

Adnexal Masses in Pregnancy: Diagnosis and Management

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Abstract: The widespread use of ultrasound in obstetrics has led to an increase in the diagnosis of asymptomatic adnexal masses in pregnancy. Ultrasound is an accurate and safe method for diagnosing the etiology of an adnexal mass and distinguishing benign from malignant pathology. The management of an adnexal mass in pregnancy is controversial. Historically, it was recommended that any adnexal mass be removed electively in the second trimester to exclude malignancy and prevent complications such as torsion, rupture, and obstruction of labor. More recent recommendations have limited surgical intervention in pregnancy to symptomatic adnexal masses and those that are highly suggestive of malignancy. Surgery in pregnancy is associated with an increased risk of adverse pregnancy outcomes. However, laparoscopy appears to be a safe alternative to laparotomy for benign masses when performed by experienced surgeons.

Key words: Adnexal mass, pregnancy complications, ultrasound

Learning objectives

- To list the differential diagnoses of adnexal masses in pregnancy
- To interpret ultrasound images of adnexal masses and distinguish benign from malignant masses
- To describe the management options for adnexal masses in pregnancy, including the indications and options for surgical intervention.

INTRODUCTION

Detection of adnexal masses in pregnancy has become increasingly common. Before the routine use of ultrasound, adnexal masses in pregnancy were diagnosed by physical examination either incidentally or because of symptoms such as pain. Currently, the American College of Obstetricians and Gynecologists, in collaboration with the American Institute of Ultrasound in Medicine and the American College of Radiology, requires that an attempt to evaluate the uterus and adnexa may be made during obstetric ultrasounds.¹

INCIDENCE OF AN ADNEXAL MASS IN PREGNANCY

Adnexal masses are diagnosed in approximately 1 to 4% of all pregnancies.²⁻⁵ The majority of adnexal masses are incidental findings on ultrasounds performed for obstetrical indications. A smaller number of adnexal masses are identified because of symptoms such as pain. It is likely that more pregnant women will be diagnosed with incidental adnexal masses as an increasing number of obstetrical ultrasounds are being performed, especially in the first trimester. In addition, ultrasound technology continues to improve, which will result in the identification of smaller masses.

There is significant variability in the reported incidence of adnexal masses diagnosed in pregnancy that depends on the definition of an adnexal mass and whether the diagnosis is made by imaging, surgery, or discharge diagnosis code. Because a pathologic specimen is necessary for definitive diagnosis, ovarian cysts, that are managed expectantly or resolved, are likely to be underdiagnosed.⁶ Studies that include patients diagnosed in the first trimester, will likely find an increased number of simple ovarian cysts compared with second and third trimester studies because most simple cysts resolve after the first trimester. There is also a significant variation in the minimum size of cysts that are included in studies of adnexal masses in pregnancy. Other factors such as suboptimal visualization of one or both ovaries and assisted reproduction likely influence the prevalence of adnexal masses diagnosed in pregnancy.

Detection of ovarian masses in pregnancy is directly related to the ability to visualize the ovaries. Visualization of both ovaries is highest in the first trimester when high frequency transvaginal probes can be used, and when there is less interference from the gravid uterus. With transvaginal ultrasound in the first trimester, both ovaries can be adequately visualized 95% of the

time. The use of transabdominal ultrasound in the first trimester has been shown to detect both ovaries in one-third of patients and only one ovary in two-thirds. In the second and third trimesters, transabdominal ultrasound was able to visualize both ovaries only 16% of the time, and in over half of cases (60%), neither ovary could be identified.⁷

Because the ovaries are more easily visualized by ultrasound in the first trimester, it is not surprising that adnexal masses are diagnosed more often in early pregnancy.⁸ In addition to improved visualization of the ovaries it is the fact that a significant number of ovarian cysts resolve with advancing gestation. The incidence of adnexal pathology detected in the first trimester varies from 0.2 to 6%.^{9,10} In a prospective, observational longitudinal study of 3,000 women undergoing ultrasound evaluation prior to 14 weeks gestation, 182 (6%) ovarian cysts were diagnosed.¹⁰ Cysts were defined as either simple cysts greater than 2.5 cm or complex ovarian cysts of any size. Of the cysts diagnosed in the first trimester, 72% resolved spontaneously. In another study, 69% of simple ovarian cysts greater than 3 cm reduced in diameter by more than 50% or resolved completely.¹¹ When stratified by size, 81% of cysts less than 5 cm in diameter reduced or resolved, compared with only 50% of the cysts that were greater than 5 cm.

