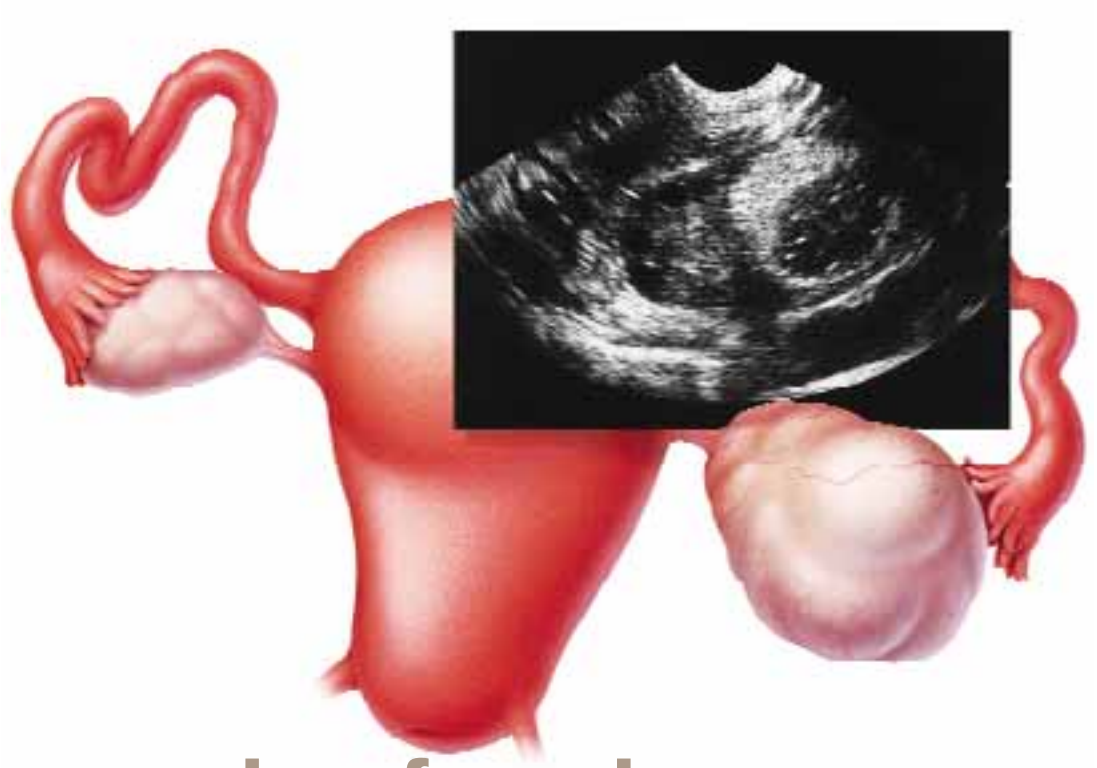
OBG MANAGEMENT

COVER ARTICLE



Sonography of ovarian masses

9 key questions to guide clinical evaluation

BY LYNDON M. HILL, MD

Hallmark characteristics of benign and malignant lesions help point to the need for surgery. An expert sonologist details morphologic criteria that assist in diagnosis.

Although no sonologist can make a definitive diagnosis in every case of clinically suspected ovarian pathology, hallmark characteristics of an ovarian mass contribute greatly to the clinician's appraisal of a tumor's malignant potential.

Ultrasound reveals details about the size and architecture of ovarian masses that are indispensable in the initial evaluation of clinically suspect ovarian pathology. Nevertheless, determining whether a mass requires surgery remains a formidable challenge, thanks to the variability in the macroscopic characteristics of benign and malignant lesions. The task is further complicated by the diversity among ovarian tumors, which can be classified into 35 subtypes.[1]

Here, I present a systematic approach to

investigating an ovarian mass via ultrasound, focusing on 9 key questions. The morphologic criteria outlined in this article provide the basis for distinguishing between benign and potentially malignant lesions, with a high probability of success.

