

Adnexal Masses in Pregnancy

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Abstract: With the advent of routine obstetrical ultrasound, the diagnosis of an adnexal mass in pregnancy has become increasingly common. Although the reported incidence and expected clinical course varies based on the gestational age at the time of diagnosis and the criteria used to define an adnexal mass, the majority of adnexal masses diagnosed in pregnancy are benign and are likely to resolve without complication or intervention. This review will discuss the epidemiology of adnexal masses in pregnancy, diagnostic tools, potential complications, and management options during pregnancy.

Key words: adnexal mass, adnexal cyst, ovarian cyst, pregnancy, ovarian torsion

Epidemiology

The diagnosis of an adnexal mass during pregnancy has become increasingly common with the advent of routine obstetrical ultrasound. The majority of adnexal masses are discovered incidentally during routine prenatal ultrasound performed for obstetric indications. As such, the reported incidence and expected clinical course varies based on the gestational age at the time of diagnosis and the criteria are used to define an adnexal mass. Goh et al¹ found

a 4.9% incidence of ovarian masses among over 24,000 women undergoing routine obstetric ultrasound between 2001 and 2009, with a mean gestational age of diagnosis between 17 and 18 weeks. An analysis of 3000 pregnant women who underwent an ultrasound before 14 weeks showed a 6.1% incidence of adnexal masses.² Similarly, Glanc et al³ found a 5.3% incidence of adnexal masses between 8 and 10 weeks' gestation, which had decreased to 1.5% by 12 to 14 weeks' gestation.

The majority of small adnexal masses discovered on early ultrasound regress spontaneously. This is attributed to the benign nature of most of these masses, which tend to be either corpus luteum or other physiological cysts (Fig. 1). Resolution is also related to size, with complete resolution occurring in approximately 71% to 89% of adnexal masses of < 5 cm.^{2,4,5} In 1 study of 422 women with adnexal masses in pregnancy, the rate of resolution was quite high for even larger and more complex cysts, with 69% of cysts > 5 cm or with complex features that were not removed surgically resolving later in pregnancy.⁵ In contrast, a prospective study of nonpregnant premenopausal women with adnexal masses of < 8 cm in size showed resolution of 61% of cysts managed expectantly (95/155).⁶

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The authors declare that they have nothing to disclose.

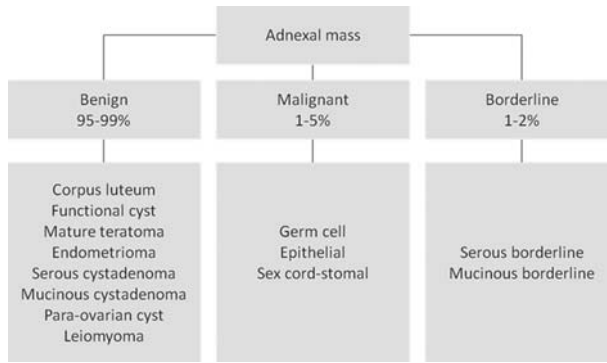


FIGURE 1. Histopathology of adnexal masses removed in pregnancy. Benign ovarian masses account for the majority of masses diagnosed in pregnancy, most of which are mature cystic teratomas, corpus luteum cysts, and cystadenomas.

Histology of an adnexal mass also affects the likelihood of regression. In a study by Zanetta et al,⁷ 9 of the 77 masses were classified as dermoids and were expectantly managed; all persisted at the end of the pregnancy. The same was true for 5 of 5 borderline tumors. Conversely,

only 10 of 37 (27%) of simple cysts persisted until the end of pregnancy.

