O-RADS for Ultrasound: A User's Guide, From the *AJR* Special Series on Radiology Reporting and Data Systems

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The Ovarian-Adnexal Reporting and Data System (O-RADS) is a lexicon and risk stratification tool designed for the accurate characterization of adnexal lesions and is essential for optimal patient management. O-RADS is a recent addition to the American College of Radiology (ACR) reporting and data systems and consists of ultrasound (US) and MRI arms. Since most ovarian or adnexal lesions are first detected with US, O-RADS US is considered the primary assessment tool. Application of O-RADS US is recommended whenever a nonphysiologic lesion is encountered. Lesion characterization may be streamlined by use of an algorithmic approach focused on relevant features and an abbreviated version of the lexicon. Resources to expedite O-RADS US categorization and determination of a management recommendation include easy online access to the ACR color-coded risk stratification scorecards and an O-RADS US calculator that is available as a smartphone app. Reporting should be concise and include relevant features for risk stratification that adhere to lexicon terminology. Technical considerations include optimization of gray-scale and color Doppler technique and performance of problem-solving maneuvers to help avoid common pitfalls. This review provides a user-friendly summary of O-RADS US with practical tips for everyday clinical use.

Ovarian cancer is a lethal but infrequent disease. The cancer statistics estimate for 2020 [1] was that approximately 21,750 women in the United States would received a new ovarian cancer diagnosis and that approximately 13,940 women would die of the disease. Given the deadly nature of the disease, the phrase "cannot exclude malignancy" often concludes radiologists' reports. Additionally, ambiguous terms such as "complex" and "heterogeneous" are often encountered in lieu of more specific descriptors. Such terms result in unnecessary surgery that yields physiologic findings, nonneoplastic lesions, or benign neoplasms, which account for by far the most ovarian and adnexal lesions [2]. Yet, surgery has risks; surgical evaluation for false-positive findings on ultrasound (US) performed for ovarian cancer screening results in major postsurgical complications in as many as 15% of patients [3]. Furthermore, even though women with ovarian or tubal malignancies fare better when a gynecologic oncologist performs the initial surgery, this surgery is often performed by a general gynecologist [4]. Knowing when and to whom to refer a patient with an adnexal lesion is therefore of utmost importance to all woman, both those with and those without cancer [5].

These issues were the impetus for creation of the American College of Radiology (ACR) Ovarian-Adnexal Reporting and Data System (O-RADS) [5, 6]. O-RADS consists of US and MRI risk stratification arms and a standardized lexicon. The comprehensive O-RADS US lexicon was published in 2018 [2], and risk stratification categories with corresponding risk of malignancy (ROM) and management recommendations were published in 2020 [7]. This review presents a user's guide for implementing O-RADS US in clinical practice [6].

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O-RADS for Ultrasound: Development and Justification

O-RADS US contains six risk assessment categories (0 through 5) (Table 1), defined by prevalence of malignancy based on statistical support from International Ovarian Tumor Analysis Group (IOTA) models. The proposed risk stratification reflects retrospective analysis of prospectively collected data from IOTA phase 1–3 studies [7–10] that included 5905 patients with a subsequent pathologically proven adnexal lesion. Groups of O-RADS US lexicon terms most predictive of malignancy or benignity were matched with IOTA data and placed in specified risk categories that were then assigned a management scheme with the goal of optimizing referral patterns while promoting a conservative approach to probable benign lesions [7].

Though other ovarian lesion characterization and management systems for US have been proposed, O-RADS is unique given its dual US and MRI arms, common lexicon, and data-supported risk stratification that provides an ROM to providers and patients. Several publications provide a summary or comparison of current adnexal lesion categorization systems, such as IOTA simple rules, IOTA Assessment of Different Neoplasias in the Adnexa (IOTA ADNEX), Gynecologic Imaging and Reporting and Data System (GI-RADS), and the Society of Radiology in Ultrasound consensus statement on adnexal lesions [11–14]. In one such article comparing malignancy rates, validity, and reliability of O-RADS, GI-RADS, and IOTA simple rules [11], the highest sensitivity for malignancy was achieved with O-RADS when categories 4 and 5 were combined as predictors. This higher sensitivity was attributed to the comprehensive lexicon and descriptors and to clear management guidelines. Unlike other risk stratification systems and ACR reporting and data systems, O-RADS is designed largely for lesions identified in individuals at average risk and therefore maximizes sensitivity at the expense of specificity to avoid missing ovarian cancer [2, 7].

TABLE 1: Ovarian-Adnexal Reporting and Data System (O-RADS) for Ultrasound Assessment Categories and Associated Risk of Malignancy

Category	Assessment	Risk of Malignancy (%)
0	Technically incomplete	NA
1	Physiologic, normal	0
2	Almost certainly benign	< 1
3	Low risk	1 to < 10
4	Intermediate risk	10 to < 50
5	High risk	≥ 50

Note—NA = not applicable.

HIGHLIGHTS

- *To simplify O-RADS US risk stratification, an algorithmic approach analyzing only the features relevant to lesion categorization, with limited lexicon descriptors, is strongly recommended.*
- *When classic benign lesions are seen, applying appropriate lexicon terminology in lieu of other descriptors avoids falsely upgrading a lesion to a higher category.*
- *O-RADS lexicon terminology and risk assessment categorization apply to all patients regardless of risk or symptoms; management of symptomatic patients at high risk may differ.*

When to Use O-RADS for Ultrasound

Widespread application of O-RADS US to every pelvic US examination may be reasonable in certain highly specialized or research-focused practices. At a practical level, we recommend its application whenever US depicts a nonphysiologic adnexal lesion. Application of O-RADS to physiologic findings is recommended for screening US examinations of patients who are at high risk (e.g., *BRCA* mutation carriers) and when another modality (e.g., CT) depicts a potential adnexal lesion to be evaluated with US.

Clinical Application of the Scoring System

Understand the Governing Concepts: Eight Rules

When applying any risk stratification and management system, one must first understand the ground rules, including definitions and applicability criteria. O-RADS US has eight such rules [7] (Table 2). Management recommendations were created for patients at average risk without symptoms. However, because

TABLE 2: Governing Concepts for Ovarian-Adnexal Reporting and Data System for Ultrasound: Eight Rules

Rule No.	Governing Concept
1	Recommendations serve as guidance; individual case management modifiable by judgment.
2	If patient is at high risk or has acute symptoms, management may vary; codes still apply.
3	Ultrasound specialists (those whose practice includes a focus on ultrasound of adnexal lesions) play a role.
4	Postmenopausal is defined as ≥ 1 y without menses.
5	Lesion size is defined as largest possible diameter.
6	System applies to ovaries and fallopian tubes only (i.e., not exophytic myomas); exception is paraovarian cyst.
7	Assessment is typically based on transvaginal ultrasound; transabdominal or transrectal ultrasound may be helpful or substitute.
8	When more than one lesion is present, each is coded separately; management is driven by lesion with highest code.

IOTA derivation data included both patients at high risk and patients with symptoms [7], lexicon terminology and O-RADS categorization apply to all patients, but management may differ.

The involvement of an US specialist acknowledges the diagnostic challenge in accurately characterizing adnexal lesions faced by nonspecialists, for whom O-RADS will be most helpful. Greater sensitivity and specificity can be achieved by capitalizing on the experience of those whose practice includes a focus on interpretation of adnexal lesions found on US [15–17]. Although US specialists who are practicing radiologists will usually have completed a body or women's imaging fellowship that includes pelvic US, O-RADS does not specify the training or certification that warrants US specialist designation [7]. This allows radiologists flexibility to assess their personal level of comfort and knowledge of adnexal pathology and allows patients an opportunity to be assessed by a specialist in gynecologic US. This approach seeks judicious and cost-effective use of MRI of indeterminate lesions and prevention of unnecessary surgery for benign lesions.

Although the transvaginal approach typically affords the best visualization of pelvic organs on US, in specific scenarios, the transabdominal or transrectal approach may yield useful adjunct information and may provide adequate lesion characterization when the transvaginal approach is limited or cannot be performed. [7]

Keep Scorecards Handy or Use the Smartphone App

Like all ACR reporting and data systems, O-RADS US assessment categories and management recommendations are summarized in a color-coded scorecard format for easy reference [7] (Fig. 1). Keeping these resources readily accessible, whether online or printed and displayed near the workstation, is strongly encouraged [7, 18]. In particular, because management recommendations for O-RADS category 2 vary on the basis of size, menopausal status, and lesion features, these materials serve as an invaluable resource [7, 18]. Of note, menopausal status is irrelevant for O-RADS categories 3–5 [7].

O-RADS category 0 should be reserved for technically inadequate studies. Repeat US could be attempted. However, MRI is also an option when repeat US is considered unlikely to help owing to imaging challenges [7]. Importantly, O-RADS 0 is inappropriate for user uncertainty, and O-RADS categorization should be provided for all technically acceptable US examinations.

O-RADS 3 and 4 management recommendations include further characterization by an US specialist or by means of MRI. MRI is not mandatory, particularly when US expertise is available. If based upon the imager's confidence and expertise, additional imaging by either an US specialist or MRI is considered unlikely to provide further characterization, the patient may be directly referred to a gynecologist (O-RADS 3) or to a gynecologist with gynecologic consultation (O-RADS 4).

