Diagnosis of emergencies/urgencies in gynecology and during the first trimester of pregnancy

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Abstract Several surgical and/or medical emergencies/urgencies may occur in gynecologic patients and in pregnant women during the first trimester. Particularly, ectopic pregnancies, ruptured or hemorrhagic ovarian cysts, ovarian or adnexal torsions, threatened or inevitable miscarriages, phlogistic gynecological disorders, complications involving the uterine fibroids, endometriosis, and spontaneous uterine rupture are possible acute complications. The diagnosis is suspected on the basis of symptoms (acute pelvic and/or abdominal pain, with or without vaginal bleeding or discharge, until acute abdomen with peritonitis), by means physical evaluation (abdominal, pelvic, and bimanual gynecological examinations), by means of transabdominal (TAS) and/or transvaginal (TVS) sonography, and laboratory tests. However, the diagnosis is often not that simple, especially when the symptoms and clinical signs are minimal, and ultrasound (US) examination is not diriment. The differential diagnosis of abdominal/pelvic pain is broad and includes primarily gastrointestinal and urogenital disorders. Generally, TAS should usually be used in conjunction with TVS for evaluation of the female pelvis. If the US examination is not conclusive, CT or MRI, especially in pregnant patients, should be considered.

Keywords TVS · TAS · Beta-HCG · Adnexal mass · Adnexal torsion · Hemorrhage · Rupture

Riassunto Diverse emergenze/urgenze chirurgiche e/o mediche possono interessare le pazienti ginecologiche e le gravide al primo trimestre. In particolare, le gravidanze

ectopiche, le cisti ovariche rotte o torte, le torsioni ovariche o annessiali, le minacce d'aborto o gli aborti inevitabili, le patologie infiammatorie ginecologiche, i fibromi uterini complicati, l'endometriosi e la rottura uterina spontanea rappresentano possibili complicanze acute. La diagnosi può essere sospettata in base alla sintomatologia (algie pelviche e/o addominali acute, con eventuali perdite vaginali, fino a un quadro di addome acuto con peritonite), alla visita (valutazione addominale, pelvica ed esplorazione ginecologica bimanuale), all'ecografia transaddominale (TAS) e/o transvaginale (TVS), e agli esami di laboratorio. Tuttavia, la diagnosi spesso non è semplice, soprattutto quando i sintomi e i segni clinici sono lievi e l'ecografia non è dirimente. La diagnosi differenziale del dolore addominale/pelvico comprende un'ampia varietà di disordini, in particolare gastrointestinali e urogenitali. Generalmente, la valutazione della pelvi femminile dovrebbe essere eseguita mediante ecografia sia transaddominale che transvaginale. Se l'esame ecografico non consente di fare diagnosi, dovrebbero essere presi in considerazione la TC o, specialmente nelle donne gravide, la RMI.

Introduction

Several surgical and/or medical emergencies/urgencies may occur in gynecologic patients and in pregnant women during the first trimester. Particularly, ectopic pregnancies, ruptured or hemorrhagic ovarian cysts, ovarian or adnexal torsions, threatened or inevitable miscarriages, phlogistic gynecological disorders—as pelvic inflammatory disease (PID), acute salpingitis, tubo-ovarian abscess (TOA), and pyosalpinx—complications involving the uterine fibroids—including degenerative changes, process of

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expulsion of a submucous pedunculated myoma, torsion of a pedunculated subserous myoma, and acute vaginal or intra-peritoneal hemorrhage—endometriosis, and spontaneous uterine rupture are possible acute complications [1, 2]. Classically, the patient comes to the observation because of acute pelvic and/or abdominal pain, with or without vaginal bleeding or discharge, until acute abdomen with peritonitis. The diagnosis is suspected on the basis of symptoms, and made by means of physical evaluation, including abdominal, pelvic, and bimanual gynecological examinations, of transvaginal (TVS) and/or transabdominal (TAS) sonography, and laboratory tests. However, the diagnosis is often not that simple, especially when the pain is minimal, the patient is hemodynamically stable, and ultrasound (US) examination shows no obvious ectopic implantation of pregnancy or adnexal/pelvic mass. The differential diagnosis of abdominal/pelvic pain is broad and includes primarily gastrointestinal and urogenital disorders, as acute appendicitis, acute cholecystitis, diverticulitis, bowel obstruction, perforated ulcers, pyelonephritis, and neoplastic processes [1]. Generally, TAS should be the sonographic technique for initial evaluation of the female pelvis, followed by TVS if indicated (gynecologic diseases), and when TAS is not conclusive. TVS should usually be used in conjunction with TAS. If the US examination is nondiagnostic, CT or MRI, especially in pregnant patients, should be considered. If gynecologic cause of pelvic pain is confirmed, other imaging studies might be unnecessary, thereby reducing cost, and adverse complications of CT (contrast material reactions, and radiation exposure) [3–5].