The incidence of adnexal masses detected in the second and third trimesters is 4.1%.⁵ In a study of 7,996 women in the second and third trimesters, the prevalence of adnexal masses decreased from 8% between 13 and 16 weeks' to 1.8% after 34 weeks.⁵ Bilateral adnexal masses were identified in only 2.1% of patients with an adnexal mass.

DIFFERENTIAL DIAGNOSIS OF AN ADNEXAL MASS IN PREGNANCY

Although an adnexal mass can be either gynecologic or nongynecologic, the majority are usually ovarian in origin. Table 1 enlists the differential diagnosis of adnexal masses in pregnancy. Certain adnexal masses are related to pregnancy and some are incidental findings that have a similar prevalence as in nonpregnant women of reproductive age.

Common adnexal masses specific to pregnancy include ectopic pregnancy, theca lutein cysts, luteinized follicular cysts, corpus luteum cysts, luteomas, and hyperstimulated ovaries. Incidental adnexal masses in pregnancy include benign ovarian cysts such as cystadenomas, endometriomas, mature cystic teratomas, myomas, and malignant ovarian neoplasms.

Ectopic pregnancy is a pregnancy outside the endometrial cavity (Fig. 1). Approximately 2% of pregnancies in the United States are ectopic and the incidence appears to be rising.¹² This increase may be due to earlier and more accurate diagnosis, due in part to improvements in ultrasound technology. The presence of an intrauterine pregnancy does not exclude the possibility of an ectopic pregnancy. The incidence of heterotopic

Table 1: Differential diagnosis of an adnexal mass in pregnancy

Ovarian	Nonovarian
<i>Benign</i>	Ectopic pregnancy
Functional cysts	Paraovarian cyst
Follicular cysts	Leiomyoma
Corpus luteum cysts	Hydrosalpinx
Theca-lutein cysts	Tubo-ovarian abscess
Luteomas	Peritoneal inclusion cyst
Hemorrhagic cysts	Diverticular abscess
Benign cystic teratomas	Appendiceal abscess or tumor
Serous cystadenomas	Fallopian tube cancer
Mucinous cystadenomas	Pelvic kidney
Endometriomas	Lymphoma
<i>Malignant</i>	
Epithelial	
Germ cell	
Sex cord/stromal	
Granulosa cell	
Metastatic	
Pseudomyxoma peritonei	

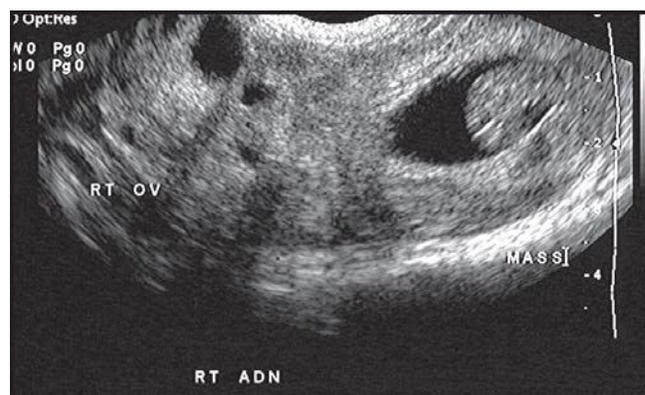


Fig. 1: Ectopic pregnancy adjacent to right ovary

pregnancy is increasing, in large part due to the increased risk associated with assisted reproduction. In the general population, the incidence of heterotopic pregnancy is now 1:4,000 but increases to 1:100 in *in vitro* fertilization pregnancies.¹³

Theca lutein cysts appear as bilateral, anechoic, multi-loculated ovarian cysts. They form as a result of overstimulation from high levels of human chorionic gonadotropin (hCG), as seen in gestational trophoblastic disease, multiple gestations, ovarian hyperstimulation and molar pregnancies, or from an increased sensitivity to hCG.

