REVIEW ARTICLE

# Adnexal masses in pregnancy: a challenge in evaluation and management

**Hafizur Rahman**
**Ezzat Khalda**[a]

Department of Obstetrics and Gynecology, Sikkim Manipal Institute of Medical Sciences, Gangtok, India and [a]Department of Radiodiagnosis, Patna Medical College, Patna, India.

**Correspondence:** Dr Hafizur Rahman; Associate Professor of Obstetrics & Gynecology, Sikkim Manipal Institute of Medical Sciences, 5th Mile, Tadong, Gangtok, Sikkim-737102, India. **e-mail: hafizezzy@gmail.com**

**ABSTRACT**

With increased use of ultrasound in early pregnancy, detection of adnexal masses in pregnancy has become more common. Adnexal masses in pregnancy have a wide spectrum of clinical manifestations and imaging characteristics. Therefore, it is important that the obstetrician be skilled in the diagnosis and management of adnexal masses in pregnancy. Common adnexal lesions seen in pregnancy include simple cysts, hemorrhagic cysts, leiomyomas, and hyperstimulated ovaries in patients who have undergone fertility treatments. Adnexal masses associated with pain include ovarian torsion and heterotopic pregnancy. Some adnexal lesions are detected incidentally that includes teratomas, endometriomas, hydrosalpinx, cystadenoma, and cystadenocarcinoma. Sonography is important in diagnosing, monitoring, and determining the malignant potential of these adnexal masses. In the absence of symptoms or sonographic findings concerning for malignancy, patients should be expectantly managed. However, an adnexal mass suspicious for malignancy, at risk for torsion, or clinically symptomatic, surgical management is recommended. When surgery is indicated, laparoscopy is safe and feasible and both perinatal and maternal outcomes are favorable when performed by trained and experienced operators.

**Key words:** Adnexal mass, laparoscopy, ovary, pregnancy, ultrasonography
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Incidence of adnexal masses in pregnancy ranges from 2% to 10% [1]. Most of these adnexal masses are diagnosed incidentally at the time of a screening first trimester ultrasound. Prior to widespread use of early antenatal ultrasound, adnexal masses in pregnancy were detected with less frequency on physical examination. The overall incidence of malignancy in an adnexal mass noted in pregnancy is 1-8%. However, malignancy is not the only risk associated with an adnexal mass in pregnancy. Masses that persist into the second trimester are at risk for torsion, rupture, or labor obstruction [2-4].

**Differential diagnosis**

Common adnexal lesions associated with pregnancy include simple cysts, hemorrhagic cysts,

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leiomyomas, and hyperstimulated ovaries in patients who have undergone fertility treatments. Uncommon adnexal lesions specific to pregnancy include hyperreactio luteinalis, theca lutein cysts with moles, and luteomas. Adnexal masses associated with pain include ovarian torsion and heterotopic pregnancy. Some adnexal lesions are detected incidentally, such as teratomas, endom-etriomas, hydrosalpinx, cystad-enomas, and cystadenocarcinomas. Table 1 gives the approximate incidence of most common adnexal masses in pregnancy [2, 3, 5, 6].

**Table 1. Incidence common adnexal masses in pregnancy** [2, 3, 5, 6]

| ***Nature of mass*** | ***Incidence (%)*** |
|---|---|
| Teratoma | 25 |
| Corpus luteal cyst, functional cyst, paraovarian cyst | 17 |
| Serous cystadenoma | 14 |
| Mucinous cystadenoma | 11 |
| Enodmetrioma | 8 |
| Low malignant potential tumor | 3 |
| Carcinoma | 2.8 |
| Leiomyoma | 2 |

**Evaluation**

Most adnexal masses in pregnancy are diagnosed incidentally during a routine screening ultrasound in the first trimester [7]. If an adnexal mass is palpated on examination, ultrasound is the preferred method of confirmation of diagnosis because of its ability to differentiate morphology. This will ultimately allow stratification of risk without compromising maternal and fetal safety [8]. The ultimate goal of an ultrasound evaluation is to aid the obstetrician in determining those adnexal masses in which conservative management with observation is possible versus those requiring surgery.