Keep in mind: Ultrasound cannot provide histologic information. This limitation is important because several types of ovarian masses can have a similar sonographic appearance. The endpoint should be whether or not a specific patient requires surgical intervention.

Whether a patient should be referred to a subspecialist depends on the gynecologist's level of experience as well as the sonographic criteria.

Evaluate ovarian cancer risk

The first step in evaluating an ovarian mass, prior to ultrasound examination, is to estimate the likelihood of malignancy. In the general population, the risk of ovarian cancer is 1 in 55 (1.8%),[2] but certain factors may increase this risk:

- **Age.** In women with adnexal masses, those 60 to 69 years of age have 12 times the malignancy risk of those aged 20 to 29.[3]
- **Family history.** Five percent of women with ovarian cancer have a family history of the disease.[4] The lifetime risk of ovarian cancer based on family history alone ranges from 6.7% for 1 first-degree relative with the disease to 40% for women with hereditary syndrome (TABLE 1).[5,6] Ovarian cancer risk is not increased in the relatives of women with borderline tumors.[5] When ovarian cancer has an autosomal dominant inheritance pattern, the age of onset is progressively younger by 10 to 15 years in each generation.[7]

On the other hand, the use of oral contraceptives for 5 years has been found to reduce the lifetime risk of ovarian cancer in the general population to 0.8%.[8]

Transabdominal versus transvaginal views

Transabdominal sonography provides an overview of the pelvis and permits evaluation of masses beyond the field of view of the transvaginal transducer.

In contrast, the transvaginal approach permits utilization of higher-frequency transducers, offering superior resolution.

Transvaginal sonography yields the greatest amount of information when used as an extension of a thorough pelvic examination. During real-time scanning, an examiner can optimize visualization of some adnexal masses by placing pressure on the transvaginal probe and on the patient's abdomen with his or her free hand. Such examination may elicit pelvic tenderness and helps the examiner assess the mobility and compressibility of an ovarian mass, as well as the consistency of its internal structures.

Question 1

What is the size of the lesion?

The risk of malignancy increases with size, regardless of sonomorphology. In general, ovarian tumors larger than 10 cm are unsuitable for morphologic assessment. In most

9 key questions

1. What is the size of the lesion?
2. Is the mass solid?
3. Is it a simple or complex cyst?
4. Is the cyst loculated?
5. Are papillary excrescences present?
6. Are there echo-dense foci?
7. Is there echogenicity of interior fluid?
8. Is measurable fluid in the cul-de-sac?
9. How does the mass change over time?

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TABLE 1

Lifetime risk of ovarian cancer

GROUP	RISK (%)
General population	1.8
1 first-degree relative	6.7
2 to 3 first-degree relatives	8.2
Hereditary syndrome	40

Data from: Schildkraut and Thompson[5] and NIH Consensus Panel[6]

TABLE 2

Size as a predictor of malignancy in ovarian tumors

AUTHOR	YEAR	POSITIVE PREDICTIVE VALUE OF TUMOR SIZE		
		<5 cm	5-10 cm	>10 cm
Rulin[32]	1987	3.1	10.9	63.5
Granberg[13]	1989	5.9	21.3	43.6
Sassone[33]	1991	3.3	7.2	12.5
Luxman[34]	1991	13.9	35.6	38.1

cases, the clinician would proceed to surgery.

For tumors smaller than 5 cm, morphology and Doppler studies may yield relevant information.

The morphologic assessment of tumors between 5 and 10 cm should be considered on an individual basis. All the criteria outlined below help determine whether observation or surgery is best in a specific case. For example, a clear 7-cm cyst in an asymptomatic 21-year-old patient might best be observed.

TABLE 2 lists the positive predictive values of size from different series. Variation among them may be explained by a different prevalence of ovarian malignancy in each series.

Question 2

Is the mass solid?