Ectopic pregnancy

The incidence of ectopic pregnancy (EP) is rising, largely due to increase of pelvic inflammatory disease (PID), of cesarean delivery (CD) rate, of assisted reproductive technologies (ART). The tubal pregnancy is the most common form of EP. Other possible and more rare localizations are the implantations within interstitial portion of the fallopian tube (interstitial pregnancy), the scar of a previous cesarean delivery (cesarean scar pregnancy, CSP), the cervix (cervical pregnancy), the ovary (ovarian pregnancy), or very rarely in the extragenital site, pelvic or abdominal (bowel or other). Embryo (and/or yolk sac) may be visualized, viable or not. Twin ectopic pregnancies were described [6, 7]. In few cases, the EP may coexist with an intrauterine pregnancy (heterotopic pregnancy). TVS has been shown to be superior to TAS when EP is suspected [1, 3].

The suspicion and diagnosis of tubal pregnancy (TP) is based on menstrual and medical history (last menstrual period, previous PID, previous TP, use of intrauterine

device (IUD), previous abdominal/pelvic surgery, endometriosis, etc.), as well as physical, US and laboratory [quantitative serum beta-human chorionic gonadotrophin (beta-hCG) levels] findings. The clinical pattern is characterized by pelvic pain associated with amenorrhoea, with or without vaginal bleeding. TVS can show an empty uterine cavity with endometrial thickness of less than 8 mm, unspecific adnexal mass or gestational sac with or without embryo, with “tubal ring sign” (Fig. 1), and free or clotted fluid in the pelvis/abdomen, in case of TP rupture. The “tubal ring sign” appears as peritrophoblastic ring-shaped flow by Color Doppler examination [1]. US diagnosis of EP should be based upon the visualization of an adnexal mass rather than the absence of an intrauterine gestational sac. When serum beta-hCG concentrations are below the discriminatory zone—the range of beta-hCG above which a gestational sac can be visualized consistently by TVS (1,000–2,000 IU/L)—and no intrauterine (IUP) or extrauterine pregnancy is seen, the pregnancy is defined unknown localization (PUL) [1, 8, 9]. PUL may result in spontaneous miscarriage, possible EP, or IP, according to beta-HCG trend [8]. Tubal pregnancy can be managed by laparoscopic or laparotomic surgery, medically, and selectively by observation alone [9, 10].

CSP is diagnosed by TVS when a gestational sac embedded in the hysterotomy scar is detected, and a triangular (≤ 8 weeks) or rounded/oval (≥ 8 weeks) gestational sac fills the niche of the scar; in the presence of a thin (1–3 mm) or absent myometrial layer between the gestational sac and the bladder; in the presence of a closed and empty cervical canal; in the presence of a prominent and at times rich vascular pattern in the area of a CD scar [11, 12].

Interstitial pregnancy should not be confused with the angular or cornual pregnancy because clinical findings, management and outcomes are different. Angular pregnancy is an intrauterine pregnancy implanted in one lateral angle of the uterine cavity, that leads to asymmetric and symptomatic enlargement of the uterus, and that, under laparoscopic vision, appears as a bulge in one uterine angle, medially to the round ligament. Indeed, the cornual pregnancy is a pregnancy in a horn of a bicornuate uterus, where the clinical outcome depends on the size of the involved horn. Interstitial pregnancy is an ectopic pregnancy that is implanted in the interstitial portion of the fallopian tube, which is the tract originating at the tubal ostium and traversing the muscular wall of the uterus. Under laparoscopic vision interstitial pregnancy appears lateral to the round ligament. The interstitial pregnancy may remain asymptomatic until 7–16 weeks of gestation [13] because of the proximal segment of the tube, as surrounded by muscle, has a significantly greater capacity to expand before rupture than the distal tubal tract. The main complication is a