Diagnosis and Evaluation

Given the high rate of spontaneous resolution, ultrasound and other ancillary

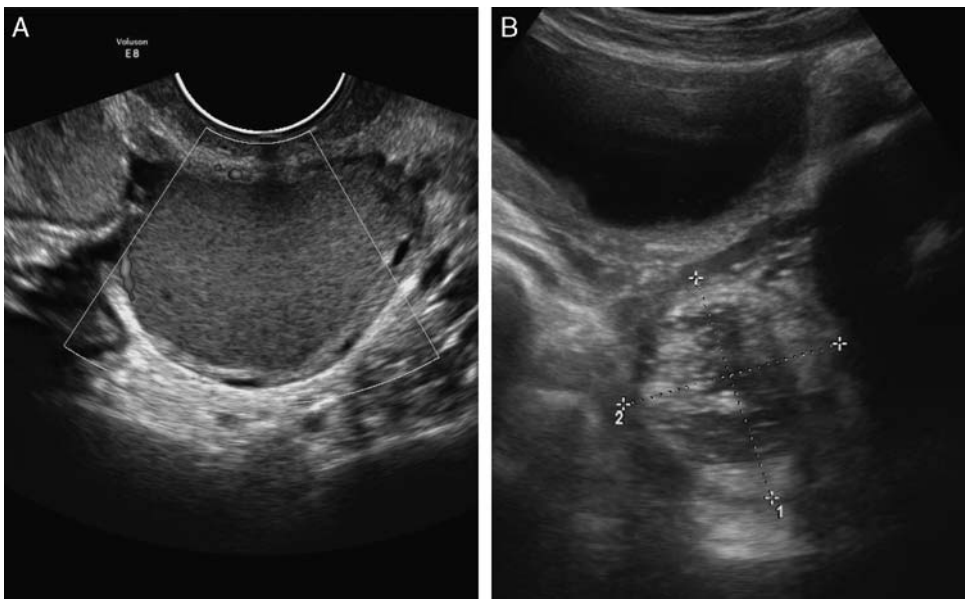


FIGURE 2. Benign adnexal masses. Ultrasound images of an ovarian endometrioma (A) with characteristic homogenous echogenicity in a cystic mass, and a mature cystic teratoma (B) with heterogenous echogenicity and calcifications, both diagnosed in pregnancy. Images courtesy of Dr Bryann Bromley.

testing are used to determine whether an otherwise asymptomatic adnexal mass should be managed expectantly or through surgical removal. An accurate evaluation is important both to assess for the possibility of malignancy, and for likely benign masses, to help assess the likelihood of complications including rupture, torsion, and labor obstruction.

ULTRASOUND

Ultrasound is the preferred initial imaging study to assess an adnexal mass, both in and out of pregnancy. It has specifically been shown to be accurate in characterization of adnexal masses during pregnancy in several studies.^{8–10} In 1 study of 125 women with 133 adnexal masses, ultrasound correctly identified 95% of dermoids, 80% of endometriomas, and 71% of simple cysts with a 0.8% malignancy rate among the total lesions.⁹ Whitecar and colleagues similarly were able to correctly suspect all malignancies in their series with a malignancy rate of 4.6% in 130 women. In another study, the authors reviewed all women who were found to have an adnexal mass > 5 cm in size during pregnancy over a 13-year

period. Of these women, all patients who were found to have a malignancy on pathology were correctly suspected on ultrasound.¹⁰

Benign masses diagnosed in pregnancy consist primarily of corpus luteum cysts, mature cystic teratomas, endometriomas, and fibroids (Fig. 2).¹¹ Features raising suspicion for malignancy include thickened or abnormal wall structure, thick septa, solid features, papillary projections, solid components, and increased size (Fig. 3).¹⁰ Several scoring systems have been developed in the nonpregnant population for prediction of malignant ovarian tumors.^{12–16} In a review by Klangsin and colleagues, the Depriest system was found to be the most sensitive in detecting ovarian malignancy (89.1%) with a negative predictive value of 100% for a score of < 5.¹⁴ In this study, the most consistent sonographic feature of malignant tumors was abnormal wall structure.

Although ultrasound is quite sensitive in detecting features concerning for malignancy, the false-positive rate has been reported to range from 68% to as high as 93%.^{9,14} Further imaging studies and tumor markers may be helpful to better

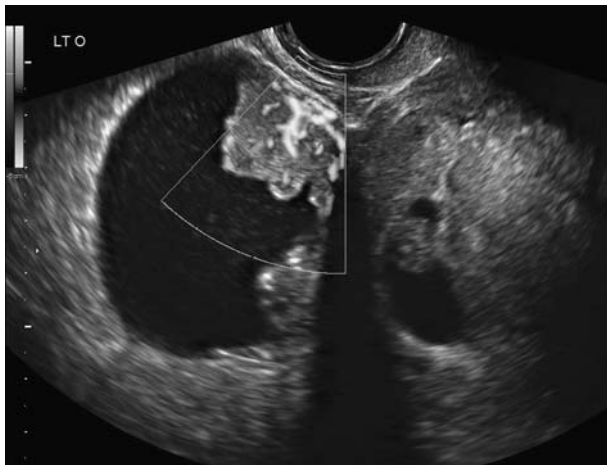


FIGURE 3. Malignancy. Ultrasound image of an endometrioid ovarian adenocarcinoma with papillary projections diagnosed during pregnancy. Image courtesy of Dr. Bryann Bromley.

identify those patients who will benefit from surgical management during pregnancy, as well as to develop an appropriate follow-up plan for those who can be managed expectantly. Although maternal health should be paramount in the management of a suspicious mass, careful consideration should be taken to discuss both the pregnancy-specific risks of surgery and the nuances of potential staging procedures of a woman who is expecting.

