Pelvic ultrasonography (US) remains the imaging modality most frequently used to detect and characterize adnexal masses. Although evaluation is often aimed at distinguishing benign from malignant masses, the majority of adnexal masses are benign. About 90% of adnexal masses can be adequately characterized with US alone. In this article, the important US features that should allow one to make a reasonably confident diagnosis in most cases will be discussed. The role of follow-up US and alternative imaging modalities, along with the importance of careful reporting of adnexal masses, will also be reviewed.
Ultrasoundography (US) continues to be the primary imaging modality used to identify and characterize adnexal masses (1,2). The collective experience from numerous centers worldwide has provided a wealth of information that allows accurate characterization of about 90% of adnexal masses on the basis of their US features (3). Adequate characterization of an adnexal mass is important both to determine which patients need surgery and to help define the type of surgery and whether a surgical subspecialist is needed (4).

Various approaches to characterizing adnexal masses have been used, including subjective assessment, simple scoring systems, statistically derived scoring systems or probability predictors based on logistic regression analysis, and more complex mathematical models such as neural networks (5). Of these, the subjective approach, also called a pattern recognition approach, has been shown to be superior to other methods, with a sensitivity of 89%–100% and specificity of 62%–96% for predicting malignancy (6–8). The high accuracy of the subjective approach was obtained in specialized centers with experienced imagers. The quality of US scans may not be as consistent in less specialized centers (7), although the knowledge and skill set needed to reproduce this degree of performance should be attainable by anyone who routinely performs gynecologic US (8).

When determining the risk of malignancy for an adnexal mass, consideration should also be given to factors other than imaging findings. These include patient age, menopausal status, personal or family history of breast or ovarian cancer, and serum CA-125 level. CA-125 levels are less valuable in premenopausal women since many benign diseases will cause it to increase, though usually only to a mild degree.

In this article, we will focus on US features that are most useful to predict malignancy and will emphasize how these features differ from those of benign disease. Although many physicians are understandably concerned about the failure to detect an ovarian malignancy, it is important to realize that the majority of adnexal masses, particularly in premenopausal women, are benign (3,9–12). We will review the distinguishing US features that can be used to confidently identify the majority of common benign masses. With this knowledge, we can avoid creating unnecessary concern for the patient or the referring physician while remaining vigilant for adnexal malignancy. Extraovarian masses, along with the role of follow-up US and alternative imaging modalities, will also be discussed. Finally, we will examine the role and method of US reporting, discussing potential problems that may lead to micromanagement and adversely affect patient care. Concomitantly, we will suggest alternative approaches to better convey this information. We will limit our discussion to adults. Masses due to ectopic pregnancy and adnexal torsion are beyond the scope of our discussion.

**US Technique**

While transabdominal US is helpful for larger masses or those located superiority or laterally in the pelvis, transvaginal US provides optimal visualization of most adnexal diseases. Real-time US observations contribute to improved characterization (13) and suggest value in recording video clips. Two-dimensional US remains the mainstay for pelvic US, though three-dimensional US is being used with increasing frequency. Little formal comparison of the two techniques is currently available, but three-dimensional US has not been shown to be superior to two-dimensional US in characterizing adnexal masses (14). Three-dimensional US may have some value in determining the origin of an adnexal mass, however (15). Doppler US is useful in cases with an apparent solid area or septum and will be discussed subsequently. Contrast material–enhanced US remains an investigational technique (14).

**Features of Malignant Ovarian Neoplasms**

Classification of ovarian neoplasms is based on histologic features and typically includes the general categories of epithelial, germ cell, sex cord-stromal, and metastatic neoplasms (16). About 90% of primary ovarian malignancies arise in the epithelial group (11). Borderline tumors, also known as tumors of low malignant potential, are a subgroup of epithelial cancers and have a more favorable prognosis. Most germ cell and sex cord-stromal neoplasms are benign, with a few uncommon malignant varieties in these groups. In general, US features that indicate malignancy include a solid component (particularly if there is visible flow in it at Doppler evaluation), thick septa, and ascites (17).