A luteinized follicular cyst is an uncommon benign cyst of the ovary. These cysts are believed to be stimulated by hCG. On ultrasound, they appear as large, solitary, thin-walled,

unilocular cysts. The mean diameter of luteinized follicular cysts is 25 cm; however, a cyst as large as 55 cm has been reported.¹⁴

A *corpus luteum* is always associated with pregnancy. Normally the corpus luteum enlarges during the first trimester and regresses by the 12th week of gestation.¹⁵ A corpus luteum can appear as unilocular, anechoic, smooth, thin walled simple cyst. A hemorrhagic corpus luteum cyst can have a varied appearance due to the evolution of the blood clot. Initially, a hemorrhagic corpus luteum will appear as an echogenic mass with internal echoes that are more hyperechoic than the surrounding ovary. As the clot matures, the hemorrhagic corpus luteum will appear as an anechoic cyst with thick septations that resemble a “cob web” appearance (Fig. 2). Because hemorrhagic corpus luteum cysts are fluid-filled, they demonstrate sound-through transmission.¹⁶

Luteomas are usually solid tumors that, because of their sonographic appearance, are often mistaken for malignancy. They develop during pregnancy and resolve spontaneously after delivery. Approximately half are bilateral. Luteomas are thought to result from hypersensitivity to hCG. Most patients with luteomas are asymptomatic; however in some cases both the mother and fetus will show signs of virilization. For this reason, the diagnosis should be suspected in any pregnant patient with a solid adnexal mass and signs of virilization.¹⁶

Hyperstimulated ovaries are enlarged ovaries that contain multiple follicles. They are usually found in patients who have undergone ovulation induction. The majority of these cysts resolve spontaneously in pregnancy or after delivery. Ultrasound reveals enlarged ovaries containing multiple, peripherally located, thin walled cysts. The more severe form, i.e. ovarian hyperstimulation syndrome, is associated with enlarged ovaries containing multiple hypoechoic areas and often free fluid in the pelvis. Hyperstimulated ovaries are at risk of torsion and hemorrhage.

Cystadenomas are benign ovarian neoplasms. They may be simple or have thin septations. Serous cystadenomas appear as anechoic cysts. Mucinous cystadenomas have low level internal echoes, are more likely to be multiloculated, unilateral, and larger in size. Rapid growth and pain of a cystadenoma can complicate pregnancy and necessitate surgical intervention.¹⁷

Endometriomas are benign cysts that are formed by ectopic endometrial tissue. Sonographically, they appear as a thick-walled, complex cysts with homogeneous low-level internal echoes (Fig. 3). Additional sonographic features include multilocularity and hyperechoic wall foci.¹⁸ Because of their association with infertility, they are relatively uncommon in pregnancy.¹⁶

Myomas are the most common solid pelvic tumors in women of reproductive age with a prevalence of 20 to 40%.¹⁹ Myomas are benign smooth muscle tumors that arise from the uterus and may appear as adnexal masses. On ultrasound, a myoma can have a variety of appearances, but most commonly they appear



