Third of four parts

# Skilled US imaging of the adnexae

## PART 3: OVARIAN NEOPLASMS

Not all neoplasms represent cancer, and some have overlapping sonographic characteristics. Here's what you need to know to differentiate what is benign from what is malignant.

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Although roughly three quarters of ovarian neoplasms occur in premenopausal women, 87% of masses in this population are benign. The vast majority of *malignant* neoplasms—about 75%—are diagnosed in postmenopausal women.

These figures suggest that you have some discerning to do. Specifically, how do you identify the small percentage of masses in premenopausal women that are malignant—and winnow out the benign neoplasms in the postmenopausal population?

Now that we've equipped you with an understanding of the morphologic building blocks of adnexal masses, and how those masses are assessed using ultrasonography (US) (described in **Part 2** of this four-part series), you can apply your skills of discernment to ovarian neoplasms. Specifically:

- **teratoma** (dermoid cyst)—one of the two most prevalent benign neoplasms of the ovary
- **serous cystadenoma**—the other most prevalent benign neoplasm
- **hormone-secreting tumors**
- **malignant neoplasms.**

Recall that **Part 1** of this series offered a starting point for US imaging of the adnexae by describing (and showing) how basic pelvic structures appear in grayscale US and color and power Doppler. **Part 2** focused on nonneoplastic ovarian masses. (Both of these installments are readily available to you still at obgmanagement.com.) **Part 4** will take as its subject tubal entities such as torsion, ectopic pregnancy, and cancer.

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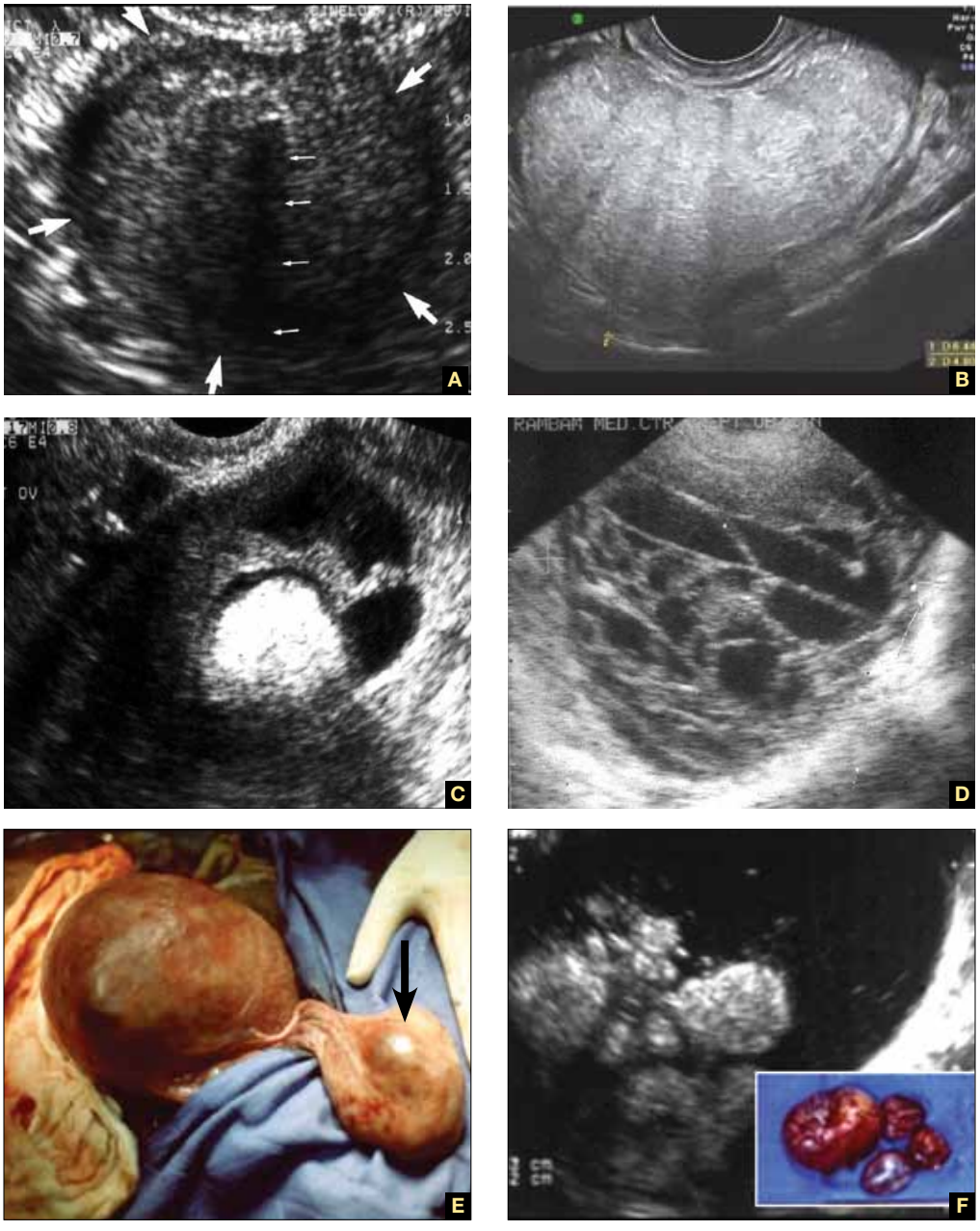
## Teratomas present a variety of "faces"