**Solid Component**

US demonstration of a solid component within a cystic mass (Fig 1) is the most important predictor of malignancy, and conversely, malignancy is very unlikely in the absence of a solid component (4,8,17,18). Terminology to describe the solid component varies and also includes papillary projection, excrescence, vegetation, and nodule. The distinction between wall irregularity and small papillary projections along the wall can be difficult. It has been suggested that small solid areas that protrude...
3 mm or more from the cyst wall be considered as papillary projections (8,19).

Though a solid component within a cystic mass is generally a reliable indicator of neoplasia (4,18), pitfalls can occasionally lead to diagnostic problems. Solid components can be seen with benign, as well as borderline and malignant neoplasms (3,20). Papillary projections are known to occur in some serous and mucinous cystadenomas and cystadenofibromas (8). Solid-appearing components may also be present in dermoids and hemorrhagic cysts, both common benign lesions that will be discussed in more detail subsequently. With a dermoid (Fig 2), the solid area is typically hyperechoic compared with the cyst wall and often has acoustic shadowing (17). In contrast, the mural nodule of other neoplasms usually has echogenicity similar to that of the cyst wall (4). Clot in a hemorrhagic cyst may occasionally mimic a solid nodule of a neoplasm. Clot, however, often has concave borders (Fig 3) due to clot retraction, while a true mural nodule has outwardly convex borders (4,21). Color or power Doppler US can be helpful in this distinction, with absent flow characteristic for clot and definite visible flow typical for neoplasm (4). Wall irregularities due to a collapsing cyst (Fig 4) can simulate small solid nodules that may be misconstrued for malignancy (4). Awareness of this pitfall and follow-up US to confirm resolution should elucidate its benign etiology. Endometriomas may contain a small solid area in 4%-20% of cases (Fig 5), and these can simulate the mural nodule of malignant neoplasm (22,23). While this most likely is due to clot or endometrial tissue, Doppler US can sometimes depict flow when the solid area is endometrial tissue, and the reliability of Doppler US in this setting is unclear (24,25).

The completely solid adnexal mass is another potential problem. Most commonly, such a mass is due to a pedunculated uterine leiomyoma or an ovarian fibroma (26). The definition of a solid mass in some studies, however, allows for up to a 20% cystic component and such masses have been found to be associated with malignancy (19,27,28). We suspect that malignancies in predominately solid masses usually occur in those masses that still have some cystic component. The majority of epithelial ovarian malignancies have a cystic component and are rarely completely solid (27,28). There are sporadic
exceptions, but the majority of completely (ie, 100%) solid, solitary adnexal masses are benign in our experience, and other authors have a similar opinion (8,29). Ovarian malignancies that are most likely to manifest as solid or nearly completely solid masses include metastases, lymphoma, neoplasms of the sex cord-stromal group, and other rare malignancies such as malignant teratomas or dysgerminomas (11,30). In particular, when the patient has a malignancy with a propensity to metastasize to the ovaries, the presence of bilateral solid masses should raise concern for metastases (31). Breast and gastrointestinal tract carcinomas are the most common neoplasms to metastasize to the ovary. Given the above considerations, most truly solid adnexal masses that cannot be confidently attributed to pedunculated uterine leiomyomas are removed surgically (29).

**Septa**

Septa in a cystic ovarian mass (Fig 6) are strong evidence of a neoplasm (4) and are more likely to indicate malignancy if they are greater than 2–3 mm in thickness or have detectable flow on Doppler US scans (17). A cystic ovarian mass with septa (particularly when thin) but without a solid component is likely to be a benign neoplasm, though occasionally may be malignant when there are a very large number of septa (8). A cystic mass with multiple, smooth, thin septa and no nodularity is suggestive of a mucinous cystadenoma (8).

There are also a few pitfalls related to septa. Fibrin strands within a hemorrhagic cyst should not be misconstrued for true septa. Fibrin strands (Fig 7) are typically very thin weak reflectors, are numerous, and do not traverse the entire cyst (4). In contrast, true septa are usually thicker, less numerous, and extend in continuity across the cyst (4). Another pitfall may occur when the juxtaposed walls between two or more adjacent simple cysts (Fig 8) mimic a septum (4). Follow-up US is often helpful to differentiate this from a septated cystic mass.