Fig. 2: Hemorrhagic cyst

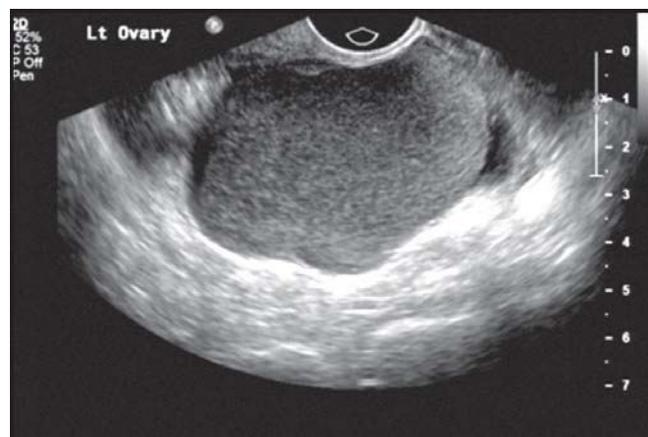


Fig. 3: Endometrioma



Fig. 4: Myoma

as a solid, hypoechoic mass (Fig. 4). Myomas tend to increase in size during pregnancy due to the increase in estrogen and blood flow to the uterus. Larger fibroids may outgrow their blood supply resulting in degeneration which is associated with pain and a complex cystic appearance on ultrasound. MRI

may be helpful for distinguishing a myoma in the broad ligament from an ovarian mass.

Mature teratomas, or dermoids, are the most common ovarian tumor in pregnancy, comprising up to 44% of all ovarian neoplasms.²⁰ They are germ cell tumors that are almost always benign and contain elements derived from the three germ cell layers, i.e. the ectoderm, mesoderm, and endoderm. Characteristically, they are multicystic masses that often contain hair, skin, fat, teeth, and sebaceous material (Fig. 5). A solid area, known as Rokitansky's protuberance is located between the dermoid and normal ovary. Dermoids are bilateral in 10 to 15 percent of cases. On ultrasound, dermoids often appear as a complex cyst due to the varied composition. Echogenic calcifications can be seen that cause acoustic shadowing; fat, hair, and skin are moderately echogenic; and sebaceous components can layer with serous fluid resulting in anechoic portions. Complications related to dermoid cysts in pregnancy include torsion, rupture, obstruction of the birth canal, and rarely malignant transformation. However, it does not appear that these complications are increased in pregnancy.²¹

A *hydrosalpinx* results from inflammation that occludes the fimbriated end of the fallopian tube. Consequently, intraluminal secretions distend the tube, resulting in an anechoic tubular structure on ultrasound that is usually tapered at the uterine end (Fig. 6). Other features of a hydrosalpinx include incomplete septations which represent folds in the wall of the tube, and a "cogwheel" sign when the tube is viewed in cross-section. The finding of thin walls with nodules is consistent with chronic disease, while thick walls are seen in acute hydrosalpinx.

Peritoneal inclusion cysts appear as septated, cystic masses surrounding the ovary. They are due to pelvic adhesions that usually result from previous surgeries, endometriosis or pelvic inflammatory disease. Visualization of a normal ovary is necessary to exclude ovarian pathology.

Paraovarian cysts appear as thin-walled, anechoic, simple cysts adjacent to the ovary. These arise from Wolffian duct remnants. These cysts can undergo torsion and hemorrhage.

Ovarian malignancy is rare in pregnancy, but should be suspected when any adnexal mass is identified that does not have the characteristic findings of a benign mass as outlined above. In general, malignant adnexal masses should be suspected when a complex or solid mass is identified. A complex cystic mass may contain both solid and cystic components with nodular, irregular walls and thick septations (Figs 7 and 8). Solid masses are uniformly filled with heterogeneous irregular echoes without any sonolucent areas.

