasound examiners and referring clinicians. The ultimate objective will be to apply the lexicon to a risk stratification classification for consistent follow-up and management in clinical practice. This white paper describes the consensus process in the creation of a standardized lexicon for ovarian and adnexal lesions and the resultant lexicon.

Key Words: Ovarian mass, ovarian cancer, ultrasound, structured reporting, pelvic imaging

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INTRODUCTION

The lack of standardized terms in gynecologic imaging, especially those related to adnexal pathology, has become a cause for concern [1]. Inconsistency internationally, nationally, and even among local institutions in the use of morphologic imaging descriptors and definitions often results in significant differences in subsequent interpretations. In the case of ovarian masses, the use of internationally agreed upon standardized descriptors should lead to consistent interpretations and decrease or eliminate ambiguity in reports, resulting in a higher probability of a correct diagnosis, the key to accuracy in determining the risk of malignancy and, ultimately, optimal patient management strategies.

There have been previous efforts involving characterization and management of adnexal masses as seen on ultrasound. In 2000, Timmerman et al [2], as part of the International Tumor Analysis Group (IOTA), a European initiative, proposed a group of terms, definitions, and measurement techniques for use in subsequent research studies. These studies led to the development of an evidence-based vocabulary that has been used in the "Simple Rules" and "ADNEX" models to differentiate benign from malignant adnexal masses [3-5]. Although the predictive value of these models is high, their acceptance has been limited in general clinical practice in the United States and Canada. The University of Kentucky proposed a "Morphology Index" with good prediction of malignancy institutionally but without widespread acceptance [6]. Amor et al [7] suggested the "Gynecologic Imaging Reporting and Data System" (GI-RADS) in 2009 for evaluating and risk-stratifying adnexal mass lesions, using transvaginal ultrasound but without general recognition. In contrast to the IOTA models and the University of Kentucky "morphology index," GI-RADS does not involve objective criteria for adnexal mass evaluation and relies on the subjective assessment of the ultrasound examiner [8]. The Society of Radiologists in Ultrasound (SRU) also published a consensus statement in 2010 addressing diagnosis and management of ovarian and adnexal cysts that gained some degree of popularity in the United States [9]. However, neither GI-RADS nor the SRU Consensus Statement addressed consistency of terminology and definitions, and the consensus statement did not include solid masses. Consequently, the need remains for a universally recognized standard reporting tool that will be accurate, useful, and inclusive of all pertinent descriptors and definitions. This would promote understanding of standardized descriptors leading to reliable and reproducible morphologic end points and diagnoses.

In the summer of 2015, under the supervision of the ACR, the Ovarian-Adnexal Reporting and Data System (O-RADS) Committee was formed with the purpose of creating a standardized lexicon that would permit the development of a practical, uniform vocabulary for describing the imaging characteristics of ovarian masses. The ultimate goal will be applying the lexicon to a risk stratification classification for consistent follow-up and management in clinical practice. This system is a collaborative effort of an international group of experts in gynecological imaging and management of ovarian or adnexal masses that includes a broad spectrum of experts in radiology, gynecology, pathology, and gynecologic oncology from the United States, Canada, and Europe. Because ultrasound is widely considered the primary imaging modality in the evaluation of adnexal masses and MRI, the problem-solving tool, parallel working groups for ultrasound and MRI were formed to develop separate but consistent groups of terms specific to each modality. This article is a description of the ultrasound lexicon and the methodology used in its development. Although the document is consensus-driven, the final vocabulary was chosen based upon common usage of terms and available evidence that supports the performance of descriptors that facilitate the classification of the mass as benign or malignant.

Multiple reporting and data systems have been developed under the direction of the ACR for quality assurance, standardized communication, and clinical decision support for pathology in various organ systems. First issued in 1993, the implementation of the first and highly successful BI-RADS [10] has transformed breast imaging into a universal language with defined descriptive terminology leading to specific management recommendations. The principal goals of O-RADS are to improve the quality and communication between interpreting and referring physicians, to limit variability in reporting language, and ultimately to guide patient management based on actionable information in the imaging report. This article describes the formation of an ultrasound lexicon. A simultaneous process was undertaken for an MRI lexicon, which will be presented in a subsequent article.

METHODS

Under the auspices of the Commission on Ultrasound of the ACR headed by Commission Chair, Beverly

Coleman, MD, the O-RADS Committee was created with the mind-set of including a diversified, international group of experts to represent specialties and organizations that would be key to providing the support and worldwide acceptance of the lexicon and ultimate risk stratification and management system. The committee, led by Rochelle F. Andreotti, MD, first convened as a group in November 2015 to establish a plan for the two-step process. The first step was to develop evidence-based terminology for description of masses and associated findings. Interdisciplinary imaging specialists were primarily involved in the first phase. Nonimager gynecologists, gynecological oncologists, and a member pathologist played a larger role in the review of the developed lexicon and in determining management in the second phase of the project.

The first phase involved a literature search and assemblage of a library of articles relevant for the identification of terms. The articles were collated from a systematic literature search from 1995 through 2015 performed by the ACR, bibliographies assembled for other similar projects, and articles provided by members. Major categories that could be applied to all masses were identified, and a preliminary list of related terms was developed based upon several key articles [2,3,9,11]. Some of the titles of these categories evolved via committee discussions to describe their content more appropriately.

