Benign-appearing Incidental Adnexal Cysts at US, CT, and MRI: Putting the ACR, O-RADS, and SRU Guidelines All Together

Peter S. Wang, MD
Otto G. Schoeck, MD
Mindy M. Horrow, MD

Abbreviations: ACR = American College of Radiology, IOTA = International Ovarian Tumor Analysis, O-RADS = Ovarian-Adnexal Reporting and Data System, SRU = Society of Radiologists in Ultrasound

RadioGraphics 2022; 42:609–624

https://doi.org/10.1148/rg.210091

Content Codes: CT MR OB US

From the Department of Diagnostic Radiology, Einstein Healthcare Network, 5501 Old York Rd, Philadelphia, PA 19141-3098. Recipient of a Certificate of Merit award for an education exhibit at the 2020 RSNA Annual Meeting. Received March 28, 2021; revision requested May 11 and received July 6; accepted July 15. For this journal-based SA-CME activity, the authors P.S.W. and M.M.H. have provided disclosures (see end of article); the other author, the editor, and the reviewers have disclosed no relevant relationships. **Address correspondence to** O.G.S. (e-mail: *schoecko@einstein.edu*).

SA-CME LEARNING OBJECTIVES

After completing this journal-based SA-CME activity, participants will be able to:

- Describe the basis for the conclusion that a simple adnexal cyst does not increase cancer risk regardless of menopausal status.
- Discuss the updated recommendations of the SRU 2019 consensus for simple cysts based on size and menopausal status with parallel recommendations from the O-RADS and ACR 2019 consensus on incidental CT and MRI lesions.
- Recognize whether performing US after CT or MRI is to further characterize the lesion or to provide follow-up with time.

See rsna.org/learning-center-rg.

Adnexal cysts are a common incidental finding at US, CT, and MRI but have historically caused a diagnostic dilemma for determining when to follow up and how to manage them. Characteristic imaging features of simple adnexal cysts include a simple fluid collection with smooth walls and no solid or vascular components. Day-to-day practice guidelines were recently updated to reflect the overwhelming evidence that incidental cystic adnexal masses are almost always benign. Three major consensus articles on adnexal cystic masses were published between 2019 and 2020: the Society of Radiologists in Ultrasound (SRU) consensus update on adnexal cysts, the Ovarian-Adnexal Reporting and Data System (O-RADS) US consensus guideline, and the American College of Radiology (ACR) white paper on the management for incidental adnexal findings at CT and MRI. All three standardize reporting terminology, are based on evidence-based data and institutional practice patterns, and apply to nonpregnant women of average risk for ovarian cancer. While there are small differences in follow-up recommendations based on size thresholds, the goal of each is the same—to limit unnecessary imaging follow-up and, by doing so, save the patient time, money, and anxiety. For the diagnostic radiologist to use these guidelines, it is essential that the entire mass is visualized well. Without adequate visualization, further characterization of the mass may be necessary. To put it all together, the SRU consensus guideline and ACR white paper are easily applied in day-to-day practice for masses that are O-RADS 2 and below.

An invited commentary by Patel is available online.
The online slide presentation from the RSNA Annual Meeting is available for this article.

Introduction

From its inception as a diagnostic imaging tool, pelvic US has helped confirm a wide range of incidental adnexal cystic masses. Advances in transvaginal equipment and techniques such as color and spectral Doppler, cine clips, and two-dimensional and three-dimensional reformations have advanced our understanding of the nature of these cysts while also helping detect increasing numbers of masses. The

TEACHING POINTS

- Many other studies corroborate the conclusion that simple ovarian cysts are common in all women and do not increase their risk of carcinoma and that specific characteristics of nonsimple cystic masses can be used to stratify such masses into categories of relative risk for ovarian carcinoma.
- The SRU 2019 update limits follow-up US for postmenopausal women with simple cysts to those greater than 3–5 cm and reproductive age women with simple cysts greater than 5–7 cm.
- There are three essential components of a quality examination: certified sonographers with trained physician oversight, equipment with transvaginal sonography capabilities and Doppler imaging that allows complete cyst characterization, and up-to-date quality assurance programs. Cine images also improve the confidence of characterizing masses, as static images may not show subtle septa or solid components.
- O-RADS 0 should not be used for cystic masses that are completely visualized but for which the radiologist is unsure of the diagnosis.
- When further imaging is required after CT and/or MRI, it is designated as promptly either for characterization because of incomplete evaluation owing to technique or lack of coverage or as follow-up after 6–12 months for a well-characterized mass above the threshold size for menopausal status.

expanding use of abdominal and pelvic CT and various MRI examinations that include portions of the pelvis have further contributed to the number of incidental masses seen by radiologists. Given the deadly nature of ovarian carcinoma, which is the fifth most common cause of cancer deaths among women, our task as radiologists is to keep our patients safe by distinguishing worrisome high-risk cystic masses that require further evaluation from the low-risk masses that need minimal or no follow-up (1,2).

Fortunately, the overwhelming number of incidental cystic masses are benign. Unfortunately, the detection of incidental cystic masses is a daily occurrence. Even if we follow or further evaluate only a small percentage of masses, this translates into numerous repeat US examinations and a smaller number of pelvic MRI examinations and potentially unnecessary surgical procedures with associated morbidity and mortality, as well as great anxiety and cost. Balancing the task of diagnosing ovarian malignancy as early as possible with the need to minimize unnecessary imaging and surgery has been made easier by a large body of accumulated population-based data on the behavior and outcome of incidental adnexal cysts in women.

In 2008, the International Ovarian Tumor Analysis (IOTA) group in Europe published the simple rules, which used standardized terminology and definitions for adnexal cysts to classify ovarian masses into three categories: benign, malignant, and inconclusive (3). In 2010, the Society of Radiologists in Ultrasound (SRU) published a consensus paper that established thresholds for benign-appearing cysts that do not require follow-up (4). The IOTA simple rules and SRU guidelines became widely accepted in Europe and the United States, respectively, resulting in decreased numbers of unnecessary follow-up examinations (5,6). Another study suggested that the guidelines were applicable to symptomatic cysts (7). However, the IOTA simple rules were limited by the lack of predicted risk, and the SRU guidelines had limited descriptors and risk stratification for the indeterminate and worrisome masses.

In 2013, the American College of Radiology (ACR) issued a white paper on incidental adnexal cysts diagnosed at CT and MRI, distinguishing among masses that required immediate imaging for full characterization, imaging for follow-up, or no further imaging (8). However, these recommendations were not aligned with the US criteria for size.

To overcome many of these issues, the ACR convened an Ovarian-Adnexal Reporting and Data System (O-RADS) panel with US and MRI subcommittees to standardize the descriptor lexicon for ovarian masses. The US O-RADS lexicon was published in 2018 and the MRI lexicon in 2021 (9). The US O-RADS committee proceeded to link the terminology to a risk stratification model by collaborating with the IOTA group and by using its large dataset to test the O-RADS descriptors. Contemporaneously, the SRU reconvened the adnexal cyst panel, which revised the recommendations for simple adnexal cysts by using consensus-based guidelines to recommend management (10). In parallel, a working group revised the ACR white paper on incidental adnexal cysts at CT and MRI (11). These panels had many members in common and were able to achieve reasonable uniformity in their recommendations. Incorporation of new guidelines into daily use can be variable, requiring education of radiologists and integration into decision-support reporting systems. This article aims to advance this educational process by discussing the recent SRU and ACR consensus publications with respect to incidental benign-appearing cystic masses, including a review of physiologic masses, accepted descriptors, measurement reporting, imaging examples, and recommendations for follow-up.

Review of Major Outcomes Studies

In 1971, Barber and Graber (12) defined the term *postmenopausal palpable ovary syndrome* to promulgate their view that within 3–5 years of

menopause any palpable ovary should be a cause of alarm for underlying ovarian carcinoma, giving a recommendation for laparotomy with total hysterectomy and bilateral oophorectomy in such patients. The explanation of this position included their view that the postmenopausal ovary should never be enlarged owing to a cyst, since the only recognized cysts were the physiologic, premenopausal follicular, and corpus luteal cysts. Subsequent evidence from a few small clinical studies supported this theory (13). Meanwhile, the increasingly widespread use of pelvic US brought the entire concept into question, with studies showing frequent cases in postmenopausal women of small unilocular simple cysts with a low incidence of malignancy (14).

In 1992, Levine et al (15) published a prospective study using transabdominal and transvaginal pelvic sonography in 184 asymptomatic postmenopausal volunteers showing that simple cysts were a common waxing and waning finding (15). At initial scanning, adnexal cysts were found in 17% of the cohort. Over the next 2 years, 46 new cysts arose, with further follow-up showing that the majority resolved or were stable. The recommendation from this study was to follow a simple postmenopausal cyst less than 3 cm at US, reserving surgical resection for larger or more complex cysts.

In the ensuing years, an increasing number of studies in larger populations of both pre- and postmenopausal women have added to our knowledge of the risk of ovarian carcinoma in adnexal cysts. A cohort of 15 735 postmenopausal women enrolled in the Prostate, Lung, Colorectal, and Ovarian Cancer Screening Trial underwent 4 years of transvaginal US screening. In this group, 14% had a simple cyst on the baseline image, with one-third resolving and 8% with new cysts at follow-up. Having a simple cyst at any time during the study did not increase the risk of subsequent invasive carcinoma (16). A subsequent publication from this cohort compared the women who were screened with US and cancer antigen 125 (CA-125) level testing with a similar but unscreened cohort and not only found no decrease in ovarian cancer mortality, but in the group with false-positive screening, the diagnostic follow-up resulted in serious medical complications and increased health care costs (17).