The utility of Doppler ultrasound in the setting of evaluation of an adnexal mass in pregnancy is limited.¹⁵ In a prospective study of 34 pregnant women with adnexal masses, the pulsatility index of < 1 was used to predict malignancy utilizing the gold standard of histologic diagnosis. In this study, the positive-predictive value was 42%, with a false-positive rate of 48%.¹⁷

MAGNETIC RESONANCE IMAGING (MRI)

MRI can be a useful adjunct when ultrasound findings are unequivocal, or when a wider assessment of tissue planes and relation to other organs may be important in both obstetric and surgical planning. Noncontrast MRI has been safely used in pregnancy and does not appear to be harmful to the mother or the fetus. Advantages include a larger scanning area and improved definition of tissue planes and their composition. This has been shown to be particularly useful in differentiating decidualized endometriomas from malignant neoplasms, as both can exhibit papillary projections and abnormal walls on ultrasound.¹⁸ Secondly, MRI is useful in differentiating adnexal masses arising from the ovary from those that arise from extraovarian tissue, such as the uterus in the case of a pedunculated fibroid.³ MRI has also been helpful in the diagnosis of other intra-abdominal processes including appendicitis, inflammatory bowel disease, bowel obstruction, and diverticulitis.

TUMOR MARKERS

As in the case of nonpregnant women, tumor markers have a limited role in the initial assessment of adnexal masses during pregnancy. The most studied tumor marker in this setting is CA-125, which is elevated in the majority of women with established epithelial ovarian cancer. Its role as an effective adjunct diagnostic test among women with an adnexal mass is complicated by its propensity to be elevated in several benign gynecologic conditions including fibroids and endometriosis, both of which are not uncommon among women of childbearing age. Furthermore, pregnancy increases CA-125 values particularly in the first trimester, making its use in diagnosing an adnexal mass even more limited.¹⁹ However, in the setting of a suspicious mass, a significantly elevated CA-125 may increase concern for malignancy and also may serve as a useful baseline value before removal and subsequent adjuvant therapies.

Germ cell tumors are more common among women of reproductive age than epithelial tumors. Unfortunately, tumor markers that are typically elevated in germ cell tumors including AFP, LDH, and hCG are also altered during pregnancy, limiting their clinical utility.¹⁹

Complications

Complications of an adnexal mass in pregnancy are in general similar to the nonpregnant population, and can be categorized in 3 general groups: emergent complications of benign or malignant masses that necessitate immediate removal (torsion, rupture), labor obstruction, and malignancy. Although the unique implications of surgery during pregnancy may be considered when determining a management plan, in an emergent clinical situation where maternal health is at risk, surgery should not be delayed and women should be managed as they would be if they were not pregnant.

TORSION

Although the true incidence of ovarian torsion is unclear and varies from 0.2% to 15%, the risk of torsion appears to be increased during pregnancy.^{2,5,9,20,21} This is thought to be secondary to the displacement of the adnexa out of the pelvis by the growing gravid uterus, and their return to the pelvis following delivery.

Torsion is more common among women with larger masses. Koo et al²² studied of a series of 470 women and reported an at least 2-fold greater risk for torsion among women with masses measuring 6 to 10 cm in size. A smaller series of 174 women by Yen et al²¹ showed similar findings with an increased risk for torsion for masses measuring 6 to 8 cm in size. Masses >10 cm appear to have a decreased risk for torsion.

Ovarian torsion is more common in the first trimester and early second trimester, which likely reflects the cephalad displacement of the ovaries as the uterus enlarges out of the pelvis and into the abdomen.²² In the series by Yen et al,²¹ 60% of cases of ovarian torsion occurred between 10 and 17 weeks' gestation.