Fig. 1 **a** Gestational sac,
b small tubal ring sign

conspicuous bleeding also due to presence of the vascular anastomosis of the uterine and the ovarian arteries in this region, with consequent possible hysterectomy. An early diagnosis before rupture and treatment is fundamental to reduce morbidity and mortality, and to maintain fertility. Sonographic features include a bulky uterus and an empty uterine cavity, a gestational sac lateral to the uterine fundus and an echogenic line of myometrium around the superolateral portion of the sac. The suspicion is very high when risk factors, such as previous EP, previous salpingectomy or tubal ligation, conception after in vitro fertilization (IVF), and history of sexually transmitted disease (STD)/PID, are present. It may occur with abdominal pain and, less commonly than in other forms of ectopic pregnancy, vaginal bleeding in the first trimester of pregnancy [14].

Heterotopic pregnancy is a potentially fatal condition, frequently occurring after controlled ovarian hyperstimulation (COH), (IVF) and embryo transfer, intrauterine insemination (IUI), or more rarely in natural conception cycles [15]. Several localizations of heterotopic pregnancy were reported, as mostly tube [6, 15], or cesarean scar [16, 17], cervix [18], and even spleen [19]. Cases of twin heterotopic pregnancy were described [6].

Miscarriage

Threatened miscarriage, inevitable miscarriage, incomplete miscarriage are other situations that may require an urgent or emergent intervention because of persistent excessive bleeding, infected retained tissue (sepsis), and in case of suspected gestational trophoblastic disease [20]. The diagnosis is performed by clinical findings (vaginal bleeding, pelvic pain), physical examination, TVS, beta-HCG assay, and laboratory tests. Incomplete abortion is visualized as thickened and irregular endometrial echo, eventually richly perfused by Color Doppler US, with certain amount of intracavitary fluid.

Adnexal torsion

Adnexal torsion is considered a true gynecologic emergency. It may involve ovary, fallopian tube, or both and is due to partial or complete twisting of the vascular pedicle, which results venous, arterial, and lymphatic obstruction until ovarian necrosis. The right adnexa is most commonly involved, probably because of the longer utero-ovarian ligament than the left, and the resulting hypermobility. The left adnexa is less mobile because of the presence of the sigmoid colon, which reduces the space needed for torsion [1]. Adnexal torsion can occur at any age. It is estimated that 70–80 % of adnexal torsions occur in women of reproductive age, and 12–25 % of women with torsion are pregnant [21]. It is commonly associated with an increase of the ovarian size and weight. Ovarian mass, as luteal cyst, teratoma, serous or mucinous cystadenoma, or COH, particularly in the presence of ovarian hyperstimulation, are risk factors for adnexal torsion (Fig. 2) [1]. In a relatively large series, most of ovarian masses (50 %) were mature cystic teratomas and corpus luteal cysts [27]. Unilateral abdominal pain, typically in the lower quadrant, is the most common symptom; occasionally nausea and vomiting may occur; mild leukocytosis and fever may be present. As the absence of specific symptoms, clinical features, and laboratory markers, which may mimic those of appendicitis, PID, TOA, EP, adnexal or pelvic cyst, or clear sonographic signs, definitive diagnosis is achieved by surgery. US imaging may reveal enlarged, cystic, and sometimes edematous ovaries (edematous stroma with peripheric follicles), abnormally positioned in the pouch of Douglas, anterior to the uterus or in the contralateral side, and, eventually, pelvic free fluid, due to infarction and hemorrhage. Doppler blood flow may be abnormal or normal. The “whirlpool sign” was described as direct sonographic sign of adnexal torsion. It refers to the appearance of the ovarian supporting system (ovarian ligament or

Fig. 2 a–b Left adnexal (asterisk), gestational sac of 9 weeks (section sign), c Doppler flow

infundibulopelvic ligament), twisted around its axis. By moving the probe back and forth along this central axis, the picture produced resembles a whirlpool or spiral. Both the gray-scale ultrasonography that the evaluation of the twisted vascular pedicle by Color Doppler US have been demonstrated to be very accurate for the diagnosis of torsion. In partial or early torsion, both arterial and venous flow could be maintained with viable ovarian tissue. Absence of arterial and venous blood flow in the twisted pedicle and/or visualization of the flow in the artery alone are predictive of nonviability of the ovary. In fact, the twisting of the ovary and the tube around its own ligamentous support may cause ovarian tissue congestion due to decreased venous return, which is followed by partial or complete arterial occlusion, leading to ischemia and eventually to ovarian necrosis. The degree of vascular compromise and the rapidity of achieving detorsion may play a role in preserving the ovary [1, 22–28].