**Ascites**

Ascites, an indirect indicator of malignancy, occurs with peritoneal tumor spread (17). Ascites may allow peritoneal implants to be seen. Although a small amount of fluid in the cul-de-sac is normal in premenopausal women, an increased risk of malignancy has been reported if it measures more than 15 mm in anteroposterior dimension (28). The significance of ascites should be interpreted in light of the patient’s presentation and any preexisting illness, such as cirrhosis. Meigs syndrome is the occurrence of ascites and pleural effusion in association with a benign ovarian tumor, most frequently an ovarian fibroma. It is uncommon, however, occurring in about 1% of fibromas (32,33). Ascites alone may also occur with fibromas (33). The ascites in these cases has the potential to be mistaken for evidence of malignancy. Echogenic ascitic fluid may occur with malignancy, but it may also occur with benign disease such as hemoperitoneum from a ruptured cyst or ectopic pregnancy.

**Other US Features**

Several other features of lesser clinical utility have been associated with malignancy. These include mass size, wall thickness, and Doppler US characteristics. Larger masses are often considered more suspicious for malignancy; however, malignancy is more reliably predicted on the basis of morphologic features than size (31). A thickened cyst wall has been described as a feature of malignancy, but its usefulness is limited since this feature can be seen in many benign lesions. Spectral Doppler US does not yield any substantial improvement over grayscale US for predicting malignancy (34–36). There is a general trend toward lower pulsatility index, lower resistive
index, and higher velocity in malignant neoplasms as opposed to benign neoplasms. However, because of the substantial overlap of these spectral Doppler parameters in benign and malignant lesions, they have little to no role in the characterization of adnexal masses (8,37).

Color Doppler US is best utilized in a qualitative mode to look for flow within a solid component or septum (38) (Fig 1). If distinct vessels can be seen with color or power Doppler US, then flow is present. However, if only a few scattered pixels of color are displayed, it may be difficult to know if this is true flow or an artifact from noise. Spectral Doppler US should be performed in this instance to determine if blood flow is really present. The presence of flow increases concern for malignancy, though many benign neoplasms will also have detectable flow. If there is no detectable flow in a solid-appearing area, particularly in a premenopausal woman, one should consider the possibility of blood clot rather than a true solid component. Power Doppler US may be superior to conventional color Doppler US for identifying malignancy, with slightly higher sensitivity but similar specificity (14). Three-dimensional power Doppler US examinations, either for evaluating vessel morphology or obtaining new indexes that attempt to quantify flow, are still considered investigational (14).

**Benign Ovarian Masses That Can Usually Be Predicted at US**

**Simple Cyst**

A simple cyst (defined as having anechoic fluid, a thin wall, no solid area or septa, and distal acoustic enhancement) is usually easily recognizable (Fig 9). Most simple ovarian cysts are follicular cysts, occur in premenopausal patients, and will resolve within 1–2 months. A few simple ovarian cysts, particularly larger ones or those in older women, are serous cystadenomas.

It is rare for a simple cyst to be malignant, and this seems to occur only with large cysts. In a study of postmenopausal women, no cancers were detected in 3259 simple ovarian cysts less than 10 cm (39). The authors of that study estimated the risk of malignancy in simple cysts as less than 0.1% (39). Another study reported that malignancy only occurred in simple cysts larger than 7.5 cm, and in those cases small nodularities visible at gross pathologic examination were missed at US (20). It is unclear if malignant transformation of a serous cystadennoma (which may appear as a simple cyst) ever occurs, though such transformation is thought to be uncommon (40).