In general, symptoms of torsion among pregnant women are similar to those of nonpregnant women, and include sharp pain that is constant or intermittent, nausea, and vomiting. As with other medical complications of pregnancy, these symptoms can be difficult to differentiate from common symptoms of normal pregnancy. Pregnant women with torsion do not appear to exhibit peritoneal signs on physical examination as frequently as their nonpregnant counterparts as shown in a retrospective case-control study by Hasson et al.²³ Finally, Doppler velocimetry was found to have a high false-negative rate in both pregnant and nonpregnant women.²³ As diagnostic testing is limited in its assessment of ovarian torsion in pregnancy, the diagnosis is often made by clinical suspicion and assessment by the obstetrician rather than ultrasonographic findings.

RUPTURE

The overall risk of cyst rupture appears to be quite low, with reported rates <1%.^{8,9} Nonetheless, small series indicate it is not an uncommon indication for emergent gynecologic surgery in pregnancy. Johnson and Woodruff²⁰ conducted a 5-year review of surgical emergencies involving the adnexa among pregnant women. Of these, 3 of the 7 were for ruptured adnexal cysts.²⁰

LABOR OBSTRUCTION

Although rare, large adnexal masses can predispose to labor dystocia if they are located near the lower uterine segment and below the presenting part, similar to obstructing fibroids.^{24,25} Goh et al¹ reported a cesarean delivery rate of 25% among women with a large adnexal mass due to arrested labor.

MALIGNANCY

Most recent studies report an overall low incidence of malignancy during pregnancy, ranging from 0% to 4.6%.^{7,8,10,26} The vast majority of malignancies were early-stage cancers or tumors of low malignant potential. Decisions regarding timing of staging surgery and chemotherapy regimens should be made with the involvement of a multidisciplinary team of oncologists, obstetricians, and pediatricians.

Management**GENERAL PRINCIPLES**

Women with adnexal masses in pregnancy who undergo a complication (eg, torsion or rupture) should be managed in the same way as nonpregnant women, which is typically surgery. The approach to management of an asymptomatic adnexal mass diagnosed during pregnancy requires a balance between the maternal-fetal risks of surgery, the risks of mass-related complications, and the likelihood of a malignancy, all of which are considered within each patient's distinct clinical scenario and gestational age.

EXPECTANT MANAGEMENT

Expectant management of an asymptomatic adnexal mass without features suggestive of malignancy is reasonable and supported by the literature. Ultrasound is useful in identifying those masses that are suspicious for malignancy and should be removed surgically. As described above, the majority of adnexal masses noted on first trimester ultrasound regress later in gestation, with a 71% to 89% rate of regression for smaller sized cysts.^{2,4,5} Although larger cysts may regress, this must be weighed against the potential risk for cyst complication such as rupture or torsion.⁵ Although the true resolution rate of adnexal masses is difficult to estimate secondary to the various clinical scenarios that may prompt removal, it is clear that the majority of smaller masses do appear to resolve and thus may be reasonably managed expectantly.⁶ The risk for a cyst to cause labor dystocia is difficult to assess earlier in gestation, and thus the decision to remove a mass for this indication must be individualized and is overall quite rare.

SURGERY

Surgery should be considered in 3 general groups: (1) women who are acutely symptomatic with signs and symptoms of ovarian torsion or hemodynamically unstable due to cyst rupture; (2) complex masses that are suspicious for malignancy; and (3) larger adnexal masses that are at higher risk of the above complications.

The American College of Obstetricians and Gynecologists issued a Committee Opinion in 2011 describing gestational age guidelines for nonobstetric surgeries during pregnancy.²⁷ Although urgently indicated surgeries can be performed at any gestational age and should not be postponed, nonurgent surgeries that cannot be delayed until after delivery should be performed in the second trimester when possible thereby avoiding the increased risk of miscarriage in the first trimester and the

risk of preterm contractions and labor in the third.²⁷ This is consistent with findings from Whitecar et al,⁸ who found that preterm birth and fetal loss were less common among women who underwent laparotomy for an adnexal mass before 23 weeks.

For women undergoing surgery between 24 and 34 weeks' gestation, a prophylactic course of antenatal corticosteroids may be considered for fetal lung maturity given a possible increase in risk for preterm delivery during this gestational age window. As always, the decision as to whether to give antenatal steroids prophylactically or to await clear signs of preterm labor should be individualized to the patient, her specific clinical situation and her risk factors.