Ultrasonography can help in characterizing a mass as cystic, solid, or complex. A simple cyst is associated with five features: round shape, thin or imperceptible wall, increased acoustic enhancement, anechoic fluid, and no septations or nodules. Ultrasound identification of a simple cyst establishes a benign process in 100% of premenopausal women [9]. The use of color Doppler has generally not been shown to significantly improve diagnostic accuracy therefore, the value of color Doppler analysis is very limited [10]. However, the use of color Doppler adds significant contributions to differentiating between benign and malignant masses and is recommended in all cases of complex masses [11]. Malignant masses generally demonstrate neovascularity, with abnormal branching patterns or vessel morphology. Hence, color Doppler is indicated in the assessment of any complex or solid adnexal mass. Optimal sonographic evaluation is achieved by using a combination of grayscale morphologic assessment and color or power Doppler imaging to detect flow within any solid areas [10]. Three dimensional

**Table 2: The International Ovarian Tumor Analysis (IOTA) group ultrasound 'rules' to classify masses as benign (B-rules) or malignant (M-rules) [13, 14]**

| **B-rules** | **M-rules** |
|---|---|
| **Unilocular cysts** | Irregular solid tumor |
| **Presence of solid components where the largest solid component < 7 mm** | Ascitis |
| **Presence of acoustic shadowing** | At least four papillary structures |
| **Smooth multilocular tumor with a largest diameter <10 cm** | Irregular multilocular solid tumor with largest diameter ≥10 cm |
| **No blood flow** | Very strong blood flow |

power Doppler assessment of papillary projections or solid tumor areas may be helpful in reducing the false positive rate of benign complex cystic adnexal masses [12].

Ultrasound has been found to be very accurate in determining the malignant potential of an adnexal mass. The International Ovarian Tumor Analysis (IOTA) Group has developed simple ultrasound rules to help classify masses as benign (B-rules) or malignant (M rules) (Table 2). Using these rules the reported sensitivity is 95%, specificity 91%, positive likelihood ratio of 10.37 and negative likelihood ratio of 0.06. Women with an ovarian mass with any of the M-rules ultrasound findings should be referred to a gynecological oncologist [13, 14].

Computed tomography (CT) and magnetic resonance imaging (MRI) are useful adjuncts when ultrasound imaging is inconclusive. CT imaging provides better resolution for identifying non-obstetric causes of abdominal pathology. Although CT imaging is relatively safe in pregnancy, it exposes the mother and fetus to at least 2-4 rads [7]. Contrast materials can pass the placental barrier, so CT should be used with caution in pregnancy because their effect is unknown [4].

MRI is considered safe in pregnancy. MRI is valuable for characterizing indeterminate adnexal masses seen on USG, with sensitivity for identifying malignancy of 100% and specificity for benignity of 94%. On MRI, identification of vegetations in cystic masses and ascites is the best indicator of malignancy [15].

There are two specific situations in which MRI is the imaging study of choice in pregnancy. MRI is better in distinguishing paraovarian cystic lesions, which can be managed conservatively in pregnancy. It also provides better tissue characterization, allowing for more accurate evaluation of the large masses that are difficult to completely visualize with ultrasound. MRI can also determine the extent of a possible malignancy and aid in the diagnosis of acute bowel processes such as appendicitis and inflammatory bowel disease. However, use of MRI in pregnancy should be judicious and used solely as clarification for an inconclusive ultrasound [4].

Tumor markers should be ordered with caution in pregnant patients because of the wide variation in results and interpretation of these tests during pregnancy [16]. CA- 125 levels are elevated in pregnancy, particularly in the first trimester. They are also elevated with other benign diseases such as in uterine fibroids, and endometriomas [2]. Other tumor markers helpful in germ cell malignancy such as AFP, βHCG, and LDH are of limited use because they are significantly altered by pregnancy itself [16].