When a solid adnexal mass is detected, the sonologist should consider the possibility of a pedunculated leiomyoma. A stalk with vascular flow from the mass to the main body of the uterus confirms this pathology; a normal ovary on that side excludes it.

If the mass is within the ovary, a Brenner tumor, fibroma (FIGURE 1), granulosa cell tumor, or Sertoli-Leydig cell tumor should be considered. An ovarian fibroma may have significant attenuation[9] and may contain calcifications.[10] Solid masses are generally the smallest subset of ovarian tumors; approximately 10% are malignant.[11]

Question 3

Is it a simple or complex cyst?

The risk that a simple, thin-walled cyst is malignant increases with patient age and the size of the cyst. Osmers et al[11] found no malignancy in simple cysts removed from women 20 years of age or younger, while 3.6% of simple cysts were malignant in women over age 51.

As for size, Ekerhovd et al[12] found no malignancies in simple cysts less than 2 cm in diameter, while 6.6% of simple cysts larger than 7.9 cm were found to be malignant. In general, simple ovarian cysts less than 5 cm in diameter are unlikely to be malignant.

While the risk of malignancy increases with complex ovarian cysts, these lesions are also more commonly benign. In an evaluation of 211 cystic-solid tumors, 29.4% were functional, 20.4% were retention cysts, 33.2% were benign neoplasms, and 17% were malignant.[11] Color Doppler may improve diagnostic accuracy when a complex adnexal mass is detected.

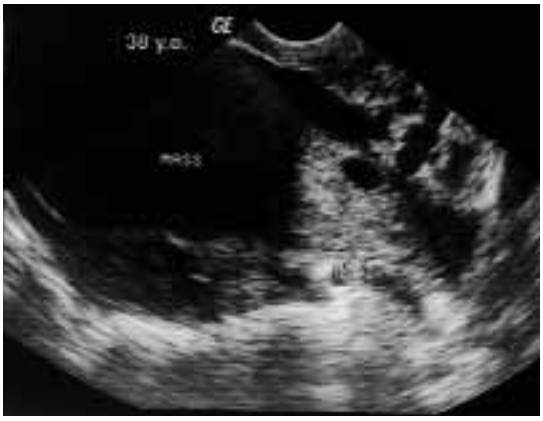
Question 4

Is the cyst loculated?

Although the risk of malignancy rises as loculated cysts become more complex, there is significant overlap between benign and malignant lesions.[13] Mucinous cystadenomas

FIGURE 1

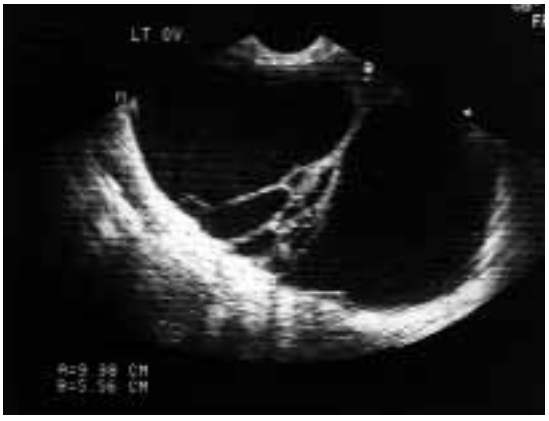
Fibroma



The well-demarcated hypoechoic mass in the right ovary is consistent with a fibroma.

FIGURE 2

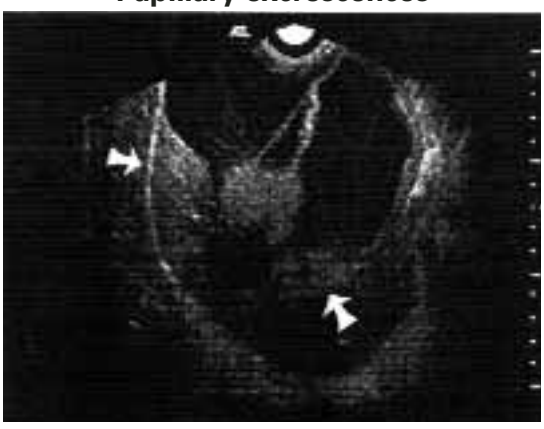
Mucinous cystadenoma



Multiseptated, debris-filled mucinous cystadenoma in the left ovary of a 20-year-old patient.

