Management of Acute Pelvic Pain: Torsion, Infection, and Rupture of Tubal or Ovarian Mass

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Abstract

Acute pelvic pain is a common complaint in women. Various underlying gynecologic and non-gynecologic pathologies can cause acute pelvic pain; thus, a thorough investigation must be undertaken in order to reach a correct diagnosis. Etiologies include ovarian torsion, ectopic pregnancy, tubo-ovarian abscess, and ruptured ovarian cysts. It is critical to correctly diagnose the etiology of the pelvic pain in order to properly manage the pathology. Depending on the underlying condition, there are many treatment options, including medical and surgical management.

Keywords

Pelvic pain • Ovarian torsion • Ectopic pregnancy • Tubo-ovarian abscess • Hemorrhagic cyst

Contents

1 Introduction

Acute pelvic pain is an event that results from various gynecologic or non-gynecologic conditions. Many of these conditions can be managed medically, while others could be life threatening and require surgical intervention. In this chapter, the most common pathologies and their treatment options are reviewed.

2 Ovarian Torsion: Etiology and Risk Factors

Ovarian torsion is the partial or complete twisting of an ovary around its ligamentous supports (the infundibulopelvic and utero-ovarian ligaments)

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D. Shoupe (ed.), *Handbook of Gynecology*,
DOI 10.1007/978-3-319-17798-4_32

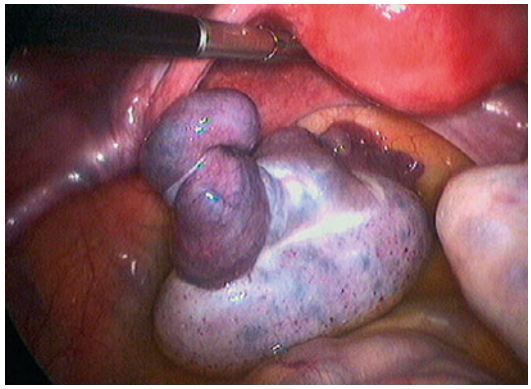

Fig. 1 Ovarian torsion

(Fig. 1) that can result in disruption of the blood supply to the ovary. Torsion is an uncommon cause of acute pelvic pain, with a prevalence of 2.7% (Dupuis and Kim 2015) affecting women of all ages. Due to the nonspecific nature of the pain caused by ovarian torsion and the consequences of delayed diagnosis, it is critical to quickly and accurately diagnose torsion in order to conserve ovarian function. The biggest concern associated with ovarian torsion is the complete occlusion of the blood supply that can result in necrosis, infarction, hemorrhage, and loss of ovarian function (Dupuis and Kim 2015). Approximately 60% of torsion cases occur in the right adnexa (Schraga et al. 2016).

The most likely causes of ovarian torsion in adult females are benign masses such as functional cysts or corpus lutea. In addition, any neoplasm increases the likelihood of torsion, with increasing risk as the size of the neoplasm increases. Torsion can also occur in normal ovaries without any risk factors; however, it is not well understood how it occurs. When ovarian torsion occurs in a normal ovary, it is more likely to occur in premenarchal females as the utero-ovarian ligament is longer in premenarchal females as it shortens as they go through puberty (Schraga et al. 2016; Karayalçın et al. 2011). In fact, it has been noted that 50% of patients with ovarian torsion who were younger than 15 years old had ovaries with no apparent pathology (Barnhart et al. 2003).

Ovarian masses, especially if $\geq$5 cm, remain the biggest risk factor for torsion. These masses are usually associated with the menstrual cycle or reproductive hormones, thus increasing the risk of torsion in reproductive age women. Another major risk factor for torsion is the size of the ovary. When it is 5 cm or more in diameter, the risk of torsion increases significantly as shown by a series of case studies where it was reported that 83–93% of torsed ovaries were noted to be 5 cm or larger (Tulandi 2015). Women undergoing ovulation induction during infertility treatment are also at an increased risk for torsion due to the presence of large follicular cysts and ovarian enlargement. In patients undergoing infertility treatment who present with acute abdominal pain, nausea and vomiting, and large polycystic ovaries, it is important to consider the possibility of torsion (Dupuis and Kim 2015). Pregnancy, associated with torsion in approximately 20% of torsion cases, and history of pelvic surgery, primarily tubal ligation, are also risk factors for ovarian torsion.