**Common adnexal lesions in pregnancy**

***Simple cysts***

Most adnexal masses detected on sonography during pregnancy are simple cysts or hemorrhagic corpus luteum cysts. Simple cysts are unilocular and anechoic and have a smooth, thin wall. Corpus luteum cysts enlarge during the first trimester, start regressing by the $12^{th}$ week of gestation, and disappear later in the pregnancy [17]. Size is the best indicator of whether they require surgical intervention or not. 90% to 100% of masses are smaller than 5 cm in diameter and will resolve spontaneously. Because larger cysts have an increased risk of torsion, rupture, and labor obstruction, close monitoring and sometimes surgery are necessary [18].

***Hemorrhagic cysts***

Hemorrhagic corpus luteum cysts can have a variety of sonographic appearances due to the changing appearance of the blood clot. Most resolve by the second trimester. Acute hemorrhagic cysts can appear as echogenic masses with internal echoes more hyperechoic than surrounding normal ovarian parenchyma [19].

***Hyperstimulated ovaries***

Hyperstimulated ovaries are typically diagnosed in patients who have undergone ovulation induction.

The ovaries are enlarged with multiple cysts. More than 90% of patients who have

hyperstimulation will have spontaneous resolution of these benign cysts. Ovarian hyperstimulation syndrome appears as markedly enlarged ovaries containing multiple, large, peripherally located, thin-walled cysts that sometimes exude fluid from hemorrhage or ascites. The large ovaries are at risk of torsion and hemorrhage, but usually they regress spontaneously later in pregnancy or after delivery [20].

**Adnexal Masses Unique to Pregnancy**

***Hyperreactio luteinalis***

Like hyperstimulated ovaries a similar appearance can be seen in patients who have not undergone ovulation induction. It is thought to result from hypersensitivity of the ovary to circulating human chorionic gonadotrophin (hCG), the levels of which may or may not be high. Because this is commonly mistaken for an ovarian neoplasm, MRI can be used to better visualize the predicted sites for peritoneal implants that are associated with ovarian malignancy and to decrease the likelihood of this possibility. The lesions usually spontaneously involute after delivery. This condition can be seen in a normal pregnancy but has also been associated with polycystic ovary disease and in triplet pregnancies due to high levels of hCG. Clinical manifestations include maternal abdominal pain, excessive abdominal distention, abnormal liver function test results, respiratory difficulties, and hirsutism. Patients with this condition may also be asymptomatic. These lesions may be found incidentally during routine obstetric imaging or at cesarean delivery [21].

***Luteomas in pregnancy***

Luteomas are solid ovarian lesions that rarely occur in pregnancy. Less than 200 cases of luteoma have been reported in the literature [22]. Luteomas may cause maternal virilization in about 25% of cases and carry a 50% risk of virilizing a female fetus. Luteomas are usually asymptomatic and are found incidentally at cesarean delivery [23, 24]. They are believed to result from elevated plasma androgens after stromal cell proliferation during pregnancy and they regress postpartum with falling androgen levels [22, 23]. On ultrasound, they appear as heterogeneous solid masses, predominantly hypoechoic compared with normal ovarian tissue, with thick walls and irregular internal contours in an enlarged ovary. They are often highly vascular and can mimic ovarian neoplasms [22]. The appearance of virilizing symptoms in the pregnant patient leads to this diagnosis. When a luteoma is suspected, laparotomy should be avoided during pregnancy because the lesions regress after delivery.

***Theca lutein cysts***

Molar pregnancy complicates about 0.1% of pregnancies. Theca lutein cysts are reported with complete hydatidiform moles in 14% to 30% cases. They appear as anechoic, multiloculated, ovarian cysts. The presence of a uterus filled with echogenic tissue with small cysts is the key to the diagnosis [25].