Once the ROM of a lesion exceeds 10% (O-RADS 4–5), referral to or consultation with a gynecologic oncologist is suggested. O-RADS 5 does not include specific imaging recommendations because gynecologic oncologists typically include cross-sectional imaging (e.g., staging CT) in their evaluation protocols.

Another tool to guide use of O-RADS US is the O-RADS US calculator available for iPhone and Android within the ACR Guidance App (representative search terms are "ACR Guidance" and "ACR O-RADS"). The ACR O-RADS website [6] provides detailed instructions for downloading and using the app. Requested input includes menopausal status and only those features required to obtain an assessment category and management recommendation. Easy links to helpful resources and illustrative figures are provided. Familiarity with the app assists users in quickly learning the relevant features for risk stratification and ultimately facilitates use of the risk stratification system.

Use an Algorithmic Approach Relying on Lesion-Specific Features and Lexicon Terminology

An algorithmic approach reduces the number of features needed to assess for any given lesion and is the basis for the smartphone app. The user can efficiently and confidently maneuver through a series of clicks. Findings are placed in one of three major categories: physiologic, classic benign lesion, and lesion (Fig. 2). Physiologic findings are applicable only in premenopausal women and include follicle and corpus luteum [2]. If a finding does not meet criteria for one of these two entities, one next determines whether characteristics are seen to categorize the finding as a classic benign lesion—three of which occur within the ovary (hemorrhagic cyst, dermoid cyst, endometrioma) and three of which are extraovarian (paraovarian cyst, hydrosalpinx, peritoneal inclusion cyst) [2]. If criteria are met for one of the extraovarian classic benign lesions, risk assessment is complete [7]. If the finding is consistent with an ovarian classic benign lesion, menopausal status and lesion size affect management [7]. If the finding does not meet the criteria for a physiologic cyst or classic benign lesion, the lesion should be placed into one of five subcategories: solid or solid-appearing, unilocular cystic without solid component, unilocular cystic with solid component, multilocular cystic without a solid component, and multilocular cystic with solid component [2, 7]. Before an assessment category is rendered, unexplained ascites and peritoneal nodules must be considered because these may upgrade a lesion into a higher risk category [7].

Despite best adherence to the algorithm, determining the appropriate categorization may be difficult for some challenging lesions. For such lesions, we recommend substituting the different lexicon descriptors in question to determine whether management schemes differ. If the schemes do differ, we recommend using the higher assessment category and associated management recommendations.

Physiologic findings—Physiologic findings include the follicle and corpus luteum [2]. Follicles are unilocular and anechoic with smooth inner margins [2]. Corpora lutea are thick-walled cysts with characteristic peripheral vascularity on Doppler imaging. Although the central cystic component may have an inner crenulated margin and internal echoes, when less evident, a corpus luteum may be solid appearing [2] (Fig. 3). When defining criteria are met, the terms "follicle" or "corpus luteum" should be used, rather than "cyst," to avoid a perceived abnormality by the patient or referring provider [2]. Both follicles and corpora lutea should measure 3 cm or less and be assessed O-RADS 1, thus not requiring imaging follow-up [7]. If, however, the finding is larger than 3 cm, a nonphysiologic lesion should be considered [7].

Classic benign lesions—Classic benign lesions that arise from the ovary include hemorrhagic cysts, dermoid cysts, and endometriomas [2]. Each of these lesions lacks internal flow on Doppler imaging and has a characteristic US appearance (Fig. 4). If cri-

teria are met and the greatest dimension is less than 10 cm, an O-RADS 2 assessment is rendered [7]. In this category, management varies and includes no imaging follow-up, annual surveillance US, and MRI. The proper option reflects menopausal status and lesion size, warranting use of the scorecards or app. If the lesion measures 10 cm or more, the ROM increases to the low-risk O-RADS category 3 [7]. A paucity of outcomes data support characterizing an ovarian lesion as a classic benign lesion if it exhibits interval enlargement, changing morphology, or a developing vascularized component on surveillance imaging. One encountering such a lesion should use applicable lexicon terminology, describe the interval change, and recommend referral to an US specialist or for an MRI study for characterization; an O-RADS US assessment category cannot be determined in this setting.

Classic benign lesions that are extraovarian include paraovarian simple cysts, hydrosalpinges, and peritoneal inclusion cysts [2]. For simplification purposes, paratubal cysts are considered paraovarian because these are typically only differentiated by location [2, 7]. Lesions fulfilling the criteria for these diagnoses are always assessed O-RADS 2 regardless of size [7] (Fig. 5). An important consideration for paraovarian cysts is the strict criterion that they are simple. If not, assessment should be made according to the cystic lesion categories (see later, Cystic lesions) [7]. When a cystic or solid lesion is separate from the ovary but does not meet the criteria for any of the extraovarian classic benign lesions, other nonovarian lesions should be considered. If a fallopian tube origin is suspected because of absence of features to suggest uterine or other pelvic origin (e.g., bowel, lymphatic, vascular, or musculoskeletal), assessment according to the ovarian and adnexal lesion category is encouraged. If after extensive review, a probable lesion origin cannot be ascertained, additional cross-sectional imaging can be performed for broader FOV. O-RADS scoring can be deferred until a definitive origin is determined.

Lesions (not classic benign)—Lesions in the not classic benign category range from benign lesions that are neither physiologic nor belong in the classic benign lesion category to malignant lesions. The five subcategories include the solid or solid-appearing lesion and four subcategories of cystic lesions that are further divided on the basis of septations and solid components [2]. Because degree of vascularity affects risk stratification of some lesions, we describe this feature in the Color Score section, which first explains vascularity assessment.

Color Score

Color score (CS) is a numeric categorization (1–4) developed by the IOTA group to characterize vascularity within a lesion as follows: 1, no flow; 2, minimal flow; 3, moderate flow; 4, very strong flow [8, 19] (Fig. 6). Color or power Doppler US may be used and should be optimized (see Technical Considerations and Pitfalls). Other than differentiating true flow from artifact, spectral Doppler and quantitative metrics do not currently play a role in O-RADS US [7]. Although vascularity can be assessed for all lesions, CS is relevant for risk stratification for only three subcategories: solid or solid-appearing lesion with a smooth outer contour; multilocular cystic lesion with solid component; and multilocular cystic lesion without a solid component and smooth inner walls or septa. In this third subcategory, vascularity is assessed within walls and septations [7]. Although differentiating degrees of vascularity may evoke sonographer and sonologist apprehension, in all scenarios in which CS is relevant, ranges are provided that make the distinction easier (solid, smooth, CS 1 vs CS 2–3 vs CS 4; multilocular cystic with solid component, CS 1–2 vs CS 3–4; multilocular cystic without solid component, CS 1–3 vs CS 4).

Solid or solid-appearing lesions—A solid or solid-appearing lesion has an echotexture suggestive of tissue (e.g., myometrium or ovarian stroma) [2]. When a solid lesion is hypoechoic, it is always more echogenic than anechoic cyst fluid [2]. The presence of vascular flow confirmed with color or spectral Doppler US is diagnostic of solid tissue. The absence of flow is less contributory; in the absence of flow, a lesion may be classified as solid-appearing, depending on additional supporting features and lack of the previously described imaging features of classic benign lesions.

It is important to reiterate that several exclusions from what is considered solid apply to both solid or solid-appearing lesions and solid components within a cystic lesion. The following structures should not be described as solid components of a lesion: normal ovarian stroma, blood clot or mucin, septations, and dermoid cyst components (e.g., fat, bone, cartilage, hair) [2].

To be classified as solid, a lesion should be at least 80% solid when thoroughly assessed in orthogonal planes [7]. A purely solid lesion is 100% solid with no cystic component whatsoever.

Once a lesion is determined to be solid, the key predictor of ROM is the outer contour (smooth vs irregular); hence, this is the first feature to be assessed [2, 7] (Fig. 7). If irregular (nonsmooth and including lobulations), a solid lesion carries 93% PPV for malignancy [9]. This feature alone places a solid lesion in O-RADS category 5 and warrants referral to a gynecologic oncologist [7]. Risk assessment is not influenced by CS or size (which should be reported for treatment planning purposes).

If the outer contour of a solid lesion is smooth, the critical determination for risk stratification is the CS. A solid lesion without appreciable flow (CS 1) is O-RADS 3, minimal to moderate flow (CS 2–3) is O-RADS 4, and very strong flow (CS 4) is O-RADS 5 [7].

Acoustic shadowing (artifact generated by attenuation of echoes by a structure that absorbs them) commonly occurs with entities that are typically benign, such as sex cord–stromal tumors (e.g., fibroma, thecoma, and fibroma variants) [20]. To simplify the first iteration of O-RADS, this feature was intentionally excluded from risk stratification. However, it is present in the comprehensive lexicon and routinely used by US specialists. At present, MRI is a management option for smooth solid lesions with shadowing and, if specific features of a fibroma or fibrothecoma are present (homogeneously hypointense on T2-weighted imaging and DWI), allows recategorization to the O-RADS MRI almost certainly benign category [7, 20].