The authors of a 2019 Kaiser Permanente study analyzed the US examinations of 72 093 unselected pre- and postmenopausal women, demonstrating an incidence of ovarian cancer of 0.29% (2). Simple cysts were common (23.8%). No simple cyst was subsequently diagnosed as a cancer in women younger than 50 years and only a single postmenopausal woman was diagnosed as having cancer within 3 years of visualization of a simple cyst. Complex features in a cystic mass increased the likelihood of cancer by eight times. The conclusion was that women with simple cysts, cysts with low-level echoes, or nonvisualized ovaries were at no greater risk of ovarian cancer compared with women with normal visualized ovaries. Many other studies corroborate the conclusion that simple ovarian cysts are common in all women and do not increase their risk of carcinoma and that specific characteristics of nonsimple cystic masses can be used to stratify such masses into categories of relative risk for ovarian carcinoma (18,19).

The Normal Ovary

The normal premenopausal ovary contains multiple small anechoic or simple cystic follicles. During the menstrual cycle, a dominant follicle will grow and mature in the follicular phase to become a corpus luteum after ovulation. Although they may represent other physiologic cysts, simple cysts less than or equal to 3 cm in the premenopausal woman may be considered follicles since that terminology indicates a normal physiologic finding to the patient and provider, which can potentially alleviate anxiety. The corpus luteum has typical sonographic features of a thick-walled cyst with peripheral vascularity and possibly containing internal echoes and/or a crenulated appearance. Examples of normal ovarian follicles at US and corpus luteum at CT, MRI, and US are shown in Figures 1 and 2.

The postmenopausal ovary typically becomes progressively smaller with age and the follicles start to disappear following menopause (Fig 3). Since follicles disappear after menopause, the misconception is that there should be no simple cysts in and around the postmenopausal ovary. In fact, studies have shown that transient simple cysts can occur in postmenopausal ovaries, and an autopsy study demonstrated that benign adnexal cysts are commonly found in postmenopausal women (15,20,21). Up to 10% of cysts removed are found to be extraovarian in origin, and therefore it is more appropriate to use the term *adnexal cyst* when the ovary is not distinctly visualized and an ovarian origin cannot be definitively determined (21).

SRU Consensus Update 2019

With the publication of several large studies from 2010 to 2018 demonstrating no relationship between simple cysts and increased risk of ovarian cancer, the multidisciplinary SRU adnexal cyst panel reconvened in 2019 to review the published evidence and update the guidelines

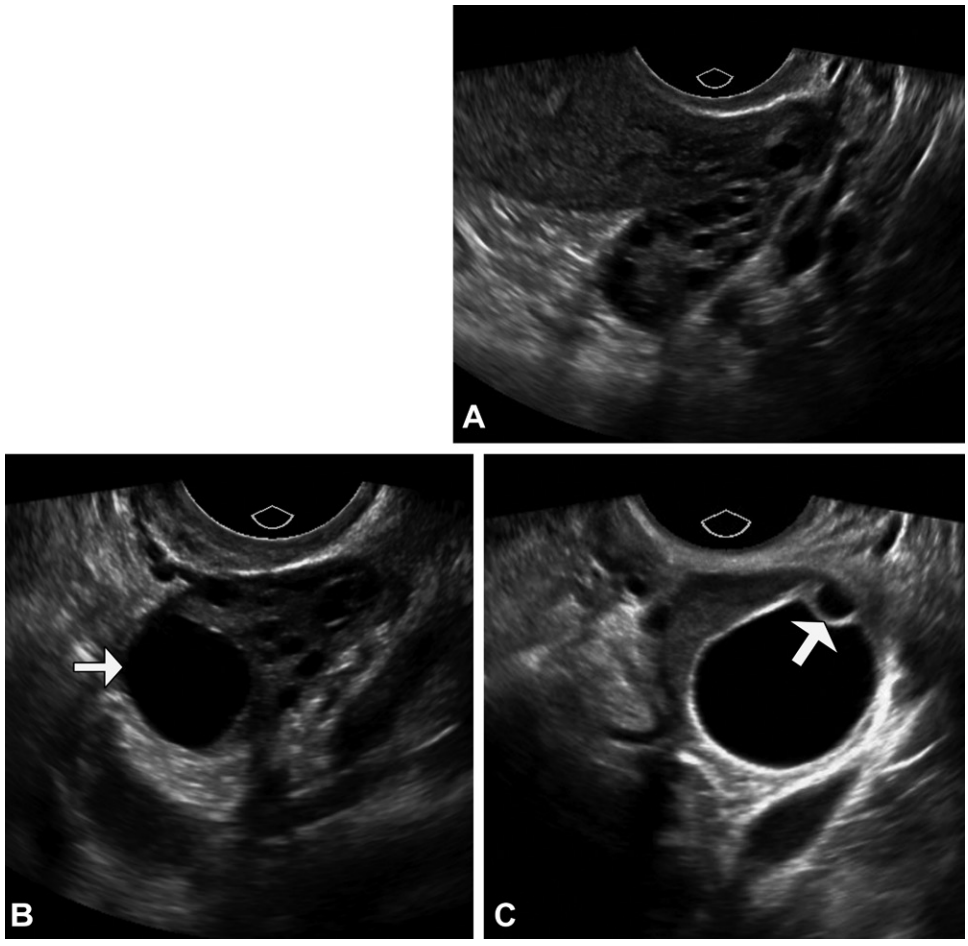


Figure 1. Normal gray-scale sonographic appearance of ovarian follicles in a premenopausal patient. **(A)** In the early follicular phase, there are multiple small anechoic follicles. **(B)** In the mid follicular phase, there is a 1.7-cm dominant anechoic follicle (arrow). **(C)** In the preovulatory phase, the dominant follicle may develop a cumulus oophorus (arrow).

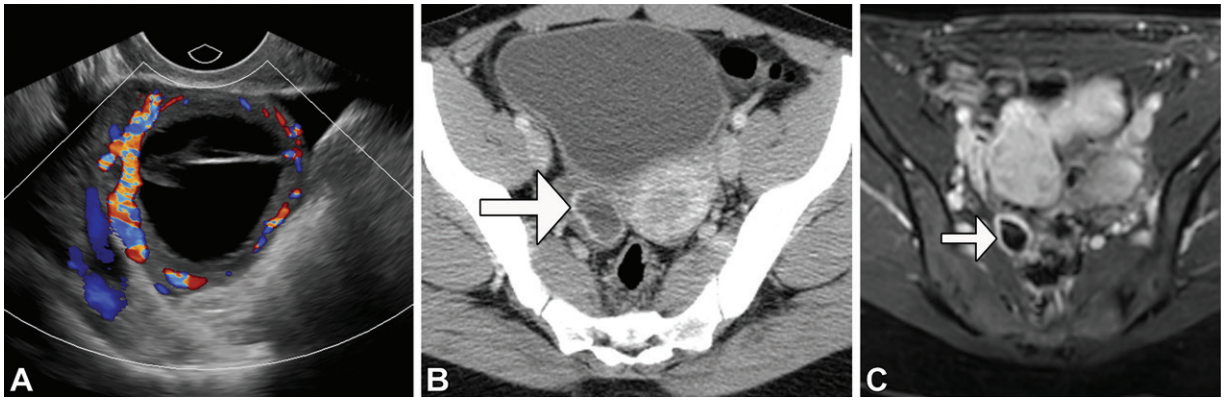


Figure 2. Normal appearance of the corpus luteum in three different patients. **(A)** Color Doppler US image shows a 2.6-cm cystic corpus luteum with peripheral vascularity. **(B)** Axial contrast-enhanced CT image shows a 2.4-cm rim-enhancing corpus luteum (arrow) in the right ovary. **(C)** Axial contrast-enhanced T1-weighted fat-suppressed MR image shows a similar 2.1-cm rim-enhancing corpus luteum (arrow) in the right ovary.

accordingly (10,16). Like O-RADS, the SRU consensus standardizes wording for reports. Unlike O-RADs, the SRU update only addresses the ovarian or adnexal simple cyst, which the committee defined as a "round or oval anechoic fluid collection with smooth thin walls, no solid component or septation, and no internal flow using color Doppler imaging." The update removed the requirement of posterior acoustic enhancement from the definition because compound imaging that is routinely used in modern equipment may mask this feature. However, optimized Doppler

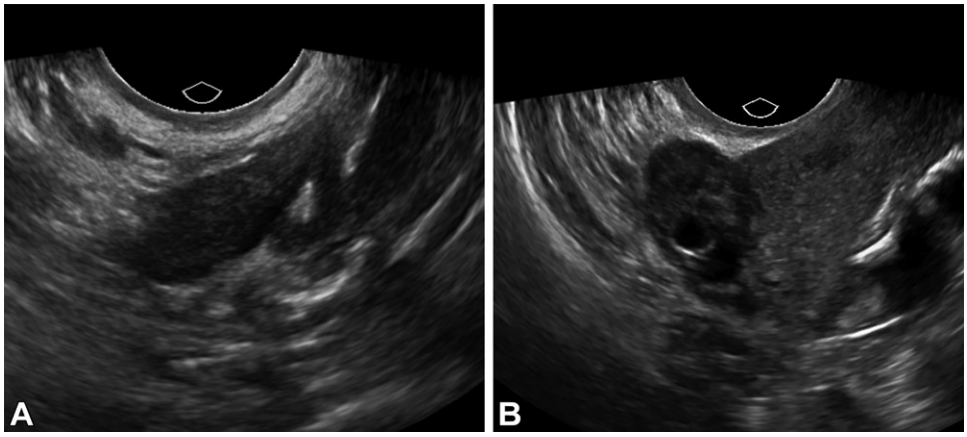


Figure 3. Normal gray-scale sonographic appearance of postmenopausal ovaries in a 57-year-old woman. **(A)** US image shows that the left ovary is atrophic and homogeneously hypoechoic and lacks follicles. **(B)** US image shows that the right ovary is atrophic, is slightly heterogeneous, and has an 8-mm cyst.

imaging is essential to avoid characterizing a very hypoechoic solid mass as a simple cyst.