An initial review of all articles retrieved was performed with subsequent exclusion of articles irrelevant to the project. The remaining articles, 20 per working group member, were reviewed via an online questionnaire. The following instructions were given to the working group members: to assess and save articles with terms that were previously identified or contained additional reasonable terms that were then added to the list; to determine whether there was evidence for usage of terms, in particular, as related to distinguishing benign versus malignant adnexal lesions; to document the methodology of each study that provided evidence. During this process, there was ongoing communication with the MR working group to maintain intermodality terminology consistency when appropriate.

A list of terms, based upon whether they were evidence-based and upon their frequency of usage, was generated from the online literature questionnaire analysis. The O-RADS Ultrasound Steering Committee then developed a preliminary set of terms and definitions with recommendations for inclusion or omission based upon their analysis of pertinent descriptors and the evidence underlying their usage. They concluded that the ultrasound terms developed by the IOTA Group were the most robust evidence-based available in the literature, leading to a steering committee recommendation to incorporate these terms as a package. The terms included the following five major descriptors: unilocular cyst ± solid components; multilocular cyst ± solid components; and mostly solid (>80%) [2,5,12,13]. This permitted us to go forward with evidence-based standardized terminology for major categories of adnexal lesions, which could then be modified by additional descriptors of their gray scale and color Doppler findings.

We then began a modified Delphi process to rate the usage of descriptor terms using an online survey in which individual descriptors were rated using a 1 to 5 scale (strongly disagree to strongly agree). The committee sought a minimum 80% consensus from all committee members to determine if a term would be included (rating consensus of 4-5) or excluded (rating consensus of 1-2). Spreadsheets that included the original references with related methodology corresponding to each term were available to each member for evaluation, hoping that this would lead to evidence-based and usage-driven responses while minimizing individual bias. On occasion, the committee agreed that even a highly used term should be intentionally excluded when deemed vague or confusing (ie, "complex"). Descriptor terms that did not achieve the minimum 80% consensus on the initial round underwent a rerating and voting process via teleconference, group e-mails, and online survey. Only those terms that reached the ultimate target of 80% consensus were incorporated into the lexicon.

A lexicon of ultrasound descriptor terms was derived and organized into major categories. The package of IOTA-derived ultrasound descriptor terms for ultrasound was included in toto**.** Occasionally, substitutions were agreed upon to maintain familiarity among users. Synonyms were provided to assist in recognition and correct application of terms, although the committee does not recommend their use.

OVARIAN OR ADNEXAL MASS TERMINOLOGY AND DEFINITIONS

Category 1: Major Categories

These are general concepts that should be understood to correctly use terms in the subsequent lexicon categories beginning with a few basic definitions followed by classes of descriptors for the characterization of any mass. (See Table 1.)

Table 1. Working Lexicon Categories, Terms & Definitions

Category	Term	Definition	Comments
1	**Major Categories**		
1a	**Physiologic Category** (consistent with normal ovarian physiology)		
	Follicle	Simple cyst $\leq$ 3 cm in premenopausal group	
	Corpus luteum (CL)	Thick walled cyst $\leq$ 3 cm that may have crenulated inner margins, internal echoes and intense peripheral color Doppler flow.	CL can sometimes appear as a hypoechoic region in the ovary with peripheral vascularity without a characteristic cystic component.
1b	**Lesion Category** (**not** consistent with normal physiology)		
	Unilocular, no solid component	Cystic lesion that contains a single compartment. May contain $\geq$ 1 incomplete septum, wall irregularity $<$ 3mm height or internal echoes.	Simple cyst is a subset of unilocular cyst with a smooth, thin wall, acoustic enhancement and no internal elements
	Unilocular cyst with solid component(s)	As above but includes solid component(s) $\geq$ 3mm in height.	
	Multilocular cyst, no solid elements	Cystic lesion with more than one compartment (at least one complete septum) but no solid component(s) $\geq$ 3mm in height.	
	Multilocular cyst with solid component(s)	As above but includes $\geq$ 1 solid component(s) $\geq$ 3 mm in height.	
	Solid (greater than or equal to 80%	Lesion with echogenicity suggestive of tissue without characteristics of a cyst. Lesion is at least 80% solid when assessed in orthogonal 2-dimensional planes.	Purely solid (100%) is a subset of a solid lesion consisting of a lesion with no cystic component.
2	**Size**		
	Maximum diameter	Maximum diameter of a lesion in any plane.	
	Maximum diameters	Largest 3 diameters in 2 perpendicular planes. One of these will be the maximum diameter of the lesion.	An optional volume may be obtained from these diameters.
	Maximum diameter of the largest solid component	Maximum diameter of the largest solid component in any plane.	
3	**Solid or Solid-Appearing Lesions**		
3a	**External contour**		
	Smooth	Regular outer margin	
	Irregular (Not Smooth)	Non-uniform outer margin	A lobulated outer margin is considered irregular.