Teratomas may appear to be solid, cystic, or both (**FIGURE 1**). At times, they have a bizarre or variable appearance. The overwhelming majority of teratomas can be recognized by shadowing, which may be extreme if the tumor contains a solid, echogenic central mass (**FIGURE 1A**). Such an echogenic core is

## FIGURE 1 Cystic and solid benign teratomas



**A.** Shadowing (small arrows) is apparent in a teratoma containing low-level echoic fluid. **B.** Several spherical "balls" floating in a cystic teratoma, with shadowing. **C.** Solid teratoma. **D.** A "typical" teratoma, with septation and multilocularity. **E.** Macroscopic view of an ovarian teratoma (arrow). **F.** Multiple sebaceous ball-shaped structures within a benign cystic teratoma (inset: macroscopic view).

sometimes called the "fried egg" sign when it is detected by transabdominal US.

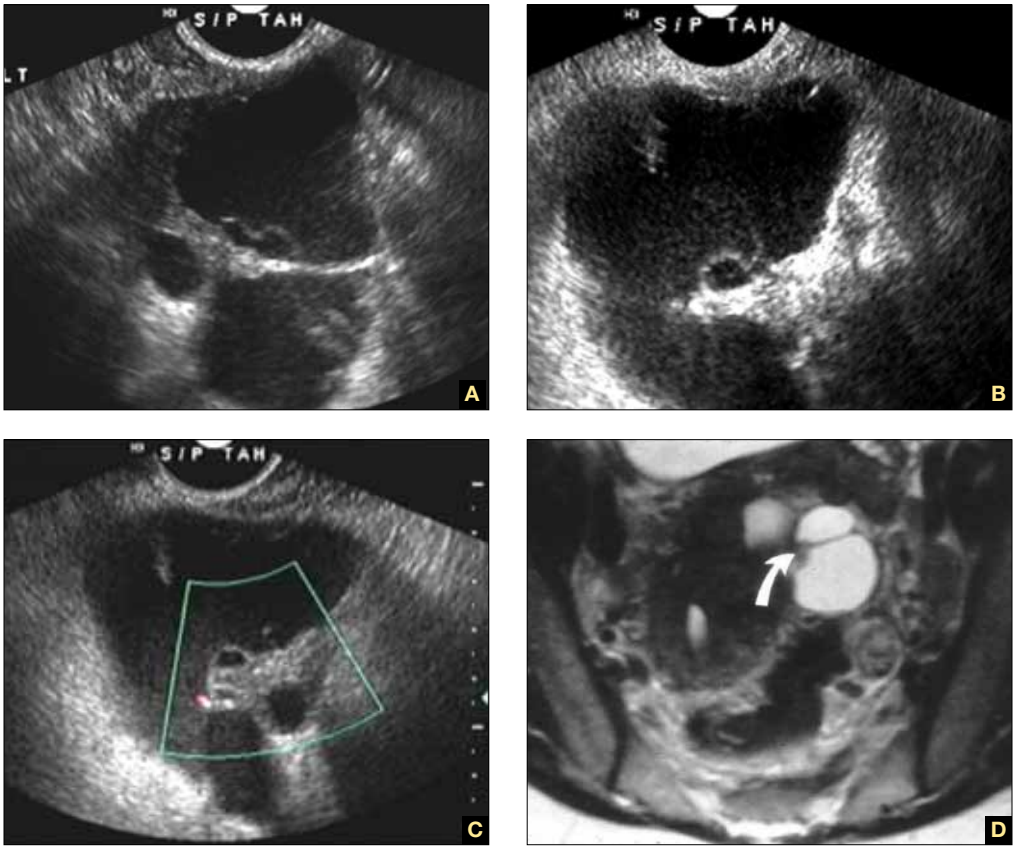
When the teratoma is cystic or partially cystic, it may contain a linear hyperechoic area consistent with sebaceous fluid and hair. Although magnetic resonance imaging (MRI) can confirm the fat content of a teratoma, US is very efficient in making the diagnosis, rendering MRI unnecessary.