LAPAROSCOPY VERSUS LAPAROTOMY

Before 2 decades ago, almost all pelvic surgeries to remove adnexal masses during pregnancy were via laparotomy. As laparoscopy is now the standard approach to these surgeries in the nonpregnant population, it is also increasingly used in pregnancy both safely and effectively.²⁸⁻³⁰ Benefits to laparoscopy in pregnancy are the same as those in the nonpregnant population, and include decreased postoperative pain, reduced need for narcotic medications, fewer wound infections, and shorter hospital stay.^{30,31} Given these advantages, laparoscopy should be considered when surgical removal of adnexal masses without suspicious features is indicated in the first or second trimester. The surgical approach to an adnexal mass with high likelihood of malignancy should be discussed with a gynecologic oncologist, as a laparotomy may be indicated given potential for leakage and possibly need for further staging procedures.

There has been concern about the effects of the mechanics of laparoscopy on pregnancy. Elevated intra-abdominal pressures can cause decreased venous return, which in turn can decrease uterine blood flow with the potential risks of fetal hypoxia.³² Nonetheless, several series

TABLE 1. Guidelines for Diagnosis, Treatment, and Use of Laparoscopy for Surgical Problems During Pregnancy Prepared by the Society of American Gastrointestinal and Endoscopic Surgeons Guidelines Committee³⁶

General Guidelines for Laparoscopy in Pregnancy

Patients should be placed in the left lateral recumbent position to minimize compression of the vena cava and the aorta

Initial access can be safely accomplished with open (Hassan), Verres needle or optical trocar technique if the location is adjusted according to fundal height, previous incisions, and experience of the surgeon. The concern for use of the Verres needle has been based on concerns for higher likelihood of injury to the uterus or other organs as the uterus increases in size

CO₂ insufflation of 10-15 mm Hg can be safely used

Intraoperative CO₂ monitoring by capnography should be used during laparoscopy

There is no indication for prophylactic tocolytic agents

Laparoscopy is recommended for both diagnosis and treatment of adnexal torsion unless clinical severity warrants laparotomy

Obstetrical consultation can be obtained preoperatively and postoperatively based on the acuteness of the patient's disease and availability

have demonstrated fetal safety of laparoscopy during pregnancy in light of these theoretical risks, including one 7-year follow-up on 11 cases who underwent mid-trimester laparoscopy during pregnancy.^{29,30,33-35} The Society of American Gastrointestinal and Endoscopic Surgeons Guidelines Committee issued guidelines in 2007 offering specific recommendations to assist obstetricians and surgeons in the approach to laparoscopy in the pregnant patient (Table 1).³⁶

DELIVERY AND POSTPARTUM

A frequent dilemma encountered by the obstetrician is whether to remove an incidentally noted adnexal mass at the time of cesarean, or to manage it expectantly with ultrasound surveillance. Although the

majority of adnexal masses surgically removed at the time of cesarean delivery are benign, most authors recommend removal to exclude malignancy and to avoid subsequent unnecessary surgical procedures.^{11,37,38}

Intraoperatively, consideration can be taken to send a newly diagnosed mass for frozen pathology, and to consult with a gynecologic oncologist in regards to intraoperative staging and follow-up. As the vast majority of cesarean deliveries are performed through a Pfannenstiel incision, exposure may not be adequate for full staging. Furthermore, in case of truly unexpected suspicious masses, care must be taken to obtain appropriate surgical consent before removal of additional organs, particularly the contralateral ovary.

For women with persistent masses during pregnancy, postpartum surveillance via ultrasound is recommended. The optimal time for an initial postpartum ultrasound is not well defined, however a 6-week interval seems reasonable as a woman will typically have completed her postpartum recovery and may safely undergo an elective surgery if needed.

Conclusions

The widespread use of routine obstetrical ultrasound has increased the incidence of adnexal masses diagnosed in pregnancy. For this reason, it is important that the obstetrician be skilled in managing this diagnosis appropriately and safely in pregnancy. Although pregnancy is a unique clinical state with many physiological changes for the mother and the presence of the fetus, maternal well-being should remain paramount when managing and treating an adnexal mass during pregnancy.