Cystic lesions—Lesions that are either completely or primarily filled with fluid fall into the cystic category [2]. The feature that should first be assessed in any cystic lesion is the presence of a complete septum. If one or more septations are present, the lesion is considered multilocular cystic, whereas the absence of a complete septum makes it unilocular [2]. The next feature to be assessed is the presence of a solid or solid-appearing component (hereafter called a solid component) attached to a wall or septation (exclusion criteria as described for solid or solid-appearing lesions) [2]. The risk assessment category for cystic lesions varies from O-RADS 2 to O-RADS 5. In general, solid components confer

a higher ROM (O-RADS 4–5) whereas those without a solid component never fall into the highest risk category (O-RADS 5) [7].

Unilocular cyst without solid component—When a cystic lesion is unilocular and without a solid component, the next feature to assess is the inner wall (smooth vs irregular) [2]. If the inner wall is smooth, the internal contents must then be assessed. When echoes are absent (anechoic), the cyst is considered simple and may be designated as such without additional descriptors. A nonsimple unilocular cyst either contains internal echoes (that do not meet criteria for homogeneous low-level echoes or hyperechoic lines and dots) or contains an incomplete septation [2] (Fig. 8). A common pitfall is using the lexicon terms "simple cyst" and "unilocular cyst" interchangeably, which is incorrect. Although all simple cysts are unilocular by definition, not all unilocular cysts are simple.

All simple and nonsimple cysts smaller than 10 cm are considered O-RADS 2, and management is based on lesion size and menopausal status. When the cyst measures 10 cm or larger, O-RADS 3 assessment is rendered, and evaluation by an US specialist or with an MRI study should be considered. Such lesions may be managed by a gynecologist rather than an oncologist given the low ROM [7]. Additionally, when the inner wall is irregular, defined as less than 3 mm in height into the cyst cavity, any unilocular cyst without a solid component is O-RADS 3 regardless of content or menopausal status [2, 7]. Given the absence of solid components and septations, CS is not used to categorize these lesions [7].

Multilocular cyst without a solid component—As with unilocular cystic lesions without a solid component, the first feature to assess in multilocular cystic lesions without a solid component is the inner wall and septa (smooth vs irregular). If either is irregular, the lesion is considered O-RADS 4 [7]. If, however, the inner wall or septa are smooth, assessment of CS should follow. When very strong flow is seen (CS 4), the assessment is O-RADS 4 [7]. When less than very strong flow is appreciated (CS 1–3), size becomes a consideration; a cutoff of 10 cm is used to categorize a lesion as O-RADS 3 (< 10 cm) versus O-RADS 4 (≥ 10 cm) (Fig. 9). Menopausal status does not influence management of these cysts [7].

Unilocular cyst with solid components—For unilocular cysts with a solid component, the differentiation of O-RADS category 4 versus 5 is based on the number of papillary projections, a specific subtype of solid component that protrudes into the cyst cavity by at least 3 mm and is surrounded by fluid on three sides [2, 7] (Fig. 10). CS does not affect this distinction. A lesion that has one to three papillary projections or a solid component of any size that does not meet the criteria for a papillary projection is classified O-RADS 4 [7]. However, the presence of four or more papillary projections increases the ROM, and hence the lesion is classified O-RADS 5 [7].

Multilocular cyst with solid components—Multilocular cysts with a solid component are also classified O-RADS 4 or 5. However, the distinction is based on CS [7]. Lower CS of 1 or 2 (absent to minimal flow) is assessed as O-RADS 4, and higher CS of 3 or 4 (moderate to very strong flow) as O-RADS 5 [7] (Fig. 11).

Caveat for Scoring

Ascites

In premenopausal women, fluid confined to the pouch of Douglas (space posterior to the uterus and between the rectum and uterus) may be considered physiologic. However, fluid that exceeds this amount is defined as ascites when it extends superior to the uterine fundus if the uterus is anteverted or anteflexed [2, 7]. If the uterus is retroverted or retroflexed, fluid superior and anterior to the uterus (between the bladder and the uterus) is considered ascites [2, 7].

When ascites is unexplained (e.g., cannot be attributed to a systemic or nonmalignant adnexal cause), a lesion otherwise assessed O-RADS 3 or 4 should be upgraded to O-RADS 5 [7]. However, if the lesion is O-RADS 1 or 2, other plausible causes, such as fluid overload, renal impairment, and cirrhosis, should be considered [7]. The report may describe the internal content of ascites, but this does not affect risk stratification [7].

Peritoneal Thickening and Nodules

For low- or intermediate-risk (O-RADS 3 or 4) adnexal lesions, peritoneal nodules also upgrade the risk assessment to O-RADS 5 [7]. Peritoneal nodules are defined as either focal or diffuse nodularity or irregular thickening of the peritoneal reflection or along the bowel serosa) [2] (Video S1) (Videos S1–S4 can be viewed in the *AJR* electronic supplement to this article, available at doi.org/10.2214/AJR.20.25064). The presence of peritoneal nodules is most commonly associated with peritoneal carcinomatosis and should therefore be the diagnosis of exclusion. Other malignant and inflammatory or infectious causes (e.g., mucinous gastrointestinal malignancies and tuberculosis) may appear similar; however, in the absence of evidence of such other causes, it is prudent to attribute the findings to the adnexal process.

Technical Considerations and Pitfalls

Adnexal detail is optimally visualized via a high-frequency endocavitary transvaginal approach. Transabdominal US may be performed either as a complementary study or as the only technique for reasons related to high ovarian position, habitus, large lesion size, or patient comfort [7]. The transrectal approach may help when neither the transvaginal nor the transabdominal approach is optimal. Orthogonal cine clips should be obtained through the ovary and lesion at an appropriate speed to thoroughly evaluate lesion features (Video S2). Detailed complete evaluation is crucial to ensure identification of wall irregularities, septations, and number of papillary projections. The adnexal region, including the cul-de-sac, broad ligament, and fallopian tube, is surveyed for locoregional abnormalities, including ascites and peritoneal nodules.

Optimization of gray-scale and color Doppler imaging technique is essential for lesion characterization. For gray-scale imaging, the appropriate overall gain, focal zone, and narrowed sector width improve detail when optimized [9, 10]. For color Doppler imaging, overall gain, small color box, appropriate velocity scale (typically down to 4 cm/s), and pulse repetition frequency (range, 3–6 MHz) [9, 10, 21] are important to ensure that low flow within lesions is not missed (Figs. 12A–12C). If it is uncertain whether flow is real or artifactual, spectral Doppler imaging is appropriate to confirm the presence of vascular flow.

Differentiating solid from cystic material can be problematic. The presence of color Doppler flow confirms solid tissue, whereas absence of flow may represent debris or necrotic tissue and is less helpful. Another tip for differentiating solid material from

debris is to apply gentle transducer pressure on the area in question; subsequent internal movement ("jiggle" sign) suggests debris, such as blood clots (Video S3). If there is doubt, the lesion should be classified as solid.

When an eccentric ovarian lesion is identified, the push test may determine whether transducer probe pressure separates the structure from the ovary. Bimanual pressure with a hand on the abdomen and the probe in the appropriate plane pushing between the lesion and the ovary may be needed to confirm ovarian versus paraovarian location (Video S4). Furthermore, when an eccentric lesion is solid, a diligent search for bridging tissue and vessels to the uterus helps differentiate a solid ovarian lesion from an exophytic subserosal leiomyoma (Fig. 12D).

Another potential pitfall is mistaking a daughter cyst as a multilocular cyst. Appreciating a round shape and a location within surrounding ovarian parenchyma excludes a septate lesion (Fig. 12E).

How to Report

Accurate reporting of adnexal lesions with O-RADS requires correct lexicon terminology to describe lesions (Tables 3 and 4). The term "lesion" is preferred to "mass," and nowhere in the O-RADS lexicon is the term "complex" used [2].

The report should note the patient's menopausal status. Inclusion of the date of last menstrual period should be considered for premenopausal women. The body of the report should give adnexal findings in order of most to least worrisome. Lexicon terminology relevant to risk stratification is strongly encouraged; additional descriptors are optional. If CS is relevant, the associated wording (no flow, minimal flow, moderate flow, very strong flow) is required; the numeric value is optional.

The three scenarios in which additional descriptors are not warranted if criteria are met are follicle, corpus luteum, and simple cyst. Because a discriminatory size (≤ 3 cm) is inherent in the definition of follicle and corpus luteum, maximum size need be reported only for simple cyst.

The impression should include a concise summary of location, size, and relevant descriptors as well as O-RADS category per lesion or finding. Because referring providers are not expected to know the numeric values, the wording associated with the category is required, but the O-RADS number is optional. If desired, the O-RADS category numbers may be used without associated wording, but a reference table (Table 5) should conclude the report. Use of ROM percentages is optional. A link to the article describing the risk stratification system may be considered [7]. The ACR O-RADS website [22] provides sample reports.

O-RADS for MRI

O-RADS MRI is a parallel arm of O-RADS and is critical in characterization and risk assessment of indeterminate adnexal lesions with US. The O-RADS MRI lexicon shares many terms with O-RADS US for standardization purposes. Categorization of O-RADS MRI risk assessment is also similar, but it provides higher NPV and PPV for malignancy owing to the enhanced soft-tissue contrast of MRI [23]. MRI is more accurate in characterizing lesion components as fat or hemorrhage on the basis of features observed on images obtained with specific sequences [23].