As for blood vessels, teratomas are

FAST TRACK

**Teratomas are known to have scant or no apparent vascularity**

**FIGURE 2** Benign cystadenoma




**A–C.** Typical sonographic appearance of a benign cystadenoma, with septae fanning out from a solid area, creating an anechoic, fluid-filled, multilocular pattern. **D.** MRI appearance of the cyst (arrow points to solid area from which the septae fan out).

FAST TRACK

**Benign cystadenomas are bilateral in 20% to 30% of cases**

known to have scant or no apparent vascularity. A rule of thumb: If a bizarre adnexal structure with no vascularity is visible on US, and if it is cystic or solid in appearance (or both), benign teratoma should be included in the differential diagnosis.

Because an ovarian teratoma can assume almost any shape and form, three-dimensional (3D) US is almost useless in its evaluation.

## Cystadenomas are relatively easy to identify on US

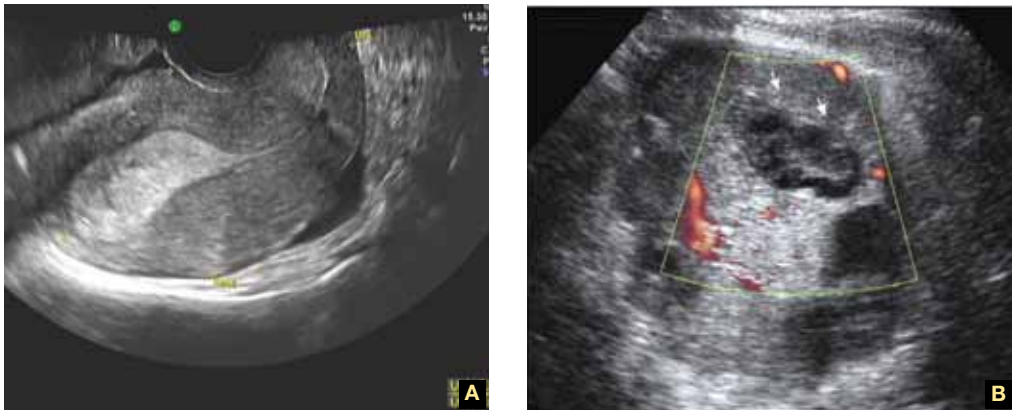
Benign cystadenomas—serous or mucinous—are extremely common. In at least 20% to 30% of cases, they are bilateral.

The US characteristics of these masses include:

- multilocularity, in many cases (although two thirds of simple unilocular cysts in postmenopausal women are serous cystadenomas)
- multiseptation, with the septae often fanning out from a central, apparently solid structure (**FIGURE 2**)
- anechoic nature when they contain fluid (in the serous variety) or with low-level echogenicity (in mucous cystadenomas).

As for vascularity, cystadenomas have a paucity of core vessels and have, if measured quantitatively, what we consider to be normal resistive and pulsatility indices and low peak systolic velocity. Histologically, they are benign. These neoplasms can be identified using US with relative ease and high confidence, rendering computed

## FIGURE 3 Granulosa cell tumor




**A.** Sagittal image of the uterus demonstrating a thick, hyperechoic endometrial echo under hormonal stimulation of the tumor. **B.** Multicystic and solid areas alternate in the enlarged uterus. Power Doppler demonstrates the typical increased vascularity. (The arrows point to the cystic area of the tumor.)

tomography (CT) and MRI (**FIGURE 2D**) virtually redundant.

### When US characteristics overlap

Based on our 20 years of experience with US assessment of adnexal masses, and the potential overlap (on grayscale as well as color and power Doppler) between the US appearance of endometriomas, cystadenomas, and cystic teratomas, we recommend that, when a mass is not pathognomonic on US, this triad of entities be considered in the differential diagnosis. The entity that has the greatest number of relevant characteristics should be listed as the most likely and first possibility on the US report.

(For a description of the US appearance of endometriomas, see **Part 2** of this series, which appeared in the October 2010 issue of OBG Management.)

