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# Adnexal lesions detected on CT in postmenopausal females with non-ovarian malignancy: do simple cysts need follow-up?

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## Abstract

*Purpose:* To assess whether CT morphology of adnexal lesions in postmenopausal women with history of non-ovarian cancer could be used to discriminate benign and malignant lesions, particularly focusing on applicability of the ACR criteria.

*Materials and methods:* This was an IRB-approved HIPAA-compliant retrospective review of contrast-enhanced CTs of 199 women, 55 years and older. Lesions were classified as simple cystic, complex cystic, solid-cystic, or solid based on CT morphology, and were diagnosed as benign, indeterminate, or malignant on follow-up imaging or pathology. Associated metastatic disease was noted, if present. Findings were analyzed to correlate CT morphology, primary tumor pathology, and metastatic disease pattern with eventual lesion diagnosis.

*Results:* There were 223 adnexal lesions, including 123 (55%) simple cystic, 48 (22%) complex cystic, 40 (18%) solid-cystic, and 12 (5%) solid lesions. 186/223 (83%) lesions were benign, and 37/223 (17%) were malignant. Primary colorectal cancer was significantly associated with an increased likelihood of malignant adnexal lesions (OR 10.2, $p < 0.001$) compared to patients with other cancers. Adnexal malignancy was significantly associated with the presence of non-ovarian peritoneal metastases ($p < 0.001$). None of the simple cysts (including 85 cysts between 1–3 cm and 38 cysts > 3 cm) were found to be malignant (malignancy rate: 0.0%, 95% CI 0.0–3.0%). Complex cysts were more likely to be malignant than simple cysts ($p = 0.002$) and solid-cystic lesions were more likely to be malignant than complex cysts ($p < 0.001$).

*Conclusion:* Simple adnexal lesions on CT in this cohort were unlikely to be malignant, supporting the ACR guidelines. A higher size threshold of 3 cm (vs. 1 cm) may be preferred in all cases of simple cysts for recommending further follow-up. However, more complex-appearing cysts need further evaluation as the risk of malignancy is increased. Peritoneal metastases have a significant correlation with malignant adnexal involvement.

**Key words:** Ovarian cyst—Adnexal cyst—Ovarian lesion—Adnexal lesion—CT

Adnexal lesions are commonly detected in postmenopausal patients imaged for other purposes, with several large prior ultrasound (US), CT, and autopsy reports reporting an incidence from 2.5–18% [1–4]. US is the modality of choice for characterizing adnexal masses, and the majority of data regarding characterization and management is based on sonographic features [1, 2, 5]. In 2010, the Society of Radiologists in Ultrasound (SRU) published their consensus statement regarding managing asymptomatic ovarian/adnexal cysts seen on US [5]. However, many incidental cystic adnexal lesions are detected initially on CT, and the 2013 American College of Radiology (ACR) white paper on incidental adnexal findings on CT/MRI gave detailed recommendations for their management [6]. Unfortunately, there is scant recent data on the ability of CT to differentiate benign and neoplastic adnexal lesions [4]. The ACR white paper acknowledged the lack of adequate research determining CT accuracy characterizing 'simple' adnexal cysts (and in correlating CT and US findings), and based its recommendations predominantly on the sonographic criteria [5, 6].

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A particular gray area exists in the management of incidental ovarian cysts $> 1$ and $\leq 3$ cm in postmenopausal women (Fig. 1). The ACR white paper states that benign-appearing cysts $\leq 3$ cm in late postmenopausal patients do not require further evaluation with US or any follow-up, but offers the caveat that the threshold for follow-up US may be decreased to 1 cm to increase the sensitivity for neoplasm (6). By contrast, the SRU recommendations state that any simple cyst $> 1$ cm in a postmenopausal patient should undergo yearly follow-up, although also offering the caveat that some practices may choose a threshold size slightly higher than 1 cm [5, 6]. Moreover, many incidental adnexal lesions are seen on CT in females with a history of cancer, and it is unclear whether this represents a higher-risk cohort. Technically, the ACR recommendations are still applicable for patients with a history of non-ovarian cancer, but, in our personal experience, many radiologists believe these patients to be at higher risk and recommend further evaluation with US for all adnexal lesions $> 1$ cm.

With improved spatial and contrast resolution of CT and a better understanding of the natural history of adnexal lesions, we sought to determine when CT morphology is a good enough discriminator to avoid further investigations. By identifying which patients do not need further sonographic evaluation, CT characterization could potentially decrease patient anxiety and inconvenience, as well as healthcare expenses. This study specifically focused on patients with a history of cancer since they could be considered a relatively high-risk cohort routinely imaged with CT and commonly found to have incidental findings. Therefore, the purpose of our study was to determine whether CT morphology of adnexal lesions could be used to discriminate benign and malignant lesions for postmenopausal women ($\geq 55$ years old) with a history of a non-ovarian cancer. We hypothesize that simple-appearing cysts on CT need no further follow-up or evaluation even in this high-risk group of patients. We also assessed correlation between the adnexal lesion and the patient's primary tumor and metastatic pattern.