3 Ovarian Torsion: Presenting Symptoms

Patients with ovarian torsion present with acute, moderate to severe pelvic pain and can also have nausea and vomiting (Karayalçın et al. 2011). The main signs and symptoms seen in patients with ovarian torsion in descending order are: pelvic pain (90%), adnexal mass (86–95%), nausea and vomiting (47–70%), abnormal vaginal bleeding (4%), and fever (2%) (Karayalçın et al. 2011). Clinically patients often complain of sudden unilateral lower abdominal pain with onset after exercise or an agitating movement although history and physical findings are highly variable. In contrast to adults with ovarian torsion, infants with torsion may present with feeding intolerance, vomiting, abdominal distension, and general irritability (Barnhart et al. 2003).

On physical examination, patients may have abdominal or pelvic tenderness, with or without a palpable pelvic mass. In the setting of peritoneal signs, adnexal necrosis might be present, and thus is it critical to reach the correct diagnosis quickly.

4 Ovarian Torsion: Workup and Treatment

Workup of a patient with suspected ovarian torsion should include serum β-hCG level to exclude an ectopic pregnancy, complete blood count (CBC) to monitor for leukocytosis in the setting of adnexal necrosis, and a complete metabolic panel (CMP). Unfortunately, no lab value is specific for ovarian torsion. Imaging, however, may be beneficial in the diagnosis of torsion. It must be noted that while imaging is beneficial, ovarian torsion is a clinical diagnosis. Ultrasound is the initial and preferred imaging method used to detect ovarian torsion, due to its cost-efficiency and diagnostic accuracy (Karayalçın et al. 2011). There are many characteristic ultrasonographic signs that can assist in the diagnosis of torsion such as a heterogeneous appearance of the ovarian stroma due to edema and hemorrhage:

- Decreased or absent Doppler flow within the ovary may be present as seen in Fig. 2b; however, the presence of flow to the ovary does not rule out torsion due to dual blood supply to the ovary (Dupuis and Kim 2015). The blockage of venous blood flow results in engorgement of the parenchyma and edema and that causes the ovaries to enlarge.
- On ultrasound, this can appear hypoechoic with prominent and peripherally located non-ovulatory follicles (Dupuis and Kim 2015).
- Ultrasound was found to have a sensitivity and specificity of 72.1% and 99.6% for torsion, while the positive and negative predictive values were 96.9% and 95.9%, respectively (Swenson et al. 2014).
- Alternatively, magnetic resonance imaging (MRI) and computerized tomography (CT) scan may be utilized; however, they are not as preferable as ultrasonography due to the time consumption and high cost associated with these modalities (Tulandi 2015).

Although imaging is important for diagnosing ovarian torsion, definitive diagnosis is only made via direct visualization. A minimally invasive surgical approach is preferred, unless there is a suspicion for ovarian or fallopian tube malignancy. During surgery, the main goal should be to determine the presence of ovarian torsion and, if present, to assess the viability of the tube and ovary (Swenson et al. 2014). An ovary that is blue or black in color is not necessarily nonviable; however, dark color and enlargement with vascular and lymphatic congestion most likely indicate nonviability (Swenson et al. 2014).

In children with ovarian torsion, ovarian conservation is recommended regardless of the intraoperative findings. This approach helps to preserve potential fertility and avoids the negative