3b	**Internal contents**		
	Hypoechoic/ isoechoic/ hyperechoic	Decreased/similar/increased echogenicity when compared to the internal reference of normal ovarian stroma.	Hypoechoic solid lesions typically represent fibromas or pedunculated/broad ligament fibroids.
	Calcification(s)	High-level echogenic component with associated acoustic shadowing within the solid appearing portion of the lesion.	
	Acoustic shadowing	Artifact produced by attenuated echoes behind a sound absorbing structure.	Descriptor is commonly associated with calcification(s) or fibromatous type lesion.
4	**Cystic Lesions**		
4a	**Inner Margin or Walls**		
	Smooth	Regular, uniform inner margin	
	Irregular (not smooth)	Irregular, non-uniform inner margin. May include wall irregularities due to incomplete septations, solid components $<$ 3mm height or papillary projections (solid components $\geq$ 3mm in height)	
	Calcification(s)	High-level echogenicity within wall which is curvilinear or plaque-like and may demonstrate associated acoustic shadowing	
4b	**Internal Content, Cystic Component**		
	Anechoic fluid	No internal echoes or structures of any kind	Using appropriate technical gain settings
	Hyperechoic components	Area of increased echogenicity with respect to normal ovarian parenchyma without acoustic shadowing	Descriptor associated with dermoid or hemorrhagic lesions
	Scattered low-level echoes	Scattered or heterogeneously dispersed echoes within a cyst	Descriptor typical of mucinous material within a cyst
	Fluid/fluid level	Nondependent portion that is relatively hypoechoic with respect to the dependent portion with horizontal delineation	Typically related to evolving blood clots with supernatant relatively hypoechoic to the contracted clot material
		Nondependent portion that is relatively echogenic to the dependent portion with horizontal delineation	Fat-fluid level with the nondependent fat containing material that appears relatively echogenic
Endometrioma Descriptor	Ground glass or homogeneous low-level echoes	Homogeneously evenly dispersed echoes within a cyst	

(continued)

Table 1. Continued

Category	Term	Definition	Comments
Dermoid Descriptors	Echogenic component with acoustic shadowing	Attenuation of the acoustic beam distal to a hyperechoic component	
	Hyperechoic lines and dots	Bright linear echoes and foci representing linear echoes seen en face	Represents sections through hair within the liquefied component.
	Floating echogenic spherical structures	Non-dependent echogenic spheres that may be associated with posterior acoustic shadowing and have been called dermoid balls	Descriptor highly characteristic of dermoid lesion, albeit uncommon
Hemorrhagic cyst descriptors	Reticular pattern	Fine thin intersecting lines representing fibrin strands that should not be confused with septations	
	Retractile clot	Avascular echogenic component with angular, straight, or concave margins	
Septations	Complete	Strand of tissue extending across the cyst cavity from one internal wall to another in all scanning planes	
	Incomplete	Strand tissue not completely extending from one internal wall to another in all planes	
4c	**Solid or Solid/Appearing Component**		
	Papillary projection or nodule	Solid component whose height $\geq$ 3 mm, arises from the cyst wall or septation and protrudes into the cyst cavity.	Number of papillary projections should be included
Outer contour	Smooth	The contour of the solid component within a cyst demonstrates no irregularities	
	Irregular (not smooth)	The contour of the solid component or of any internal cystic area within the solid component demonstrates irregularities	
5	**Vascularity**		
	Circumferential color Doppler Wall Flow	Color Doppler flow is restricted to the wall and includes the majority of the circumference of the wall	Descriptor typically associated with corpus luteum
	Internal color Doppler flow	Color Doppler flow is detected internally within a solid component/mural nodule or in a septation of the lesion with or without peripheral (wall) flow.	
	Color score 1-4	Overall subjective assessment of color Doppler flow within the entire lesion (wall and/or internal component) Color Score = 1 = No flow Color Score = 2 = Minimal Flow Color Score = 3 = Moderate flow Color Score = 4 = Very Strong Flow	IOTA Group criteria[2]

6	General and Extra-Ovarian Findings		
Cysts	Peritoneal inclusion cyst	Cyst with no mass effect conforming to contours of pelvic structures, typically contains fine septations. The ovary is either at the margin or suspended within the lesion.	
	Paraovarian cyst	Simple cyst exists separate from ovary and moves independent of the ovary	Alternate term para-tubal cyst
Fallopian Tube Descriptors (abnormal)	Incomplete Septation	Non-continuous tissue is seen extending across the cystic cavity due to the wall of the distended fallopian tube folded upon itself	
	Tubular	Substantially longer in one dimension than in the two perpendicular dimensions.	
	Endosalpingeal folds	Short round projections around the inner wall of a fluid distended tubular structure	
Fluid Descriptors	Cul-de-sac fluid	Confined to pouch of Douglas as defined by remaining below uterine fundus or between uterus and bladder when uterus retroverted/retroflexed	
	Ascites	Fluid extending above uterine fundus beyond the pouch of Douglas or cul-de-sac when anteverted/anteflexed, and anterior/superior to uterus when retroverted/retroflexed	
	Anechoic	Simple fluid	
	Fluid containing internal echoes	Not simple fluid	
Other	Peritoneal thickening or nodules	Nodularity or diffuse thickening of the peritoneal lining(s) or along the bowel serosal surface or peritoneum associated with peritoneal carcinomatosis	
	Adenopathy	Lymph nodes measured in short axis	

- Basic definitions
  - Unilateral or bilateral: This refers to the presence of a mass within one or both adnexa prompting detailed assessment of the right, left, or both sides.
  - Cyst: A cyst is a fluid-containing structure with avascular internal contents that may be anechoic or demonstrate differing degrees of internal echoes and that is associated with acoustic enhancement. A cyst may also contain solid components that are tissue or nontissue, avascular or vascular. It may be physiologic or nonphysiologic in nature.
  - Solid or solid-appearing: This is a mass or component of a mass that has echogenicity suggestive of tissue (eg, myometrium or ovarian stroma), usually isoechoic or hyperechoic when compared with the echogenicity of normal ovarian parenchyma (when available for comparison). On occasion, the solid or solid-appearing structure is hypoechoic but always more echogenic than anechoic cyst fluid.

The structure is judged by its echogenicity, by the absence of internal movement when moving the transducer, and by its vascularity. The presence of vascular flow that can be confirmed with Doppler ultrasound (spectral Doppler, if necessary) is diagnostic of solid tissue. The absence of flow is less informative, and the lesion should then be considered solid-appearing.