## Materials and methods

This was a single-institutional Health Insurance Portability and Accountability Act-compliant retrospective study approved by the local Institutional Review Board. A waiver of informed consent was obtained.

### *Inclusion and exclusion criteria*

Patients were identified using the search terms 'ovarian/adnexal cyst, ovarian/adnexal cystic, ovarian/adnexal low attenuation, ovarian/adnexal low density, cystic ovarian/adnexal, hypodense ovarian/adnexal, ovarian/adnexal hypodensity; solid ovarian/adnexal, complex ovarian/adnexal, ovarian/adnexal mass' on radiology reports between 1999 and 2013. Our inclusion criteria were women $\geq 55$ years of age with a history of a non-ovarian primary malignancy, a contrast-enhanced CT, at least one ovarian lesion $\geq 1$ cm found on the initial contrast-enhanced CT, and either a pathological diagnosis of the ovarian lesion or a follow-up imaging study at least 12 months later. Exclusion criteria included radiological diagnosis of dermoid with macroscopic fat and indeterminate lesion diagnosis based on lack of pathology and/or insufficient imaging follow-up as described below (Fig. 2). Two radiologists then reviewed the electronic medical records to restrict the sample to those 55 years or older and with a history of non-ovarian malignancy (excluding brain tumors, and non-melanoma skin cancers as they rarely metastasize).

### *Clinical and histopathologic data*

Detailed information was extracted from the electronic medical records regarding patient demographics, site, and pathology of the primary tumor, and the presence or absence of metastatic disease. Final pathology was reviewed at our institution in all cases to confirm the diagnosis of the primary malignancy, and of the adnexal lesion whenever available. If the initial pathology was from an outside center, the reinterpretation performed at

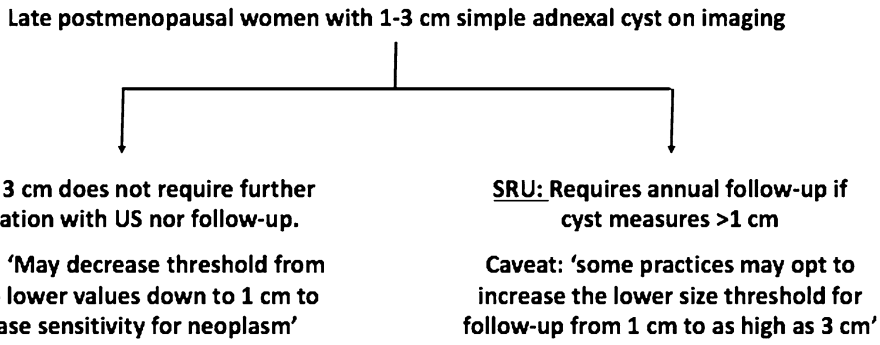


Fig. 1. ACR criteria for managing incidental adnexal lesions detected on CT vs. SRU criteria for managing incidental adnexal lesions detected on US.

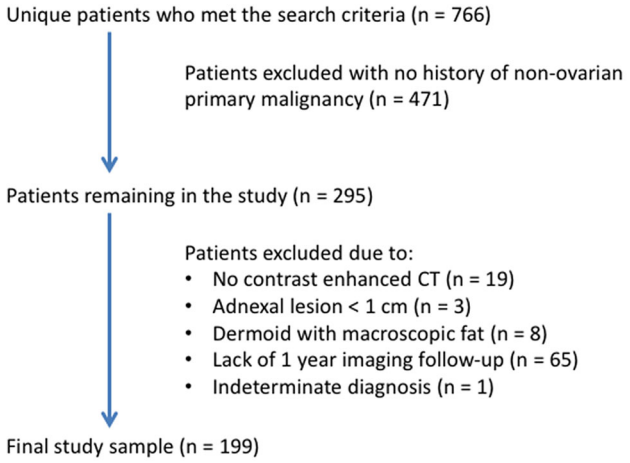


Fig. 2. Schematic representation of the patient selection process.

our institution was considered the final diagnosis for the study.