Rupture or hemorrhage of ovarian cyst

In addition, massive rupture or hemorrhage of an ovarian cyst can present as an emergency requiring immediate surgical intervention. Hemorrhagic ovarian cysts, generally functional, as corpus luteum cysts, occur most commonly in reproductive age women, in luteal phase of the menstrual cycle, or during the first trimester in pregnant women [1]. Acute abdominal pain is the main symptom in case of ruptured or hemorrhagic ovarian cyst, with or without signs of hemodynamic instability (hypotension, tachycardia, and decreased hematocrit). TAS or TVS may reveal initially anechoic cyst, then as the blood begins to clot, internal fluid may appear with a reticular “spider-web” appearance (Fig. 3). Fluid–fluid or fluid–debris levels within the cyst and a peripheral “ring of fire” flow may be present. Intra-peritoneal fluid, due to haematic effusion, may be liquid or clotted, and blood clots may be visualized as rounded, hyperechoic, and avascular masses, without peristalsis, distinguishing from bowel loops. Sometimes, the cyst wall

Fig. 3 Hemorrhagic ovarian cyst (asterisk), intra-peritoneal fluid (arrow)

may be collapsed, particularly in case of massive hemoperitoneum. When the diagnosis is unclear, CT imaging may be used, once excluded a pregnancy, or eventually RMI [1].

Adnexal mass in pregnancy

Adnexal masses may occur in pregnant women [29, 30]. Most of these are diagnosed incidentally during screening first trimester ultrasound and occasionally occur with torsion (1–22 %), or rupture (0–9 %), becoming an emergency, due to acute abdomen, more frequently in the first and early second trimesters. The most common ovarian masses in pregnancy are functional cyst, as corpus luteum (13–17 %), and other benign masses, such as cystic teratoma (7–37 %), serous cystadenoma (5–28 %) and mucinous cystadenoma (3–24 %), endometrioma (0.8–27 %), paraovarian cysts (<5 %), leiomyoma (1–2.5 %), and ovarian malignancy (1–8 %) [22]. Malignant ovarian tumors and endometriomas are rarer causes due to adhesions or invasion of the neighboring tissues. Adnexal mass may be palpated on

examination, but the diagnosis, the definition of its morphology and the stratification of risk may be made by means TVS and TAS [31–33].

Pelvic inflammatory disease and tubo-ovarian abscess

PID is an infection and inflammation of the upper female genital tract (cervix, fallopian tubes, and endometrium), due to an ascending infection from the lower genital tract, common complication of STD. The signs and symptoms of PID can be vague and nonspecific, including mostly abdominal pain, nausea and vomiting, mucopurulent vaginal discharge, abnormal vaginal bleeding, eventually fever, leukocytosis, elevated C-reactive protein, and CA-125. Peritonitis may also be present. The lack of specific symptoms can determine a failure/delay diagnosis. TOA is a serious complication of PID, and may be the result of nongynecologic diseases, as diverticulitis, appendicitis, inflammatory bowel disease, and surgery [1]. US is the diagnostic imaging modality of choice for PID and TOA. Sonographic markers of tubal inflammatory disease are the shape, the wall structure and thickness, ovarian involvement, and the presence of fluid. Inflamed fallopian tubes on longitudinal section may be pear-shaped, ovoid, or retort-shaped structure containing sonolucent or low-level echoes. Incomplete septa originate as a triangular protrusion from one of the walls, but do not reach the opposite wall. “Cogwheel” sign, defined as a sonolucent cogwheel-shaped structure visible in the cross-section of the tube with thick walls, and “beads on a string” sign, defined as hyperechoic mural nodules (2–3 mm) on the cross-section of the fluid-filled distended structure, may be present. Walls may be thick (≥ 5 mm) or thin (< 5 mm). Ovary may appear normal and distinctly identified, or may be involved. Ovaries and fallopian tubes may be identified, but the ovaries cannot be separated when the tube is pushed with the vaginal probe (tubo-ovarian complex). These features may be associated with clinical signs and symptoms of acute PID. In case of TOA, the adnexa appears as a conglomerate in which neither the ovary nor the tube can be separately recognized as such. The fluid may be present as free or in the shape of a pelvic peritoneal inclusion cyst in the cul-de-sac, with thin adhesions between the different organs in the pelvis, without tenderness with touch of the vaginal probe or clinical signs and symptoms of an acute illness [34]. CT scanning can be used, especially during the acute presentation when the diagnosis may be unclear and other intra-abdominal pathology may be suspected [35, 36].