**Masses Associated With Pain**

***Leiomyomas***

Leiomyomas are the most common solid masses in pregnancy [17]. They are seen on sonography in 1.4% of pregnancies. Most are within the body of the uterus, but pedunculated and broad-ligament myomas can mimic an ovarian neoplasm. They appear on sonography as hypoechoic, round, persistent masses. Leiomyomas may enlarge during pregnancy and may cause focal pain. When the leiomyoma outgrows its blood supply, it may undergo red degeneration [26]. Sonography is the mainstay of leiomyoma diagnosis. However, MRI can be helpful in confirming the diagnosis of a large degenerating leiomyoma, which can simulate an ovarian neoplasm on sonography. MRI can clearly delineate the uterine origin of leiomyomas, which can help differentiate them from solid ovarian tumors, thereby avoiding unnecessary surgery during pregnancy [27].

***Heterotopic Pregnancy***

Heterotopic pregnancy occurs in 1 in 7000 pregnancies and is increasing because of the rising prevalence of ectopic pregnancies and increased

use of fertility treatments [28]. The reference standard is being able to identify cardiac motion in intrauterine and extrauterine pregnancies, but this only occurs in about 14% of cases [29].

### *Ovarian torsion*

About 1% of large and complex masses undergo torsion. Torsion of an ovarian mass most frequently occurs in the mid to late first trimester, when the gravid uterus is enlarging most rapidly [30]. Lack of flow on two-dimensional Doppler sonography of the ovarian vessels on the ipsilateral side of the pathology is the classic finding of ovarian torsion. When an adnexal mass is seen and the patient has severe pain, torsion should be considered. Massive ovarian edema occurs when there is intermittent torsion of an ovary, which interferes with venous and lymphatic drainage and causes ovarian enlargement. It is usually unilateral and involves the right ovary in two thirds of cases. On sonography, it appears as a solid mass with a cystic component and heterogeneous internal echo texture [31].

## Incidental detection

### *Teratomas*

Teratomas show a complex echo pattern due to the presence of fat, solid components and calcified material [17]. Most ovarian teratomas have a typical sonographic appearance and can be correctly diagnosed by sonography. In the rare cases in which the diagnosis is unclear, MRI is often helpful in highlighting the fat within the mass [27]. Teratomas may be pedunculated and are prone to undergoing torsion and rupture, leading to peritonitis [17].

### *Hydrosalpinx*

Hydrosalpinx appears as anechoic tubular fluid collections. They typically do not change in size or appearance throughout pregnancy [32].

### *Endometriomas*

It is uncommon to find an unsuspected endometrioma at routine obstetric imaging in pregnancy as they are often associated with infertility. Endometriomas have a classic appearance of a "chocolate cyst" with diffuse low-level internal echoes.

### *Cystadenomas and Cystadenocarcinomas*

Cystadenomas may be simple cysts or have thin septations. When an ovarian mass is complex, the likelihood of neoplasm is increased. Irregular septations and mural nodules increase the likelihood of malignancy.

## Management

Most ovarian masses detected in pregnancy resolve spontaneously, and aggressive surgical management is not required. Characteristics favorable for spontaneous resolution include masses that are simple in nature by ultrasound, less than 5-6 cm in diameter, and diagnosed before 16 weeks [4]. Larger masses or those with more complex morphology are less likely to resolve spontaneously and may represent a neoplastic process [3, 4, 5]. Persistent adnexal masses are also more likely to result in complications in pregnancy by torsion (1-22%), rupture (0-9%), or obstruction of labor (2-17%) [2, 5].

Surgical management is advocated when there is concern that the persistent or larger ovarian mass will place the patient at higher risk for an acute abdomen secondary to torsion or rupture [2]. Also, up to 10% of persistent complex ovarian masses will ultimately be diagnosed as malignancy, so observation could worsen the outcome [2, 3]. Ultimately the option of observation versus surgical management should be directed by the patient's physical symptoms as well as to the degree of concern for malignancy.