DIAGNOSTIC EVALUATION OF AN ADNEAL MASS IN PREGNANCY

Sonographic characterization of adnexal masses can accurately diagnose which masses are at increased risk of malignancy.⁸ In



Fig. 5: Mature cystic teratoma



Fig. 6: Hydrosalpinx



Fig. 7: Ovarian cyst with papillary projection

a study of 131 adnexal masses diagnosed in pregnancy, 89% were classified as benign whereas 11% were classified as malignant. Of the benign lesions, ultrasound correctly identified 71% of the simple cysts, 80% of the endometriomas, and 95% of



Fig. 8: Ovarian cyst with solid component

the dermoids. One of the 14 (7%) patients with a suspicious adnexal mass was subsequently diagnosed with ovarian cancer.⁸ Outside of pregnancy, ultrasound is able to correctly classify over 90% of adnexal masses as benign or malignant, while the diagnosis is uncertain in less than 10% of cases.²²

Scoring systems based on ultrasound morphology have been developed to predict malignancy in nonpregnant women. In general, ovarian masses can be classified as low risk if they are smooth, thin walled, sonolucent, simple cysts that measure less than 5 cm in diameter.²³ Conversely, the appearance of a solid mass, with thick septations and mixed echogenicity is at high risk of malignancy (Table 2). A scoring system was developed by Sassone *et al* and later modified by Lerner *et al* to stratify the risk of ovarian malignancy.^{23,24} The modified scoring system had a sensitivity of 97% for identifying a malignant mass, which means that 3% of malignancies were missed. The positive predictive value was 29%, which indicates that a significant number of benign masses had features of malignancy. The negative predictive value was 99.6%, which indicates that this scoring system was able to confidently exclude malignancy.²⁴

The addition of color Doppler sonography was studied in 34 patients with complex adnexal masses in the second trimester of pregnancy.²⁵ The low impedance seen in malignant tumors is thought to be due to neovascularization. In this study, a pulsatility index of less than 1.0 had a sensitivity of 89% for identifying malignant masses; however, the false-positive rate

was 48%. A pulsatility index of greater than 1.0 had a 93% sensitivity for detecting benign masses. The author concluded that color Doppler sonography can serve as a useful adjunct in the detection of malignant lesions in pregnancy; however, the use of Doppler is limited by the high false-positive rate.

Magnetic resonance imaging (MRI) is an additional imaging modality which has been shown to be beneficial for the diagnosis of adnexal masses in pregnancy.²⁶ In one series of 17 pregnant patients, MRI was more accurate than ultrasound for determining the origin of a pelvic mass, 100% versus 71% respectively.²⁷ It has also been suggested that MRI can more accurately diagnose certain pelvic masses in pregnancy so that surgery can be avoided.^{27,28} These studies support the use of MRI for the evaluation of adnexal masses in pregnancy when the ultrasound diagnosis is uncertain.

Tumor markers, such as CA-125, alpha-fetoprotein, and beta-human chorionic gonadotropin, are normally measured in nonpregnant patients with an adnexal mass that is suspicious for malignancy. In pregnancy, these markers are less specific for malignancy and therefore their measurement is not recommended.^{4,29}

MANAGEMENT OF AN ADNEAL MASS IN PREGNANCY

The management of asymptomatic adnexal masses in pregnancy is controversial. Historically, it was recommended that any patient with an adnexal mass in pregnancy undergo elective surgery in the second or third trimester to exclude malignancy and prevent complications such as torsion, hemorrhage, rupture and obstruction of labor.³⁰ These recommendations were made before the widespread use of ultrasound, when adnexal masses were diagnosed as palpable masses or because of symptoms such as pain.

Since the introduction of ultrasound, it has been recognized that the majority of small simple cysts resolve during pregnancy, and that malignancy is unlikely in masses less than 5 cm in diameter.^{5,31,32} For this reason, several studies concluded that surgical intervention should be reserved for adnexal masses larger than 5 to 6 cm and for those masses that persist into the second trimester in order to exclude malignancy and prevent torsion.^{2,33} Elective surgery to prevent torsion was recom-

Table 2: Sonographic differentiation of adnexal masses

<i>Low risk</i>	<i>Intermediate risk</i>	<i>High risk</i>
Smooth, thin wall (<3 mm)	Irregular, thick wall (>3 mm)	Solid mass
No septations	Thin septations (<3 mm)	Papillary projections (>3 mm)
Sonolucent	Low echogenicity	Thick septations
Size <5 cm		Mixed/high echogenicity