O-RADS MRI is commonly applied to evaluate lesions assessed as O-RADS 3 or 4 on US. Lesions considered indeterminate in other, non–O-RADS scoring systems, which account for 18–31% of lesions evaluated with US in clinical practice [23], can be assessed directly

TABLE 3: Lexicon for Classic Benign Lesions

Classic Benign Lesion	Lexicon Descriptors *(minimum of 1 bulleted term required)*
Hemorrhagic cyst	• Reticular pattern
	• Retractile clot
Dermoid cyst	• Hyperechoic component with acoustic shadowing
	• Hyperechoic lines and dots
	• Floating echogenic spherical structures
Endometrioma	• Homogeneous low-level echoes
	• Ground glass
Paraovarian cyst	• Simple cyst separate from ovary
	➢ Moves independent from ovary with transducer pressure
Peritoneal inclusion cyst	• Cystic lesion with ovary at margin or suspended within
	➢ Internal septations
	➢ No mass effect
	➢ Follows contour of adjacent organs or peritoneum
Hydrosalpinx	• Incomplete septation
	• Tubular
	• Endosalpingeal folds

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TABLE: 4: Lexicon for Lesions (Not Classic Benign)

Lesion (Not Classic Benign)	Lexicon Descriptors *(bulleted terms required)*
Unilocular, no solid component	• Inner wall (smooth or irregular)
	➢ If smooth, include inner contents (simple versus nonsimple) and size
Unilocular with solid component	• Number of papillary projections
Multilocular, no solid component	• Inner wall and septations (smooth or irregular)
	➢ If smooth, include size and color score
Multilocular, with solid component	• Color score
Solid	• Outer contour (smooth or irregular)
	➢ If smooth, include color score

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TABLE 5: Sample Ovarian-Adnexal Reporting and Data System for Ultrasound (O-RADS US) Risk Assessment Category Charts for Reporting

Sample Without ROM		Sample With ROM	
O-RADS Category	Assessment	O-RADS Category	Assessment
0	Incomplete due to technical factors	0	Incomplete due to technical factors
1	Normal or physiologic ovary	1	Normal or physiologic ovary (0% ROM)
2	Almost certainly benign	2	Almost certainly benign (< 1% ROM)
3	Low risk	3	Low risk (1% to < 10% ROM)
4	Intermediate risk	4	Intermediate risk (10% to < 50% ROM)
5	High risk	5	High risk (≥ 50% ROM)

Note—Based on information from [2]. ROM = risk of malignancy.

with MRI. O-RADS MRI is an invaluable resource for characterizing solid ovarian lesions with a smooth outer contour, atypical-appearing endometriomas, and dermoid cysts and for differentiating nonovarian lesions from ovarian and tubal processes (e.g., chronic scarred hydrosalpinx or exophytic and broad ligament myomas). The ACR O-RADS website [6] provides further references and tables.

Conclusion

O-RADS US is a lexicon and risk stratification tool that may be used to simplify characterization of adnexal lesions, avoid misleading terminology, and triage management. Most radiologists will use the ACR color-coded risk stratification scorecards for easy reference. Others will download the ACR Guidance App. Both require understanding of governing concepts and accurate use of lexicon terminology that guide users to the appropriate risk stratification category. An algorithmic approach, whether from this review or the app, streamlines assessment. Although prospective validation trials are needed, early adoption and clear and succinct reporting by use of the lexicon terminology promise to standardize terminology with the goal of minimizing needless surgery and establishing a judicious referral pattern to a gynecologic oncologist.

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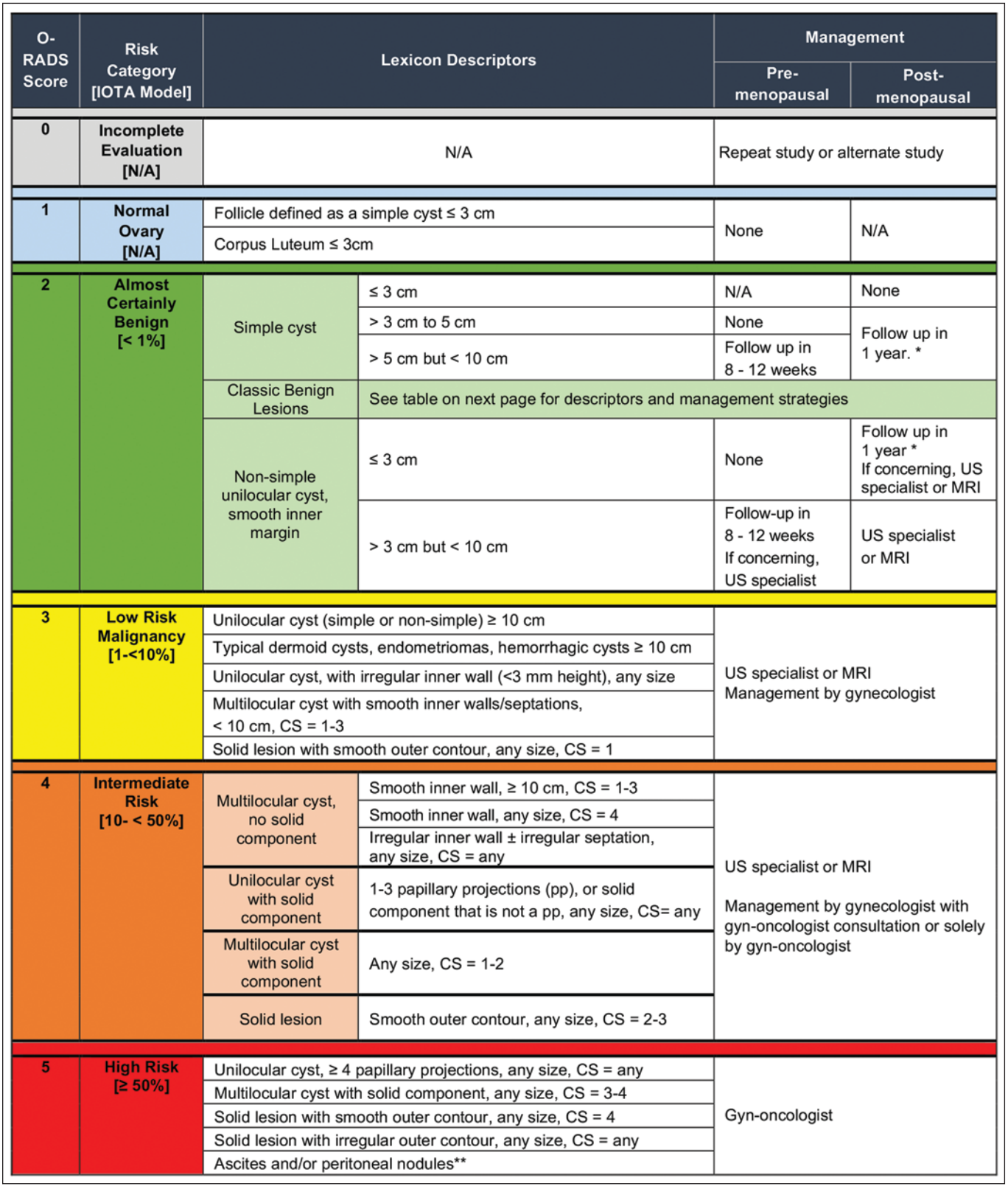


O-RADS Score	Risk Category [IOTA Model]	Lexicon Descriptors		Management: Pre-menopausal	Management: Post-menopausal
0	Incomplete Evaluation [N/A]	N/A		Repeat study or alternate study	
1	Normal Ovary [N/A]	Follicle defined as a simple cyst ≤ 3 cm		None	N/A
		Corpus Luteum ≤ 3cm			
2	Almost Certainly Benign [< 1%]	Simple cyst	≤ 3 cm	N/A	None
			> 3 cm to 5 cm	None	Follow up in 1 year. *
			> 5 cm but < 10 cm	Follow up in 8 - 12 weeks	
		Classic Benign Lesions	See table on next page for descriptors and management strategies		
		Non-simple unilocular cyst, smooth inner margin	≤ 3 cm	None	Follow up in 1 year * If concerning, US specialist or MRI
			> 3 cm but < 10 cm	Follow-up in 8 - 12 weeks If concerning, US specialist	US specialist or MRI
3	Low Risk Malignancy [1-<10%]	Unilocular cyst (simple or non-simple) ≥ 10 cm		US specialist or MRI Management by gynecologist	
		Typical dermoid cysts, endometriomas, hemorrhagic cysts ≥ 10 cm			
		Unilocular cyst, with irregular inner wall (<3 mm height), any size			
		Multilocular cyst with smooth inner walls/septations, < 10 cm, CS = 1-3			
		Solid lesion with smooth outer contour, any size, CS = 1			
4	Intermediate Risk [10- < 50%]	Multilocular cyst, no solid component	Smooth inner wall, ≥ 10 cm, CS = 1-3	US specialist or MRI Management by gynecologist with gyn-oncologist consultation or solely by gyn-oncologist	
			Smooth inner wall, any size, CS = 4		
			Irregular inner wall ± irregular septation, any size, CS = any		
		Unilocular cyst with solid component	1-3 papillary projections (pp), or solid component that is not a pp, any size, CS= any		
		Multilocular cyst with solid component	Any size, CS = 1-2		
		Solid lesion	Smooth outer contour, any size, CS = 2-3		
5	High Risk [≥ 50%]	Unilocular cyst, ≥ 4 papillary projections, any size, CS = any		Gyn-oncologist	
		Multilocular cyst with solid component, any size, CS = 3-4			
		Solid lesion with smooth outer contour, any size, CS = 4			
		Solid lesion with irregular outer contour, any size, CS = any			
		Ascites and/or peritoneal nodules**			