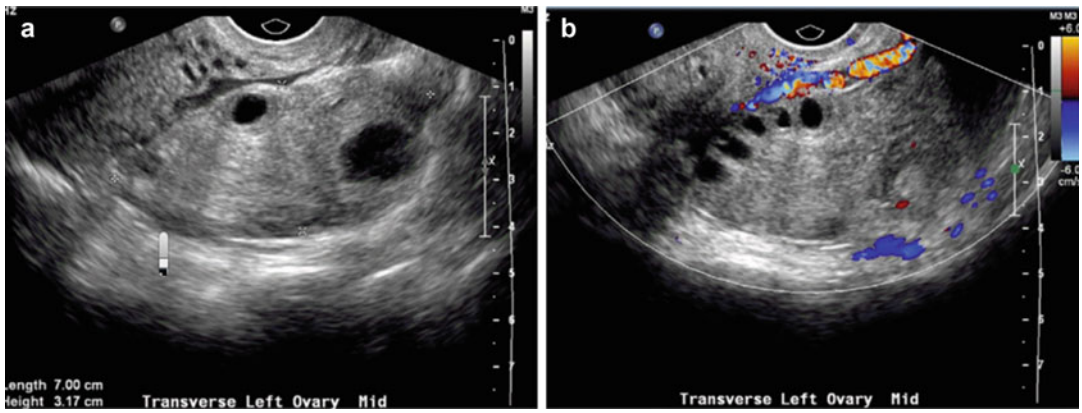

Fig. 2 Gray-scale (**a**) and color (**b**) sonograms of ovarian torsion show an enlarged ovary with prominent peripherally located follicles. The ovarian parenchyma is heterogeneous, and on color images there is a complete lack of parenchymal blood flow (Dupuis and Kim 2015)

physical, social, and emotional impact on children due to loss of ovarian function (Barnhart et al. 2003).

> In premenopausal patients, it is recommended that a conservative approach of untwisting the adnexa and preserving the ovary should be considered particularly where symptoms to surgery is less than 44 h (Karayalçın et al. 2011).

If it is clear that the ovary is necrotic or if there is a mass suspicious for malignancy, then salpingo-oophorectomy should be performed and a gynecologic oncology consultation should be made (Swenson et al. 2014). In postmenopausal women, salpingo-oophorectomy is usually the preferred route of treatment (Swenson et al. 2014).

After conservative treatment of ovarian torsion, there are several options available to prevent recurrence. In the setting of ovarian cysts, high-dose oral contraceptive pills (OCPs) may be used to suppress cyst formation although research support for this is lacking. Oophoropexy, which is fixation or suspension of the ovary, is another option that could be performed at the time of surgery. This procedure is often performed in children with ovarian torsion or in women who had undergone an oophorectomy on the contralateral side due to prior ovarian torsion (Beigi 2015b). However, there is not enough data to support this practice, and further research is needed in order to establish treatment protocols (Swenson et al. 2014).

5 Ectopic Pregnancy

An ectopic pregnancy is a pregnancy which implants outside of the uterine cavity. While the majority (98%) occur in the fallopian tube, other possible sites of implantation are the cervix, uterine cornua, ovaries, and abdomen (Pfeifer et al. 2008). Risk factors for ectopic pregnancy include previous ectopic pregnancy, fallopian tube damage, pelvic inflammatory disease, pelvic adhesions, tubal surgery, current intrauterine device (IUD) use, and assisted reproductive technologies (ART) (Pfeifer et al. 2008). Immediate workup of a possible ectopic pregnancy includes a positive pregnancy test and serum quantitative β-hCG, followed by a thorough history. Fig. 3 demonstrates further workup of possible ectopic pregnancy. Patients with ectopic pregnancy may have various clinical presentations. Although not specific, the most common manifestations of ectopic pregnancy are vaginal bleeding with abdominal or pelvic pain (Pfeifer et al. 2008). Abdominal examination may be unremarkable but it may also demonstrate significant tenderness. Speculum exam should be performed to assess for cervical dilation and to quantify the amount of bleeding; this is followed by bimanual examination, where patients may exhibit cervical motion tenderness with or without an adnexal mass. If there is evidence of hemodynamic instability, such as tachycardia or hypotension, in the setting of a suspected ectopic pregnancy, then surgical exploration is warranted.

After the initial evaluation is completed and hemodynamic stability of the patient is ascertained, then accurate diagnosis of a suspected ectopic pregnancy should follow a certain algorithm. Quantitative β-hCG and ultrasound are used in conjunction to guide in patient management. If the gestational age of the fetus is greater than five and half weeks, then a transvaginal ultrasound (TVUS) can identify an ectopic pregnancy with near 100% accuracy (Fylstra 2008). Another important concept in the diagnosis of a suspected ectopic pregnancy is the discriminatory zone, the β-hCG level at which a normal intrauterine pregnancy can be visualized using ultrasound. With the advances in gray-scale ultrasonography, TVUS can determine the presence of an intrauterine pregnancy (IUP) with a β-hCG value between 1,500 and 2,500 IU/L.