### *Observation*

Given that the majority of adnexal masses in pregnancy are benign and a good percentage of them resolve spontaneously, an appropriate option for management of adnexal masses in pregnancy is serial observation with ultrasound performed each trimester. Observational management of adnexal masses in pregnancy is supported by several large and small retrospective, observational studies [2, 5, 7].

Observational management is also supported by the fact that up to 71% of benign appearing ovarian masses will either decrease in size or resolve spontaneously. Some masses with more complex features have also been shown to resolve [33]. Evidence supporting this recommendation is found in studies evaluating the incidence of adnexal masses in the first trimester of pregnancy. In the largest observational trial by Zanetta et al [34], found complete or near complete resolution in 69% of simple cysts, 77% with endometrioid-appearing cysts, and 57% with simple cysts with minimal complex components. No resolution occurred in masses with features of a mature teratoma (dermoid) or a borderline-appearing mass. In the 31 masses that persisted after pregnancy, three were borderline tumors and no other malignancies were noted to have been present. These observations certainly make observation an acceptable option for those masses of low complexity noted on ultrasound [2, 5, 34].

***Surgical Management***

The traditional surgical management for adnexal masses involves a vertical midline laparotomy to provide the best exposure to the pelvis as well as access to the upper abdomen. However, recently there has been a great deal of debate about the role of laparoscopy in the management of adnexal masses in pregnancy [35, 36].

Authors those are in favour of a laparotomy approach raise several concerns regarding laparoscopy in pregnancy including the lack of data regarding the effects of a pneumoperitoneum on the fetus; possible injection of carbon dioxide into the uterine cavity; possible injury to the gravid uterus by a Veress needle, trocar, or surgical instrument; and the potential for fetal acidosis because of maternal conversion of carbon dioxide to carbonic acid [37]. On the other hand, surgeons those who favour laparoscopy emphasize the decreased postoperative pain, less narcotic use, shorter hospital stays, and less need for uterine traction, leading to less uterine irritability associated with laparoscopy. Furthermore, laparoscopy results in faster postoperative ambulation and return to regular activity, which is very important in pregnancy because of the increased risk of thromboembolism in pregnancy [8].

Multiple observational studies have demonstrated that laparoscopic management of adnexal masses in pregnancy is technically feasible and should no longer be considered contraindicated in pregnancy [35, 36, 38]. Reedy et al [38] identified cohorts of 2,181 women undergoing laparoscopy and 1,522 women undergoing laparotomy between the fourth and 20th weeks of pregnancy for comparing outcomes of laparotomy and laparoscopy for the management of adnexal masses in pregnancy. In both groups there was an increased risk for the infant to weigh less than 2,500 gm, to be delivered before 37 weeks, and to have IUGR. They did not find any difference in birth weight, gestational duration, growth restriction, infant survival, or the rate of fetal malformation between the two groups.

Small series of laparoscopic procedures to manage an adnexal mass during pregnancy suggest that this approach is most applicable during the first (for selected emergent cases) or early second trimester to manage masses less than 10 cm in diameter, particularly when adnexectomy is planned. Mathevet et al [36] reported their experience in a series of 47 women undergoing laparoscopic surgery for an adnexal mass in pregnancy. In this series 46 of 47 women had no complications. One patient did experience a fetal loss four days after laparoscopy with no identifiable cause. Their observations demonstrated that the benefits of laparoscopic surgery with respect to pain, hospital stay, earlier ambulation, decreased blood loss, and the lower rate of infection may outweigh those of traditional open laparotomy. However, although data suggest a similar fetal risk profile for the laparoscopic approach, there is still concern over the effect of the $CO_2$ pneumoperitoneum on the fetus.

When planning surgery for an adnexal mass in pregnancy, the surgeon must balance both maternal outcome and fetal well-being while performing an expeditious removal of the mass. Pregnant women undergoing surgery are at an overall increased risk

for prematurity (up to 22%) compared with pregnant women not undergoing surgery, regardless of the route of the procedure [39]. Additionally, those in whom emergency surgical intervention is needed, such as in cases of rupture or torsion, usually result in a higher risk of fetal compromise when compared with a scheduled surgery [40].