## *Imaging*

Contrast-enhanced CT was performed on multiple CT scanners in our system during the study period, including GE Lightspeed QXi 4-slice, GE Lightspeed Ultra 8-slice, GE Lightspeed 16-slice, GE Lightspeed Pro 16-slice, GE VCT 64-slice, GE HD 750, and GE Revolution (GE Healthcare, Wisconsin, USA); Siemens Somatom 64-slice, and Siemens Somatom Force 64-slice (Siemens Healthcare, Erlangen, Germany). 2.5 mm axials along with 3 mm coronal and sagittal reconstruction were available for review. CT was obtained during the venous phase (70 s delay). Patients with an initial outside contrast-enhanced CT were included if the scan was technically adequate. The images from the initial and final scans were reviewed in all patients, and the interim reports (along with the images whenever relevant) were reviewed as well.

## *Image analysis*

Venous phase images were reviewed on Centricity PACS RA1000 (GE Health Care, Barrington, IL, USA) workstation. A review of all the images was performed in consensus by three fellowship-trained body radiologists with 6–11 years of experience, blinded to the final diagnosis. Imaging features at initial detection were recorded, including side, size, shape, morphology, attenuation, presence of enhancement or solid component, septations, hemorrhage (defined as presence of blood-fluid level), and calcification. The longest single dimension measured on axial, coronal, or sagittal plane was considered as the lesion size. Similar to clinical practice, the majority of examinations were single-phase, which made enhancement difficult to reliably prove. As a surrogate, we defined enhancement as a component with soft tissue attenuation or mural nodule ≥ skeletal muscle attenuation. Morphologically, lesions were classified as simple cystic (based on the ACR criteria), complex cystic, solid - cystic, or solid (Table 1) [6].

The presence or absence of metastatic disease was noted with specific documentation of abdominopelvic metastases, and peritoneal or pelvic nodal involvement. Lumbosacral or pelvic osseous metastases were not considered abdominopelvic metastases.

## *Clinical outcome*

Follow-up scans (including PET/CTs) were reviewed separately. Adnexal lesions were considered benign when there was histopathological confirmation, resolution on follow-up imaging in the absence of improvement of the primary neoplasm or known metastatic disease, stability for at least a year (defined as $< 10\%$ or $< 5$ mm change in the maximum transverse dimension, whichever is larger), or lack of FDG-uptake on PET/CT in the presence of an FDG-avid primary/metastases [5–7]. Lesions were considered malignant if there was corresponding pathology, if the lesion demonstrated progression or response to treatment on serial follow-up imaging concordant with other sites of neoplastic disease, or if the lesion was FDG-avid in the presence of an FDG-avid primary/metastases.

## *Statistical analysis*

Continuous variables were summarized as median (range) and categorical variables as count (percentage). Patient clinical characteristics, and lesion characteristics were compared between the benign and malignant groups (excluding indeterminate lesions). Patients were included in the malignant group if at least one lesion was classified as malignant and into the benign group if all lesions were benign. Patient characteristics were compared between groups using the Mann-Whitney test or Fisher's exact test, as appropriate. Lesion characteristics were compared between groups using permutation tests based on the Mann-Whitney, or $\chi^2$ test statistics, where lesions from the same patient were clustered to account for any dependence among lesions from the same patient [8]. Odds ratios (ORs) with 95% confidence intervals (CIs) were used to summarize the strength of association between diagnosis group and other characteristics. Generalized estimating equations (GEE) methods were used to compute confidence intervals for ORs from lesion-based comparisons to account for any dependence among lesions from the same patient [9]. Unless otherwise stated, all ORs, and $p$ values refer to univariate comparisons. All statistical calculations were conducted with the statistical computing language R (version 3.1.1;

**Table 1.** Adnexal cyst classification and associated ACR management recommendations

| Cyst classification | Definition | Management |
|---|---|---|
| Simple | Oval or round unilocular uniform fluid attenuation cystic lesion < 10 cm in size with a regular or imperceptible wall and no solid component or mural nodule | ≤ 3 cm no follow-up<br>> 3 cm prompt ultrasound |
| Complex cystic | Higher than fluid attenuation (> 20 HU, but less than skeletal muscle) or calcifications/ hemorrhage/ septae; perceptible septation | Prompt ultrasound |
| Solid-cystic | Cystic lesion with a solid component, mural nodule | Prompt ultrasound |
| Solid | Soft tissue density throughout | Prompt ultrasound |

R Foundation for Statistical Computing, Vienna, Austria). Throughout, two-sided tests were used with statistical significance defined as $p < 0.05$.