A

Fig. 1—American College of Radiology Ovarian-Adnexal Reporting and Data System (O-RADS) Ultrasound risk stratification and management system. (Reprinted from www.acr.org/-/media/ACR/Files/RADS/O-RADS/O-RADS_US-Risk-Stratification-Table.pdf, Ovarian-Adnexal Reporting and Data System Committee, American College of Radiology, with permission according to Creative Commons Attribution-NonCommercial-NoDerivatives 4.0 International License (creativecommons.org/licenses/by-nc-nd/4.0/legalcode), including disclaimer in Section 5)

A, Chart shows color-coded scorecard for O-RADS assessment categories 0–5 organized by category number, associated wording with risk of malignancy percentiles in brackets, lexicon descriptors, menopausal status (when relevant), and management recommendations. CS = color score; GYN = gynecologic; IOTA = International Ovarian Tumor Analysis; N/A = not applicable. *At a minimum, at least one-year follow-up showing stability or decrease in size is recommended with consideration of annual follow-up of up to 5 years, if stable. However, there is currently a paucity of evidence for defining the optimal duration or interval of timing for surveillance. **Presence of ascites with category 1-2 lesion, must consider other malignant or non-malignant etiologies of ascites.

(Fig. 1 continues on next page)

Lexicon Descriptor	Definition	Management	
		Premenopausal	Postmenopausal
Typical hemorrhagic cyst	Reticular pattern: Fine thin intersecting lines representing fibrin strands Retracting clot: An avascular echogenic component with angular, straight, or concave margins	≤ 5 cm None	US specialist, gynecologist or MRI
		>5 cm but < 10 cm Follow up in 8-12 weeks If persists or enlarges, referral to US specialist, gynecologist, or MRI	US specialist, gynecologist or MRI
Typical dermoid cyst < 10 cm	• Hyperechoic component with acoustic shadowing • Hyperechoic lines and dots • Floating echogenic spherical structures	Optional initial follow up in 8-12 weeks based upon confidence in diagnosis If not removed surgically, annual US follow up should then be considered * US specialist or MRI if there is enlargement, changing morphology or a developing vascular component	US specialist, gynecologist, or MRI With confident diagnosis, if not removed surgically, annual US follow up should then be considered * MRI if there is enlargement, changing morphology or a developing vascular component
Typical endometriomas < 10 cm	Ground glass/homogeneous low-level echoes		
Simple paraovarian cyst/any size	Simple cyst separate from the ovary that typically moves independent of the ovary when pressure is applied by the transducer	None If not simple, manage per ovarian criteria	Optional single follow up study in 1 year
Typical peritoneal inclusion cyst/any size	Follows the contour of the adjacent pelvic organs or peritoneum, does not exert mass effect and typically contains septations. The ovary is either at the margin or suspended within the lesion.	Gynecologist	Gynecologist
Typical hydrosalpinx/ any size	• Incomplete septation • Tubular • Endosalpingeal folds: Short round projections around the inner wall of a fluid distended tubular structure	Gynecologist	Gynecologist

B

Fig. 1 (continued)—American College of Radiology Ovarian-Adnexal Reporting and Data System (O-RADS) Ultrasound risk stratification and management system. (Reprinted from www.acr.org/-/media/ACR/Files/RADS/O-RADS/O-RADS_US-Risk-Stratification-Table.pdf, Ovarian-Adnexal Reporting and Data System Committee, American College of Radiology, with permission according to Creative Commons Attribution-NonCommercial-NoDerivatives 4.0 International License (creativecommons.org/licenses/by-nc-nd/4.0/legalcode), including disclaimer in Section 5)
B, Chart shows lexicon descriptors and management recommendations for classic benign lesions, elaborating on contents of scorecard in **A**. *There is currently a paucity of evidence for defining the optimal duration or interval of timing for surveillance. Evidence does support an increasing risk of malignancy in endometriomas following menopause.

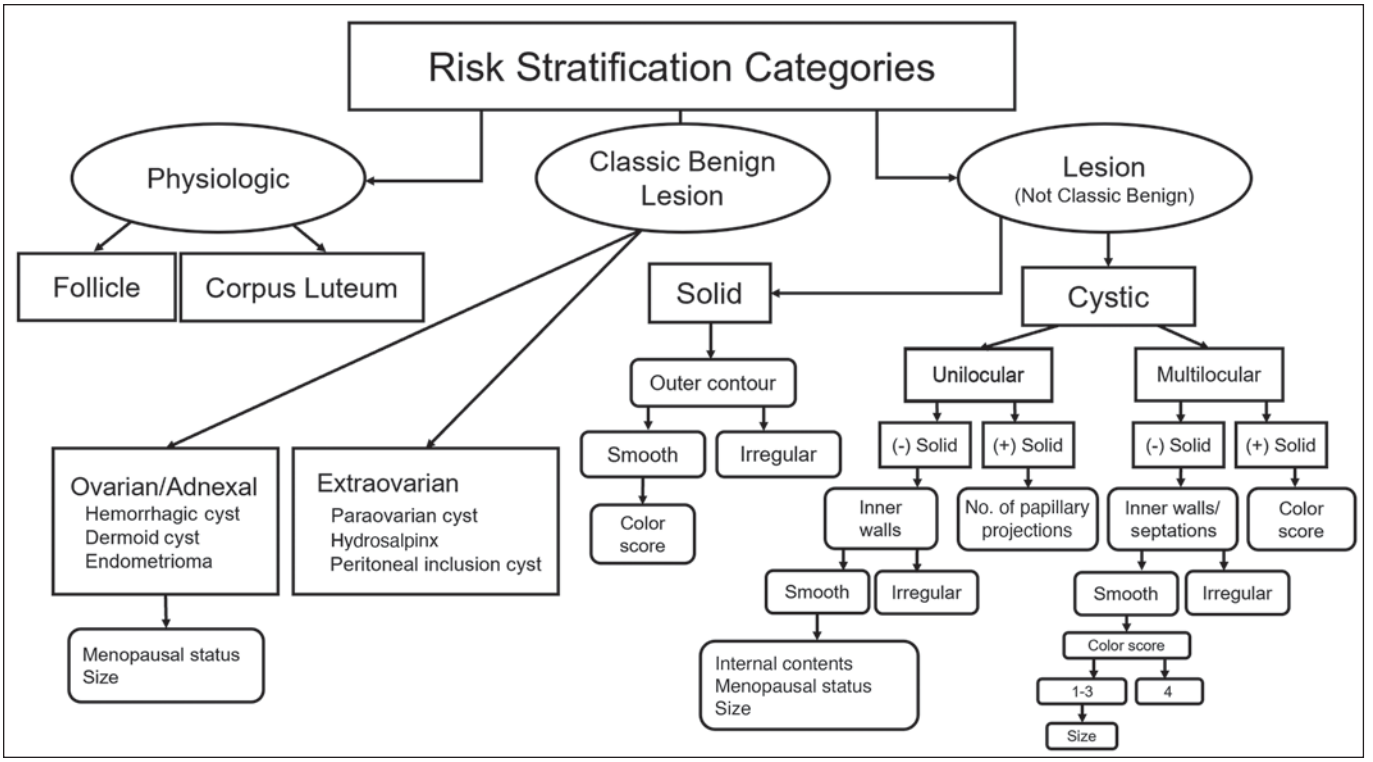


Fig. 2—Algorithmic approach to risk stratification. Diagram shows features that must be assessed and when menopausal status must be considered to appropriately characterize adnexal lesion for risk stratification. (–) = feature absent, (+) = feature present.