FIGURE 3

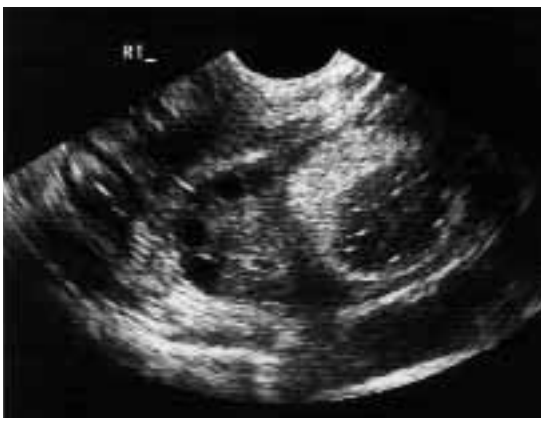
Papillary excrescences



Multiseptated 14-cm endometrioid adenocarcinoma containing several papillary excrescences (arrows).

FIGURE 4

Benign cystic teratoma



Complex cystic/solid benign cystic teratoma. Note that part of the ovary is unaffected.

(FIGURE 2) contain multiple septations and fluid with fine debris secondary to their thick mucinous content. A mucinous cystadenocarcinoma may contain papillary excrescences.[14]

Question 5

Are papillary excrescences present?

These represent localized overgrowth of the epithelium. The likelihood of malignancy rises as the number of excrescences increases (FIGURE 3).[15] Papillary projections into the cyst cavity of less than 3 mm are not strongly associated with malignancy.[16]

Because of the proportionally larger surface area that must be examined, the likelihood of missing a papillary excrescence increases with the size of the cyst.[12] Ranney and Ahmad[17] have reported significantly reduced survival when an ovarian neoplasm contains papillary excrescences.

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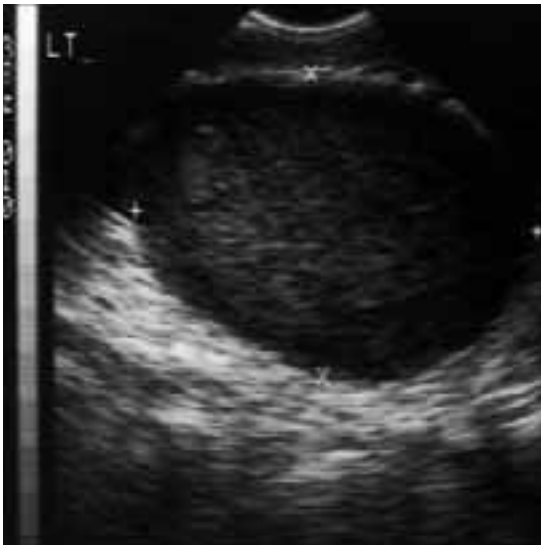
FIGURE 5

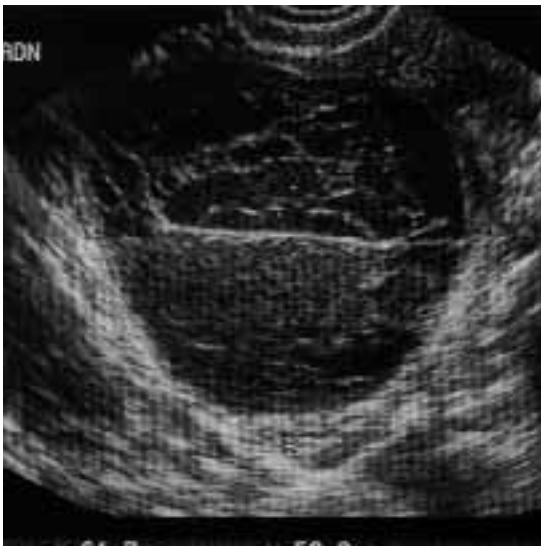
Homogeneous debris



The homogeneous debris in this left ovarian mass is consistent with an endometrioma.