For the purposes of this lexicon, the following are not considered solid components: (1) The avascular hyperechoic structure in a dermoid cyst, (2) blood clot or mucin, (3) septation(s), (4) an irregular cyst wall that consists of focal thickening that measures <3 mm in height, and (5) normal ovarian stroma.

- Classes of descriptors
  - Physiologic: This refers to ovarian structures that are consistent with normal physiology. This category incorporates normal ovarian anatomy, follicles, and the corpus luteum. When characteristic in appearance, the term "follicle" or "corpus luteum" may be used without the need of additional descriptors.
    1. A follicle is defined as a simple cyst measuring less than or equal to 3 cm in greatest diameter in the premenopausal age group.
    2. A corpus luteum is a thick-walled cyst measuring less than or equal to 3 cm in greatest diameter in the premenopausal age group that often has crenulated inner margins, internal echoes, and peripheral color Doppler flow. The corpus luteum may also appear as a hypoechoic region in the ovary with peripheral vascularity but without a characteristic cystic component [14].
  - Lesion: A lesion is an adnexal mass, or that part of an ovary, that is judged by imaging not to be consistent with normal physiology [2]. It can be initially stratified into one of five categories established by the IOTA Group [2-5]. Because these are not stand-alone features, they will be modified by additional descriptors addressed in categories 2 to 6 of the lexicon (Fig. 1).
    1. Unilocular cyst, no solid component(s): This cystic lesion contains a single compartment, no complete septa, and no solid component(s), but may contain one or more incomplete (discontinuous) septum, an irregular wall with focal wall thickening <3 mm in height, or internal echoes (Fig. 2).
       a. Simple cyst: This lesion is a subset of unilocular cyst that contains no internal elements, thus anechoic, and has a smooth thin wall and acoustic enhancement.
    2. Unilocular cyst with solid component(s): This cystic lesion contains a single compartment, no complete septa, but includes a solid component equal to or greater than 3 mm in height.
    3. Multilocular cyst, no solid elements: This cystic lesion has more than one compartment (at least one complete septum) but no solid component. It may contain an irregular wall with focal wall thickening <3 mm in height or internal echoes.
    4. Multilocular cyst with solid component(s): This cystic lesion has more than one compartment (at least one complete septum) that also contains a solid component equal to or greater than 3 mm in height.
    5. Solid (greater than or equal to 80%): This lesion has echogenicity suggestive of tissue without characteristics of a cyst. The lesion should be at least 80% solid when assessed subjectively in perpendicular two-dimensional planes. The definition of "solid or solid-appearing" under General Definitions would apply.
       a. Purely solid (100% solid): This subset of a solid lesion consists of a lesion with no cystic component.

Category 2: Size

This category includes measurements and size assessment of morphology [2,3].

- Maximum diameter of a lesion: This is the maximum diameter of a lesion regardless of the plane.

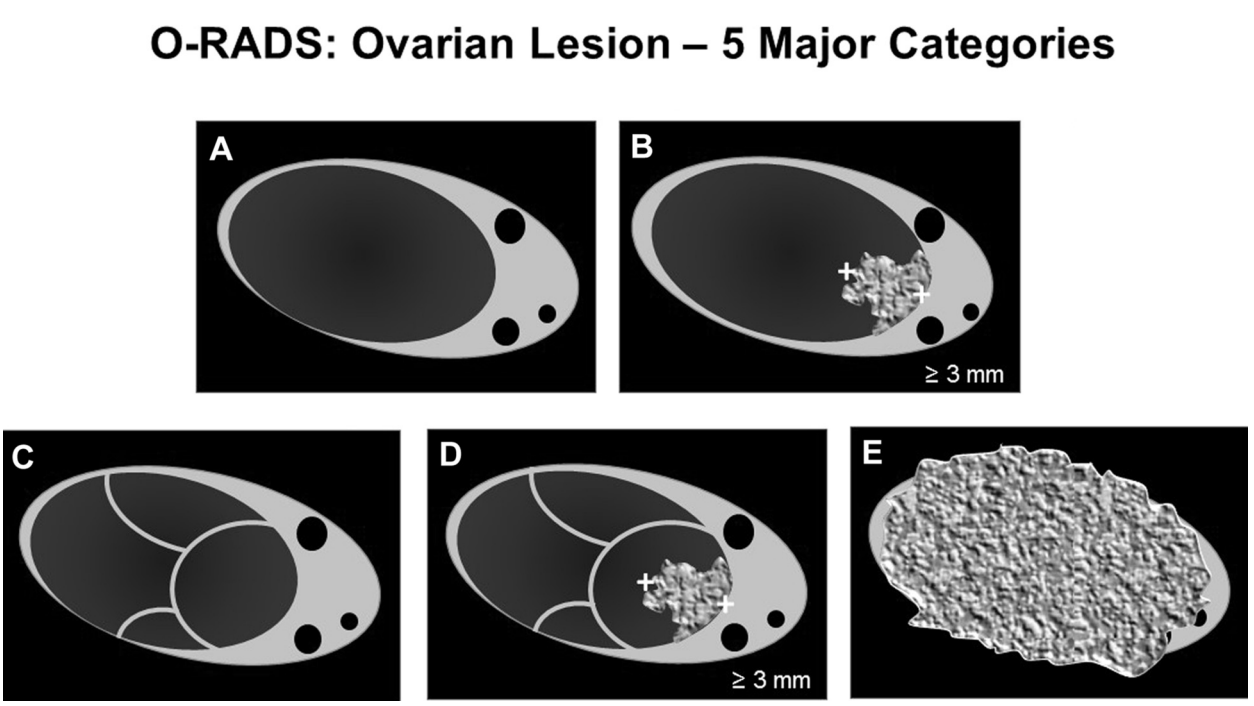

Fig 1. Ovarian lesion, five major categories: (A) Unilocular cyst with no solid component. (B) Unilocular cyst with a solid component. (C) Multilocular cyst without a solid component. (D) Multilocular cyst with a solid component. (E) Solid lesion (≥80% solid). Diagrams courtesy of Dr Lori Strachowski.