Based on the literature, the major consensus of the panel was that simple adnexal cysts "have negligible, if any, association with ovarian cancer." Since most simple cysts in premenopausal women are physiologic and gradually enlarging simple cysts are typically benign neoplasms, the question was which simple cysts, if any, should be followed and for how long. The consensus recommendations from the committee balanced the potential harm of follow-up imaging, patient anxiety, and possible surgical intervention of cysts without an increased relative risk of ovarian cancer with the need for adequate documentation of cysts that may be compared with subsequent imaging examinations and the potential for mischaracterization of large cysts. The SRU 2019 update limits follow-up US for postmenopausal women with simple cysts to those greater than 3–5 cm and reproductive age women with simple cysts greater than 5–7 cm. The lower size thresholds are used when there is standard visualization and diagnostic confidence. The larger size thresholds are used when visualization and confidence are superior. The longest single dimension of the cyst is used for the size thresholds.

A high-quality US examination is required for superior visualization and diagnostic confidence. There are three essential components of a quality examination: certified sonographers with trained physician oversight, equipment with transvaginal sonography capabilities and Doppler imaging that allows complete cyst characterization, and up-to-date quality assurance programs. Cine images also improve the confidence of characterizing masses, as static images may not show subtle septa or solid components.

Recommendations for follow-up were purposefully broad, allowing for concerns about mischaracterization and patient and physician anxiety. The range for initial follow-up was 2–12 months for premenopausal women and 3–12 months for postmenopausal women. The group consensus was to use an initial follow-up recommendation of 3–6 months if there was a concern for mischaracterization of the cyst or if the cyst has a high likelihood of resolving. A shorter follow-up interval of 2–3 months may be reasonable if there is high patient or physician anxiety regarding a cyst that is likely physiologic in a premenopausal woman. A longer initial follow-up interval of 6–12 months is preferred if the primary objective is to evaluate for growth of the cyst. There was less agreement on subsequent follow-up studies. In general, stability over 2 years indicates a nonneoplastic cyst or indolent cystic neoplasm and no further imaging is required. An enlarging simple cyst is most likely a benign neoplasm and may need further follow-up, especially as it may become symptomatic.

ACR O-RADS

While the SRU consensus statement is helpful in standardizing follow-up recommendations for ovarian and adnexal masses, it does not provide a standard lexicon to describe these masses, does not provide any risk stratification for malignancy, and is mainly used in North America (4,10). In addition, the 2019 SRU update only addresses the simple adnexal cyst. Other proposed characterization and management systems such as the University of Kentucky morphology index and the Gynecologic Imaging Reporting and Data System (GI-RADS) have not gained widespread usage (22,23).

In 2018, the ACR O-RADS committee published a white paper standardizing the US

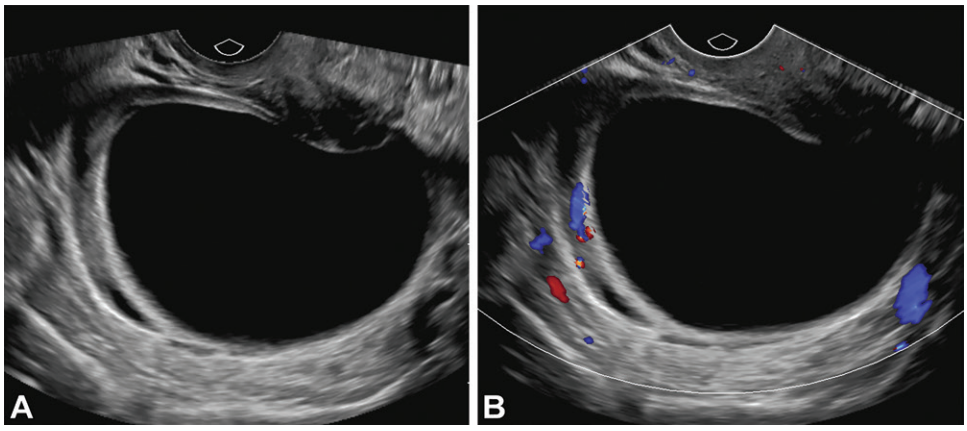


Figure 4. Simple cyst in a premenopausal woman (O-RADS 2). **(A)** Gray-scale US image shows a 7-cm simple cyst that is anechoic and unilocular and has a thin smooth wall. **(B)** Color Doppler US image shows no internal vascularity. This cyst resolved on a follow-up US image obtained 7 months later.

terminology for reporting ovarian-adnexal masses (24). The lexicon was formed by committee consensus and is largely based on the vocabulary developed by the IOTA group owing to its evidence-based efficacy in classifying adnexal masses as benign or malignant on the basis of the IOTA simple rules (3,25,26). A retrospective analysis of data collected from IOTA was performed by using the consensus lexicon to develop risk stratification of malignancy potential (27). The resultant guidelines form the O-RADS US risk stratification and management system (27). The guidelines are based on asymptomatic patients with otherwise average risk of ovarian cancer. Our discussion of O-RADS focuses primarily on cystic adnexal masses in O-RADS 1–3 categories, which in our experience are the most frequently encountered in clinical practice and most likely to have variable management recommendations.

There are several key descriptors used to stratify masses into the O-RADS categories. Masses are divided into major categories between physiologic cysts such as a follicle or corpus luteum and nonphysiologic masses including unilocular or multilocular cysts or solid masses. The size of the mass is the largest diameter of the mass regardless of the measurement plane. For cystic masses, characteristics that further stratify malignancy risk include the inner margins or walls (smooth or irregular) and the presence or absence of solid components. If a solid component is present, the number and sizes of the papillary projections and the qualitative color score or degree of vascularity are required for risk stratification. *Papillary projections* are defined as solid components 3 mm or more in height, arising from the cyst wall or septation, and protruding into the cyst cavity. The overall subjective vascularity is assessed and assigned a color score from 1–4, with a score of 1 representing no flow, a score of 2 representing minimal flow, a score of 3 representing moderate flow, and a score of 4 representing very strong flow.

O-RADS 0

The O-RADS 0 category is reserved for incomplete evaluations of adnexal or ovarian cysts due to factors such as obscuring bowel gas, incomplete visualization of the entire mass, and inability of the patient to tolerate transvaginal imaging. O-RADS 0 should not be used for cystic masses that are completely visualized but for which the radiologist is unsure of the diagnosis.

O-RADS 1

Adnexal cysts in O-RADS 1 are normal physiologic findings that routinely occur in premenopausal women and include simple cysts 3 cm or smaller or a corpus luteum (10,24,27) (Figs 1, 2). Simple cysts 3 cm or smaller occurring during the menstrual cycle are almost certainly follicles and do not require follow-up. Cysts that have the typical appearance of a corpus luteum, including a thick wall with crenulated inner margins, internal echoes, and intense peripheral color Doppler flow, also do not require follow-up.

O-RADS 2

Cystic masses in the O-RADS 2 category are almost certainly benign and have a less than 1% risk of malignancy. Masses in this category include simple cysts, nonsimple unilocular cysts with smooth inner margins, and classic benign masses. *Simple cysts* are defined as an anechoic unilocular cyst with a thin smooth wall. One difference between the O-RADS lexicon and the updated SRU guidelines is the inclusion of

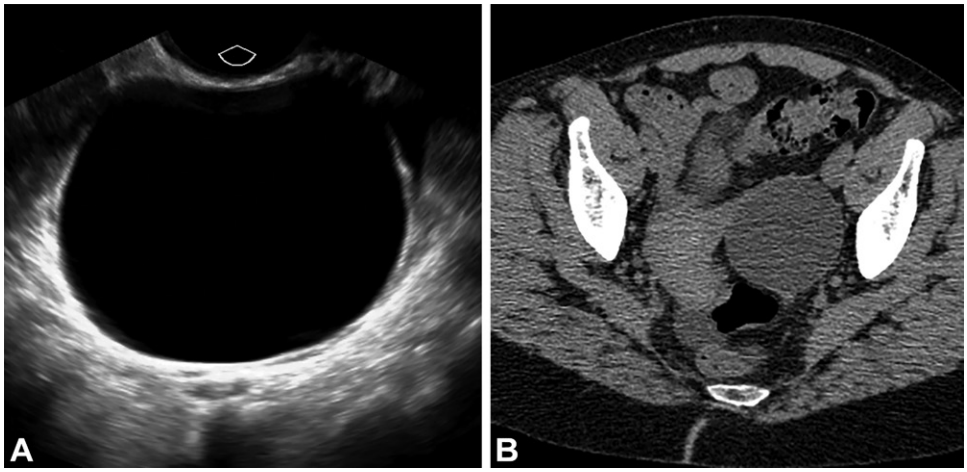


Figure 5. Simple cyst in a postmenopausal woman (O-RADS 2). **(A)** Gray-scale US image shows a simple 6-cm cyst. This simple cyst may be a slow-growing benign neoplasm or a paraovarian cyst. Based on its size, the O-RADS recommendation would be a 1-year follow-up. **(B)** Axial CT image obtained 2 years earlier shows a homogeneous hypoattenuating (2 HU) simple-appearing cyst of the same size, indicating benignity, and thus further US follow-up is unnecessary.

posterior acoustic enhancement as part of the simple cyst definition in O-RADS. This feature may be absent, especially in smaller cysts, with the use of compound imaging in modern-day equipment. Sonographers and radiologists should be aware of this pitfall and remove compound imaging if demonstration of posterior acoustic enhancement is needed to improve diagnostic confidence.

In premenopausal women, simple cysts 5 cm or smaller require no additional management. A follow-up US in 8–12 weeks is recommended for premenopausal women with simple cysts larger than 5 cm and smaller than 10 cm. While these cysts are most likely benign, the follow-up US is useful to *(a)* confirm its resolution, which typically occurs with physiologic cysts, and *(b)* to reassess a persistent cyst for any abnormalities that were not identified at the first examination, especially since subtle findings may be more difficult to visualize in larger cysts (Fig 4). For premenopausal women, follow-up examinations should be performed in the proliferative phase, if possible, to allow involution of physiologic cysts. A persistent or enlarging cyst should be referred to a US specialist or for MRI and managed by a gynecologist or gynecologic oncologist depending on its size and morphologic features at follow-up.