## Results

Using the search terms described, we identified 766 unique patients who had undergone imaging at our institute between 1999 and 2013. Of these, 295 had a history of non-ovarian malignancy. 95 of them were excluded based on the exclusion criteria. One patient, a 71-year old female with a history of lung cancer, had a 2.3 cm simple left ovarian cyst which was photopenic on the initial staging PET/CT with the primary being FDG avid. On the next follow-up CT study 6 years later, it had grown to 3.8 cm, although it remained simple appearing, and was photopenic on the follow-up PET/CT. The patient expired 2 months later due to an unrelated event. She had numerous clinical visits during that 6-year period without any mention of ovarian symptoms or concerns of malignancy. This lesion was considered indeterminate but was thought unlikely to be high-grade malignancy, and was also removed from final analysis for statistical simplicity. Thus, the final study sample included 199 patients (median age 64 years; range 55–93 years), in whom 223 adnexal lesions were identified (Fig. 2).

Out of the 199 patients, 29 (15%) had at least one malignant adnexal lesion. Nine of these patients had bilateral lesions, eight of which were bilateral malignancies. One hundred-seventy patients (85%) had only benign adnexal lesions, of which 15 had bilateral lesions (Table 2). Forty-nine patients had histopathological correlation, 17 had FDG PET/CT correlation, while the remaining 133 patients received a diagnosis based solely on imaging follow-up.

The sites and frequencies of primary and metastatic disease are summarized in Table 2. The most common cancers in the study were breast (22%), hematologic malignancies (lymphomas/ leukemias) (17%), and colorectal cancers (12%). Primary colorectal cancer was significantly associated with an increased likelihood of malignant adnexal lesions (OR 10.2, 95% CI 3.9–26.6, $p < 0.001$) compared to those with primary cancer types, whereas hematologic cancers tended to be associated with a decreased risk of adnexal malignancy (OR 0.15, 95% CI 0.02–1.1, $p = 0.067$). After adjusting for the age and the presence of non-ovarian metastasis, the associations of adnexal malignancy with colorectal cancer (OR 9.4, $p < 0.001$) and hematologic cancers (OR 0.15, $p = 0.069$) were similar.

Of the 199 patients, 93 (47%) had non-ovarian metastatic disease visualized at the time of detection of the adnexal lesion on CT. Of those with non-ovarian metastases, 55/93 (59%) patients had abdominopelvic metastases, with 24 having peritoneal involvement, and 44/93 (47%) had exclusively extra-abdominal metastases. Patients were more likely to have malignant adnexal lesions if they also had non-ovarian metastases compared to those without metastases (OR 4.4, 95% CI 1.8–10.8, $p = 0.002$), and particularly if they had peritoneal metastases (OR 28.3, 95% CI 6.5–123.4, $p < 0.001$) vs. extra-abdominal metastases. The associations with non-ovarian metastases (OR 3.3, $p = 0.018$) and non-ovarian peritoneal metastases (OR 45.1, $p < 0.001$) remained significant after adjusting for age and primary cancer type.

### *Adnexal lesions*

The median size of the 223 adnexal lesions was 2.8 cm (range: 1.2–22 cm). CT classifications, and features are summarized in Table 3. Of the 223 lesions, there were 123 (55%) simple cystic (Fig. 3), 48 (22%) complex cystic (Fig. 4), 40 (18%) solid-cystic (Fig. 5), and 12 (5%) solid lesions (Fig. 6). Overall, 186/223 (83%) lesions were benign, and 37/223 (17%) were malignant.

Lesion features, and classifications are compared between diagnosis groups in Table 4. Malignant lesions were larger on average than benign lesions (median: 5.1 vs. 2.6 cm, $p < 0.001$). Presence of an enhancing or solid component (OR 73.0, $p < 0.001$) and septae (OR 13.4, $p < 0.001$) were each individually associated with adnexal malignancy, while calcifications ($n = 16$, OR 0.32, $p = 0.36$) and hemorrhage ($n = 2$, OR 5.0, $p = 0.20$) were not found to be significantly associated with malignancy. Multivariate logistic regression analysis of the presence of enhancing or solid component (OR 47.8, 95% CI 11.7–195.0, $p < 0.001$) and septae (OR 8.6, 95% CI 1.6–46.4, $p = 0.012$), adjusting for lesion size, found that these two findings were each independently predictive of malignancy.

There were significant differences in the rates of malignancy among the four lesion categories ($p < 0.001$) (Table 3). None of the 123 simple cysts were found to be malignant (rate: 0.0%, 95% CI 0.0–3.0%). The 95% confidence interval for the rate of malignancy was