Adapted from Sassone AM, Timor-Tritsch IA, Artner A, Westhoff C, Warren WB. Transvaginal sonographic characterization of ovarian disease: evaluation of a new scoring system to predict ovarian malignancy. *Obstet Gynecol* 1991;78(1):70-6.

mended by Hess and colleagues who found that patients who underwent emergent surgery for ovarian torsion had a higher rate of adverse outcomes compared with those who had elective surgery, 40% versus 2% respectively.³⁴ More recent studies have shown significantly lower complication rates associated with emergent surgery in pregnancy.^{8,29,33,35} Furthermore, some investigators have concluded that the risk of ovarian torsion in patients with incidental adnexal masses in pregnancy is low enough to justify expectant management.^{8,29,33,36} Based on this information, some have recommended that elective surgery during pregnancy may be performed only for adnexal masses with sonographic features of malignancy. Otherwise asymptomatic, benign appearing masses regardless of size can be managed expectantly.^{2,11,29,31,37-39} Some investigators have even questioned the need to perform surgery during pregnancy for the purpose of excluding malignancy because ovarian cancer in pregnancy is rare and is normally associated with a favorable outcome.³⁹ Surgical intervention should be performed for any adnexal mass that is highly suspicious for malignancy based on rapid growth, ascites, or evidence of extraovarian disease.³⁹

Expectant Management

In general, expectant management is appropriate for asymptomatic adnexal masses and adnexal masses without features of malignancy. The risks associated with expectant management include a delayed diagnosis of malignancy, torsion, cyst rupture, and obstruction of labor.

Although ovarian cancer is rare in women of reproductive age, it is the second most frequent gynecologic cancer in pregnancy. The frequency of ovarian cancer in pregnancy is on average 1 in 16,000 pregnancies.⁴⁰ Approximately, 2 to 3% of ovarian masses detected during pregnancy are malignant.^{2,35,39,41-43} However, in one study the incidence of malignancy in persistent adnexal masses during pregnancy was 13%.³³

The frequency of the various ovarian malignancies in pregnancy is related to the age of the patient rather than the pregnancy itself. Previously it was shown that germ cell tumors are the most common ovarian malignancy in pregnancy, followed by epithelial ovarian tumors.⁴⁰ More recently, it has been reported that low malignant potential tumors, a subgroup of epithelial ovarian tumors, are the most common ovarian malignancy in pregnancy, followed by invasive epithelial ovarian tumors and then germ cell tumors³⁹ (Table 3). Unlike nongravid patients, the majority of ovarian malignancies diagnosed during pregnancy are confined to the ovary.^{35,39,44-46} In a study of 202 cases of ovarian cancers in pregnancy, 91% had stage I tumors.³⁹ In addition, ovarian cancers in pregnancy are more likely to be low grade.^{39,45,46} The overall mortality due to ovarian cancer in pregnancy is 4.7%.³⁹ This comparatively low mortality rate is likely due to the early stage of disease, the high prevalence

Table 3: Histology of ovarian malignancies in pregnancy

<i>Histology</i>	<i>Numbers</i>
Epithelial cell	159
Low malignant potential	115
Serous	14
Mucinous	10
Endometrioid	5
Clear cell	3
Other	12
Germ cell	34
Dysgerminoma	14
Malignant teratoma	12
Endodermal sinus tumor	3
Mixed germ cell tumor	3
Choriocarcinoma	2
Granulosa cell	1

Adapted from Leiserowitz GS, Xing G, Cress R, Brahmabhatt B, Dalrymple JL, Smith LH. Adnexal masses in pregnancy: how often are they malignant? *Gynecol Oncol* 2006;101:315-21.

of low malignant potential tumors and germ cell tumors both of which have an excellent prognosis, and the young age of the patients rather than some protective effect of the pregnancy itself. Given the overall favorable prognosis, some investigators advocate conservative management of suspected ovarian neoplasms in pregnancy. Furthermore, delaying surgery until after delivery is unlikely to result in a worse prognosis unless the patient has obvious signs of metastatic disease.³⁹