When the β-hCG level is above the discriminatory zone, but no intrauterine pregnancy is detected by TVUS, a dilation and curettage of the uterus is suggested to evaluate for the presence of chorionic villi (Fylstra 2008). If chorionic villi are not detected, then this is considered to be a pregnancy of unknown location and is

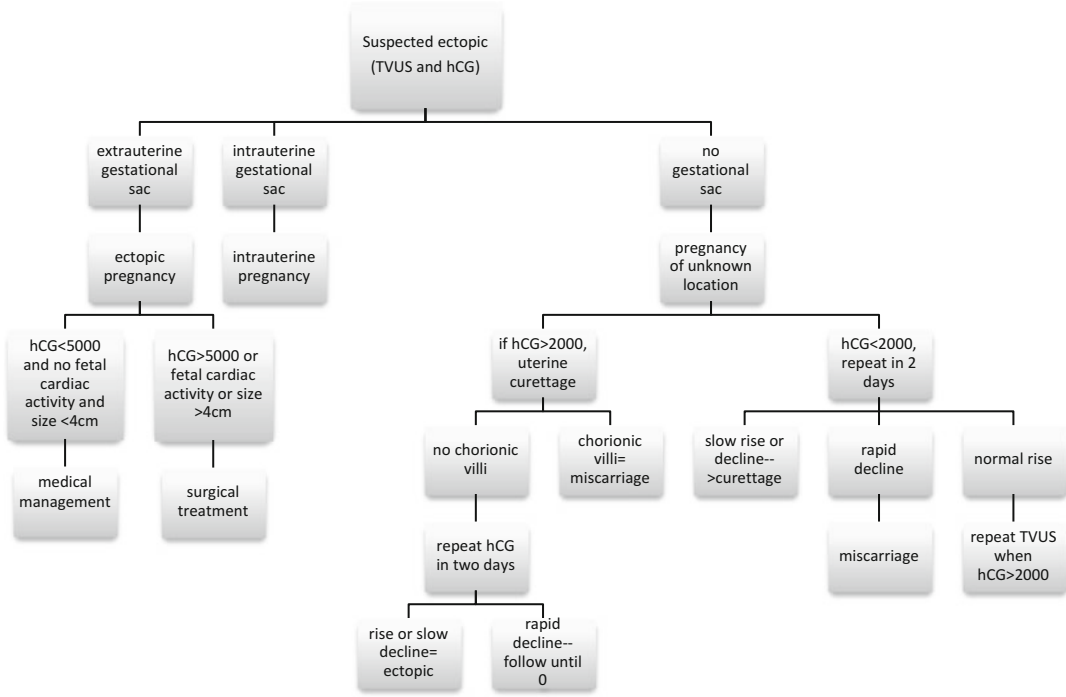

Fig. 3 Management of suspected ectopic pregnancy (Figure 1 from Fritz and Speroff 2010)

subsequently treated as an ectopic pregnancy. Alternatively, β-hCG levels may be followed and should demonstrate a minimum drop of 15%. Within 12–24 h in cases of failing IUP. If this is not the case, then an ectopic pregnancy is most likely the diagnosis (Fylstra 2008). On the other hand, when the β-hCG level is below the discriminatory zone, the value should then be serially monitored for appropriate rise as long as the patient is hemodynamically stable. β-hCG levels normally rise by 53% over a 48 h period (Fylstra 2008). The previously used value of 66% increase was determined to be unsafe as it could result in the termination of possible viable pregnancies. In these situations, a TVUS should be performed as soon as the β-hCG level is above the discriminatory zone. A decline or an inappropriate rise of the β-hCG levels indicates a nonviable pregnancy. A β-hCG level that does not decline by 21–35% over 48 h is indicative of an ectopic pregnancy rather than a spontaneous abortion and should be treated as such. MRI might aid in the diagnosis of an ectopic pregnancy when ultrasonography is equivocal. An ectopic pregnancy usually appears as a structure with a "three rings." The affected tube usually demonstrated solid components with dilation and evidence of hematosalpinx as well as enhancement of tubal wall (Rosen et al. 2009).