Uterine fibroids

Uterine fibroids may be symptomatic, resulting in pelvic pain or pressure and urinary or bowel symptoms. In addition, fibroids can rupture, hemorrhage, or twist acutely [2].

In conclusion, acute pelvic and abdominal pain is a generic symptom. In the female patient pregnancy should be excluded. However, also in pregnant women the differential diagnosis with other gynecologic disorders (as PID, acute salpingitis, pyosalpinx, TOA, endometriosis, ruptured or hemorrhagic ovarian cyst, ovarian torsion, torsion or degeneration of a uterine fibroid, spontaneous uterine rupture), with gastrointestinal disorders (as acute appendicitis, which is the most common cause of nongynecologic pelvic pain, acute cholecystitis, diverticulitis, bowel obstruction, and perforated ulcers), with urogenital disorders (as pyelonephritis), and with neoplastic processes should be made [1].

Conflict of interest Stefano Zucchini and Elena Marra declare that they have no conflict of interest.

Human and animal studies The study described in this article did not include any procedures involving humans or animals.

References

1. Boyd CA, Riall TS (2012) Unexpected gynecologic findings during abdominal surgery. *Curr Probl Surg* 49:195–251
2. Gupta S, Manyonda IT (2009) Acute complications of fibroids. *Best Pract Res Clin Obstet Gynaecol* 23(5):609–617. doi:10.1016/j.bpobgyn.2009.01.012
3. Gramith F, Sirr S, Hollerman J, Hawks L (1991) Transvaginal versus transabdominal sonography in patients suspected of having ectopic pregnancy. *Minn Med* 74(1):27–31
4. Lambert MJ, Villa M (2004) Gynecologic ultrasound in emergency medicine. *Emerg Med Clin North Am* 22(3):683–696
5. Cicchiello LA, Hamper UM, Scoutt LM (2011) Ultrasound evaluation of gynecologic causes of pelvic pain. *Obstet Gynecol Clin North Am* 38(1):85–114, viii. doi:10.1016/j.ogc.2011.02.005
6. Simsek T, Dogan A, Simsek M, Pestereli E (2008) Heterotopic triplet pregnancy (twin tubal) in a natural cycle with tubal rupture: case report and review of the literature. *J Obstet Gynaecol Res* 34(4 Pt 2):759–762
7. Casadio P, Formelli G, Spagnolo E, De Angelis D, Marra E, Armillotta F et al (2009) Laparoscopic treatment of interstitial twin pregnancy. *Fertil Steril* 92:390.e13–390.e17
8. Nama V, Manyonda I (2009) Tubal ectopic pregnancy: diagnosis and management. *Arch Gynecol Obstet* 279(4):443–453
9. Royal College of Obstetricians and Gynaecologists (2004) The management of tubal pregnancy. Guideline no. 21, May 2004, Reviewed 2010
10. Hajenius PJ, Mol F, Mol BW, Bossuyt PM, Ankum WM, van der Veen F (2007) Interventions for tubal ectopic pregnancy. *Cochrane Database Syst Rev* (1):CD000324
11. Timor-Tritsch IE, Monteagudo A, Santos R, Tsymbal T, Pineda G, Arslan AA (2012) The diagnosis, treatment, and follow-up of cesarean scar pregnancy. *Am J Obstet Gynecol* 207(1):44.e1–56.e13
12. Timor-Tritsch IE, Monteagudo A (2012) Unforeseen consequences of the increasing rate of cesarean deliveries: early placenta accreta and cesarean scar pregnancy. A review. *Am J Obstet Gynecol* 207(1):14–29
13. Lau S et al (2013) Conservative medical and surgical management of interstitial ectopic pregnancy. *Fertil Steril* 72:207–215
14. Moawad NS, Tulandi T (1999) Current diagnosis and treatment of interstitial pregnancy. *Am J Obstet Gynecol* 202(1):15–29

