Diagnosing And Managing Ovarian And Adnexal Torsion In Children

Abstract

Although ovarian torsion is rare in children, it is frequently misdiagnosed in the broad differential diagnosis of its major presenting symptom: abdominal pain. In addition to the pain that ovarian torsion causes, when left untreated, ovarian torsion represents a significant threat to the future fertility of girls. This review looks at the evidence on diagnosing ovarian torsion, focusing particularly on diagnostic imaging modalities and the major guideline recommendations to effectively differentiate ovarian torsion from the many other possible causes of abdominal pain in the pediatric female. Literature regarding the relevance of symptom duration in the prediction of ovarian salvageability is discussed as well as recurrence, complications, and conservative operative management. A combination of findings from the history, the physical examination, and ultrasound imaging will guide emergency clinicians in prompt and effective surgical referrals for ovarian torsion, offering patients the best hope to avoid morbidity.

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CME Objectives

Upon completion of this article, you should be able to:
1. Describe the possible clinical presentations of ovarian torsion in children.
2. Perform an evidence-based diagnostic workup of the patient who potentially has ovarian torsion.
3. Describe the ultrasonographic manifestations of ovarian torsion and recognize the potential pitfalls of ultrasound interpretation.
4. Discuss the controversies in the surgical management of children with ovarian torsion.

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Case Presentation

In the middle of a busy shift, you go in to see a 13-year-old female who has presented with 3 hours of constant, “cramping” right lower quadrant pain that awoke her from sleep. Since the onset of pain, she has had 10 episodes of emesis. She denies any sexual activity, and her last menstrual period was approximately 3 weeks prior. Her vital signs are appropriate for her age, and she is in moderate distress secondary to pain. Her physical examination is unremarkable except for tenderness to palpation in the right lower quadrant and suprapubic area. Although your first thought is that this patient has appendicitis, you want to make sure that you do not miss the possibility of ovarian torsion. You wonder how often ovarian torsion occurs in children and how you should proceed in the diagnostic work-up of this patient. You order basic blood work and a urinalysis, but what will you do if they are normal? Should you order a CT or an ultrasound, or should you just call the surgeon? You remember one of your partners recently had a young patient who presented similarly. She had several days of worsening symptoms, and in the ED her ultrasound showed a complex pelvic mass. Gynecology took the patient to the operating room and discovered that she had an ovarian teratoma that had torsed. The ovary was removed because it appeared necrotic. You wonder: if this patient has torsion, does the duration of her symptoms have any prognostic value? You remind yourself to ask the gynecologist if an ovary that appears ischemic at the time of surgery should be removed, and if there is any risk if it is detorsed and left in place.

Introduction

Abdominal pain is one of the most frequently encountered complaints in pediatric emergency medicine, and the emergency clinician must determine who among these patients may have serious pathology and needs further evaluation or management. Ovarian torsion is one of the “cannot miss” diagnoses that presents with abdominal pain, and it must be considered in every case of abdominal pain in a female patient. Nonetheless, ovarian torsion in the pediatric patient is an uncommon event and is frequently a challenging diagnosis to make. Clinicians who care for children in the acute setting can avoid missing this diagnosis by being aware of the symptoms and the diagnostic findings and by maintaining vigilance for ovarian torsion. This issue of Pediatric Emergency Medicine Practice focuses on the evaluation and management of the patient with suspected ovarian torsion, using the best available evidence from the literature.

Critical Appraisal Of The Literature

Ovid MEDLINE® was searched, through PubMed, for articles published since 1970. Keywords were torsion and adnexal or ovarian. Over 1300 results were retrieved, and titles and abstracts were reviewed for relevance. Papers focusing on torsion during fertility treatment or in pregnant patients and antenatal torsion were specifically excluded. More than 130 papers focusing on pediatric patients were included in this review. Nothing of relevance was found in a search of the Cochrane Database of Systematic Reviews, while a search of the National Guideline Clearinghouse (http://www.guidelines.gov) resulted in 3 relevant documents from the American College of Radiology.1-3 (See Table 1.)

The literature on history and physical examination findings is based predominantly on older, retrospective case series, with some recent additions. The majority of the literature on diagnostic imaging for ovarian torsion has been published in the last 20 years, with emphasis on ultrasonography and Doppler techniques. Since the primary challenge for the emergency clinician is making the diagnosis of ovarian torsion, a significant portion of this article will be devoted to reviewing the literature on diagnostic imaging. Unfortunately, much of this is based on retrospective case series, with very few prospective studies and no randomized trials. Recently, there has been some investigation into biomarkers for ovarian torsion, although the sample sizes are small or use animal models and, therefore, have limited applicability for the emergency clinician.