**Table 2.** Patient demographics, and cancer history

| Variable | All patients ($N$ = 199) | Adnexal diagnosis group | | OR[a] | (95% CI) | $p$ value |
|---|---|---|---|---|---|---|
| | | Malignant ($N$ = 29) | Benign ($N$ = 170) | | | |
| Age, years | 64 (55–93) | 62 (55–83) | 64 (55–93) | 0.86 | (0.67, 1.1) | 0.23 |
| Primary cancer[b] | | | | | | |
| Breast | 43 (21.6) | 7 (24.1) | 36 (20.0) | 1.2 | (0.47–3.0) | 0.72 |
| Colorectal | 23 (11.6) | 12 (41.4) | 11 (6.5) | 10.2 | (3.9–26.6) | < 0.001 |
| Lymphoma/leukemia | 34 (17.1) | 1 (3.4) | 33 (19.4) | 0.15 | (0.02–1.1) | 0.067 |
| Other | 102 (40.9) | 10 (34.5) | 92 (54.1) | 0.45 | (0.20–1.0) | 0.056 |
| Non-ovarian metastasis | | | | | | |
| Yes | 93 (46.7) | 22 (75.9) | 70 (41.8) | 4.4 | (1.8–10.8) | 0.002 |
| No | 106 (53.3) | 7 (24.1) | 97 (58.2) | (ref) | | |
| Location of non-ovarian metastasis ($n$ = 92 with metastases) | | | | | | |
| Peritoneum | 24 (25.8) | 17 (77.3) | 7 (9.9) | 28.3 | (6.5–123.4) | < 0.001 |
| Non-peritoneal abdominopelvic | 31 (33.3) | 2 (9.1) | 29 (40.9) | 0.80 | (0.13–5.1) | |
| Extra-abdominal only | 38 (40.9) | 3 (13.6) | 34 (49.3) | (ref) | | |

Values are median (range) or no. (%) unless otherwise specified
[a]Odds ratios for malignancy are per 5-year increase in age, relative to all other primary cancers, or relative to the reference category, labeled (ref)
[b]Three patients had both colorectal and breast cancer (two benign and one malignant)

**Table 3.** Characteristics of each type of adnexal lesions as visualized on CE-CT

| Feature | All lesions ($N$ =223) | Adnexal lesion classification[a] | | | |
|---|---|---|---|---|---|
| | | Simple cystic ($N$ =123) | Complex cystic ($N$ =48) | Solid-cystic ($N$ =40) | Solid ($N$ =12) |
| Calcifications | 16 (7.2) | 0 (0.0) | 8 (16.7) | 7 (17.5) | 1 (8.3) |
| Enhancement/solid component | 59 (26.5) | 0 (0.0) | 7 (14.6) | 40 (100.0) | 12 (100.0) |
| Septa | 35 (15.7) | 0 (0.0) | 19 (39.6) | 16 (40.0) | 0 (0.0) |
| Hemorrhage | 2 (0.9) | 0 (0.0) | 1 (2.1) | 1 (2.5) | 0 (0.0) |
| Lesion size, cm | 2.8 (1.2–22.0) | 2.4 (1.2–22.0) | 3.0 (1.3–16.5) | 5.3 (1.2–18.0) | 3.8 (1.8–7.4) |

[a]Values are no. (%) or median (range)

0.0–4.2% among the 85 simple cysts ≤ 3 cm and 0.0–9.3% among the 103 simple cysts > 3 cm. By contrast, 5 of the 35 non-simple cysts ≤ 3 cm were malignant (rate: 14.3%, 95% CI 2.6–26.0), as were 32 of the 65 non-simple cysts > 3 cm (rate: 49.2%, 95% CI 35.8–62.7).

Complex cystic lesions were more likely to be malignant than simple cystic lesions (15% vs. 0%, $p$ = 0.002) and solid-cystic lesions were more likely to be malignant than complex cystic lesions (OR 9.8, $p$ < 0.001). There was no significant difference in malignancy between solid-cystic and solid lesions (OR 0.43, $p$ = 0.25).

Among the 48 complex cystic lesions, the 20 lesions categorized as complex due to high mean attenuation alone (> 20 HU) were all benign (malignancy rate: 0.0%, 95% CI 0.0–16.8%) while 7 of 28 with other complex features were malignant (rate: 25.0%, 95% CI 5.7–44.3%), although this difference did not reach statistical significance ($p$ = 0.074).

## Discussion

Adnexal lesion characterization and follow-up on CT has not been adequately researched, creating a diagnostic and prognostic dilemma for a radiologist encountering such a lesion, particularly in the absence of overtly solid or malignant features. Recent data from both prospective and autopsy studies demonstrate that simple cysts can be encountered in both early and late postmenopausal females [1–3, 6, 10]. Most studies use US for characterization and follow-up, with very limited data using CT or MRI characterization of adnexal lesions [1, 2, 11]. A 1997 CT study involving 3448 patients reported detection of incidental adnexal lesions in 168 (5%) patients, with two malignancies, whereas a more recent study involving 2869 low-dose unenhanced CTs detected 118 (4.1%) indeterminate adnexal lesions, none of which were malignant [4, 12]. Another recent study in 42,111 women detected ovarian cysts in 2763 (6.6%) patients, with ovarian cancer in 18 (0.7%) patients [13]. Another CT study including 621 women detected an adnexal cyst or mass in 66 (10.6%) of them, of which 31 needed at least one additional study or follow-up for further evaluation [14].