In postmenopausal women, simple cysts 3 cm or smaller do not require additional management. For simple cysts larger than 3 cm and smaller than 10 cm, a 1-year follow-up is recommended and annual follow-up for up to 5 years should be considered (Fig 5). If there is enlargement of the cyst or development of features indicating higher malignancy risk at follow-up, referral to a gynecologist should be recommended.

Nonsimple unilocular cysts that have smooth inner walls do not require additional management when they are 3 cm or smaller in premenopausal women. When these cysts are greater than 3 cm and less than 10 cm, a follow-up in 8–12 weeks is recommended in premenopausal women. A persistent or enlarging cyst at a follow-up examination should be referred to a US specialist or for MRI for characterization and a gynecologist for management. Nonsimple unilocular cysts in postmenopausal patients should be managed by a gynecologist, and referral to a US specialist or for MRI should be considered regardless of the cyst size. However, for cysts 3 cm or smaller, a 1-year follow-up US examination may be an alternative option.

Adnexal masses that have characteristic US findings for a specific benign diagnosis are also classified as O-RADS 2. These masses include paratubal or paraovarian cysts, hydrosalpinx, and peritoneal inclusion cysts of any size and hemorrhagic cysts, dermoids, and endometriomas that are less than 10 cm. Typically, these masses have classic sonographic features that are well established and are part of the O-RADS lexicon (24) (Fig 6). When a confident diagnosis of these masses can be made, their management recommendations are displayed in the Table. When a confident diagnosis of a classic benign mass cannot be made, the management should be tailored on an individual basis, depending on the factors for the equivocality. For example, when the diagnostic dilemma between an endometrioma and atypical hemorrhagic cyst is encountered, a follow-up US examination in

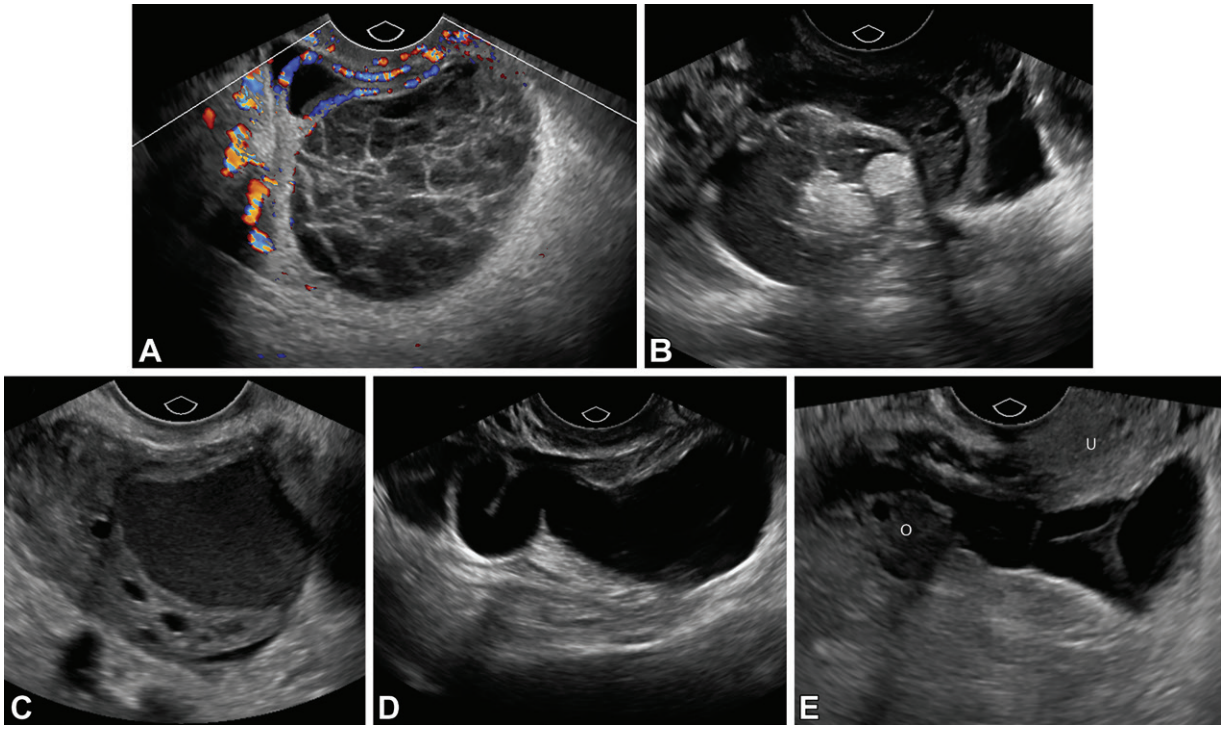


Figure 6. Examples of benign adnexal lesions with characteristic sonographic appearances (O-RADS 2). **(A)** Color Doppler US image in a premenopausal woman shows a 4.8-cm hemorrhagic cyst containing lacy reticular echoes and no internal vascularity. **(B)** US image in a premenopausal woman shows a 4.1-cm ovarian dermoid containing echogenic nodules and linear echoes representing hair. **(C)** US image in a premenopausal woman shows a 3.3-cm endometrioma, which contains diffuse fine low-level echoes and has a ground-glass appearance. **(D)** US image of a hydrosalpinx in a premenopausal woman shows a tubular simple fluid-filled structure with an "incomplete septa" sign separate from the adjacent ovary (not shown). **(E)** US image of a peritoneal inclusion cyst in a premenopausal woman shows a cystic mass abutting the ovary *(O)* and separate from the uterus *(U)*. Other than thin bright reticular echoes, which are adhesions, the fluid is anechoic and conforms to the peritoneal space.

Management Recommendations for Characteristic Adnexal Lesions at US

	Management	
Classic Benign Lesion	Premenopausal Patient	Postmenopausal Patient
Hemorrhagic cysts	≤5 cm: No further management >5 cm and <10 cm: US at 8–12 weeks	Any size: MRI, US specialist, or gynecologist follow-up
Dermoid cysts and endometriomas	<10 cm: Optional follow-up US in 8–12 weeks (may be helpful to differentiate endometriomas from atypical hemorrhagic cysts that typically resolve)	<10 cm: MRI, US specialist, gynecologist follow-up If not resected, consider performing annual US surveillance and additional MRI characterization for changes to morphology and increasing size
Simple paraovarian and/or paratubal cysts	None	Optional follow-up US in 1 year
Peritoneal inclusion cysts, hydrosalpinx	Refer to gynecologist	Refer to gynecologist

8–12 weeks may be helpful for differentiation, as hemorrhagic cysts typically resolve. Additionally, if there is uncertainty between a typical benign observation such as a hydrosalpinx or peritoneal inclusion cyst and a complex septated ovarian cyst, appropriate management may include referral to a US specialist or for MRI.

O-RADS 3

Adnexal masses in the low-risk category that carry a malignancy risk of 1% to less than 10% are classified as O-RADS 3 (27). In our experience, the masses in this category that present the most difficult management or follow-up dilemma are those that have features favoring benignity and

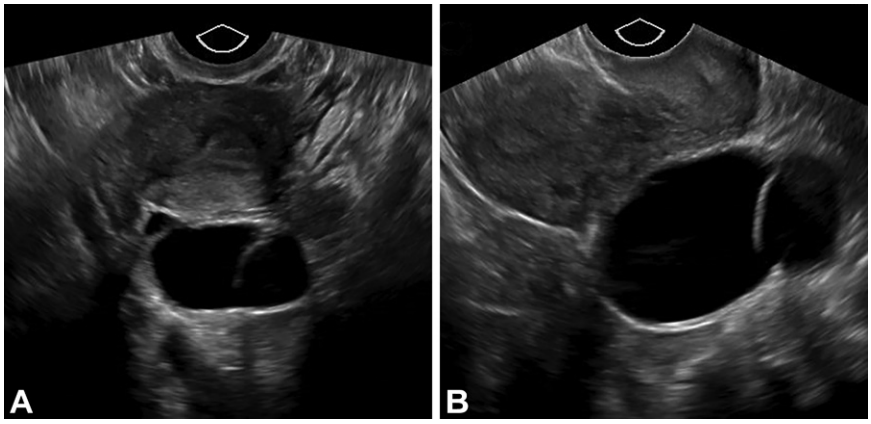


Figure 7. Right ovarian cyst with a septum in a premenopausal woman (O-RADS 3). **(A)** Gray-scale US image shows a 3.8-cm cyst with a single septum and a smooth inner wall in the right ovary. **(B)** Follow-up US image obtained 1 year later shows enlargement of the septated cystic mass, which is now 4.8 cm. Pathologic analysis results of the resected mass confirmed mucinous cystadenoma.

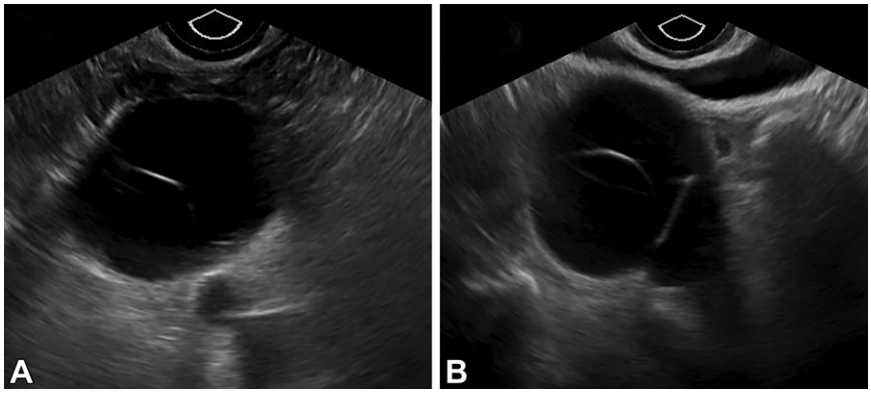


Figure 8. Multilocular right ovarian cyst in a postmenopausal woman (O-RADS 3). **(A)** Gray-scale US image shows a 4.6-cm cystic mass with a thin septum. **(B)** Follow-up US image obtained several years later shows enlargement of the cyst to 5.9 cm and development of additional thin septa. No additional follow-up is available, but this most likely represents a benign epithelial ovarian neoplasm.

would otherwise be categorized in O-RADS 2 but are 10 cm or larger. These masses include simple cysts, unilocular smooth nonsimple cysts, dermoid cysts, endometriomas, and hemorrhagic cysts. The 10-cm size threshold was used owing to the increased risk of malignancy when this threshold was applied to adnexal masses in the IOTA data (27). The other masses in the O-RADS 3 category include unilocular cysts with wall irregularity, multilocular cysts less than 10 cm without solid components and with a color score less than 4, and avascular solid or solid-appearing masses with a smooth contour (Figs 7, 8). Due to the increased risk of malignancy, masses in O-RADS 3 should be referred for evaluation by a US specialist or at MRI and should be managed by a gynecologist.