**Corpus Luteum**

It is important to recognize the corpus luteum as a normal finding and not mistake it for disease. This physiologic structure develops after ovulation and is typically less than 3 cm in diameter. It may appear as a cystic mass with a slightly thick, crenulated wall and internal echoes (Fig 10) or as a subtle isoechoic or minimally hypoechogenic solid-appearing area due to hemorrhage and/or wall thickening (Fig 11) (31). While the corpus luteum is usually avascular centrally, color or power Doppler US will often...
Hemorrhagic Cyst

Hemorrhagic ovarian cysts are likely caused by bleeding into a corpus luteum. The majority have typical US features that allow a confident diagnosis to be made (21). A reticular pattern of internal echoes due to fibrin strands (Fig 7) is a strong predictor of a hemorrhagic cyst. This pattern has also been referred to as having a fishnet, lacy, cobweb, or spiderweb appearance. The distinction of true septa from fibrin strands was discussed earlier. While a clot may occasionally simulate a solid nodule, it is usually recognizable by its concave outer margin and/or absence of detectable flow at color or power Doppler US (Fig 3). Follow-up US scans are useful if one is not confident. Blood clot can sometimes be recognized on a gray-scale US scan by its jellylike movement when pressure is applied with the transducer (8). A fluid level occasionally occurs in a hemorrhagic cyst (44). If imaged acutely, before fibrin strands or a retracting clot develops, a hemorrhagic cyst can be partly or completely filled with heterogeneous echoes (Fig 12) that may simulate a solid mass (31,44). One should consider this possibility in a younger woman with an ovarian mass that contains a seemingly solid heterogeneous component that lacks internal flow at Doppler US.

Endometrioma

Endometriomas (Fig 13) typically appear as complex cysts, either unilocular or multilocular, that have a ground glass appearance due to diffuse, homogeneous, low to medium level internal echoes (8). Similar diffuse internal echoes may sometimes occur in other lesions such as hemorrhagic cysts, dermoids, and some ovarian carcinomas (4). Thus, one should carefully evaluate for any other features such as a solid component that would suggest a different diagnosis. An endometrioma is very likely when there are diffuse internal echoes in a cystic mass lacking other US features (22). It is unclear whether lack of acoustic streaming (movement of fluid due to energy transfer from the ultrasound wave) following insonation with Doppler US is a predictive feature of endometriomas (43). Additional features reported with endometriomas include echogenic foci in the wall and small solid areas along the wall, as discussed previously (22,25). Not surprisingly, the occasional small solid area may confound US interpretation, making it difficult to distinguish endometriomas from neoplasms. A small percentage (probably < 15%) of endometriomas have less typical US features such as anechoic fluid, a fluid-fluid level, heterogeneity, or calcification (22,25,46–48). Endometriomas may occasionally simulate a solid mass, especially when they are chronic (46,49,50). Rarely, endometroid or clear cell carcinoma may develop within an endometrioma; this is more likely in women older than 45 years of age and in endometriomas larger than 9 cm (51).

Mature Cystic Teratoma

Mature cystic teratomas, often referred to as dermoids or dermoid cysts, are usually easily recognized at US (8). A hyperechoic area (Fig 2) is a highly predictive feature of a dermoid, particularly when it is associated with distal acoustic shadowing (52,53). This hyperechoic area is not usually as intensely echogenic as
calcification, but it is hyperechoic relative to adjacent soft tissues. Hyperechoic lines and dots, sometimes called the dermoid mesh (Fig 14), are also very predictive (52,53). Less common but also characteristic are a fluid-fluid level with the more echogenic fluid located in a nondependent position (54) and floating globules (55). The demonstration of any two or more of the above features in a mass is particularly predictive of a dermoid (53). Calcification, often due to bone or a tooth, occurs in some dermoids, but cannot be used alone as definitive evidence of a dermoid since other neoplasms can also calcify. Rarely, a dermoid will have none of these characteristic US features (8).