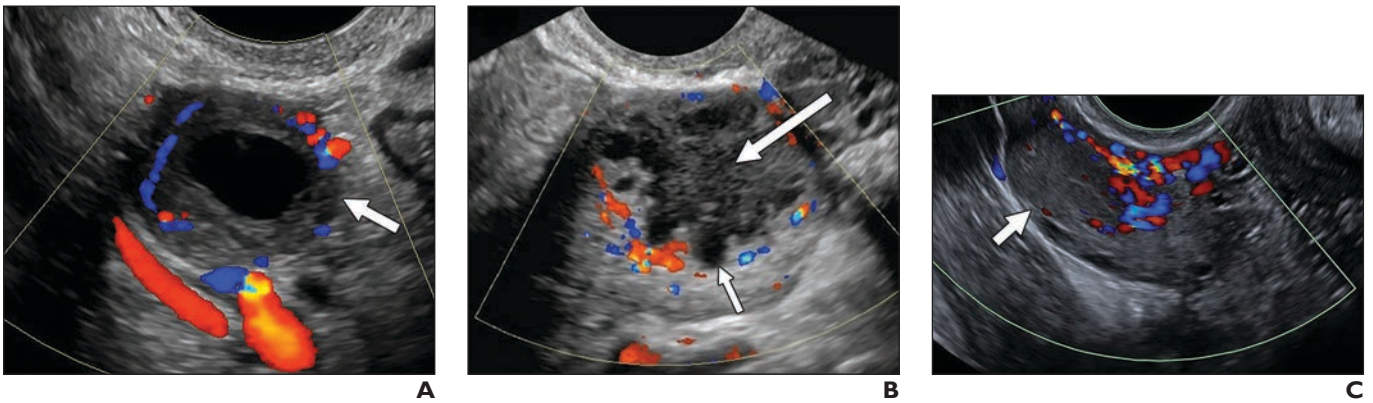


Fig. 3—Corpora lutea.
A, 23-year-old woman with pelvic fullness and corpus luteum. Color Doppler ultrasound image shows right ovarian thick-walled cyst (*arrow*) measuring ≤ 3 cm with smooth inner margin and peripheral flow consistent with corpus luteum (Ovarian-Adnexal Reporting and Data System [O-RADS] category 1).
B, 35-year-old woman with abnormal uterine bleeding and corpus luteum. Color Doppler ultrasound image shows left ovarian cyst with internal echoes (*long arrow*), crenulated inner margin (*short arrow*), and peripheral vascularity as different manifestation of corpus luteum (O-RADS 1).
C, 27-year-old pregnant woman in first trimester with corpus luteum. Color Doppler ultrasound image shows solid-appearing (≤ 3 cm) corpus luteum (*arrow*) with peripheral vascularity (O-RADS 1). Peripheral vascularity is extremely useful in this setting to exclude intraovarian solid lesion (which exhibits internal vascularity).

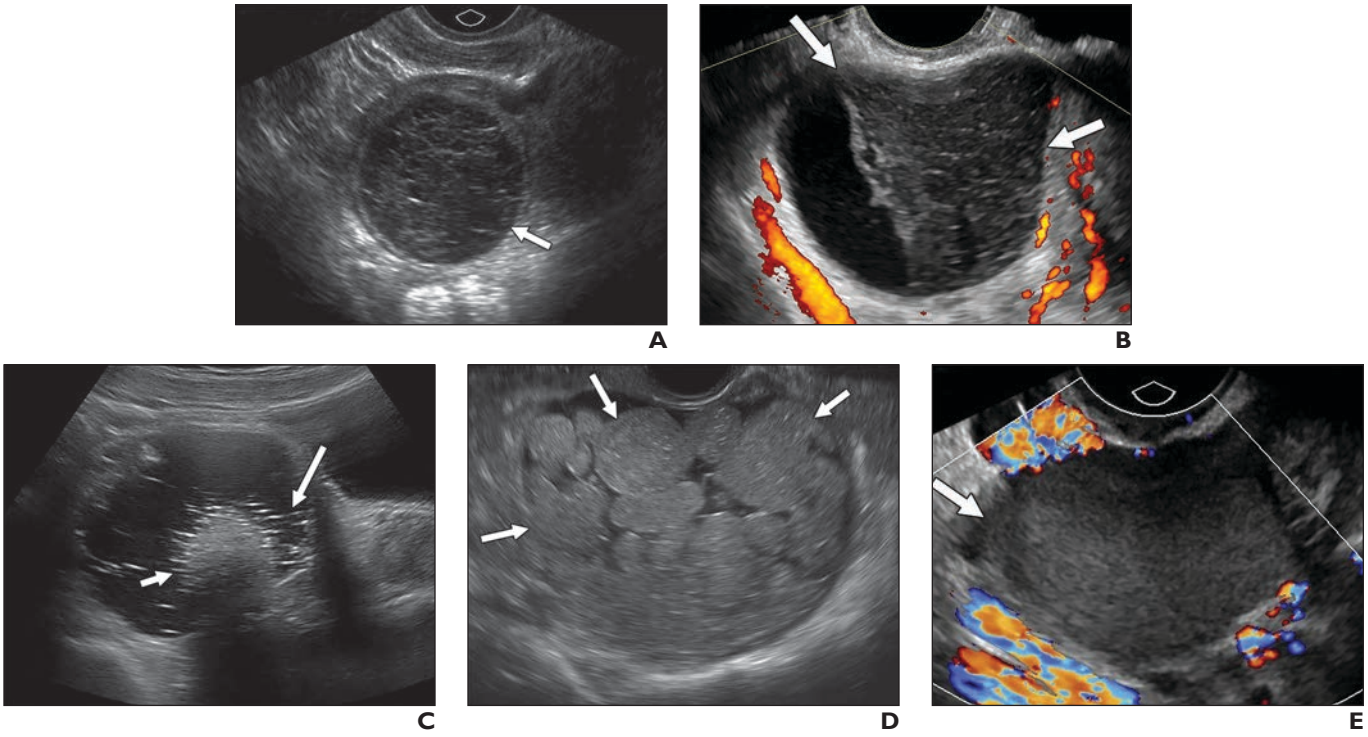


Fig. 4—Classic benign lesions, intraovarian.
A, 27-year-old woman with hemorrhagic cyst. Ultrasound image shows avascular cyst in right ovary has reticular pattern (*arrow*) consistent with hemorrhagic cyst. Because it is smaller than 10 cm, cyst is consistent with Ovarian-Adnexal Reporting and Data System (O-RADS) category 2 lesion. Hemorrhagic cysts larger than 10 cm fall into O-RADS category 3 risk assessment.
B, 22-year-old woman with left pelvic pain and hemorrhagic cyst. Color Doppler ultrasound image shows 4.0-cm left ovarian avascular cyst containing retractile clot (*arrows*), evidenced by straight margin and reticular pattern consistent with hemorrhagic cyst (O-RADS 2 lesion).
C, 39-year-old woman with irregular menses and dermoid cyst. Ultrasound image shows right ovarian cystic lesion containing hyperechoic component with shadowing (*short arrow*) and hyperechoic lines and dots (*long arrow*) consistent with dermoid cyst (O-RADS 2).
D, 49-year-old woman with palpable left pelvic mass consistent with dermoid cyst. Ultrasound image shows right adnexal cyst containing numerous floating echogenic spherical structures (*arrows*) consistent with dermoid cyst (O-RADS 2).
E, 35-year-old woman with chronic pelvic pain and endometrioma. Color Doppler ultrasound image shows right ovarian unilocular cyst with homogeneous low-level echoes (*arrow*) and absent internal flow consistent with endometrioma (O-RADS 2). Any classic benign lesion larger than 10 cm is categorized O-RADS 3.

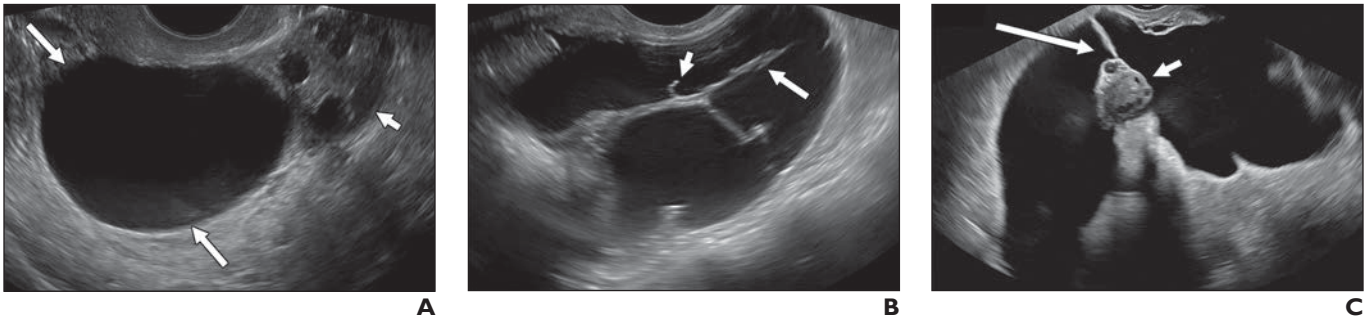


Fig. 5—Classic benign lesions, extraovarian.
A, 34-year-old woman with abnormal uterine bleeding. Ultrasound image shows incidental finding of right paraovarian simple cyst (*long arrows*) adjacent to but separate from ovary (*short arrow*). All extraovarian classic benign lesions fall into Ovarian-Adnexal Reporting and Data System (O-RADS) category 2, irrespective of size.
B, 33-year-old woman with history of pelvic inflammatory disease. Ultrasound image shows left-sided, tubular, fluid-filled structure with incomplete septations representing tubal folds (*long arrow*) and short projections along walls and folds (*short arrow*) representing endosalpingeal folds. This structure is separate from ovary (not shown) and is consistent with hydrosalpinx (classic benign lesion, O-RADS 2).
C, 28-year-old pregnant woman with history of appendectomy presenting for first trimester evaluation, at which right peritoneal inclusion cyst was incidentally detected. Ultrasound image shows characteristic imaging features: fluid collection without mass effect, which conforms to adjacent pelvic organs; suspended ovary (*short arrow*); and adjacent septation (*long arrow*) that represents adhesion. Care should be taken not to mistake ovary for solid component. Peritoneal inclusion cysts are classic benign lesions (O-RADS 2).