Treatment options for ectopic pregnancy include expectant, medical, or surgical management and vary according to different clinical scenarios. Expectant management can be offered to patients with pregnancy of unknown location or when there is concern for an ectopic pregnancy in the setting of low or decreasing β-hCG. A β-hCG that is over 2,000 IU/ml is a contraindication for expectant management, and patients should be treated medically with methotrexate (MTX) or surgically (Fylstra 2008). Medical management with MTX is offered to hemodynamically stable patients without severe or persistent pain and without relative or absolute contraindications to MTX therapy (Teng et al. 2003). Methotrexate is

administered as a single dose, double dose, or fixed multidose with serial β-hCG measurements depending on each specific protocol (Teng et al. 2003). Surgical management is reserved for when there is evidence of hemodynamic instability or contraindication for MTX therapy.

A minimally invasive approach is preferred unless there is concern for hemodynamic shock and large hemoperitoneum or when there is suspicion for multiple adhesions or if the pregnancy is extratubal or intra-abdominal (Fylstra 2008). Both, a laparoscopic and an open technique, are equally effective; however, laparoscopy is associated with less blood loss and shorter hospital stay.

Decision to perform a salpingectomy or salpingostomy is usually made intraoperatively depending on the status of the tube. If the tube is ruptured or severely damaged, salpingectomy is preferred as tubal function might be compromised; however, the number of performed salpingostomies has been declining with an increase in in vitro fertilization (IVF) cycle success (Fylstra 2008). While both salpingostomy and salpingectomy procedures yielded a similar subsequent intrauterine pregnancy rates, there was a higher rate of subsequent ectopic pregnancy in patients who had a salpingostomy (10% vs. 15%) in some but not all reports (Fylstra 2008). Treatment with salpingostomy may also fail if the trophoblastic tissue is not completely resected from the tube, in which case the β-hCG levels must be monitored to ascertain their decline to normal.

Future reproductive outcomes appear to be similar after either medical or surgical treatment. It has been shown that the risk of a repeat ectopic pregnancy in patients with previous ectopic is about 10%, regardless of whether the patient underwent MTX treatment or salpingostomy; these patients should be closely monitored for signs and symptoms of ectopic pregnancy (Tulandi 2015).

5.1 Tubo-ovarian Abscess

Tubo-ovarian abscesses (TOAs) are inflammatory masses that involve the fallopian tube, ovary, and adjacent organs. The most common cause of TOA is ascending pelvic inflammatory disease (PID) or any upper genital tract infection (Beigi 2015a). Prior to the use of antibiotics and current surgical techniques, the mortality rate as a result of TOA was over 50% (Sandesh et al. 2014). Currently, the mortality rates are less than 5% for both ruptured and non-ruptured abscesses (Sandesh et al. 2014). Most women with TOA are of reproductive age, and the risk factors are the same as those for PID. These include a prior history of PID, multiple sexual partners, and age between 15 and 25 years. In addition, patients undergoing oocyte retrieval during ART are at an increased risk of developing TOAs (McNeely et al. 1998).

The microbiology of PID is complex and often includes both aerobic and anaerobic organisms such as *E. coli*, aerobic streptococci, such as *S. agalactiae*, and *Bacteroides fragilis*. Although TOAs are often associated with microorganisms similar to those found in PID, *Neisseria gonorrhea* and *Chlamydia trachomatis* are not often seen in cases of TOA (Beigi 2015a).

Patients with TOA often present with a similar clinical presentation as those with PID. Symptoms include lower abdominal pain, fever, chills, and vaginal discharge. Patients with a ruptured TOA are more likely to present with signs and symptoms of acute abdomen or sepsis (Beigi 2015a). On physical examination patients with PID or TOA may present with vaginal discharge, cervical motion tenderness, fevers, tachycardia, rebound tenderness and guarding on abdominal exam, as well as vaginal discharge. Workup of a patient with suspected PID/TOA should include a complete blood count (CBC), erythrocyte sedimentation rate (ESR) or C-reactive protein (CRP), a pregnancy test, as well as nucleic acid amplification testing (NAAT) for *N. gonorrhea* and *C. trachomatis* (Sandesh et al. 2014). Abnormalities seen in these tests include elevated white blood cell count, ESR, and CRP levels.