The rate of ovarian torsion in patients with a known adnexal mass varies from 1 to 7%.^{4,7,36} This number depends on the gestational age when the adnexal mass was diagnosed and the method used to confirm torsion. Of patients who require surgical management of adnexal masses in pregnancy, torsion is the most common acute complication with an incidence of 5 to 44%.^{35,44} Although torsion is more common in the first trimester when the gravid uterus is expanding most rapidly, cases of outside the first trimester have been reported.^{8,11} Ovarian torsion is difficult to diagnose in pregnancy. The diagnosis should be suspected in any patient with pelvic pain and an adnexal mass. The ability of Doppler ultrasound to diagnose torsion is controversial. While diminished or absent blood flow by Doppler sonography is suggestive of torsion, the presence of normal flow does not exclude the diagnosis. Because of the low risk of ovarian torsion, especially outside the first trimester, surgical intervention to avoid the risk of torsion does not seem justified.

Reports of cyst rupture and obstruction of labor are rare.^{11,35} For this reason, surgical intervention to avoid these complications is generally not recommended; however, management should be individualized based on factors such as cyst size and

location. Because the risks of torsion, malignancy, cyst rupture and obstruction of labor are small, expectant management of asymptomatic adnexal masses in pregnancy is appropriate for most cases.

Surgical Management

Ideally surgery is avoided in pregnancy because of the potential risks to the mother and fetus. Studies have shown that surgery for adnexal masses during pregnancy is associated with an increased risk of spontaneous abortion, preterm labor, fetal growth restriction, and neonatal death.^{35,37,39,40,42,47} Despite the potential risks of surgery in pregnancy, surgical management is indicated for any symptomatic adnexal mass regardless of the gestational age and should be considered if malignancy is suspected.

Laparoscopic surgery for the diagnosis and management of adnexal masses in pregnancy is a reasonable option for patients with an ovarian mass that is not suspicious for malignancy.³⁹ Concern regarding the use of laparoscopy for suspected malignancy is based on the increased risk of cyst rupture and port site recurrences, which occur in 2.3% of patients treated laparoscopically.^{29,48} The safety of laparoscopy for adnexal masses in pregnancy has been demonstrated in several studies.⁴⁹⁻⁵²

Aspiration of an ovarian cyst during pregnancy has been shown to be safe. In a series of 10 cases of fine needle aspiration of simple cysts in pregnancy, 5 resolved and there were no complications.⁵³ However, similar rates of simple cyst resolution have been observed in cases managed expectantly. Although cyst drainage is associated with a risk of infection, hemorrhage, and preterm labor, it may be appropriate in cases of suspected pelvic obstruction or mild symptoms.³⁷ Cyst aspiration is not recommended as a diagnostic procedure because of the cytologic similarities of many adnexal cysts and the potential risk of malignant fluid spillage.^{4,39}

In general, stable, asymptomatic ovarian masses can be managed expectantly with surgical evaluation at the time of cesarean delivery or postpartum. In contrast, symptomatic adnexal masses or masses that are highly suspicious for malignancy due to rapid interval growth or extraovarian evidence of disease such as ascites require intervention.³⁹

CONCLUSIONS

The detection of an adnexal mass in pregnancy is becoming more common due to the increasing use of routine ultrasound in obstetrics. The differential diagnosis for an adnexal masses in pregnancy is long. However, ultrasound is an accurate tool for diagnosing adnexal masses and distinguishing benign from malignant ovarian pathology. The management of adnexal masses in pregnancy is controversial. Recommendations vary

from removal of any mass that persists into the second trimester to exclude malignancy and prevent complications, to expectant management of all asymptomatic masses that are not highly suggestive of malignancy. Surgical intervention is indicated for any symptomatic ovarian mass regardless of gestational age. Laparoscopy appears to be a safe alternative to laparotomy for benign masses when performed by experienced surgeons.

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