The purpose of our study was to focus on the postmenopausal female with a known history of non-ovarian primary and to determine if simple cysts need further workup. We found that none of the 123 simple (benign-appearing) cysts in our study were malignant. This is consistent with the current ultrasound data and supports

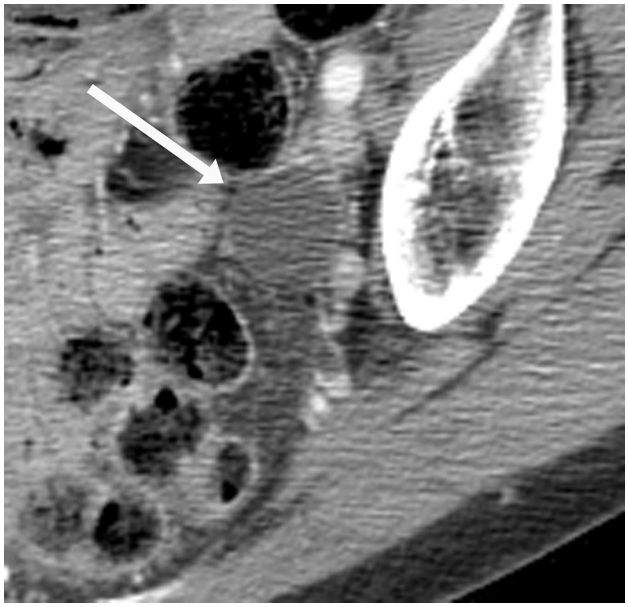

Fig. 3. 62-year-old female with breast cancer. Axial contrast-enhanced CT shows a simple (mean HU = 8) 1.3 cm simple left adnexal cyst (arrow), stable for three years on follow-up imaging.

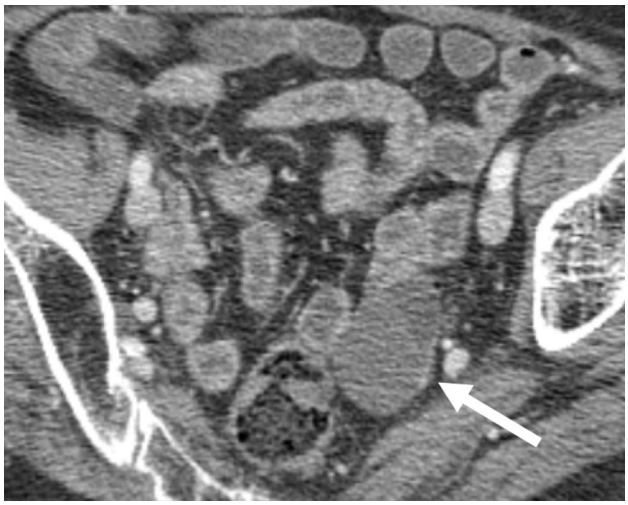

Fig. 4. 75-year-old lady with cervical cancer. Axial contrast-enhanced CT shows a 4.6 cm left adnexal (arrow) complex cystic lesion (mean HU 33) with a thin septation. It was unchanged at stable for 18 months on follow-up imaging.

the ACR guidelines that benign-appearing cysts ≤ 3 cm in early and late postmenopausal patients do not require further evaluation with US or any specific follow-up. Our data suggests that the same can be applied to patients with history of a non-ovarian malignancy as well. Our data also suggests that the size threshold for follow-up/further evaluation of simple cysts could be potentially raised higher than the current 3 cm, though this observation is based on only 38 simple cysts > 3 cm with an upper 95% CI bound of 9.3% for the malignancy rate.

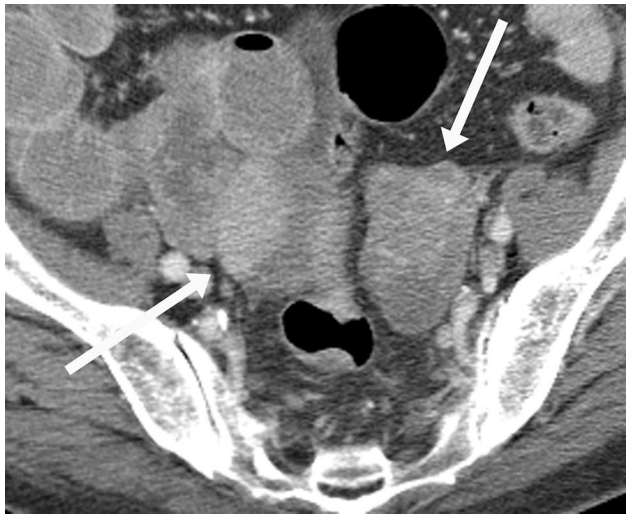

Fig. 5. 73-year-old female with breast cancer. Axial contrast-enhanced CT demonstrates bilateral solid-cystic adnexal masses (arrows), which progressed on follow-up studies, consistent with metastatic disease.