Rapid and accurate diagnosis of TOA is crucial since delaying treatment can lead to further

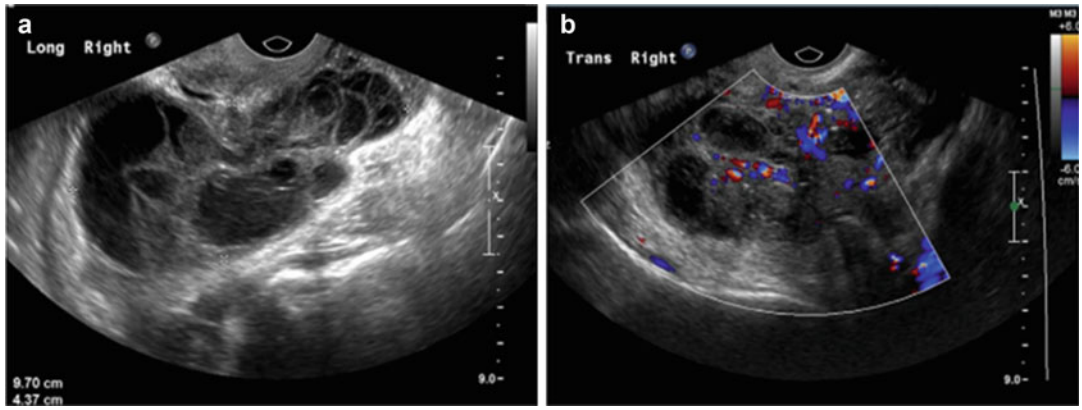

Fig. 4 **a**, **b** A 47-year-old female with complex and solid cystic mass in the right adnexa with internal vascularity in this patient with tubo-ovarian mass. Patient underwent percutaneous transgluteal drainage under CT guidance (Swenson et al. 2014)

sequelae such as infertility, future ectopic pregnancy, and chronic pelvic pain (Beigi 2015a). Imaging is indicated in patients with PID who are acutely ill or have severe abdominal tenderness, as well as when there is suspicion for a TOA. Ultrasound is the imaging modality of choice due to accuracy and cost efficiency. On ultrasound, TOAs appear as complex multilocular masses that often alter the normal architecture of the adnexa as seen in Fig. 4. They tend to have internal echoes that are consistent with inflammatory debris (Dupuis and Kim 2015). CT scan has increased sensitivity and may exclude other abdominal pathologies; however, the financial cost to the hospital is much greater. Findings on CT scan include thick-walled, rim-enhancing adnexal masses, with high-density fluid indicative of pus (McNeely et al. 1998).

Management of TOA can be medical or surgical, based on the severity of the clinical presentation and the qualities of the abscess on imaging. Antibiotic therapy is sufficient in 70% of patients with TOA (Tan et al. 2014).

> Candidates for antibiotics are those who are hemodynamically stable without signs of rupture and have an abscess less than 9 cm and who show an initial adequate response to antibiotic therapy (Beigi 2015b).

Patients undergoing medical treatment will often show signs of improvement within 48–72 h of treatment (Beigi 2015b). Those who do not improve within this time period or worsen will require either drainage or surgery. Table 1 outlines the various inpatient and outpatient regimens for treatment of TOA, but triple therapy with ampicillin, gentamicin, and clindamycin has been shown to be superior to the standard regimen of cefoxitin or cefotetan, plus doxycycline (Beigi 2015b). The first 48–72 h period of antibiotics treatment is critical, as there is high risk of rupture and sepsis. There are no determined guidelines for the duration of antibiotic therapy; however, the most commonly reported is 10–14 days (Beigi 2015b).

Surgical management is necessary when rupture is suspected, and antibiotic therapy should be initiated immediately even when surgical management is chosen. Laparotomy is the approach of choice for most physicians due to improved visibility of the entire pelvis; however, a minimally invasive approach has been employed successfully in patients without evidence of rupture and is generally performed by experienced surgeons (Beigi 2015b). A minimally invasive laparoscopic approach has been shown to have low complication rates when offered to patients who desire to preserve fertility (McNeely et al. 1998). Intraoperatively, excision of the abscess is carefully performed followed by copious irrigation of

Table 1 Antibiotic regimens for inpatient and outpatient treatment of tubo-ovarian abscess

Regimen	Dose
Inpatient treatment	
Cefoxitin and	2 g IV every 6 h
Doxycycline	100 mg PO or IV every 12 h
Cefotetan and	2 g IV every 6 h
Doxycycline	100 mg PO or IV every 12 h
Clindamycin and	900 mg IV every 8 h
Gentamicin	2 mg/kg loading dose ➔ 1.5 mg/kg every 8 h IV/IM
Ampicillin and	2 g IV every 6 h
Clindamycin and	900 mg IV every 8 h
Gentamicin	2 mg/kg loading dose ➔ 1.5 mg/kg every 8 h IV/IM
Outpatient treatment	
Levofloxacin and	500 mg PO daily
Metronidazole	500 mg PO twice daily

Beigi (2015b)

the peritoneal cavity to decrease the intensity of inflammation. A positive response is seen in 90–100% of patients who undergo immediate surgical treatment with laparoscopy, while 20–87% of patients undergoing medical management will show a positive response (Beigi 2015b).