Other notable contributions to the recent literature deal with operative strategies, specifically with regard to ovarian conservation and functional outcome. There are some larger case series and a few prospective studies, although there is, again, an absence of any randomized trials. Although much has been written about the diagnosis and treatment of ovarian torsion, we are limited by an overwhelming preponderance of anecdotal and retrospective data, so there is little true evidence to support much of current practice.

Epidemiology, Etiology, And Pathophysiology

Ovarian torsion is an infrequent cause of acute abdominal pain. In one estimate, it accounts for only 2.7% of cases in adult females.4 Pediatric patients account only for about 15% of all cases of ovarian torsion,4 with major centers reporting 0.3 to 3.5 cases of pediatric ovarian torsion per year.5 Ovarian torsion is described in all ages and is, overall, more common after menarche, although among pediatric patients, the average age is 10 years and many patients are premenarchal. In one series, the age range was 3 years to 15 years (mean 10.2), and 15 of 22 patients were premenarchal.6 Guthrie et al identified 1232 pediatric (ie, 20 years of age or younger) cases of ovarian torsion from the Kids’ Inpatient Database in 2006. This database
included data from 3739 hospitals in 38 states, allowing the authors to calculate a national estimate of 1965 total cases, or an annual incidence of 4.9 per 100,000 females aged 1 to 20 years.\textsuperscript{7} This is comparable to the rate of testicular torsion in a similar age group: 4.5 per 100,000 males aged 1 to 25.\textsuperscript{7}

Ovarian torsion begins when an ovary twists on its pedicle. As the lymphatic drainage and venous outflow become obstructed, the ovary becomes engorged and edematous. Continuing increases in parenchymal pressure finally lead to the late findings of arterial occlusion and ovarian infarction.\textsuperscript{6} Torsion may involve the ovary, the fallopian tube, or both (from one series, the relative percentages are 31%, 10%, and 59% of patients, respectively).\textsuperscript{8} Untreated, ovarian torsion typically results in autoamputation with calcification and functional loss of the ovary, although rare cases of mortality attributable to ovarian torsion have been reported.\textsuperscript{9-13}

Physiologic factors that may predispose a patient to ovarian torsion include abrupt changes in intra-abdominal pressure from vomiting and coughing or sudden movements such as jumping on a trampoline.\textsuperscript{14} Anatomic factors predisposing to ovarian torsion include benign or malignant masses and ovarian cysts. Polycystic ovary syndrome (PCOS) has also been diagnosed in some premenarchal patients with ovarian torsion.\textsuperscript{15} Elongation of the fallopian tube or its supportive ligaments has also been implicated.\textsuperscript{16-18} Interestingly, an irreducible inguinal hernia may contain a torsed ovary, although this is typically seen only in patients less than 1 year of age.\textsuperscript{19,22} Between 40% and 84% of surgical specimens contain some pathological feature; in the Guthrie cohort, 58% of the ovaries were abnormal.\textsuperscript{7} Premenarchal children are more likely to have mature cystic teratomas or normal ovaries, while postmenarchal children are more likely to have follicular or corpus luteal cysts. The risk of torsion is related to the size of the cyst or mass, reaching a peak in cysts measuring 4 cm to 5 cm. In pediatric patients, malignancy is very uncommon.\textsuperscript{23-25} It is hypothesized that the local inflammation and adhesion associated with malignancies fixes the ovary in place and thus decreases the likelihood of torsion. Oltmann et al calculated an overall malignancy rate by combining 4 malignancy cases in their own series of 114 patients with 9 malignancies from 593 other patients identified through an exhaustive literature review. By combining these cases, they calculated an overall malignancy rate of only 1.8%.\textsuperscript{26}

### Differential Diagnosis

Since abdominal pain is the hallmark symptom of ovarian torsion, the differential diagnosis is broad and includes many abdominal and gynecological etiologies. (See Table 2, page 4.) Because ovarian torsion can mimic more common causes of pain, it is frequently misdiagnosed. Often, the diagnosis is made only after the patient has been taken to the operating room for a different presumed etiology, with suspected acute appendicitis representing many of these cases.\textsuperscript{27-35} Ovarian torsion has also been mistaken for intussusception in the very young.\textsuperscript{36,37} Microscopic hematuria is occasionally seen, which can lead to a misdiagnosis of nephrolithiasis.\textsuperscript{38} There is such a significant overlap in the clinical presentations of ovarian torsion and acute appendicitis that distinguishing the 2 disorders can be quite challenging.\textsuperscript{39,40} There are even a few case reports of ovarian torsion with concurrent appendicitis.\textsuperscript{41} In one series, 17% of patients (9 of 51) with ovarian torsion were diagnosed during surgery for acute appendicitis.\textsuperscript{16} In the only study directly comparing