Further studies are needed to confirm this finding. Indeed, prior US studies have shown that even larger simple-appearing cysts are usually benign [15–17]. A retrospective surgical study of 236 simple cysts or cysts with isolated septa on US measuring > 5 cm in postmenopausal women observed no malignancy or borderline histology in any lesions [16]. Another prospective study of 166 postmenopausal women with 192 benign-appearing unilocular or multilocular cysts on US measuring < 8 cm demonstrated only two malignancies (one carcinoma and one borderline tumor) [15].

Secondly, follow-up for all complex cysts may not need to be as stringent based on the low likelihood of malignancy. In our results, none of the 20 complex cysts characterized solely based on mean attenuation > 20 HU were found to be malignant, although—as with simple cysts > 3 cm,—the sample size was small and the upper bound of the 95% CI for the malignancy rate was relatively high at 16.8%. A recent review of 1363 complex adnexal masses between 1 and 6 cm on US found only 18 (1.3%) cancers or borderline tumors, with growth apparent in all lesions by seven months [18]. Many gynecologists believe that follow-up of even complex cystic adnexal masses should be stopped after a year if they remain stable [19]. Given our data, lesions determined to be complex based on high attenuation without other features of complexity (i.e., hemorrhagic cysts) in postmenopausal patients with history of non-ovarian malignancy could potentially need less short-term and long-term follow-ups, although this observation needs further evaluation on a larger and more general patient database to be validated. On the other hand, solid-cystic and solid adnexal lesions are often malig-

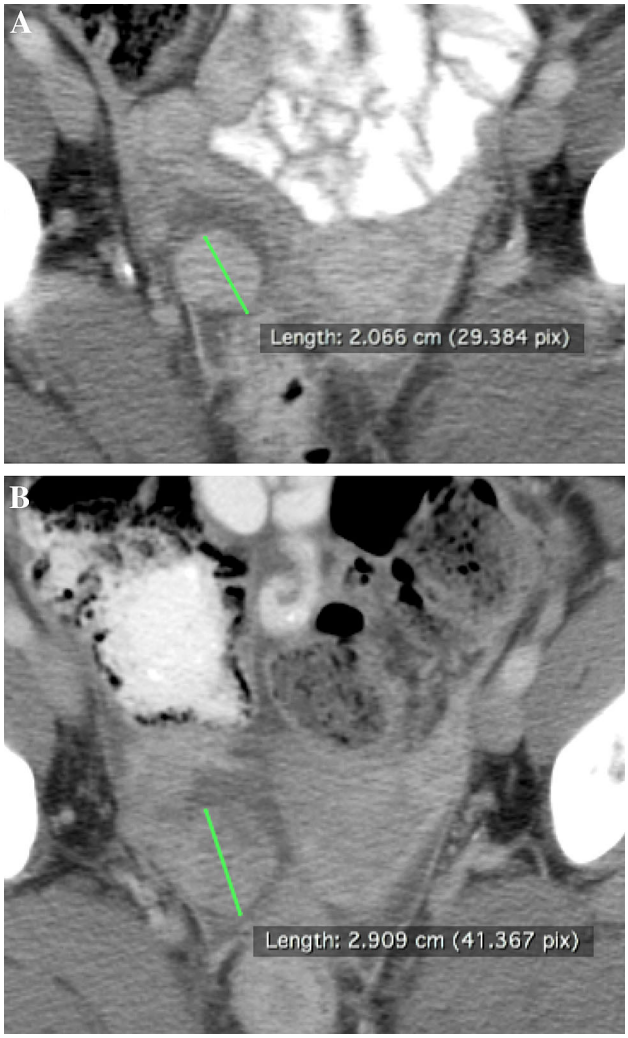


**Fig. 6.** 56-year-old female with breast cancer. Axial contrast-enhanced CT demonstrates a right solid adnexal mass which progressed from 2 cm (**A**) to 2.9 cm (**B**) on follow-up CT, consistent with metastatic disease.

nant, and such patients should be immediately evaluated with further imaging or surgery [15].