Ultrasound- or CT-guided drainage of the TOA is another treatment option that is widely used. It has been shown that abscess drainage with antibiotic therapy has a higher rate of successful treatment when compared to antibiotics alone (McNeely et al. 1998). Image-guided TOA drainage secondary to PID has been shown to help avoid subsequent salpingo-oophorectomy in 94% of patients (McNeely et al. 1998).

6 Ruptured Ovarian Cysts

Ruptured ovarian cysts can lead to gynecologic emergencies. When an ovarian cyst ruptures, the patient may be asymptomatic, or she can have sudden onset abdominal pain as is seen in the pathologies reviewed above. Upon evaluation of the patient, it is important to determine the risks for cyst rupture. These include ovarian cysts, endometriosis, PID, and coagulation abnormalities.

On physical exam, the patient is usually hemodynamically stable, although she can present with a low-grade fever. Right lower-quadrant pain on palpation is most often seen as the sigmoid colon can have a protective effect over the left ovary (Seeber and Barnhart 2006). Some patients may present with signs of acute abdomen if sebaceous material or blood leaks into the abdomen. Blood may also leak into the ovary, which can cause the patient pain due to stretching of the ovarian cortex (Seeber and Barnhart 2006).

Laboratory and imaging studies for these patients is similar to those performed in the pathologies mentioned previously.

- As with any gynecologic workup, pregnancy must first be ruled out.
- However, if the patient is pregnant, ectopic pregnancy must also be ruled out. In addition to hCG, CBC, urinalysis (UA), blood, and urine cultures should be obtained to determine if there is an infectious cause.
- Ultrasound is also preferred in the evaluation of ruptured ovarian cyst for the same reasons of cost efficiency and diagnostic accuracy. On US, an adnexal mass and fluid in the pelvis will be seen as in Fig. 5 (Swenson et al. 2014). Of note, these findings can be similar to those found with ectopic pregnancy or pus from a TOA. If diagnosis is still unclear after US, CT may be performed due to improved visualization of the ovary.

Management of ruptured ovarian cysts is dictated by whether the cyst is complex or simple and whether the rupture is complicated or not. Ovarian cyst rupture is classified as uncomplicated when the patient is hemodynamically stable without signs of acute abdomen or an expanding hemoperitoneum. Such patients may be treated on an outpatient basis with oral analgesia, allowing for the cyst fluid to be resorbed spontaneously within 24–48 h, with subsequent

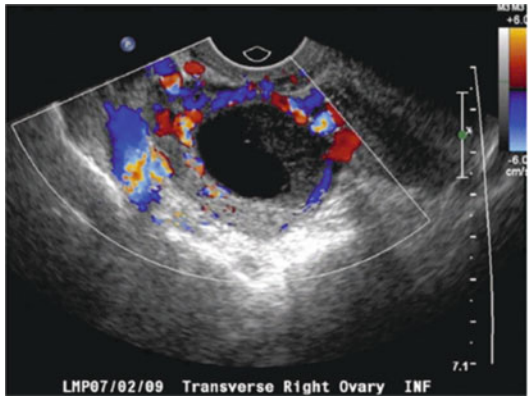

Fig. 5 Complex cystic structure in the right ovary with heterogeneous internal echoes and peripheral solid components with a peripheral ring of vascularity, consistent with a hemorrhagic corpus luteum cyst (Swenson et al. 2014)

improvement of symptoms (Seeber and Barnhart 2006). If the cyst rupture is complicated by large and ongoing blood loss, then patients are usually hospitalized for serial monitoring of vital signs, abdominal exams, and monitoring of hemoglobin and hematocrit levels to determine whether or not further intervention is required (Seeber and Barnhart 2006). Surgical intervention is recommended when bleeding is ongoing or if there are signs of hemodynamic instability. Choosing an exploratory laparotomy or a minimally invasive laparoscopic approach depends on the hemodynamic stability of the patient and the expertise of the surgeon. In most cases laparoscopic ovarian cystectomy with control of bleeding is feasible and is the preferred method in premenopausal patients. An oophorectomy is an acceptable option for postmenopausal patients (Herman et al. 2015).