## Hormone-secreting tumors are small and symptomatic

Although hormone-secreting tumors are not malignant in the strict sense of the definition, they should be mentioned here because of the high probability that they can be diagnosed by transvaginal sonography (TVS). These tumors are small, hiding at times in an ovary of almost normal size. They are also vascular, featuring a characteristic ring-like pattern, much like that of the corpus luteum, on color or power Doppler. They also produce general and clear clinical symptoms and signs. For example, testosterone-like tumors cause male-pattern baldness, hirsutism, and voice changes.

Many providers suspect a hormone-secreting tumor based on its signs and symptoms, and seek US confirmation from us. In many of these cases, laboratory tests have been done and point to the possible diagnosis—e.g., a high testosterone level in the case of a Sertoli-Leydig cell tumor.

One typical estrogen-secreting tumor is the granulosa cell tumor (**FIGURE 3**). This tumor can usually be identified by the solid-appearing tissue surrounding multiple cysts of different sizes; it is typically richly supplied with blood vessels.

Another clue to the diagnosis is the state of the endometrium. Because a granulosa cell tumor secretes estrogen, it causes a thickened endometrial lining and, usually, abnormal uterine bleeding.

## Malignant ovarian neoplasms are rare

As a rule, the larger the lesion, the more suspicious it is.

FAST TRACK

**A granulosa cell tumor causes a thickened endometrial lining and, usually, abnormal uterine bleeding**

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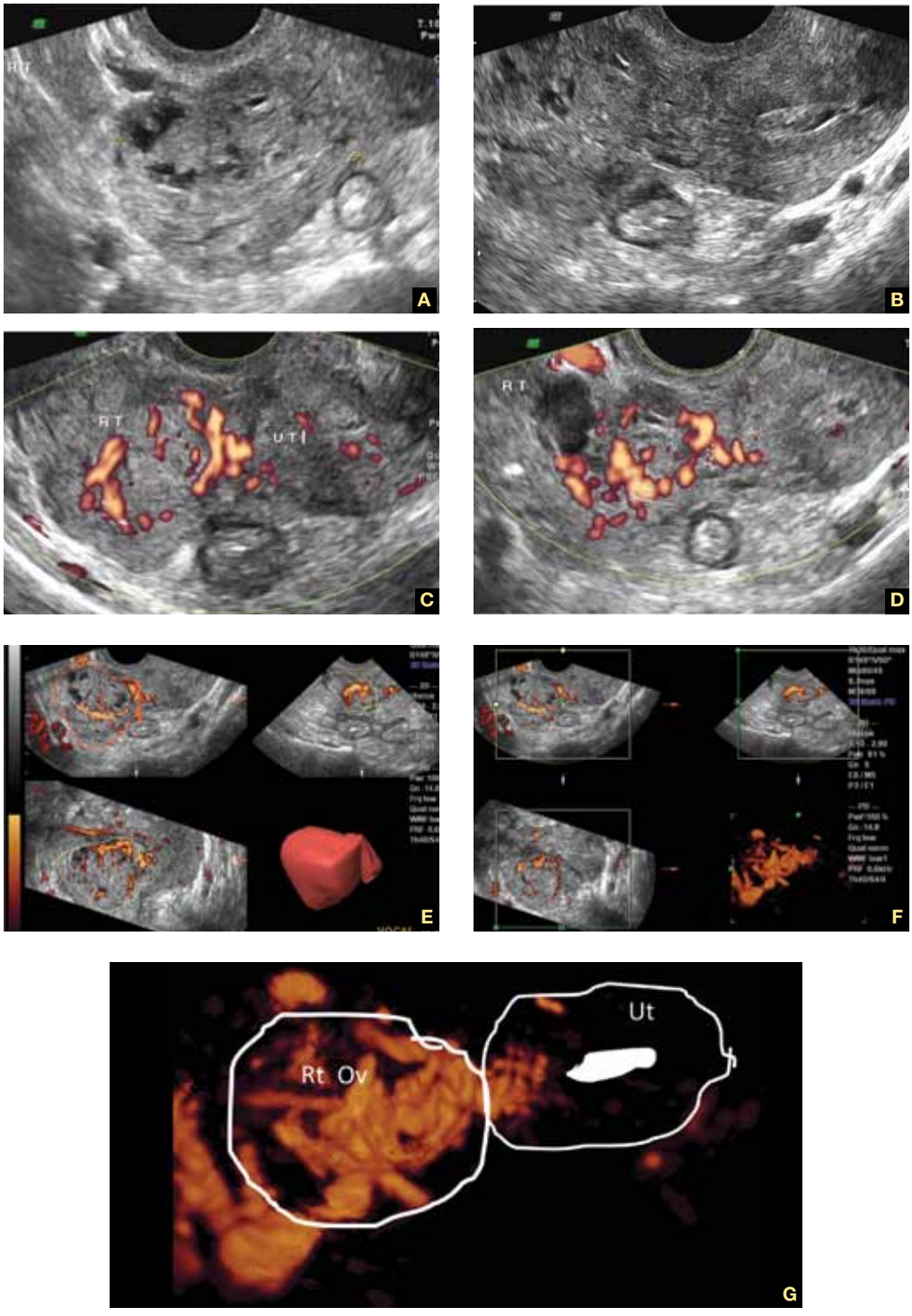
## FIGURE 4 Adenocarcinoma of the ovary