There were some interesting observations when evaluating the primary cancer and the metastatic pattern. Specifically, patients with colorectal cancer had a significantly increased risk of adnexal metastases. The incidence of ovarian metastases in colorectal cancer varies from 0 to 8.6% based on clinical studies, and 5–31% based on autopsy studies [20, 21]. Also, we noted patients with peritoneal metastases to have a significantly higher risk of ovarian involvement ($p < 0.001$). Hence, in patients with peritoneal metastases, adnexal lesions that are not clearly benign-appearing (simple cysts) on CT should be considered highly suspicious.

The limitations in our study included the retrospective nature, the small number of patients with surgical correlation, and the small number of lesions in some categories. Correlation with other imaging modalities was also not evaluated. Since the lesions were detected incidentally, almost all the CT studies evaluated were single-phase, which limited our ability to reliably differentiate a complex cyst with high attenuation from a mildly enhancing solid lesion. As such, some of the complex cystic lesions could potentially have been misclassified as subjective characterization was performed in comparison with skeletal muscle attenuation. However, this limitation mirrors clinical practice where the vast majority of incidental cystic adnexal lesions are detected on single-phase examinations, and radiologists must use their discretion as to whether a cystic lesion has an enhancing component. Another limitation of our study is that since the study period extended across at least 1–2 major hardware upgrades at several of our sites, it is possible that with the newer technology, some lesions would have been differently classified (e.g., thin septations may have been seen which were not previously seen). We could not adequately evaluate this due to the

**Table 4.** CT characteristics of adnexal lesions

| Variable | All lesions | | Adnexal diagnosis[a] | | OR[b] | (95% CI) | *p* value |
|---|---|---|---|---|---|---|---|
| | No. (%) | Median (range) of lesion size, cm | Malignant ($N = 37$) | Benign ($N = 186$) | | | |
| Lesion size, cm | 223 (100.0) | 2.8 (1.2–22.0) | 5.1 | 2.6 | – | | **< 0.001** |
| Individual features | | | | | | | |
| Calcifications | 16 (7.2) | 2.7 (1.2–9.0) | 1 (2.7) | 15 (8.1) | 0.32 | (0.04–2.5) | 0.36 |
| Enhancement/solid component | 59 (26.5) | 4.6 (1.2–18.0) | 34 (91.9) | 25 (13.4) | 73.0 | (15.2–351.4) | **< 0.001** |
| Septa | 35 (15.7) | 4.6 (1.6–18.0) | 20 (54.1) | 15 (8.1) | 13.4 | (5.1–35.0) | **< 0.001** |
| Hemorrhage | 2 (0.9) | 7.2 (1.5–13.0) | 1 (2.7) | 1 (0.5) | 5.1 | (0.31–84.8) | 0.20 |
| Classification | | | | | | | |
| Simple cystic | 123 (55.2) | 2.4 (1.2–22.0) | 0 (0.0) | 123 (66.1) | – | | **< 0.001** |
| Complex cystic | 48 (21.5) | 3.0 (1.3–16.5) | 7 (18.9) | 41 (22.0) | (ref) | | |
| Solid-cystic | 40 (17.9) | 5.3 (1.2–18.0) | 25 (67.6) | 15 (8.1) | 9.8 | (2.9–32.4) | |
| Solid | 12 (5.4) | 3.8 (1.8–7.4) | 5 (13.5) | 7 (3.8) | 4.2 | (0.84–20.9) | |
| Complex cyst classification ($n = 48$ complex cystic lesions) | | | | | | | |
| High attenuation only (> 20 HU) | 20 (41.7) | 3.0 (1.3–7.8) | 0 (0.0) | 20 (48.8) | (ref) | | 0.074 |
| Other complex features | 28 (58.3) | 3.0 (1.3–16.5) | 7 (100.0) | 21 (51.2) | ∞ | – | |

OR, odds ratio

[a]Values are median or no. (%)

[b]Odds ratios for malignancy are relative to the reference category, labeled (ref) or relative to the absence of the feature (for the individual features)

limited number of patients having scans both before and after an upgrade. We were able to identify 5 such patients, and all 5 had a sufficiently similar appearance that no classification would be affected. These included 2 simple cysts and 3 complex cysts, with sizes between 1.3 and 2 cm. While we cannot rule out any impact due to varying imaging platforms, we did not find any evidence of an issue based on the very limited assessment we could perform.

In conclusion, our study supports the ACR recommendations on incidental adnexal lesions on CT even in patients with known non-ovarian neoplasm, and supports having the higher threshold of 3 cm (vs. 1 cm) for not following simple adnexal cysts on CT. Among sites of coexistent metastatic disease, peritoneal metastases have a significant correlation with ovarian involvement.

**Compliance with ethical standards**

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**Ethical approval** This article does not contain any studies with human participants or animals performed by any of the authors.

**Informed consent** This was a retrospective review with waiver of informed consent.

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