**Fibrothecomas**

Ovarian fibroma is the most common sex-cord stromal neoplasm and is almost always benign (56). A thecoma is another sex-cord stromal neoplasm, and occasionally there will be histologic features of both fibroma and thecoma, giving rise to the term fibrothecoma. Fibromas typically occur in middle-aged women and appear as heterogeneous or homogeneous solid masses (Fig 15), similar to pedunculated fibroids. On occasion, they may have a small cystic component. Marked acoustic shadowing (Fig 16) is a predictive feature that occurs in 18%–52% of fibromas (57,58). With fibromas, the acoustic shadowing does not originate from an area of increased echogenicity due to calcification or from the hyperechoic nodule of a dermoid. Instead, the shadowing occurs because of marked attenuation of sound by the hyperechoic mass of the fibroma. A minority of ovarian fibromas grow exophytically from the ovary (26), which may hinder distinction from a pedunculated uterine leiomyoma. In our experience, a completely solid ovarian mass, particularly in a middle-aged woman, is usually a fibroma.

**Benign Extraovarian Masses That Can Usually Be Predicted at US**

Most adnexal masses arise from the ovary, but diagnostic errors can result when this is assumed, rather than proved, by US findings. Most extraovarian masses are benign, and several of them can be reliably diagnosed on the basis of their US appearance (8). The following benign extraovarian masses can usually be predicted at US.

**Paraovarian Cysts**

Paraovarian cysts usually occur in the broad ligament and arise from parame- onephric, mesothelial, or mesonephric remnants (59). They are usually simple cysts and are easily recognized if a separate ipsilateral ovary is identified.

**Hydrosalpinx**

A hydrosalpinx should be suspected on the basis of its location and configuration. Characteristically, it is a tubular-shaped cystic structure that is separate from the ipsilateral ovary. Its configuration may reveal indentations on the opposite sides of the wall (Fig 17), referred to as the “waist sign,” which is a strong predictor of hydrosalpinx (61). The waist sign in combination with a tubular-shaped cystic mass has been found to be pathognomonic of a hydrosalpinx (61). Incomplete septa (Fig 18), due to the wall of the tube folding on itself, or small mural nodules (Fig 19), due to thickening of endosalpingeal folds (termed beads on a string), are also typical and are more predictive of hydrosalpinx when the mass is tubular in shape (61,62). It is particularly important to not misconstrue the “beads on a string” appearance for neoplastic mural nodules. This distinction is easier when one recognizes that the mass is separate from the ovary. Additionally, the solid component of the rare fallopian
tube carcinoma is usually larger and less numerous than the multiple small nodules due to thickened endosalpingeal folds. Peritoneal Inclusion Cyst

A peritoneal inclusion cyst is believed to occur in the presence of a functioning ovary and adhesions, with the latter usually due to prior pelvic surgery, endometriosis, or pelvic inflammatory disease. Peritoneal inclusion cysts (Fig 20) typically appear as cystic masses with septa (63,64). The septa may be thick and contain detectable flow at color Doppler US. Peritoneal inclusion cysts may be mistaken for ovarian neoplasms, but the key to their recognition is the demonstration of a normal ovary within or along the periphery of the cystic mass. Typically, the configuration of a peritoneal inclusion cyst is passive and conforms to the contours of the adjacent pelvic structures, but it may also have a spherical or ovoid shape (8).

Pedunculated Uterine Leiomyoma

These are typically solid masses (Fig 21) that may be mistaken for an ovarian fibroma if one does not identify a separate ipsilateral ovary. Color or power Doppler US demonstration of a vascular pedicle connecting the mass to the uterus is good evidence of a pedunculated fibroid (65,66). Rarely, cystic degeneration can occur, leading to confusion with malignancy, particularly if the extraovarian location is not recognized.

Adnexal Masses That Are More Challenging to Predict at US

Less than 10% of adnexal masses are difficult to characterize at US (3). This may occur with a technically suboptimal examination, as a result of overlapping US features between some types of lesions, or with rare lesions.
Uncommon Ovarian Neoplasms

By virtue of their rarity, some ovarian neoplasms are difficult to diagnose at US or any other imaging modality. Sex cord-stromal tumors other than benign fibrothecomas are often low-grade malignancies and fall into this category. Some can be suggested if accompanied by endocrine dysfunction. Granulosa cell tumors, which tend to be solid or multiloculated with solid components, may produce estrogen and cause endometrial disease (69). Sertoli-Leydig cell tumors may produce androgens and cause virilization (70). These latter tumors can be subtle on US scans, as many are small solid tumors.