- Maximum diameters of a lesion: This is the largest three diameters in two perpendicular planes. One of these will be the maximum diameter of the lesion. An optional volume may be obtained from these diameters using the modified formula for an ellipse (0.52 × length × width × height).
- Maximum diameter of the largest solid component: This is the maximum diameter of the largest solid component in any plane.

Generally, lesions that have a maximum diameter of 10 cm or larger, or solid components with a maximum diameter of 0.7 cm or larger, are at higher risk for malignancy when compared with smaller lesions or solid components [3,5,15].

Category 3: Solid or Solid-Appearing Lesions

External Contour. Describing the external contour of a solid lesion as smooth or irregular (not smooth) has been found to be a key descriptor in the prediction of malignancy risk. An irregular solid lesion has a positive predictive value for malignancy of 93% according to the IOTA Simple Rules cohort involving 1,233 adnexal lesions [3] (Supplement Fig. 1A).

- Smooth: This lesion or solid component has a regular, uniform outer margin (Supplement Fig. 1A).
- Irregular (not smooth): This lesion has a nonuniform outer margin. A lobulated outer margin will be considered irregular (Supplement Fig. 1B).

Internal Content. As described in our Basic Definitions, a solid lesion demonstrates echogenicity suggestive of tissue although, occasionally, because of similarities in appearance, it may represent nontissue components (ie, blood clot). The following descriptors may also describe a solid component of a cystic lesion, although they are usually more applicable to a solid lesion.

- Hypoechoic, isoechoic, or hyperechoic: This is decreased, similar, or increased echogenicity when compared with the internal reference of normal ovarian stroma. When no ovarian stroma is identified, it is recommended to use uterine myometrium as a reference standard. Solid lesions that are typically hypoechoic are ovarian sex-cord stromal tumors (ie, fibromas) and to a lesser extent a fibroid (pedunculated or interligamentous) that can mimic an ovarian lesion.
- Calcifications: This describes the presence of an echogenic component with associated shadowing within the solid-appearing portion of the lesion.
- Acoustic shadowing: This is an artifact produced by attenuated echoes behind a sound absorbing structure that is often associated with a macrocalcification or a fibroma.