Ultrasound is the primary imaging modality to diagnose and assess an adnexal mass during pregnancy. Although the overall complication rate of an adnexal mass is low, ovarian torsion may occur more frequently during pregnancy and should be

considered on the differential diagnosis when a pregnant woman complains of sharp abdominal pain, nausea, and vomiting. Torsion and acute hemorrhage should be managed surgically in an immediate manner. Malignancy is a rare but serious complication, although most cancers diagnosed during pregnancy are early-stage or borderline tumors. Whether to remove these masses during pregnancy or manage them expectantly requires a careful discussion of the risks of both these strategies with the patient: the risks of expectant management being a potentially delayed diagnosis of malignancy and the potential for torsion or rupture of the mass, and the risks of surgery being potential fetal or maternal risks of surgery during pregnancy.

Although both laparotomy and laparoscopy are acceptable during pregnancy, laparoscopy is associated with improved pain control, shorter hospital stay, shorter recovery time, and decreased postoperative wound infections. For this reason, laparoscopy should be considered as the primary approach to adnexal surgery during pregnancy if a skilled surgeon, equipment, and staffing are available.

Acknowledgement

The authors would like to thank Dr. Bryann Bromley for her expertise and for providing the images.

References

- Goh WA, Rincon M, Bohrer J, et al. Persistent ovarian masses and pregnancy outcomes. *J Matern Fetal Neonatal Med.* 2013;26:1090–1093.
- Condous G, Khalid A, Okaro E, et al. Should we be examining the ovaries in pregnancy? Prevalence and natural history of adnexal pathology detected at first-trimester sonography. *Ultrasound Obstet Gynecol.* 2004;24:62–66.
- Glanc P, Brofman N, Salem S, et al. The prevalence of incidental simple ovarian cysts > or = 3 cm detected by transvaginal sonography in early pregnancy. *J Obstet Gynaecol Can.* 2007;29:502–506.
- Hogston P, Lilford RJ. Ultrasound study of ovarian cysts in pregnancy: prevalence and significance. *Br J Obstet Gynaecol.* 1986;93:625–628.
- Bernhard LM, Klebba PK, Gray DL, et al. Predictors of persistence of adnexal masses in pregnancy. *Obstet Gynecol.* 1999;93:585–589.
- Alcázar JL, Olartecochea B, Guerriero S, et al. Expectant management of adnexal masses in selected premenopausal women: a prospective observational study. *Ultrasound Obstet Gynecol.* 2013;41:582–588.
- Zanetta G, Mariani E, Lissoni A, et al. A prospective study of the role of ultrasound in the management of adnexal masses in pregnancy. *BJOG.* 2003;110:578–583.
- Whitecar MP, Turner S, Higby MK. Adnexal masses in pregnancy: a review of 130 cases undergoing surgical management. *Am J Obstet Gynecol.* 1999;181:19–24.
- Bromley B, Benacerraf B. Adnexal masses during pregnancy: accuracy of sonographic diagnosis and outcome. *JUM.* 1997;16:447–452.
- Schmeler KM, Mayo-Smith WW, Peipert JF, et al. Adnexal masses in pregnancy: surgery compared with observation. *Obstet Gynecol.* 2005;105 (5 pt 1):1098–1103.
- Baser E, Erkilinc S, Esin S, et al. Adnexal masses encountered during cesarean delivery. *Int J Gynaecol Obstet.* 2013;123:124–126.
- Lerner JP, Timor-Tritsch IE, Federman A, et al. Transvaginal ultrasonographic characterization of ovarian masses with an improved, weighted scoring system. *Am J Obstet Gynecol.* 1994;170 (1 pt 1):81–85.
- Klangsin S, Suntharasaj T, Suwanrath C, et al. Comparison of the five sonographic morphology scoring systems for the diagnosis of malignant ovarian tumors. *Gynecol Obstet Invest.* 2013;76:248–253.
- DePriest PD, Shenson D, Fried A, et al. A morphology index based on sonographic findings in ovarian cancer. *Gynecol Oncol.* 1993;51:7–11.
- Timmerman D, Ameye L, Fischerova D, et al. Simple ultrasound rules to distinguish between benign and malignant adnexal masses before surgery: prospective validation by IOTA group. *BMJ.* 2010;341:c6839.
- Abbas AM. A new scoring model for characterization of adnexal masses based on two-dimensional gray-scale and colour Doppler sonographic features. *Facts Views Vis Obgyn.* 2014;6:68–74.
- Wheeler TC, Fleischer AC. Complex adnexal mass in pregnancy: predictive value of color Doppler sonography. *J Ultrasound Med.* 1997;16:425–428.
- Barbieri M, Somigliana E, Oneda S, et al. Decidualized ovarian endometriosis in pregnancy: a challenging diagnostic entity. *Hum Reprod.* 2009;24:1818–1824.