Within the germ cell group, variants of ovarian teratoma can be challenging to diagnose. Struma ovarii, a teratoma composed mostly of thyroid tissue, does not usually have the typical features of a teratoma at US or MR imaging and is only rarely associated with thyrotoxicosis (3.71). These are rare and tend to develop in older women whose masses are larger than 6 cm (72). In contrast to their benign counterpart, malignant teratomas have more solid components with exophytic extension. Isoechoic branching structures within the mass have been suggested as a sign of malignancy (73). Because of their rarity, use of these features to diagnose a malignant teratoma is difficult to apply in daily practice. Other rare germ cell neoplasms include dysergominomas (which typically are solid masses occurring most frequently in adolescence and young adults), endodermal sinus tumors, choriocarcinomas, and embryonal carcinoma (74).

Uncommon Extraovarian Masses

Several extraovarian masses occur too infrequently to discuss in detail. Tarlov cysts (also known as perineural cysts) should be considered when complex cystic masses with internal echoes are seen posteriorly, separate from the ovaries (75). An appendicectomy mucocele typically appears as a complex cystic mass with internal echoes in the right lower abdomen or pelvis. Solid extraovarian masses include neural tumors, lymphadenopathy, and the rudimentary horn of a unicornuate uterus. The postoperative nature of some cystic masses may suggest their diagnosis, such as hematomas, lymphoceles, or seromas.

Fallopian tube carcinoma, a rare tumor, is considered within the spectrum of malignancies associated with BRCA1 and BRCA2 mutations (76). They are often diagnosed at surgery, having originally been suspected to be an ovarian malignancy (76). A tubular-shaped mass with a large solid component suggests the diagnosis (77,78). This appearance should be contrasted with the multiple tiny nodules causing a “beads on a string” appearance that may occur with a hydrosalpinx. The appearance of fallopian tube carcinoma is variable, however, and unfortunately it may appear as a completely solid mass, lacking US evidence of a tubular component (78).

Adnexal Masses in Pregnancy

A thorough discussion of adnexal masses in pregnancy is beyond the scope of this article, but the US approach and criteria are essentially the same as those used in a nonpregnant premenopausal woman (9). A more detailed discussion of adnexal masses in pregnancy is available elsewhere (79).

A few ovarian masses are uniquely related to pregnancy. Theca lutein cysts typically develop in response to elevated levels of serum beta human chorionic gonadotropin that occur with complete molar pregnancy. Theca lutein cysts may rarely occur with a singleton or a multiple pregnancy or with fetal hydrops, and in these situations have been referred to as hyperreactive luteina (79). Both ovaries are typically enlarged and contain multiple cysts that may result in a “spoke wheel” appearance (79). A similar appearance may be seen in patients undergoing assisted reproductive techniques, particularly when ovarian hyperstimulation syndrome develops (Fig 22).

Luteoma of pregnancy is a rare benign mass that has a nonspecific appearance but should be suspected if there is hyperandrogenism (79). Endometriomas may become decidualized during pregnancy, resulting in solid vascular areas that mimic ovarian carcinoma (80). Fortunately, this is a rare occurrence and awareness, along with MR evaluation and follow-up imaging, may facilitate the appropriate diagnosis (80).

Follow-up US

Follow-up imaging is appropriate in many cases when the initial US examination findings suggest benign disease, when the diagnosis is uncertain, or when there are compelling reasons to
avoid surgery (9). In premenopausal women, many masses are functional cysts that will spontaneously resolve in several weeks. This often prompts a follow-up US about 6 weeks after the initial examination. Some of these studies may be unnecessary, although there is no consensus regarding which cysts do not need US follow-up. In an asymptomatic premenopausal woman, it has been suggested that a simple ovarian cyst smaller than about 4 cm may not need follow-up (4,81). Similarly, a classic-appearing hemorrhagic cyst probably does not need to be followed if the patient is, or becomes, asymptomatic (4).