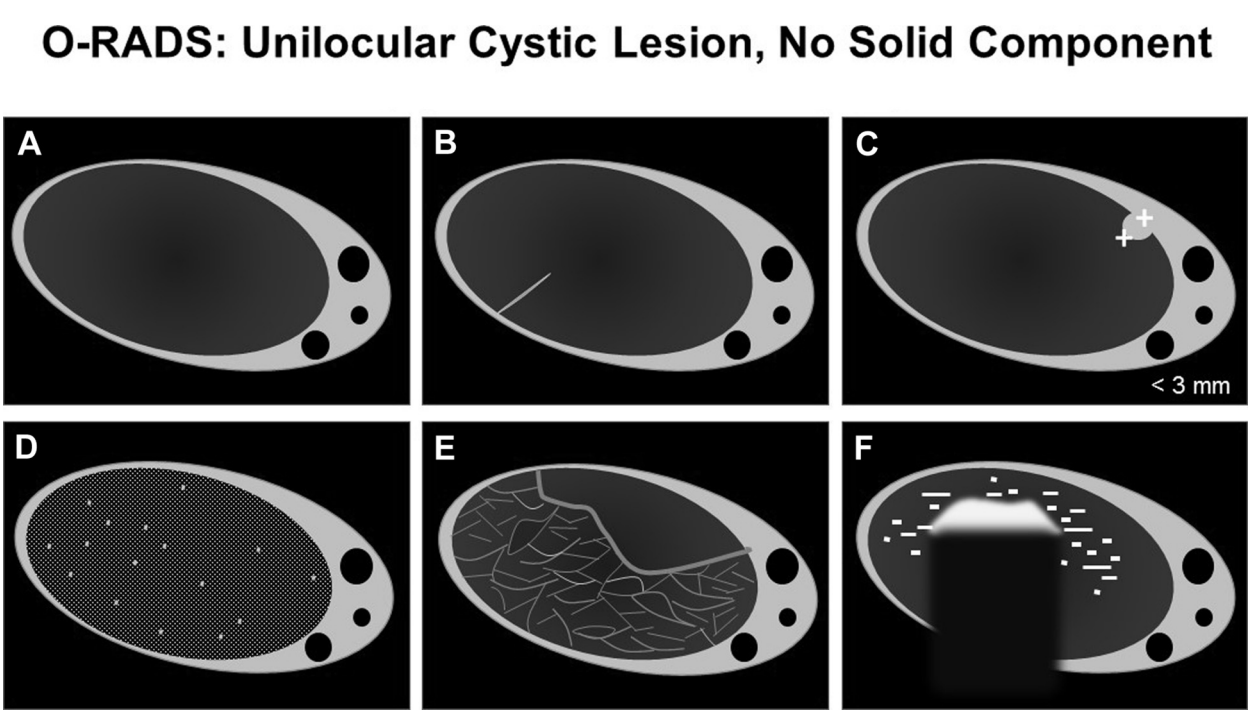

Fig 2. Unilocular cystic lesion, no solid component: (A) A simple cyst that is a subcategory of a unilocular cyst that has no internal elements, thus anechoic, a smooth thin wall, acoustic shadowing, and no internal septations (complete or incomplete). (B) Unilocular cyst with incomplete septum. (C) Unilocular cyst with focal wall thickening < 3 mm in height. (D) Unilocular cyst with internal echoes (homogeneous low level or ground glass or scattered). (E) A unilocular cyst demonstrating a reticular pattern of internal echoes characteristic of a hemorrhagic cyst. (F) Unilocular cyst that contains an echogenic component with associated acoustic shadowing and hyperechoic lines and dots both descriptors highly characteristic of a dermoid cyst. For the purposes of this lexicon, these are to be considered a part of the cystic component. Diagrams courtesy of Dr Lori Strachowski.

Category 4: Cystic Lesions

Inner Margins or Internal Walls of Cystic Lesions. Just as the outer contour of a solid mass is a key descriptor in malignancy risk assessment, similar predictive characteristics apply to the inner margins of cystic lesions. The external wall of a cyst is not taken into account [3,5,6].

- Smooth walls: The inner margin is uniform throughout with no irregularities (Supplement Fig. 2A).
- Irregular: The inner margin is uneven or nonuniform. This would include papillary projections (addressed in category 5b) and solid areas < 3 mm in height that are not tall enough to be called papillary projections (Supplement Fig. 2B).
- Wall calcification: Focal high-level echogenicity within the wall is curvilinear or plaquelike and is associated with acoustic shadowing when large enough.

Internal Content of a Cystic Lesion, Cystic Component. These terms describe the elements of cyst fluid that are not considered solid components and have been shown to have some degree of specificity in lesion risk assessment and diagnosis. Some of these are classic benign descriptors that have successfully been used in the diagnosis of hemorrhagic cysts, dermoid cysts, and endometriomas [16].

- Anechoic fluid: No internal echoes or structures of any kind are seen within the cyst at appropriate gain settings. An anechoic, unilocular cyst (eg, simple cyst) has a risk of malignancy of <1% [15].
- Hyperechoic (echogenic) components: Areas of increased echogenicity with respect to normal ovarian parenchyma without acoustic shadowing are seen. These may be present in dermoids, hemorrhagic cysts, and endometriomas.
- Ground glass or homogeneous low-level echoes: Homogeneous, evenly dispersed echoes are evident within the cyst. Either of the terms is acceptable, with the term "ground glass" used in the IOTA terminology and "homogeneous low-level echoes" being the more accustomed terminology in North America. This appearance is highly characteristic of the blood products within an endometrioma [2,3,9,17-19] (Supplement Fig. 3A).

- Scattered low-level echoes: Scattered or heterogeneously dispersed echoes are evident within the cyst. This may be associated with mucinous material within a cyst [2] (Supplement Fig. 3B).
- Fluid or fluid level: There are two types of fluid or fluid levels. The first demonstrates a nondependent portion that is relatively hypoechoic with respect to the dependent portion with horizontal delineation. This is typically related to evolving blood clots with supernatant relatively hypoechoic to the contracted clot material (Supplement Fig. 3C).
- The second demonstrates the opposite appearance with a nondependent portion that is relatively echogenic to the dependent portion, also with horizontal delineation. This suggests a fat-fluid level within a dermoid with the nondependent fat-containing material that appears relatively echogenic [20].
- Dermoid descriptors [21-23] (Supplement Fig. 3D)
  - Hyperechoic component with acoustic shadowing: This is the attenuation of the acoustic beam distal to a hyperechoic component of a dermoid cyst. It has been referred to as the "tip of the iceberg" sign when it is the majority of the lesion or a Rokitansky nodule when it is a smaller portion of the lesion. For consistency and to avoid confusion, the committee discourages the use of these latter terms.
  - Hyperechoic lines and dots: Bright linear echoes and foci represent sections through hair within the liquefied component. Encountered synonyms that are discouraged by the committee include dermoid mesh and dot-dash sign.
  - Floating echogenic spherical structures: Nondependent echogenic spheres may be associated with posterior acoustic shadowing and have been called dermoid balls. Although these spherical structures are uncommon, they are highly characteristic.
- Hemorrhagic cyst descriptors [3,20,24]
  - Reticular pattern: Fine thin intersecting lines represent fibrin strands that should not be confused with septations. The terms "cobweb," "fishnet," "lacy," and "spider web pattern" have also been used to describe this appearance (Supplement Fig. 3E).
  - Retracting clot: This is an avascular echogenic component with angular, straight, or concave margins. When the appearance is typical, the term "retracting clot" may be applied without the need for additional descriptors (Supplement Fig. 3F).
- Septations: Septal thickness has been consistently used as a descriptor of multilocular cysts. Although the committee agreed to keep the distinction of thick and thin septations, this distinction does not correlate with risk of malignancy in recent published literature [3,25].
  - Septation complete or incomplete: A complete septation is a strand of tissue extending across the cyst cavity from one internal wall to another in all scanning planes. If not continuous in any plane, the septum is incomplete. A lesion containing incomplete septations is generally associated with a lower risk of malignancy than a lesion with complete septations.
  - Thin septation: The septation measures ≤ 3 mm in greatest thickness. Thin septations have been associated with cystadenomas and a relatively low risk of malignancy [2,3,26].
  - Thick septation: The septation measures > 3 mm in greatest thickness. Recent literature does not support a significant association with a higher risk of malignancy [25,26]. Other lexicon descriptors (ie, smooth or irregular, solid component, color Doppler score) especially when used together, have a higher predictive value [3,7,9,27].