19. Sarandakou A, Protonotariou E, Rizos D. Tumor markers in biological fluids associated with pregnancy. *Crit Rev Clin Lab Sci*. 2007;44:151–178.
20. Johnson TR, Woodruff JD. Surgical emergencies of the uterine adnexae during pregnancy. *Int J Gynaecol Obstet*. 1986;24:331–335.
21. Yen C-F, Lin S-L, Murk W, et al. Risk analysis of torsion and malignancy for adnexal masses during pregnancy. *Fertil Steril*. 2009;91:1895–1902.
22. Koo Y-J, Kim T-J, Lee J-E, et al. Risk of torsion and malignancy by adnexal mass size in pregnant women. *Acta Obstet Gynecol Scand*. 2011;90:358–361.
23. Hasson J, Tsafirir Z, Azem F, et al. Comparison of adnexal torsion between pregnant and nonpregnant women. *Am J Obstet Gynecol*. 2010;202:536.e1–6.
24. Hess LW, Peaceman A, O'Brien WF, et al. Adnexal mass occurring with intrauterine pregnancy: report of fifty-four patients requiring laparotomy for definitive management. *Am J Obstet Gynecol*. 1988;158:1029–1034.
25. Al-Fozan H, Tulandi T. Safety and risks of laparoscopy in pregnancy. *Curr Opin Obstet Gynecol*. 2002;14:375–379.
26. Platek DN, Henderson CE, Goldberg GL. The management of a persistent adnexal mass in pregnancy. *Am J Obstet Gynecol*. 1995;173:1236–1240.
27. ACOG Committee on Obstetric Practice. ACOG Committee Opinion No. 474: nonobstetric surgery during pregnancy. *Obstet Gynecol*. 2011;117(2 pt 1):420–421.
28. Balthazar U, Steiner AZ, Boggess JF, et al. Management of a persistent adnexal mass in pregnancy: what is the ideal surgical approach? *J Minim Invasive Gynecol*. 2011;18:720–725.
29. Koo Y-J, Kim HJ, Lim K-T, et al. Laparotomy versus laparoscopy for the treatment of adnexal masses during pregnancy. *Aust N Z J Obstet Gynaecol*. 2012;52:34–38.
30. Ngu S-F, Cheung VYT, Pun T-C. Surgical management of adnexal masses in pregnancy. *JSLs*. 2014;18:71–75.
31. Chang S-D, Yen C-F, Lo L-M, et al. Surgical intervention for maternal ovarian torsion in pregnancy. *Taiwan J Obstet Gynecol*. 2011;50:458–462.
32. Horowitz NS. Management of adnexal masses in pregnancy. *Clin Obstet Gynecol*. 2011;54:519–527.
33. Candiani M, Maddalena S, Barbieri M, et al. Adnexal masses in pregnancy: fetomaternal blood flow indices during laparoscopic surgery. *J Minim Invasive Gynecol*. 2012;19:443–447.
34. Rizzo AG. Laparoscopic surgery in pregnancy: long-term follow-up. *J Laparoendosc Adv Surg Tech A*. 2003;13:11–15.
35. Reedy MB, Källén B, Kuehl TJ. Laparoscopy during pregnancy: a study of five fetal outcome parameters with use of the Swedish Health Registry. *Am J Obstet Gynecol*. 1997;177:673–679.
36. Guidelines Committee of the Society of American Gastrointestinal and Endoscopic Surgeons Yumi H. Guidelines for diagnosis, treatment, and use of laparoscopy for surgical problems during pregnancy: this statement was reviewed and approved by the Board of Governors of the Society of American Gastrointestinal and Endoscopic Surgeons (SAGES), September 2007. It was prepared by the SAGES Guidelines Committee. *Surg Endosc*. 2008;22:849–861.
37. Ulker V, Gedikbasi A, Numanoglu C, et al. Incidental adnexal masses at cesarean section and review of the literature. *J Obstet Gynaecol Res*. 2010;36:502–505.
38. Dede M, Yenen MC, Yilmaz A, et al. Treatment of incidental adnexal masses at cesarean section: a retrospective study. *Int J Gynecol Cancer*. 2007;17:339–341.