FIGURE 6

Hemorrhagic cyst



Ground-glass appearance of a hemorrhagic ovarian cyst.

Question 6

Are there echo-dense foci?

Because fat mixed with hair produces echogenic foci with acoustic shadowing, the echo-dense foci in benign cystic teratomas are usually easily identifiable (FIGURE 4). In fact, morphologic assessment alone has a sensitivity of 93.1% for the detection of benign cystic teratomas.[18] Be aware, however, that some malignant tumors may have components that cast an acoustic shadow.[19]

Benign cystic teratomas grow at a mean rate of 1.8 mm per year in premenopausal women,[20] and 72% of cystic teratomas are avascular.[18] If the solid components of an apparent benign cystic teratoma have vascular flow, a struma ovarii consisting largely of thyroid tissue should be considered.[21]

Question 7

Is there echogenicity of interior fluid?

If so, it may provide a clue to diagnosis. For example, a serous cyst generally contains clear fluid, while mucinous cysts contain fine debris. An endometrioma tends to contain homogeneous debris[22] (FIGURE 5), while a hemorrhagic cyst may have a ground-glass appearance (FIGURE 6). Echogenic particles within a hypoechoic background are characteristic of a benign cystic teratoma.

Question 8

Is measurable fluid in the cul-de-sac?

As the ovaries become atrophic, the production of cul-de-sac fluid declines. A postmenopausal patient has 5.5 ± 7.8 mL of cul-de-sac fluid, depending on the degree of ovarian activity.[23] Since transvaginal ultrasound can consistently detect 8 mL or more of cul-de-sac fluid, no fluid is identified in the majority of postmenopausal patients.[24] Thus, a moderate amount of cul-de-sac fluid in a postmenopausal patient should raise the sonologist's index of suspicion concerning a possible ovarian tumor.

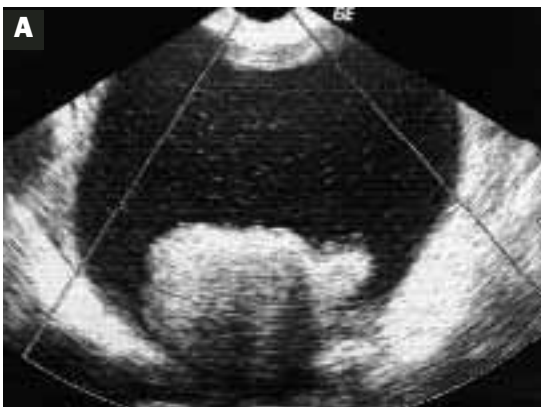
Question 9

How does the mass change over time?

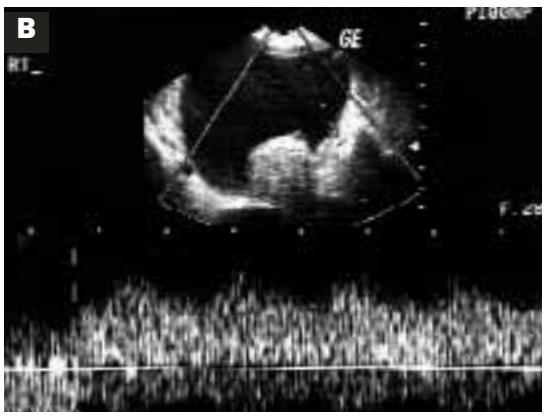
The architectural pattern of ovarian masses is frequently dynamic. For example, between