O-RADS 4 and 5

A discussion of O-RADS 4 and 5 is beyond the scope of this article. However, in routine clinical practice, we have found that these masses usually do not produce widely variable management or follow-up recommendations since they have features radiologists usually associate with higher risk of malignancy such as a solid component(s), internal vascularity, irregular or thickened septa, or other extra-adnexal features of malignancy. Hence, masses in these categories are typically referred to a gynecologic oncologist for management.

Incidental Adnexal Cysts at CT or MRI: CT White Paper 2020

The ubiquitous use of CT of the abdomen and pelvis and MRI for pelvic musculoskeletal and other non–genital tract indications has increased the number of incidental adnexal cysts detected with these modalities. Reporting and management of these masses were initially addressed by a white paper as part of the ACR Incidental Findings Committee in 2013 and then updated in 2020 to

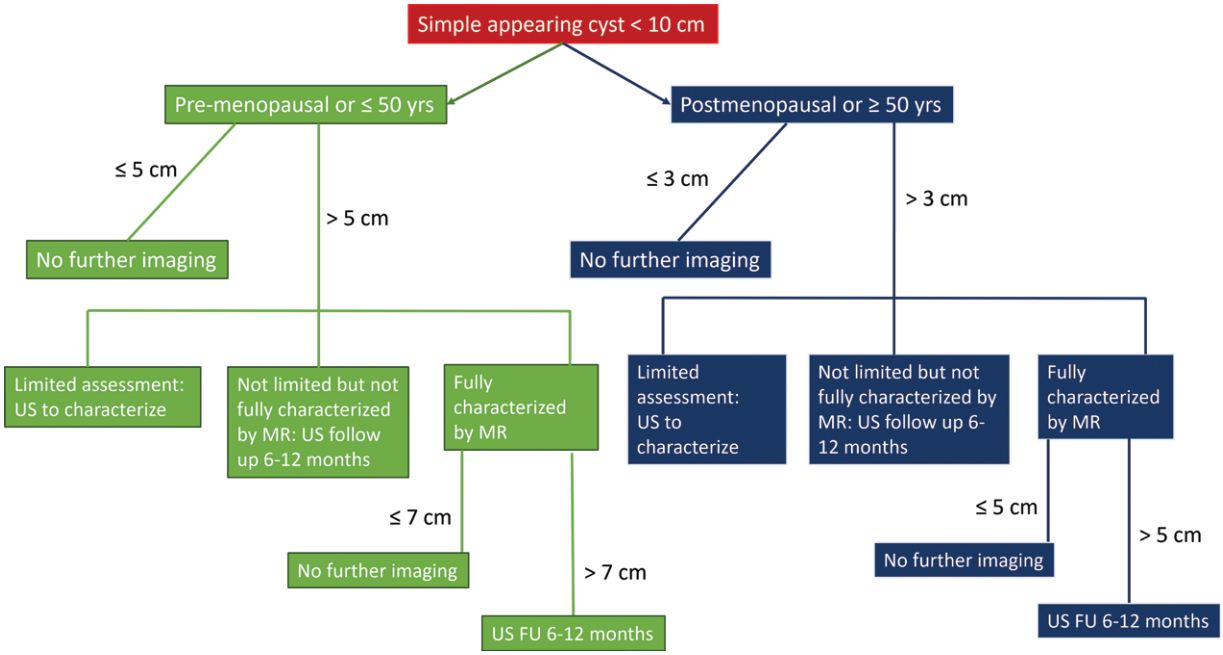


Figure 9. Flowchart shows recommendations for incidental simple-appearing adnexal cysts at CT and/or MRI that are greater than 1 cm and less than 10 cm (11). *FU* = follow-up, *yrs* = years.

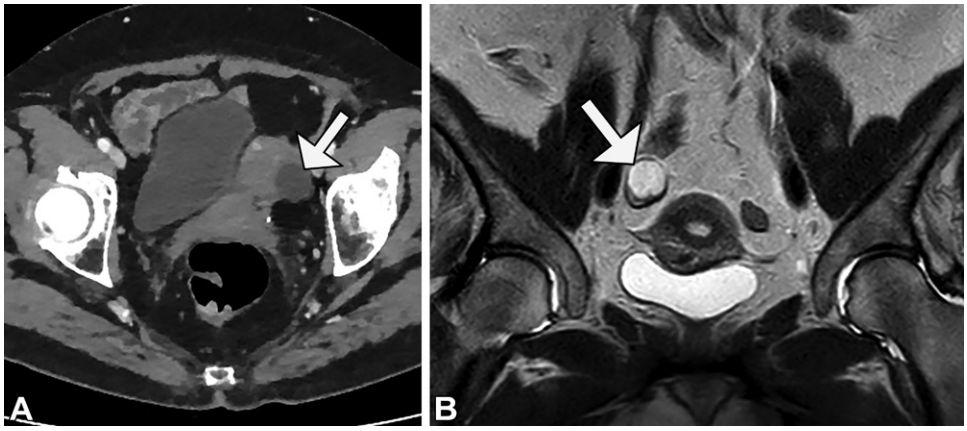


Figure 10. Simple-appearing ovarian cysts 3 cm or smaller (arrow) in two postmenopausal women at CT and MRI that do not require US characterization or follow-up. **(A)** Axial CT image shows a left ovarian cyst (arrow) smaller than 2 cm that is homogeneous and measures 4 HU. **(B)** Axial T2-weighted MR image in a different patient shows a homogeneous T2-hyperintense 2-cm right ovarian cyst (arrow).

align with the 2019 SRU guidelines. While many fewer dedicated publications address outcomes of incidental cysts at CT and MRI, it is reasonable to apply the accumulated knowledge of these cysts from US studies to CT and MRI interpretations (28,29). Thus, the major update of the CT and MRI white paper is the larger size of masses requiring follow-up. As in the US literature, if a confident diagnosis can be made of an adnexal mass on the basis of its imaging characteristics, further management should be based on that diagnosis.

An understanding of the various appearances of the ovary on CT and MR images during the normal menstrual cycle as well as the appearance of characteristic benign masses such as a hemorrhagic or involuting corpus luteum, hydrosalpinx, or paraovarian cyst is essential to avoid unnecessary follow-up imaging. Examples of a corpus luteum are shown in Figure 2. To avoid any confusion, it is appropriate to describe these findings in the body of the report and mention them as "normal" or "physiologic." Identifiable masses such as a simple hydrosalpinx may have clinical relevance to the patient, although further follow-up is unnecessary.

Reports of incidental adnexal cysts should include four elements: characteristics, size, technical issues, and menopausal status. The mass characteristics are defined as simple-appearing cyst, non-simple-appearing cyst with characteristics allowing

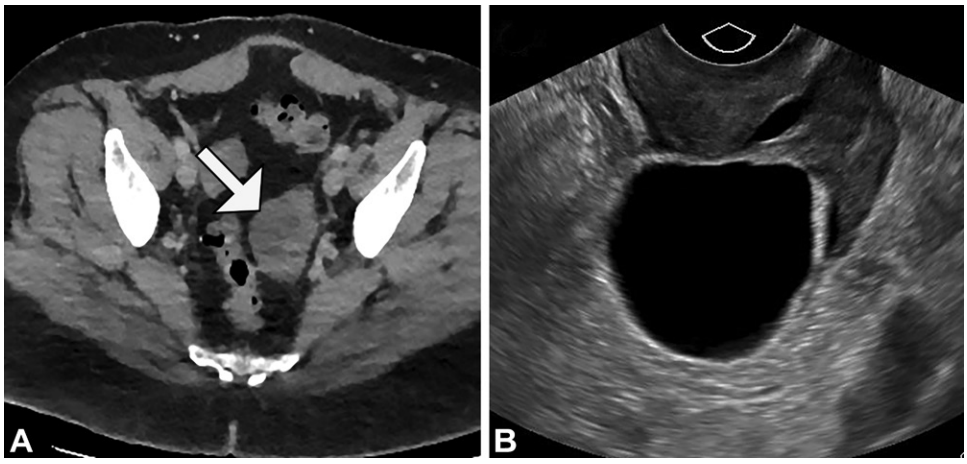


Figure 11. Cyst larger than 3 cm in a postmenopausal woman at CT that requires follow-up. **(A)** Axial CT image shows a 4-cm left ovarian cystic mass of 15 HU (arrow). The margins of the mass are difficult to characterize owing to technical limitations from poor signal-to-noise ratio secondary to body habitus. **(B)** Follow-up US image obtained 6 months later confirms stability of a simple anechoic cyst.

a specific diagnosis, or cystic mass with uncertain diagnosis. The preferred term *simple-appearing cyst* at CT or MRI is considered equivalent to the US terminology of simple cyst. These are masses with smooth round or ovoid contours, with imperceptible walls, and filled with simple-appearing fluid. If a specific alternative diagnosis cannot be made and the mass is not simple-appearing, it should be described as having an uncertain diagnosis.