15. Varras M, Akrivis C, Hadjopoulos G, Antoniou N (2003) Heterotopic pregnancy in a natural conception cycle presenting with tubal rupture: a case report and review of the literature. *Eur J Obstet Gynecol Reprod Biol* 106(1):79–82
16. Bai XX, Gao HJ, Yang XF, Dong MY, Zhu YM (2012) Expectant management of heterotopic cesarean scar pregnancy. *Chin Med J (Engl)* 125(7):1341–1344
17. Ugurlucan FG, Bastu E, Dogan M, Kalelioglu I, Alanya S, Has R (2012) Management of cesarean heterotopic pregnancy with transvaginal ultrasound-guided potassium chloride injection and gestational sac aspiration, and review of the literature. *J Minim Invasive Gynecol* 19(5):671–673
18. Moragianni VA, Hamar BD, McArdle C, Ryley DA (2012) Management of a cervical heterotopic pregnancy presenting with first-trimester bleeding: case report and review of the literature. *Fertil Steril* 98(1):89–94
19. Julania S, Tai R (2013) Heterotopic simultaneous splenic and intrauterine pregnancy after spontaneous conception and review of literature. *J Obstet Gynaecol Res* 39:367–370
20. Royal College of Obstetricians and Gynaecologists (2006) The management of early pregnancy loss. Green-top Guideline No. 25 October 2006
21. Rackow BW, Patrizio P (2007) Successful pregnancy complicated by early and late adnexal torsion after in vitro fertilization. *Fertil Steril* 87:697
22. Hoover K, Jenkins TR (2011) Evaluation and management of adnexal mass in pregnancy. *Am J Obstet Gynecol* 205(2):97–102
23. Glanc P, Salem S, Farine D (2008) Adnexal masses in the pregnant patient: a diagnostic and management challenge. *Ultrasound Q* 24(4):225–240
24. Huchon C, Fauconnier A (2010) Adnexal torsion: a literature review. *Eur J Obstet Gynecol Reprod Biol* 150(1):8–12
25. Valsky DV, Esh-Broder E, Cohen SM, Lipschuetz M, Yagel S (2010) Added value of the gray-scale whirlpool sign in the diagnosis of adnexal torsion. *Ultrasound Obstet Gynecol* 36(5):630–634
26. Vijayaraghavan SB (2004) Sonographic whirlpool sign in ovarian torsion. *J Ultrasound Med* 23(12):1643–1649 (quiz 1650–1651)
27. Koo YJ, Lee JE, Lim KT, Shim JU, Mok JE, Kim TJ (2011) A 10-year experience of laparoscopic surgery for adnexal masses during pregnancy. *Int J Gynaecol Obstet* 113(1):36–39
28. Hasson J, Tsafir Z, Azem F, Bar-On S, Almog B, Mashiaeh R et al (2010) Comparison of adnexal torsion between pregnant and nonpregnant women. *Am J Obstet Gynecol* 202(6):536.e1–536.e6
29. Leiserowitz G (2006) Managing ovarian masses during pregnancy. *Obstet Gynecol Surv* 61:463–470
30. Whitecar MP, Turner S, Higby MK (1999) Adnexal masses in pregnancy: a review of 130 cases undergoing surgical management. *Am J Obstet Gynecol* 181:19–24
31. Yuen P, Ng PS, Leung PL, Rogers MS (2004) Outcome in laparoscopic management of persistent adnexal mass during the second trimester of pregnancy. *Surg Endosc* 18:1354–1357
32. Ko ML, Lai TH, Chen SC (2009) Laparoscopic management of complicated adnexal masses in the first trimester of pregnancy. *Fertil Steril* 92:283–287
33. Mathevet P, Nessah K, Dargent D, Mellier G (2003) Laparoscopic management of adnexal masses in pregnancy: a case series. *Eur J Obstet Gynecol Biol* 108:217–222
34. Timor-Tritsch IE, Lerner JP, Monteagudo A, Murphy KE, Heller DS (1998) Transvaginal sonographic markers of tubal inflammatory disease. *Ultrasound Obstet Gynecol* 12:56–66
35. Jaiyeoba O, Soper DE (2011) A practical approach to the diagnosis of pelvic inflammatory disease. *Infect Dis Obstet Gynecol* 2011:753037. doi:[10.1155/2011/753037](https://doi.org/10.1155/2011/753037)
36. Mirhashemi R, Schoell WM, Estape R, Angioli R, Averette HE (1999) Trends in the management of pelvic abscesses. *J Am Coll Surg* 188(5):567–572