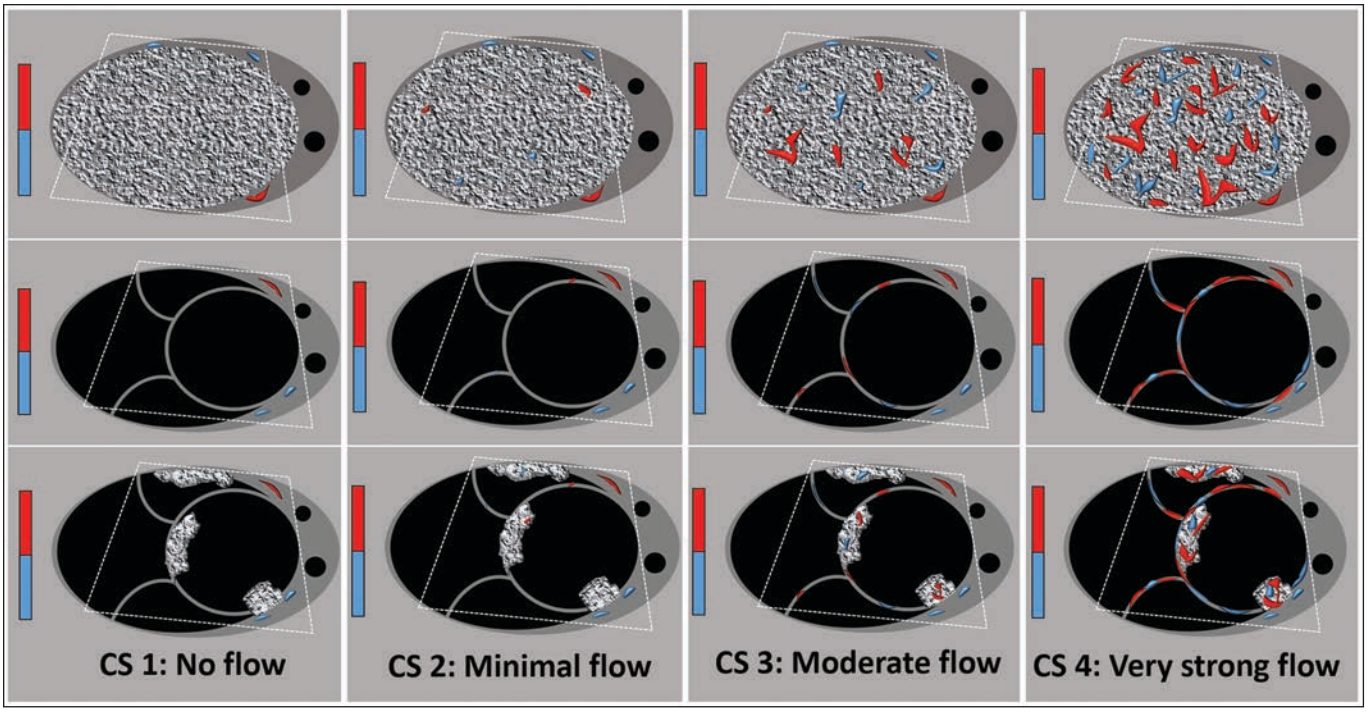


Fig. 6—Schematic shows color score (CS) grading system of degree of internal vascularity within lesion used for risk stratification of solid lesions with smooth outer contour, multilocular cystic lesions with smooth inner walls and septation, and multilocular cystic lesions with solid components. Tips to ensure accurate interpretation of CS include using an adjacent structure (e.g., uterus or contralateral ovary) and optimizing baseline settings. CS 1 reflects no detectable flow. CS 2 should be rendered when flow is present, albeit challenging to see. CS 4 reflects robust flow that is easily seen. Anything between these two should be categorized as moderate flow, CS 3.

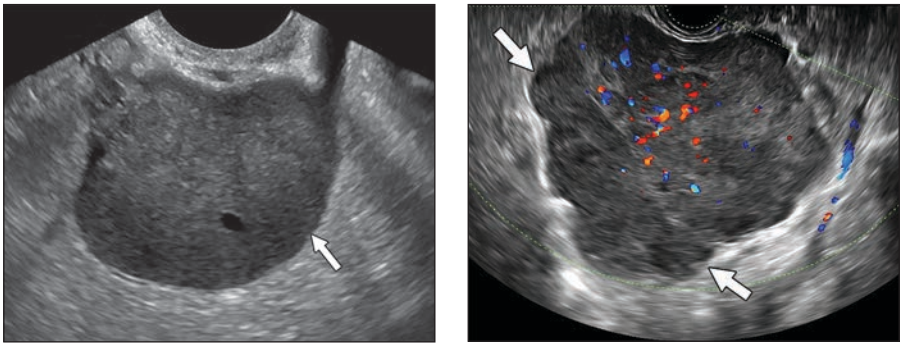


Fig. 7—Solid ovarian lesions, outer contour.
A, 39-year-old woman with acute myelogenous leukemia and ovarian chloroma. Ultrasound image shows left ovarian solid lesion with smooth outer contour (*arrow*). Color score (CS) assessment (not shown) was determined to be CS 4, consistent with Ovarian-Adnexal Reporting and Data System (O-RADS) category 5 lesion.
B, 20-year-old woman with positive serum β-HCG result, elevated α-fetoprotein levels, and dysgerminoma at pathologic analysis. Color Doppler ultrasound image shows solid right ovarian lesion with irregular outer contour (*arrows*), consistent with O-RADS 5 lesion. CS assessment does not affect risk stratification of solid lesions with irregular outer contour. (Courtesy of Blanchette-Porter M, University of Vermont, Burlington, VT)

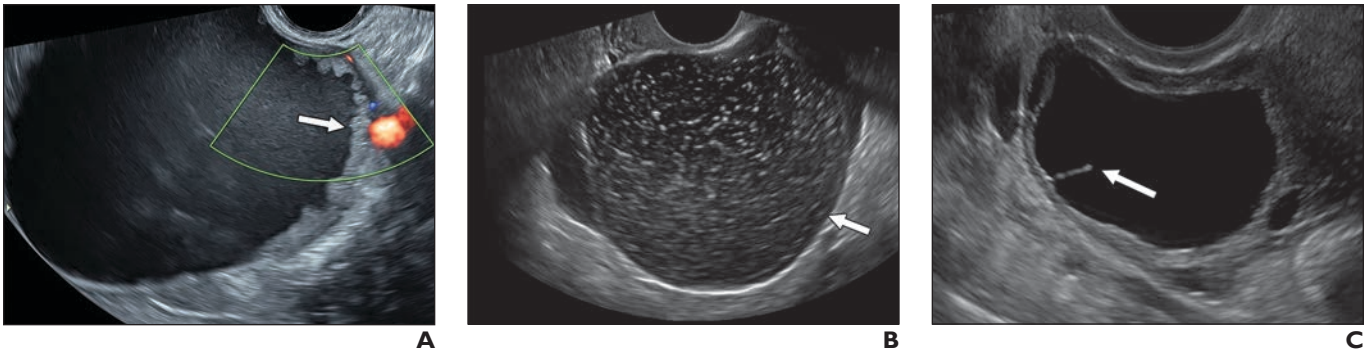


Fig. 8—Unilocular cysts without solid components.
A, 46-year-old woman with pelvic fullness due to mucinous cystadenoma. Color Doppler ultrasound image shows right ovarian unilocular cyst with inner wall irregularity (*arrow*) consistent with Ovarian-Adnexal Reporting and Data System (O-RADS) category 3 lesion. Wall irregularity does not protrude more than 3 mm into cyst lumen and hence does not meet criteria for solid component or papillary projection.
B, 56-year-old woman with vague abdominal pain and borderline serous tumor. Ultrasound image shows 10.5-cm right ovarian unilocular cystic lesion with scattered internal echoes (*arrow*) consistent with O-RADS 3 lesion.
C, 28-year-old woman with abnormal uterine bleeding and benign ovarian cyst. Ultrasound image shows incidentally detected left ovarian unilocular cyst with incomplete septation (*arrow*). For appropriate O-RADS categorization, this lesion is considered nonsimple cyst and to not have irregular wall. Because of 4.2-cm size, assessment is O-RADS category 2. For this premenopausal woman, follow-up ultrasound at 8 weeks was pursued and showed complete interval resolution consistent with benign process.