7 Conclusion

Acute pelvic pain is common presenting complaint that could result from various pathologies. It is critical for clinicians to be able to combine clinical judgment with imaging and laboratory findings in order to make an accurate diagnosis and properly treat the patient. Prompt appropriate treatment is of utmost importance as the consequences of misdiagnosis or mistreatment can be devastating.

References

Barnhart KT, Gosman G, Ashby R, Sammel M. The medical management of ectopic pregnancy: a meta-analysis comparing single dose and multidose regimens. Obstet Gynecol. 2003;101:778–84.

Beigi, Richard H. Epidemiology, clinical manifestations and diagnosis of tuboovarian abscess. [Cited September 2015a]. Available from http://www.uptodate.com/contents/epidemiology-clinical-manifestations-and-diagnosis-of-tuboovarian-abscess?source=search_result&search=tuboovarian+abscess&selectedTitle=2~33.

Beigi, Richard H. Management and complications of tuboovarian abscess. [Cited September 2015b]. Available from http://www.uptodate.com/contents/management-and-complications-of-tuboovarian-abscess?source=search_result&search=tuboovarian+abscess&selectedTitle=1~33.

Dupuis C, Kim Y. Ultrasonography of adnexal causes of acute pelvic pain in pre-menopausal non-pregnant women. Ultrasonography. 2015;34(4):258–67.

Fritz, Marc, Speroff, Leon. Ectopic pregnancy. Clin Gynecol Endocrinol Infertility 2010; 1388–1407, 978-0-7817-7968-5.

Fylstra D. Medical management of ectopic pregnancy ACOG Practice Bulletin No. 98. Obstet Gynecol. 2008;111:1479–85.

Herman H et al. Clinical characteristics of adnexal torsion in premenarchal patients. Arch Gynecol Obstet. 2015;293(3):603–8.

Karayalçın R, Özcan S, et al. Conservative laparoscopic management of adnexal torsion. J Turk Ger Gynecol Assoc. 2011;12(1):4–8.

McNeely G, Hendrix S, et al. Medically sound, cost effective treatment for pelvic inflammatory disease and tuboovarian abscess. Am J Obstet Gynecol. 1998;178(6):1272–8.

Sandesh V. Parelkar, et al. Should the ovary always be conserved in torsion? A tertiary care institute experience. J Pediatr Surg 2014;49(3):465–8.

Pfeifer S, Goldberg J, Lobo R, et al. Fertil Steril. 2008;90:206–12.

Rosen M, Breitkpf D, Waud K. Tubo-ovarian abscess management options for women who desire fertility. Obstet Gynecol Surv. 2009;64(10):681–9.

Schraga ED, Fleischer AC, Lin EC. Ovarian torsion. Medscape. May 17, 2016 emedicine.medscape.com/article/2026938-overview last assessed 11 Nov 2016

Seeber BE, Barnhart KT. Suspected ectopic pregnancy. Obstet Gynecol. 2006;107(2):399–413.

Swenson D et al. Ovarian torsion: case-control study comparing the sensitivity and specificity of

ultrasonography and computed tomography for diagnosis in the emergency department. Eur J Radiol. 2014;83(4):733–8.

Tan, T, Tan K et al. Practical obstetrics and gynaecology handbook for clinicians and general practitioners. World Sci, 2014; 50.

Teng SW, Tseng JY, et al. Comparison of laparoscopy and laparotomy in managing hemodinamically stable patients with ruptured corpus luteum with hemoperitoneum. J Am Assoc Gynecol Laparosc. 2003;10:474.

Tulandi, Togas. Ectopic pregnancy. Clin Manifestations Diagn. [Cited September 2015] Available from http://www.uptodate.com/contents/ectopic-pregnancy-clinical-manifestations-and-diagnosis?source=search_result&search=ruptured+ectopic&selectedTitle=1~150.