The size of an ovoid or round mass requires reporting only the longest single dimension. If the shape is irregular, three orthogonal measurements may be more useful. Technical considerations that limit confidence in a diagnosis are important to include such as artifact from orthopedic hardware, poor signal-to-noise ratio from body habitus, lack of intravenous contrast material, and/or incomplete coverage of the mass. Menopausal status, an essential component in the interpretation of incidental adnexal masses, is inconsistently recorded for CT and MRI examinations. For this reason, 50 years of age was considered the cut-off between pre- and postmenopausal status.

Several exclusion criteria are emphasized in the white paper. The algorithms for incidental cysts at CT or MRI do not apply if a prior examination is available that shows no change over 2 or more years, if there is an increased risk of malignancy based on history or genetic status, if the cyst becomes symptomatic, or if the cyst is greater than or equal to 10 cm. Any cystic mass greater than or equal to 10 cm whether simple appearing or of uncertain diagnosis requires further characterization with either US or MRI, coincidental with the O-RADS 3 recommendation for masses of this size. Cysts less than or equal to 1 cm are not included because they are considered ubiquitous in premenopausal women, common after menopause, and often too small to adequately characterize at CT and MRI.

The algorithm for reporting and management of incidental adnexal cystic masses at CT and MRI is shown in Figure 9. The major update in the white paper is the size of a mass requiring follow-up with respect to menopausal status: cysts less than or equal to 5 cm in premenopausal women and less than or equal to 3 cm in postmenopausal women require no further US characterization or follow-up even if assessment is limited (Fig 10). When further imaging is required after CT and/or MRI, it is designated as promptly either for characterization because of incomplete evaluation owing to technique or lack of coverage or as follow-up after 6–12 months for a well-characterized mass above the threshold size for menopausal status. Usually, the additional imaging modality is US, but occasionally MRI characterization is preferred, particularly with larger masses. For larger masses initially well characterized at CT and/or MRI, sonographic follow-up in 6–12 months provides evidence of cyst growth rate; most cysts will decrease or resolve. A stable or slowly growing cyst is likely a benign neoplasm. This recommended range of timing attempts to limit the number of follow-up examinations while allowing for the possibility of mischaracterization at the original CT and/or MRI examination. Examples of cysts requiring follow-up are shown in Figures 11 and 12, and those needing further characterization are shown in Figures 13–15.

Putting It All Together

The SRU consensus update provides a framework for limiting follow-up of simple cysts to

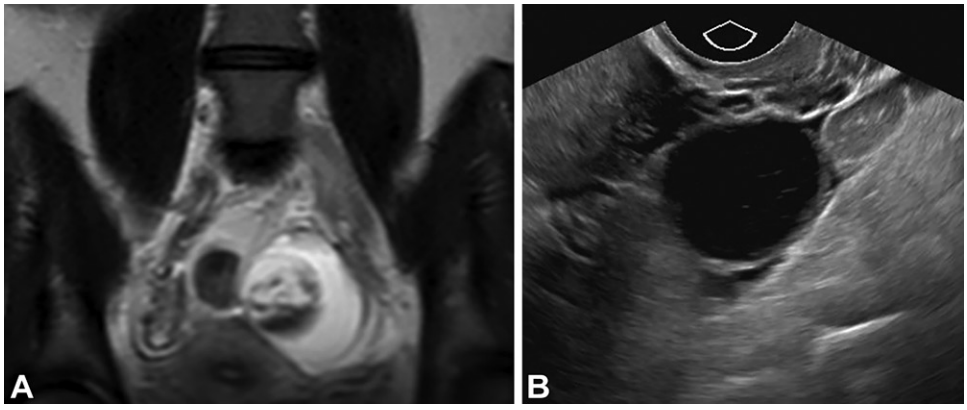
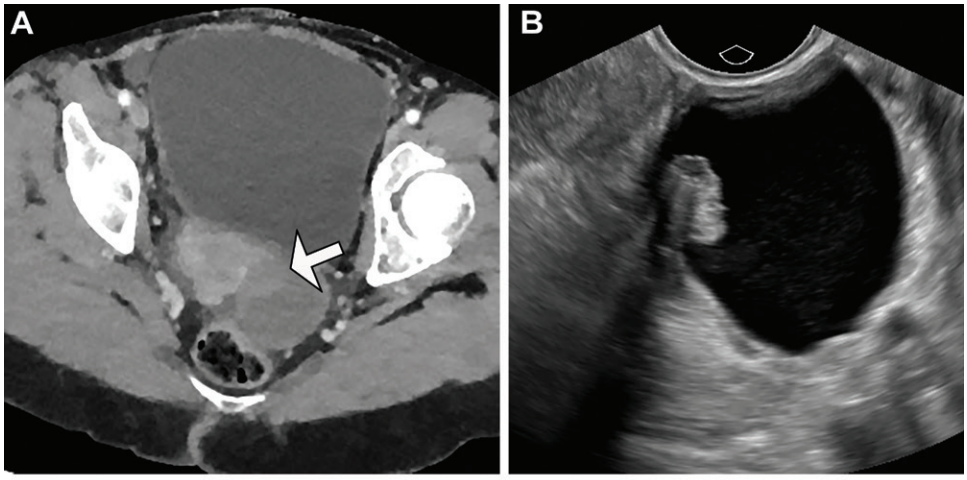


Figure 12. Cyst larger than 3 cm in a premenopausal woman at MRI that requires additional characterization. **(A)** Coronal T2-weighted abdominal MR image in a woman with polycystic kidney and liver disease shows a 5.2-cm left ovarian cyst containing hypointense components. The cyst was only visualized on the large field-of-view sequence from abdominal MRI (abdominal structures cropped from image). From this single image, it could not be determined if the T2-hypointense signal in the cyst was artifactual or represented other noncystic internal components. Therefore, US was recommended for further characterization. **(B)** US image obtained 1 month later shows a smaller 2-cm cyst containing fine reticular echoes consistent with a resolving hemorrhagic cyst.



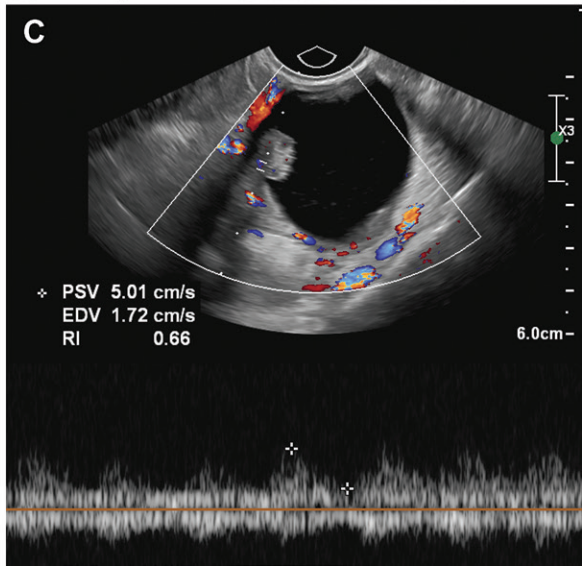


Figure 13. Nonsimple cyst in a postmenopausal patient at CT that requires additional characterization. **(A)** Axial CT image shows a nonsimple 5-cm left ovarian cystic mass that has a 1.7-cm peripheral nodular soft-tissue component (arrow). **(B)** Gray-scale US image obtained for characterization shows a 4.3-cm cystic mass with a 1.4-cm peripheral echogenic solid nodule with mild posterior shadowing. **(C)** Doppler US image shows low-resistance arterial flow. The pathologic diagnosis was benign cystadenofibroma.

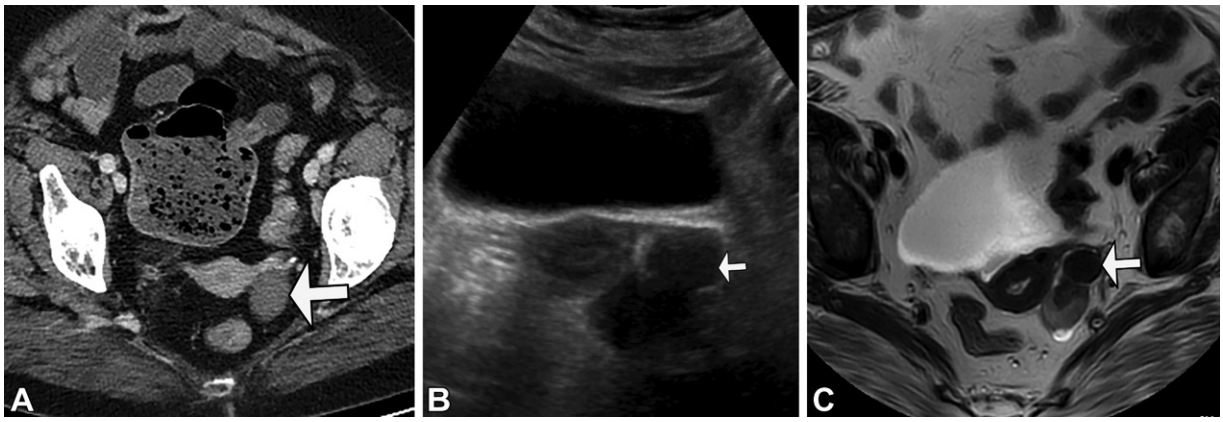


Figure 14. Incompletely evaluated cystic lesion at CT in a postmenopausal patient that requires additional characterization. **(A)** Axial CT image obtained through the pelvis during a venous run-off study with images obtained only every 5 cm shows a hypoattenuating lesion measuring 42 HU (arrow) in the left ovary. **(B)** Transabdominal US image obtained for additional characterization shows a hypoechoic bilobed lesion in the left ovary. The anterior portion of the lesion is hypoechoic and appears solid (arrow) while the posterior portion appears anechoic and cystic. The patient could not tolerate transvaginal imaging. **(C)** Axial T2-weighted MR image shows a bilobed left ovarian mass that has a hypointense component anteriorly (arrow) and a partially cystic component posteriorly. Postcontrast MR images showed mild enhancement (not shown). Pathologic analysis results confirmed a sex cord stromal tumor.