**A.** An enlarged right ovary containing several cystic structures. **B.** Right ovary and transverse section of the uterus. **C, D.** Power Doppler evaluation demonstrating rich vascularization. **E.** 3D orthogonal planes and volume calculation of the ovary (31.1 cc). **F.** 3D angiogram (lower right image) of the rich vascularization of the cancer. **G.** Relationship between the vascular right ovary and the uterus.

**FAST TRACK**

**Tumor vascularity is a marker suggestive of ovarian malignancy. Look for low resistance and high-velocity flow.**

Malignant tumors usually have a complex appearance:

- thick walls (≥4 mm)
- heterogeneous texture
- multilocularity
- solid components
- papillary excrescences within the tumor as well as on the outer surface (**FIGURE 4A** and **4B**).

Tumor vascularity is another marker suggestive of ovarian malignancy (**FIGURE 4C** and **4D**). A fast-growing tumor requires a vascular "infrastructure," a mesh of blood vessels that is laid down in expedited fashion and that is controlled by vascular growth factors. As explained in **Part 2** of this series, the vessels in this vascular mesh lack the muscular layer of normal vessels. They frequently are intertwined, forming anastomoses and vascular lakes through which blood flows without much resistance. Look, therefore, for low resistance and high-velocity flow.

A new way to employ 3D US is to detect, measure, and quantify the blood supply to a tumor. **FIGURE 4E** shows how the vascularity and volume of an ovarian mass are calculated, with 3D angiographic display of the blood vessels contained within it demonstrated in **FIGURE 4F**. This vascular pattern can also be viewed in the context of the pelvic organs (**FIGURE 4G**), an approach that is useful in teaching.

Recently, Sladkevicus and colleagues used 3D US angiography to define tumor vascularity, identifying straight vessels, those that had changes in caliber, and bridging between vessels.[1] They studied 104 patients who had 77 benign tumors, 6 borderline tumors, and 21 cancers. The researchers concluded that dense vessel patterns in the tumor made malignancy five times more likely. Widely dispersed straight vessels without branching were the strongest predictors of benign status, reducing the likelihood of malignancy by a factor of 10.[1]

We described the importance of a finding of blood vessels in an internal papillary structure as an accurate predictor of malignancy. We focused on a small volume of the mass, which was selected by a software program, and found that a preselected volume of 1 cc could reliably predict an increased, and pathological, vascular supply to an ovary containing cancer.[2,3]

## Stay tuned!

In the final installment of this series, coming next month, we discuss the use of US imaging to evaluate tubal anomalies, including torsion, ectopic pregnancy, and cancer.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## Why US assessment matters in the adnexae

Although ovarian cancer is rare, affecting 30 to 50 women of every 100,000, it is particularly deadly, with a 5-year survival rate (all stages) of 50%. If cancer is detected and treated during stage I, the 5-year survival rate rises substantially—to 95%. Sadly, only 25% of cases are detected while the cancer is still localized.

In stages III and IV, the 5-year survival rate is 28% or lower. It has been estimated that, if 75% of patients had their cancer detected during stage I, the mortality rate could be halved.

The lifetime risk of ovarian cancer in a woman who has no affected relative is 1.4% (1 case in every 70 women). When the patient has one affected first-degree relative, that risk rises to 5% (1 case in 20 women), and it rises to 7% (1 case in 14 women) when she has two or more affected first-degree relatives.

FAST TRACK

**When ovarian cancer is detected in stages III and IV, the 5-year survival rate is 28% or lower**