The Society of American Gastrointestinal and Endoscopic Surgeons published the following recommendations specific to performing laparoscopy during pregnancy: [8]

- Laparoscopic management of an adnexal mass should be performed only by those trained and proficient in advanced laparoscopy and with availability of a gynecologic oncologist in masses highly suspicious for malignancy.
- Laparoscopy can be performed at any gestation, but non emergency cases should optimally be scheduled at 16-20 weeks. This recommendation is based on allowing time for spontaneous resolution of the adnexal mass, optimizing visualization of the mass with the enlarging uterus, and decreasing the rate of preterm labor associated with higher gestations.
- Patients should be placed with left or right tilt to decrease compression on the vena cava and improve cardiac return.
- The open Hassan technique is the preferred route of initial laparoscopic entry because it offers the ability to visualize entry, although use of the Veress needle is not contraindicated. The surgeon may consider using the Veress needle in conjunction with ultrasound guidance.
- Trocars should be placed at least 6 cm above the fundus or in the left upper quadrant.
- Intraoperative $CO_2$ monitoring by capnography is ideal.
- There is no need for routine blood gas monitoring.
- Intraoperative abdominal pressure should be maintained less than 15mm Hg while in Trendelenberg position to ensure adequate venous return and uteroplacental sufficiency.
- Currently, prophylactic tocolysis is not indicated for antenatal surgery.

**When only size is the problem**

Some ovarian tumors are so large they seem incompatible with an advancing pregnancy. Tumors up to 20 cm in diameter have been removed intact at the time of cesarean section [41]. The tumor may accommodate in shape and become less problematic as it is gradually pushed into the upper abdomen. The ability of the peritoneal cavity to accommodate a tumor varies greatly among women. As pregnancy advances, the likelihood that a large cystic mass will rupture tends to increase. Depending on the circumstances, percutaneous aspiration or removal of a benign-appearing cystic tumor may be appropriate [41, 42].

Most persistent adnexal masses move well out of the pelvis as pregnancy advances. Occasionally, however, an ovarian tumor may be located in the posterior cul-de-sac even at term, which may be confirmed by pelvic examination or by ultrasonography. A tumor in the posterior cul-de-sac can obstruct delivery or rupture. When it has a benign cystic appearance on ultrasonography, it may be decompressed via transvaginal aspiration. Otherwise, the best approach is cesarean section and concomitant removal of the mass [42].

***Conclusion***

Widespread use of antenatal ultrasound for pregnancy dating and aneuploidy screening, the diagnosis of adnexal masses in pregnancy has become more common. Adnexal masses exhibit a wide range of imaging characteristics. Knowledge of the clinical appearance and sonographic findings allows for correct diagnosis in most. Therefore, it is imperative that the obstetrician be skilled in the diagnosis and management of adnexal masses in pregnancy.

Fortunately, the majority of adnexal masses diagnosed in pregnancy are benign and will resolve spontaneously without invasive intervention. Consequently, in the absence of symptoms or sonographic findings concerning for malignancy,

expectantly management is recommended. For patients with a complex mass, possibly suggestive of a malignancy, observational management can also be offered until delivery or postpartum as an acceptable option. Patients choosing observation should be counseled on the potential for ovarian torsion, potential need for surgery later in the pregnancy, and the potential delay in the diagnosis of a malignancy. They should also be aware that antenatal surgery might become necessary should she become symptomatic or features of the mass change over time.

The decision whether to postpone surgical management of a complex mass until the time of delivery or postpartum must balance the risks and benefits, weighing the risks of malignancy versus the potential for unnecessary surgical risk for mother and fetus. If surgery is indicated, laparoscopy is safe and feasible and both perinatal and maternal outcomes are favorable when performed by surgeons with appropriate skill and experience.

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