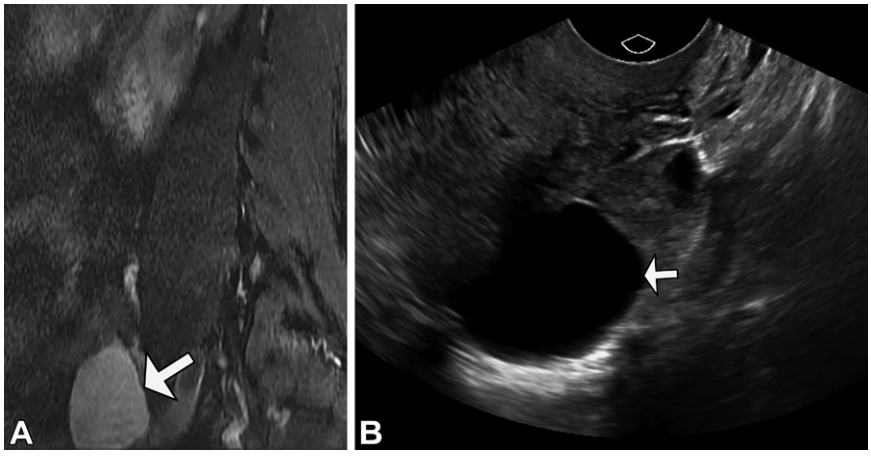


Figure 15. Incompletely evaluated adnexal cyst at lumbar spine MRI in a postmenopausal patient that requires additional characterization. **(A)** Sagittal fat-suppressed T2-weighted MR image from a lumbar spine examination shows a partially visualized 4-cm left adnexal cystic mass (arrow). This is the last image in the sequence, and portions of the mass are excluded from the field of view. **(B)** Subsequent US image shows a simple unilocular cyst (arrow).

those greater than 3 cm in postmenopausal women and to those greater than 5 cm in premenopausal women. This was taken a step further with O-RADS, providing risk-stratification to the masses on the basis of standardized descriptors. Both guidelines provide similar follow-up and management recommendations. With the updated CT and MRI white paper, the guidelines for those modalities are now aligned with those for US, especially the size thresholds for follow-up. Thus, there is now a uniform approach to evaluating and managing incidental adnexal cysts that provides appropriate management for higher-risk masses while minimizing unnecessary follow-up and surgery for benign masses regardless of imaging modality. These guidelines will be helpful in standardizing assessment and management recommendations not only for the radiologist specialized in gynecologic imaging but also for the nonspecialist who may frequently encounter adnexal cysts incidentally. The O-RADS guidelines are also conveniently available as a smartphone app for both Android (Google) and Apple (Apple) devices. Instructions for downloading the app are on the ACR website: *https://www.acr.org/-/media/ACR/Files/RADS/O-RADS/ACR-Guidance-App.pdf*.

We present two examples illustrating the utility of having a uniform approach to evaluation and management of adnexal cysts. The first example involves a premenopausal woman with an incidental 7.5-cm cyst at CT, which was confirmed as a simple cyst at US. Over a period of 8 years, a total of 10 follow-up US examinations were

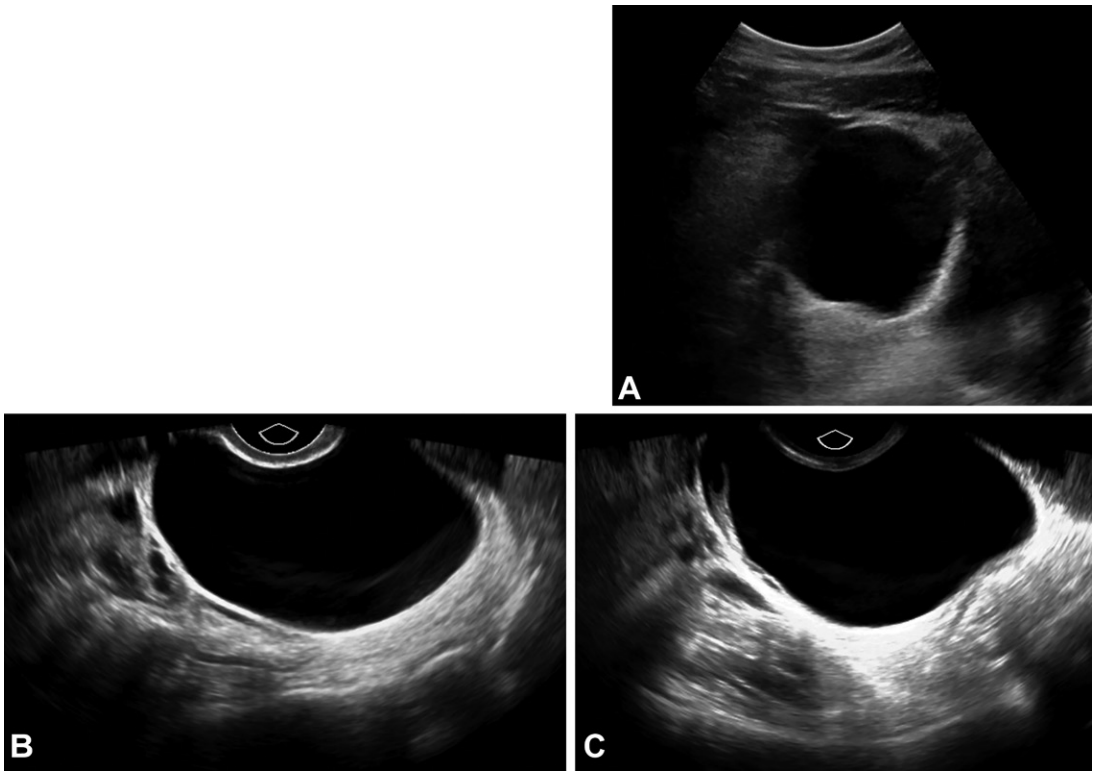


Figure 16. Simple cyst in a premenopausal woman who underwent multiple follow-up examinations. **(A)** Transabdominal gray-scale US image from initial US performed to characterize an incidental cystic lesion at CT (not shown) shows a 7.7-cm simple anechoic right ovarian cyst. **(B)** Transvaginal gray-scale US image obtained at 1-year follow-up shows the simple anechoic cyst, which was reported to have increased in size to 8.2 cm. **(C)** Transvaginal gray-scale US image obtained 2 years after the initial US image shows the same simple cyst, but this time it was reported to have decreased in size to 6.4 cm. Multiple follow-up US examinations were performed over several years because slight changes in size were reported. These variations in size were likely the result of the measurement technique and differences in transducer pressure.

performed, each demonstrating slight increases or decreases in the size of the cyst, which in retrospect are likely the result of differences in transducer pressure and measurement techniques. According to O-RADS, gynecologist management is suggested for an O-RADS 2 simple cyst in a premenopausal woman that persists at follow-up US. While there is no specific guideline or recommendation for the number of follow-up examinations required in this instance, we believe that the total number of follow-up examinations in this case may have been reduced if the differences in the size measurements of the cyst owing to technique could have been minimized and the overall low risk of malignancy in this cyst (according to O-RADS risk stratification) was stressed, thus reducing patient and provider anxiety (Fig 16).

The second example is a postmenopausal woman who had an initial US examination demonstrating a 3.2-cm simple cyst, which required 1-year follow-up US. On follow-up US images, the cyst increased in size to 5.4 cm at 1 year, 7.4 cm at 5 years, and 8.7 cm at 8 years after initial US. In addition to the interval growth, the 8-year follow-up US study also demonstrated an increased number of septa and a new color score of 2, upgrading the mass to O-RADS 3. On review of the cine loop images from the 5-year follow-up US study, a single thin septum was present but not identified at the time of the examination (Fig 17). This example highlights the importance of a high-quality examination including cine clips and scrupulous review of all images for the final interpretation.

Conclusion

Based on a large body of outcomes-based imaging, we now understand that a simple adnexal cyst does not increase the likelihood of malignancy in a woman of average risk regardless of menopausal status. Much progress has been made in the 50 years since the nonimaging-based recommendation for surgery for any palpable postmenopausal ovary. Whether one chooses to use O-RADS 1 and 2 designations or just describe a simple cyst and use SRU terminology, the recommendations for management are the same. For large cysts or those with more complexity, O-RADS 3 and higher designations should be used. With respect to incidental adnexal cystic masses at CT and MRI, the same