FIGURE 7

Malignancy



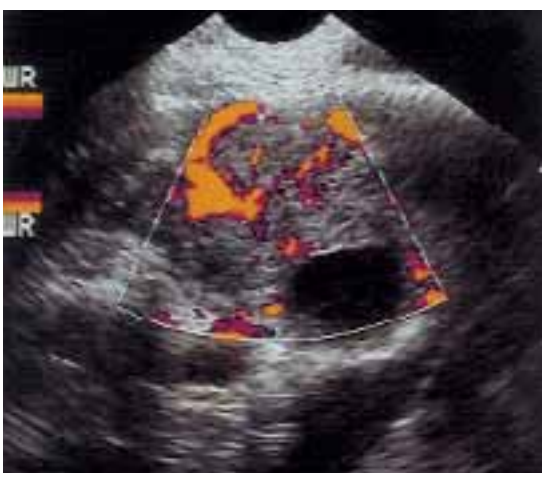
A 55-year-old patient with an 11-cm right ovarian malignancy. **A)** A 4.5-cm echogenic focus within the primary cystic mass.



B) Low resistance index (0.297) in a peripheral vessel.

FIGURE 8

Power Doppler



Power Doppler of abnormal vessels within an ovarian carcinoma.

53% and 89% of functional cysts spontaneously regress.[11] Thus, a follow-up ultrasound examination in 6 to 8 weeks may provide additional information about a mass's etiology. Repeat sonography is recommended in cases without obvious stigmata of malignancy or a size that would mandate surgery.

For example, a recent hemorrhagic cyst may result in an enlarged ovary with mixed echogenicity. Over 6 weeks the liquefaction of the clot within the cyst will result in either resolution of the mass or a markedly different sonographic appearance.

Other studies

Ovarian Doppler. Because of the many types of ovarian masses, sonographic morphology is usually not pathognomic and—when used alone—results in a high false-positive rate in the diagnosis of malignancy. The role of color and pulse Doppler is to reduce these false-positives. Note, however, that the positive predictive value of gray scale and color Doppler is lower in premenopausal patients than postmenopausal women because of the higher prevalence of malignancy in the latter group.

Although initial color Doppler studies of ovarian masses suggested that clinicians could use a cut-off resistance index (**FIGURE 7**) or pulsatility index to satisfactorily discriminate between benign and malignant lesions,[25] subsequent studies demonstrated considerable overlap in the values obtained.[26] As a result, evaluation of vessel distribution and architecture has taken on additional importance (**FIGURE 8**).

▪ **Findings suggestive of malignancy.** Malignant tumors characteristically contain dilated, saccular, and randomly dispersed

vessels.[27] Centrally located flow, flow along septations, and flow within papillary excrescences also suggest malignancy.

▪ **Findings suggesting a benign mass.** Peripheral flow is more consistent with a benign neoplasm. Hemorrhage in a mass is highly suggestive of a benign mass or cyst.[28]

Morphology scores. Almost monthly a new morphology scoring system is published that attempts to substitute objective criteria and measurements for the subjective assessment of an ovarian mass. Most morphologic scoring systems include the parameters reviewed thus far, and some include menopausal status and CA-125 values. Sensitivities and specificities as high as 95% have been reported.[29]

Inevitably, when these scoring systems are validated externally, both the sensitivity and specificity fall. Currently, the proposed models perform no better than an experienced clinician using the patient's history, sonographic findings, and CA-125 measurement.[30]

Three-dimensional sonography. Three-dimensional power imaging may enable visualization of malignant vessel abnormalities (ie, arteriovenous shunts, tumor lakes, etc). It also may improve the evaluation of tumor architecture and tumor invasion through the ovarian capsule. To date, however, 3-dimensional imaging has not been shown to significantly affect the morphology score assigned by 2-dimensional imaging.[31] ■

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