Postmenopausal women with a simple ovarian cyst less than 1 cm may be able to forego follow-up US (4). Postmenopausal women with a simple ovarian cyst greater than 1 cm, but less than 5 cm, can usually be followed with US (82–84), although optimum follow-up interval is uncertain. With short-interval follow-up, slow growth can occur with a benign neoplasm such as a serous cystadenoma and may not be appreciated (4). Performance of US in about 6 months seems reasonable for the initial follow-up US examination (4), with further follow-up intervals adjusted on the basis of the degree of change. The Society of Radiologists in Ultrasound is sponsoring a consensus conference on the management of adnexal cysts that will address the issue of follow-up US for many adnexal cysts.

If the etiology of a mass is uncertain, but its appearance is not suspicious for malignancy, then follow-up US is also reasonable. For example, if a mass is likely a hemorrhagic cyst but also has atypical features, a follow-up US examination performed in 6 weeks is reasonable. This amount of time allows for resolution of most cysts and is at a different time of the menstrual cycle so that any new cyst will hopefully have a different appearance. Serial US examination may also be indicated to follow the course of a previously characterized benign lesion. This is commonly performed in a patient with a dermoid, endometrioma, hydrosalpinx, or a peritoneal inclusion cyst. While some persistent benign-appearing adnexal masses may be removed due to potential torsion or rupture, recent evidence suggests that these complications are less frequent than previously reported (4,85).

Alternative Imaging Modalities
To further evaluate an adnexal mass, additional imaging studies may be recommended. Since MR imaging performs well for characterizing adnexal masses (86,87), it is the modality most frequently used to further evaluate adnexal masses deemed indeterminate at US (10,88). The problem with this approach is a lack of what defines a mass as indeterminate at US. Fortunately, when one applies the previously described US criteria to characterize adnexal masses, the number of truly US-indeterminate examination findings is small. Furthermore, once a thorough US examination has been performed, additional imaging with other modalities is often of limited value (9). MR imaging is most beneficial when a mass is very large, is located superiorly or laterally in the pelvis, has atypical US features, or is of unclear origin (4,9,89,90).

CT may be able to characterize adnexal masses as benign or malignant (91), but it has little role in the routine detection or characterization of adnexal masses. CT cannot usually be as specific as to the type of benign mass in the manner that US can. Given the numerous advantages inherent to US, including wide availability, large collective experience with this modality, lower cost, and lack of ionizing radiation, CT should generally be reserved to evaluate for spread of ovarian malignancy (9). While CT can demonstrate fat in dermoids, if there is no macroscopic fat in the mass, CT usually contributes little further information for characterization. We prefer MR in this context if the diagnosis is unclear at US, since it cannot only demonstrate fat, but has the capacity to identify blood products within an endometrioma or hemorrhagic cyst, masses that are occasionally confused for a dermoid at US (53). CT may have utility in selected cases of suspected tubo-ovarian abscess, since it is superior to US for revealing contiguous inflammatory changes and involvement of adjacent organs (67).

Positron emission tomography (PET) may provide some information as to the etiology of a mass (92,93); however, current data do not support the use of PET scanning in the preoperative characterization of adnexal masses (9). PET or PET/CT scans may be useful in selected cases where recurrent cancer is suspected.

Reporting of the US Examination
The importance of communicating US findings in a clearly worded, succinct report cannot be overstated. Reports that provide a clear description of the findings and a most likely diagnosis, or a short list of most likely diagnoses, contribute to proper care of the patient. Inappropriate reporting may lead to unwarranted concern by the patient and referring clinician and could lead to unnecessary additional tests or surgery. This issue has been well discussed (94), and it is important that radiologists remain aware of these problems and take responsibility for solving them. In our opinion, problems that relate to reporting involve four areas that we will discuss below. A reporting method similar to the Breast Imaging Reporting and Data System classification used for breast masses has been suggested for adnexal masses (95) and could potentially improve communication of US results, but there is no agreement yet on such an approach.