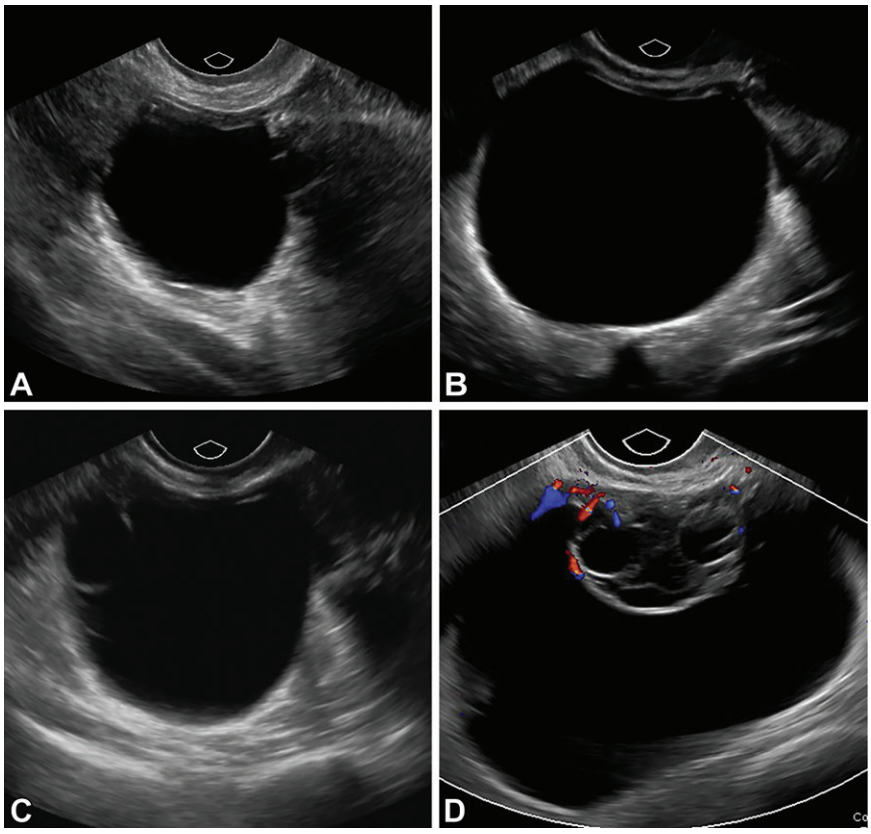


Figure 17. Importance of a high-quality US examination in the evaluation of ovarian cysts. **(A)** Initial US image shows a simple ovarian cyst measuring 3.2 cm in a postmenopausal woman. No cine clip was included in the examination. This lesion would have been classified as O-RADS 2. **(B)** Follow-up US image obtained 5 years later shows a larger simple cyst measuring 7.4 cm. **(C)** Static gray-scale US image from the cine clip of this examination shows a thin septum, which was not reported. **(D)** Final follow-up US image obtained 8 years after the initial study shows enlargement of the cyst with increased complexity, more septa, and color Doppler flow that is consistent with an O-RADS 3 lesion. This case highlights the importance of a quality US examination with review of cine clips, as the lesion would have been categorized as O-RADS 3 at the 5-year follow-up and potentially may have been more complex than depicted on the static images from the initial US study. The patient has not had additional follow-up and declined surgery for this presumed epithelial neoplasm.

risk of malignancy applies—simple-appearing cysts have a low malignant potential and require follow-up based on size and menopausal status.

***Disclosures of conflicts of interest.*—P.S.W.** Payment for spectral CT presentation from Philips. **M.M.H.** Editorial board member of *RadioGraphics*.

References

1. American Cancer Society. Ovarian Cancer Statistics: How Common is Ovarian Cancer. https://www.cancer.org/cancer/ovarian-cancer/about/key-statistics.html. Last updated January 12, 2021. Accessed March 11, 2021.
2. Smith-Bindman R, Poder L, Johnson E, Miglioretti DL. Risk of Malignant Ovarian Cancer Based on Ultrasonography Findings in a Large Unselected Population. JAMA Intern Med 2019;179(1):71–77.
3. Timmerman D, Testa AC, Bourne T, et al. Simple ultrasound-based rules for the diagnosis of ovarian cancer. Ultrasound Obstet Gynecol 2008;31(6):681–690.
4. Levine D, Brown DL, Andreotti RF, et al. Management of asymptomatic ovarian and other adnexal cysts imaged at US: Society of Radiologists in Ultrasound Consensus Conference Statement. Radiology 2010;256(3):943–954.
5. Ghosh E, Levine D. Recommendations for adnexal cysts: have the Society of Radiologists in Ultrasound consensus conference guidelines affected utilization of ultrasound? Ultrasound Q 2013;29(1):21–24.
6. Kim DC, Bennett GL, Somberg M, et al. A Multidisciplinary Approach to Improving Appropriate Follow-Up Imaging of Ovarian Cysts: A Quality Improvement Initiative. J Am Coll Radiol 2016;13(5):535–541.
7. Maturen KE, Blaty AD, Wasnik AP, et al. Risk Stratification of Adnexal Cysts and Cystic Masses: Clinical Performance of Society of Radiologists in Ultrasound Guidelines. Radiology 2017;285(2):650–659.
8. Patel MD, Ascher SM, Paspulati RM, et al. Managing incidental findings on abdominal and pelvic CT and MRI, part 1: white paper of the ACR Incidental Findings Committee II on adnexal findings. J Am Coll Radiol 2013;10(9):675–681.
9. Reinhold C, Rockall A, Sadowski EA, et al. Ovarian-Adnexal Reporting Lexicon for MRI: A White Paper of the ACR Ovarian-Adnexal Reporting and Data Systems MRI Committee. J Am Coll Radiol 2021;18(5):713–729.
10. Levine D, Patel MD, Suh-Burgmann EJ, et al. Simple Adnexal Cysts: SRU Consensus Conference Update on Follow-up and Reporting. Radiology 2019;293(2):359–371.
11. Patel MD, Ascher SM, Horrow MM, et al. Management of Incidental Adnexal Findings on CT and MRI: A White

Paper of the ACR Incidental Findings Committee. J Am Coll Radiol 2020;17(2):248–254.
12. Barber HRK, Graber EA. The PMPO syndrome (postmenopausal palpable ovary syndrome). Obstet Gynecol 1971;38(6):921–923.
13. Miller RC, Nash JD, Weiser EB, Hoskins WJ. The postmenopausal palpable ovary syndrome. A retrospective review with histopathologic correlates. J Reprod Med 1991;36(8):568–571.
14. Goldstein SR, Subramanyam B, Snyder JR, Beller U, Raghavendra BN, Beckman EM. The postmenopausal cystic adnexal mass: the potential role of ultrasound in conservative management. Obstet Gynecol 1989;73(1):8–10.
15. Levine D, Gosink BB, Wolf SI, Feldesman MR, Pretorius DH. Simple adnexal cysts: the natural history in postmenopausal women. Radiology 1992;184(3):653–659.
16. Greenlee RT, Kessel B, Williams CR, et al. Prevalence, incidence, and natural history of simple ovarian cysts among women >55 years old in a large cancer screening trial. Am J Obstet Gynecol 2010;202(4):373.e1–373.e9.
17. Buys SS, Partridge E, Black A, et al. Effect of screening on ovarian cancer mortality: the Prostate, Lung, Colorectal and Ovarian (PLCO) Cancer Screening Randomized Controlled Trial. JAMA 2011;305(22):2295–2303.
18. Suh-Burgmann E, Flanagan T, Osinski T, Alavi M, Herrinton L. Prospective Validation of a Standardized Ultrasonography-Based Ovarian Cancer Risk Assessment System. Obstet Gynecol 2018;132(5):1101–1111.
19. Nunes N, Ambler G, Foo X, Naftalin J, Widschwendter M, Jurkovic D. Use of IOTA simple rules for diagnosis of ovarian cancer: meta-analysis. Ultrasound Obstet Gynecol 2014;44(5):503–514.
20. Valentin L, Akrawi D. The natural history of adnexal cysts incidentally detected at transvaginal ultrasound examination in postmenopausal women. Ultrasound Obstet Gynecol 2002;20(2):174–180.
21. Valentin L, Skoog L, Epstein E. Frequency and type of adnexal lesions in autopsy material from postmenopausal women: ultrasound study with histological correlation. Ultrasound Obstet Gynecol 2003;22(3):284–289.
22. DePriest PD, Shenson D, Fried A, et al. A morphology index based on sonographic findings in ovarian cancer. Gynecol Oncol 1993;51(1):7–11.
23. Amor F, Alcázar JL, Vaccaro H, León M, Iturra A. GI-RADS reporting system for ultrasound evaluation of adnexal masses in clinical practice: a prospective multicenter study. Ultrasound Obstet Gynecol 2011;38(4):450–455.
24. Andreotti RF, Timmerman D, Benacerraf BR, et al. Ovarian-Adnexal Reporting Lexicon for Ultrasound: A White Paper of the ACR Ovarian-Adnexal Reporting and Data System Committee. J Am Coll Radiol 2018;15(10):1415–1429 [Published correction appears in J Am Coll Radiol 2019;16(3):403–406.].
25. Timmerman D, Valentin L, Bourne TH, et al. Terms, definitions and measurements to describe the sonographic features of adnexal tumors: a consensus opinion from the International Ovarian Tumor Analysis (IOTA) Group. Ultrasound Obstet Gynecol 2000;16(5):500–505.
26. Timmerman D, Van Calster B, Testa A, et al. Predicting the risk of malignancy in adnexal masses based on the Simple Rules from the International Ovarian Tumor Analysis group. Am J Obstet Gynecol 2016;214(4):424–437.
27. Andreotti RF, Timmerman D, Strachowski LM, et al. O-RADS US Risk Stratification and Management System: A Consensus Guideline from the ACR Ovarian-Adnexal Reporting and Data System Committee. Radiology 2020;294(1):168–185.
28. Pooler BD, Kim DH, Pickhardt PJ. Indeterminate but Likely Unimportant Extracolonic Findings at Screening CT Colonography (C-RADS Category E3): Incidence and Outcomes Data From a Clinical Screening Program. AJR Am J Roentgenol 2016;207(5):996–1001.
29. Lee SY, Landis MS, Ross IG, Goela A, Leung AE. Extraspinal findings at lumbar spine CT examinations: prevalence and clinical importance. Radiology 2012;263 (2):502–509.

RadioGraphics
Erratum
May-June 2022 • Volume 42 • Number 3

Originally published in:

https://doi.org/10.1148/rg.210091

Benign-appearing Incidental Adnexal Cysts at US, CT, and MRI: Putting the ACR, O-RADS, and SRU Guidelines All Together

Peter S. Wang, Otto G. Schoeck, Mindy M. Horrow

Erratum in:

https://doi.org/10.1148/rg.229008

In the **print** version only, the following paragraph should appear on p. 615, after the paragraph that begins with "In postmenopausal women…":

Nonsimple unilocular cysts that have smooth inner walls do not require additional management when they are 3 cm or smaller in premenopausal women. When these cysts are greater than 3 cm and less than 10 cm, a follow-up in 8–12 weeks is recommended in premenopausal women. A persistent or enlarging cyst at a follow-up examination should be referred to a US specialist or for MRI for characterization and a gynecologist for management. Nonsimple unilocular cysts in postmenopausal patients should be managed by a gynecologist, and referral to a US specialist or for MRI should be considered regardless of the cyst size. However, for cysts 3 cm or smaller, a 1-year follow-up US examination may be an alternative option.