Internal Content of a Cystic Lesion, Solid or Solid-Appearing Component. A solid component demonstrates echogenicity suggestive of tissue but does not refer to normal ovarian tissue or to the wall of a cyst.

- Papillary projection or nodule: This is a solid component with height ≥ 3 mm that arises from the cyst wall or a septation and protrudes into the cyst cavity [3] (Supplement Figs. 4A and 4B). If a papillary projection or nodule is present, the cyst wall is always irregular by definition. If the solid component is <3 mm in height, it is a cyst wall irregularity and not a papillary projection. Additional descriptors of a papillary projection(s) or nodule(s) include:
  - Papillary height: This is a measurement in millimeters from the interior cyst wall or septal origin [3].
  - Number of papillary projections: The total count of papillary projections or nodules is documented. Four or more papillary projections within a cyst have been found to have an increased association with malignancy [3].
- Smooth solid component: If the contour of the solid component within a cyst demonstrates no irregularities, the solid component is described as smooth (Supplement Fig. 4A).
- Irregular solid component: The contour of the solid component within a cyst is nonuniform (spiky or lobular) (Supplement Fig. 4B) or the contour of any internal cystic area(s) is nonuniform (spiky or angular) rather than smooth (Supplement Fig. 4C).

Internal variation in echogenicity does not make the solid component "irregular solid."

Category 5: Vascularity

Color Doppler assessment of the lesion has been shown to be useful in the evaluation of malignancy [28]. Spectral Doppler parameters alone do not effectively discriminate malignant from benign lesions; however, it may be a useful adjunct to distinguish vascularity from artifact when vessels are not clearly delineated with color Doppler.

- Circumferential color Doppler flow in wall: Flow is restricted to the wall and includes the majority of the circumference of the wall. This is also referred to as peripheral color Doppler flow or the "ring of fire." Circumferential color Doppler flow in the appropriate setting may indicate a corpus luteum.
- Internal color Doppler flow: Flow is detected internally within a solid component or mural nodule or in a septation of the lesion with or without peripheral (wall) flow.
- Color score 1-4: This is an overall assessment of color Doppler flow within the entire lesion developed by the IOTA Group that includes the wall or an internal component. Color Doppler flow is designated as no flow (color score 1), minimal (color score 2), moderately strong (color score 3), or very strong (color score 4), determined on a subjective basis without the aid of spectral Doppler assessment [2] (Fig. 3).

Category 6: General and Extra-Ovarian Findings

Adnexal findings that do not directly involve the ovary or do not fit into any of the prior categories but are useful in the evaluation of malignancy are defined in this section. This includes descriptors of free intraperitoneal fluid, the fluid distended fallopian tube, and other extra-ovarian masses as well as the concept of mobility of the ovary with respect to other structures.

- Peritoneal inclusion cyst: Also called a peritoneal pseudocyst, this is a cystic lesion that does not exert mass effect and typically contains septations. The ovary is either at the margin or suspended within the lesion. The cyst follows the contour of the adjacent pelvic organs or peritoneum. It is usually associated with pelvic adhesions, such as from prior surgery, inflammation, or endometriosis. To alleviate wordiness, when typical in appearance, the term "peritoneal inclusion cyst" is acceptable as the primary descriptor [19,29] (Supplement Fig. 5A).
- Para-ovarian cyst: This is a simple cyst existing separate from the ovary that typically moves independent of the ovary when pressure is applied by the transducer. The terms "para-ovarian" and "paratubal" are used interchangeably as the origin often cannot be determined sonographically [19] (Supplement Fig. 5B).
- Fallopian tube descriptors [30]: These descriptors would apply to an abnormal (fluid distended) fallopian tube (Supplement Fig. 5C).

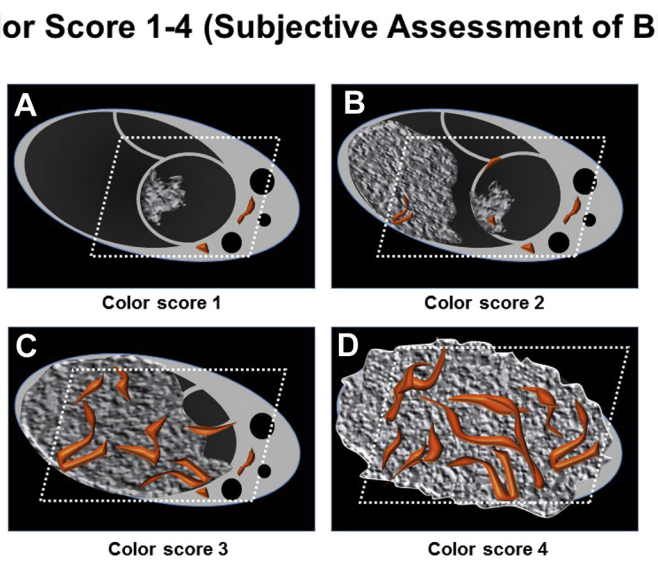

Fig 3. O-RADS: color score 1 to 4 (subjective assessment of blood flow by the International Tumor Analysis Group adopted as part of the O-RADS Lexicon [2]): (A) Color score 1 is given when no blood flow is detected in the cyst wall, septa, or solid component. (B) Color score 2 is given when only minimal flow is detected. (C) Color score 3 is given when moderate flow is present. (D) Color score 4 is given when the adnexal lesion is highly vascular with marked blood flow. Diagrams courtesy of Dr Lori Strachowski. O-RADS = Ovarian-Adnexal Reporting and Data System.