Use of the Term Cyst
In any organ other than the ovary, an identifiable cyst indicates an abnormality, albeit usually benign. The premenopausal ovary is unique, however, in that small simple cysts, that is, follicles, are part of its normal structure. Thus, use of the term cyst with respect to the ovary has the potential to be misunderstood, since “cyst” tends to connote disease (94). Of the several small follicles normally present, the dominant follicle will generally enlarge to a diameter...
of 20–25 mm before ovulation occurs. Therefore, a simple cyst less than about 25 mm is usually a normal follicle in a premenopausal woman, particularly when visible at mid cycle. Thus, it seems more precise and less likely to be misunderstood if one refrains from using the term cyst in any form to describe normal follicles, but rather just states that the ovary is “normal” or refers to them as “follicles” (4,94). Even reports of “multiple follicles” or “several small follicles” can be misinterpreted if the referring physician wonders about increased numbers of follicles in regard to polycystic ovary syndrome. Reporting the ovary as “normal” seems to be the clearest wording.

Similarly, when there are typical features of a corpus luteum, also a normal part of the ovary, the ovary should be reported either as “normal” or as containing a “corpus luteum.” The term corpus luteum cyst to describe this small normal finding should usually be avoided, since the word “cyst” typically implies disease (94). Occasionally, the corpus luteum may enlarge more than is typical and at some point addition of the word “cyst” or use of a term such as hemorrhagic corpus luteum cyst may be suitable (94), although the size where this distinction is most appropriate is unclear.

Incomplete or Vague Description of the Mass

The description of an adnexal mass will also be problematic if the report only states the presence of a “complex cystic adnexal mass.” Since many benign and most malignant masses are complex, additional descriptive adjectives and synthesis to include a likely diagnosis are necessary to avoid an incomplete and vague report that could be misunderstood by the referring clinician. We do not object to the word “complex” as long as further descriptors are provided regarding the features that produce the complex appearance. We realize that approaches to reporting vary, with radiologists and other imagers being more or less detailed in their description, as is the norm in their practice. Nevertheless, with rare exception, there should at least be an assessment of the findings that results in a conclusion regarding the most likely diagnosis or a short list of the most likely diagnoses. Patients sometimes seek a second opinion in another locale, and accurate description and synthesis are even more important in this situation.

Frequent Suggestion of Malignancy as a Diagnosis

Reports that frequently state ovarian cancer cannot be excluded or those that frequently include ovarian cancer in the differential diagnosis may also contribute to improper patient care. Before the US examination is performed, the referring clinician is well aware of the long differential diagnosis of an adnexal mass, which includes ovarian cancer (94). Since most adnexal masses are benign and have defining characteristic features that can be identified on the US scan, the role of US is to substantially narrow the list of diagnostic possibilities. Certainly, consideration of ovarian cancer is appropriate in some cases, but when all adnexal masses are taken into account, ovarian malignancy is relatively uncommon and should only be reported when neoplastic features are visible.

Frequent Recommendation of Alternative Imaging Modalities

Alternative imaging may be appropriate in a small number of cases, as discussed previously. However, if the radiologist frequently recommends additional imaging studies, it is unlikely that all of the information from the US examination is being considered. Furthermore, when follow-up imaging is needed, a repeat US examination often suffices. Frequent recommendation of other diagnostic imaging modalities contributes to unnecessary imaging and additional costs and may place the referring clinician in a difficult situation if he or she does not concur that further imaging is warranted.

Summary

The overwhelming majority of adnexal masses are benign and most can be recognized on the basis of characteristic US features. Malignancy, while infrequent, is likewise usually identifiable by a different set of distinguishing US features. Accordingly, in most cases the report should reflect a reasonably confident diagnosis of a benign or malignant entity. Clear communication of the US results will assist in proper patient care and should include a sufficient description and/or conclusion regarding the most likely diagnosis. In less definitive cases, unambiguous reporting will still aid in appropriate patient care. Following this approach will maximize the potential of US to correctly characterize a mass and should allow the majority of women to either have no follow-up at all or undergo a follow-up US when appropriate. It should also assist in determining the minority of women who need alternative imaging or surgery and help reduce unnecessary imaging and unwarranted clinical concern.

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