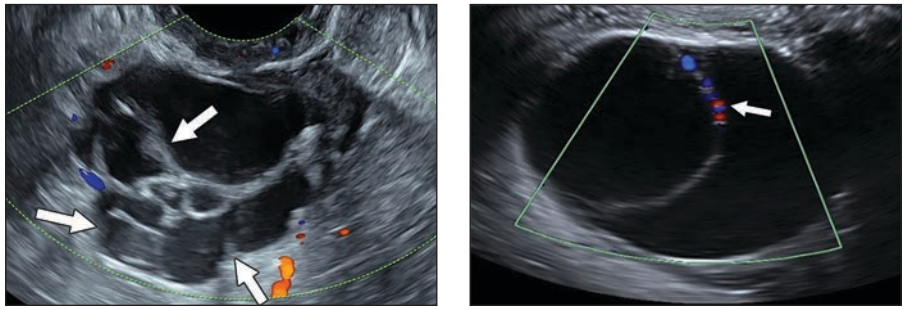


Fig. 9—Multilocular cysts without solid components.
A, 68-year-old woman with bloating and left ovarian borderline serous cystadenoma. Color Doppler ultrasound image shows multilocular cyst with irregular inner walls and septations (*arrows*) and no solid component, consistent with Ovarian-Adnexal Reporting and Data System (O-RADS) category 4 lesion. Color score (CS), representing internal vascularity, and size do not contribute to O-RADS risk assessment when inner walls or septation in multilocular cysts are irregular.
B, 42-year-old woman with secondary infertility and benign serous cystadenoma. Color Doppler ultrasound image shows incidentally identified multilocular cyst with smooth inner walls and single smooth complete septation (*arrow*). Size and CS are important parameters for accurate O-RADS categorization. CS only has to be categorized as greater than very strong flow (CS 4) versus any score less than very strong flow (CS 1–3) for multilocular cysts without solid components. This lesion has moderate flow (CS 3) and maximum dimension of 5.2 cm (< 10 cm), placing it in O-RADS category 3.

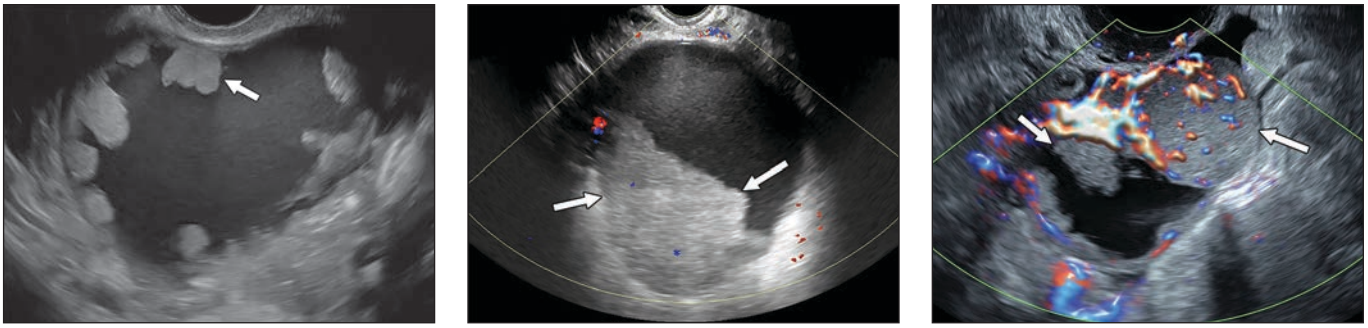


Fig. 10—Unilocular cysts with solid components.
A, 35-year-old woman with right lower quadrant fullness and borderline serous cystadenoma. Ultrasound image shows unilocular cyst with multiple papillary projections (*arrow*). Assessment is Ovarian-Adnexal Reporting and Data System (O-RADS) category 5. Papillary projections represent subtype of solid component that protrudes into cyst cavity, measures at least 3 mm in height, and is surrounded by fluid on three sides. Papillary projection has acute angles at its interface with wall or septum to which it is attached, whereas solid component makes obtuse angles and appears sessile. Number of papillary projections contributes to O-RADS risk category assessment, four or more papillary projections conferring higher risk of malignancy. (Courtesy of Blanchette-Porter M, University of Vermont, Burlington, VT)
B, 22-year-old woman with mixed germ cell tumor and right pelvic pain. Color Doppler ultrasound image shows unilocular cyst in right ovary with vascularized solid component (*arrows*) that is sessile and hence does not meet criteria for papillary projection. Assessment is O-RADS category 4.

Fig. 11—67-year-old woman with weight loss. Color Doppler ultrasound image shows multilocular cystic lesion with large, solid, vascularized components (*arrows*) proven to be high-grade serous tubal carcinoma. Color score (CS) is important for appropriate Ovarian-Adnexal Reporting and Data System (O-RADS) categorization of multilocular cystic lesions with solid components. Color Doppler imaging shows very strong flow (CS 4) consistent with O-RADS category 5 lesion. Size is irrelevant for risk stratification of lesions with these features. Distinction between papillary projection and nonpapillary solid component is not relevant for O-RADS categorization of multilocular cystic lesions.

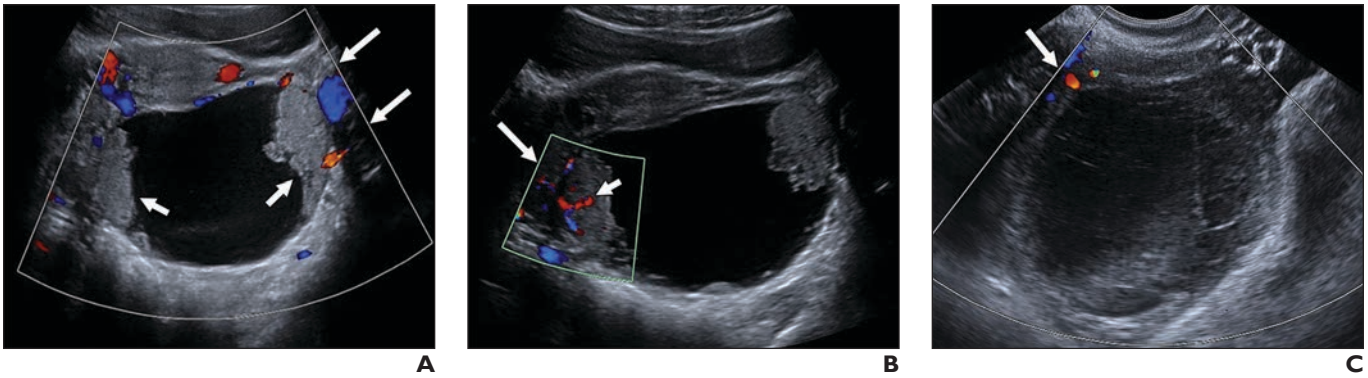
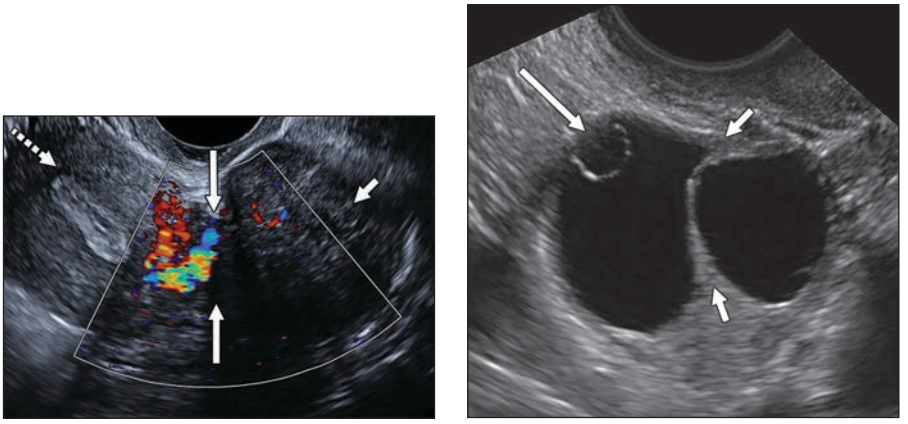


Fig. 12—Technical considerations and pitfalls.
A, 30-year-old pregnant woman undergoing nuchal translucency testing at 13 weeks 5 days of gestation found to have unilocular cyst with solid component. Initial color Doppler ultrasound image with larger color box (*large arrows*) than in **B** shows no flow in solid-appearing components (*small arrows*). This could lead to misinterpretation as debris such as clot.
B, Same patient as in **A**. Color Doppler ultrasound image with smaller color box (*large arrow*) than in **A** shows flow confirming solid tissue (*small arrow*). Serous borderline tumor was excised at 18 weeks' gestational age.
C, 28-year-old woman with pain due to hemorrhagic cyst. Color Doppler ultrasound image shows flow in surrounding ovarian parenchyma (*arrow*), which assures adequate color flow assessment, increasing diagnostic confidence. When color Doppler imaging is performed, some color must be visualized within box to ensure adequate technical assessment.

(Fig. 12 continues on next page)



D E

Fig. 12 (continued)—Technical considerations and pitfalls.
D, 36-year-old woman undergoing evaluation of solid left ovarian lesion seen on outside imaging. Color Doppler ultrasound image shows bridging vessels (*long solid arrows*) between uterus (*dashed arrow*) and solid lesion (*short solid arrow*) confirming exophytic subserosal leiomyoma and not ovarian lesion. Because most common solid adnexal mass is exophytic myoma, it is prudent to search for connection to uterus when separate ovary is not seen and ovarian cause is suspected.
E, 22-year-old woman with secondary amenorrhea. Ultrasound image shows cyst-within-cyst appearance or daughter cyst (*long arrow*) representing partial volume averaging of separate follicle within adjacent ovarian parenchyma. Finding should not be confused with multilocular cyst. Differentiating two adjacent follicles or cysts from single septate cyst may also be challenging. Presence of ovarian tissue (*small arrows*) coming to peak on both sides of questionable septum (figure-of-eight sign) confirms adjacent follicles and excludes true septate cyst.