- Incomplete septation: Noncontinuous linear tissue is seen extending into the cystic cavity due to the wall of the distended fallopian tube folded upon itself.
- Tubular: This is substantially longer in one dimension than in the two perpendicular dimensions.
- Endosalpingeal folds: Short round projections are seen around the inner wall of the tubular structure. Other applicable terms include "beads on a string" and "cogwheel sign."

- Fluid descriptors: These are terms used to describe free intraperitoneal fluid in the pelvis and abdomen.
  - Ascites: This is fluid extending superior to uterine fundus beyond the pouch of Douglas or cul-de-sac, defined as the space posterior to the uterus, between the uterus and rectum, if anteverted or anteflexed. When the uterus is retroverted or retroflexed, ascites is considered present when the fluid is seen anterior and superior to the uterus, between uterus and bladder.
  - Cul-de-sac fluid: This is fluid confined to a pouch of Douglas as defined by remaining below uterine fundus or between uterus and bladder when the uterus is retroverted or retroflexed. In the appropriate setting involving a premenopausal female, this may be considered physiologic fluid.
  - Anechoic (simple) fluid: This is peritoneal fluid that does not contain internal echoes.
  - Fluid containing internal echoes (not simple fluid): Internal echoes within the peritoneal fluid are present. This has also been described as "echogenic fluid," although the committee agreed that, for clarity and consistency, use of this term should be discouraged.
- Peritoneal thickening or nodules: Focal nodularity or diffuse thickening of the peritoneal lining(s) or along the bowel serosal surface or peritoneum is evident. It is most often associated with peritoneal carcinomatosis but rarely may be seen in inflammatory conditions such as tuberculous peritonitis.
- Adenopathy: Enlarged lymph nodes are occasionally seen in the pelvis associated with neoplastic or inflammatory states. These should be measured in short axis and the location reported for management considerations.

DISCUSSION

Ultrasound is the initial imaging modality of choice for evaluation of ovarian and other adnexal masses. There is currently no internationally agreed upon standardized set of ultrasound descriptors with specific definitions that would lead to consistent interpretation and more accurate morphologic end points. We present here a practical vocabulary that permits a standardized description of the imaging characteristics of ovarian masses. This lexicon is based upon evidence and common usage of terms with the ultimate goal of applying it to a risk stratification classification for consistent follow-up and management in clinical practice.

The lexicon is based upon consensus of the committee taking into consideration supporting evidence for performance of terms with regards to classification of the mass as benign or malignant and common usage of terms. A large part of the lexicon, including the major classes of lesions, is based upon terms or descriptors in use by the IOTA Group, whose members have compiled decades of outcomes data based upon ovarian lesion characterization. These terms demonstrate consistency regarding performance in evaluation of malignancy risk and have been supplemented with other modifying, non-IOTA descriptors. Some are synonyms to IOTA descriptors that have been added for user familiarity.

The structured terminology can be used to accurately describe ovarian and adnexal masses, facilitating reliable interpretations that lead to appropriate management strategies. In addition, a uniform lexicon will permit the accumulation of reports utilizing structured tools, which will provide a collaborative opportunity for data scientists to improve outcomes research in the era of precision medicine and ultimately improve ovarian cancer detection rates [31].

Historically, significant disagreement regarding the understanding of imaging interpretations between authors and readers has been reported [32]. In an effort to standardize mammography reporting, the ACR developed the BI-RADS lexicon, now in its fifth edition [10]. The success of this first standardized reporting lexicon has led to the development of other lexicons, which have demonstrated success in improving the quality of communication among imagers, between imagers and referring clinicians, and ultimately in choosing appropriate management strategies [10,33,34]. The use of structured reporting terms has improved interpretation agreement as well as provided standard expected content of the report, which is a form of best practice [31].

This terminology is now positioned to be a desired universal quality assurance tool that is practical and inclusive of all applicable ovarian ultrasound descriptors

and definitions. Widespread adoption of the O-RADS Lexicon in clinical practice should help to maximize the clinical impact of ovarian and adnexal ultrasound for the care of patients with these lesions. O-RADS is intended to be a dynamic lexicon that will undergo future iterations to ensure that evidence-based recommendations remain appropriate and up-to-date. The committee's next step is to incorporate the O-RADS Lexicon and IOTA outcomes data in the development of a system to categorize malignancy risk and provide guidelines for patient management in the different risk categories.

TAKE-HOME POINTS

- This is a multidisciplinary international initiative with the goal of developing standardized terminology for evaluation of ovarian and adnexal masses to obtain consistent and accurate interpretations of malignancy risk and to determine optimal patient management strategies.
- Using a modified Delphi process, a set of terms was developed based on frequency of usage and evidence for their use in determining risk of malignancy.
- Terms developed by the IOTA Group that are strongly evidence based were incorporated as a package modified by descriptors that are IOTA and non-IOTA based.
- These descriptors will provide a structured method for interpretation of ovarian and adnexal masses that will help maximize the clinical impact of ovarian and adnexal ultrasound.
- The ultimate objective is to apply this lexicon to a risk stratification classification for consistent follow-up and management in clinical practice based on actionable information from the imaging report.

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ADDITIONAL RESOURCES

Additional resources can be found online at: https://doi.org/10.1016/j.jacr.2018.07.004.

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