### Table 1. American College Of Radiology Guidelines On Imaging In Suspected Ovarian Torsion\textsuperscript{1-3}

<table>
<thead>
<tr>
<th>Title</th>
<th>Recommendations</th>
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| ACR Appropriateness Criteria® Acute Pelvic Pain in the Reproductive Age Group\textsuperscript{1} | In the nonpregnant patient with acute pelvic pain when a gynecologic etiology is suspected:  
- Pelvic ultrasound with Doppler as an adjunct is usually appropriate  
- MRI may be appropriate if ultrasound is inconclusive or nondiagnostic  
- CT may be appropriate if ultrasound is inconclusive or MRI is not available. Cumulative radiation dose should be considered in patients undergoing repeat imaging. |
| ACR Appropriateness Criteria® Clinically Suspected Adnexal Mass\textsuperscript{2} | For the initial evaluation of the nonpregnant reproductive-age female with clinically suspected adnexal mass:  
- Pelvic ultrasound (transabdominal, transvaginal, and Doppler, depending on the clinical circumstance) is most appropriate  
- MRI may be appropriate as a second-line if ultrasound is inconclusive or technically limited  
- CT is least appropriate |
| ACR Practice Guideline for the Performance of Magnetic Resonance Imaging (MRI) of the Soft-Tissue Components of the Pelvis\textsuperscript{3} | Indications for MRI of the pelvis include evaluation of pelvic pain, mass, cyst, or suspected torsion |

Note: All recommendations are evidence-based consensus guidelines.  
Abbreviations: ACR, American College of Radiology; CT, computed tomography; MRI, magnetic resonance imaging.
Prehospital Care

Ovarian torsion is unlikely to be suspected in the prehospital environment, and there is no literature that explores the out-of-hospital management of these patients. However, prehospital providers frequently encounter patients with undifferentiated abdominal pain and should be able to provide appropriate and patient-specific care. History should include menstrual history, including whether the patient is known to be pregnant and at what stage. Management may include obtaining intravenous (IV) access and administering fluids or analgesics. Prehospital providers should also be able to recognize the signs and symptoms of shock and be able to intervene appropriately. Patients with abdominal pain should be expeditiously transported to an appropriate facility for further investigation and management. Local protocols may further dictate that pediatric patients only be transported to facilities with capability and experience in the imaging and surgical management of children.

Table 2. Differential Diagnosis For Abdominal Pain In The Pediatric Female

<table>
<thead>
<tr>
<th>Abdominal or Genitourinary Causes</th>
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<tbody>
<tr>
<td>Appendicitis</td>
</tr>
<tr>
<td>Cholecystitis</td>
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<tr>
<td>Gastroenteritis</td>
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<tr>
<td>Intestinal obstruction</td>
</tr>
<tr>
<td>Intussusception</td>
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<tr>
<td>Nephrolithiasis</td>
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<tr>
<td>Mesenteric adenitis</td>
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<tr>
<td>Pancreatitis</td>
</tr>
<tr>
<td>Urinary tract infection</td>
</tr>
<tr>
<td>Gynecologic Causes</td>
</tr>
<tr>
<td>Ectopic pregnancy</td>
</tr>
<tr>
<td>Mittelschmerz</td>
</tr>
<tr>
<td>Ovarian cysts</td>
</tr>
<tr>
<td>Ovarian torsion</td>
</tr>
<tr>
<td>Pelvic inflammatory disease</td>
</tr>
<tr>
<td>Tubo-ovarian abscess</td>
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</tbody>
</table>

Emergency Department Evaluation

History

The hallmark symptom of ovarian torsion is abdominal pain, and all patients presenting with abdominal pain should be questioned about its onset, location, and character. Ovarian torsion classically presents with the sudden onset of severe, constant, unilateral pain in the pelvis or lower abdomen. For unclear reasons, it is seen more frequently on the right side than the left side. In a series of 45 cases, all but one case described an abrupt onset of pain. Although the pain of ovarian torsion is usually constant, it may be intermittent or episodic, and this is believed to result from spontaneous torsion and detorsion. When specifically asked, many patients with ovarian torsion will recall a history of similar pain in the past. Furthermore, spontaneous detorsion has been documented in several cases and should be considered in a patient with severe pain that has resolved. The emergency clinician should also inquire about associated symptoms. Although nausea is nonspecific, it is very frequently seen with ovarian torsion, and 60% of patients in one series had vomiting synchronous with pain onset. In addition to gastrointestinal symptoms, patients may also complain of urinary tract symptoms such as dysuria, frequency, or retention.

Physical Examination

The physical examination is essential to help narrow the differential diagnosis in any child presenting with abdominal pain. Although the physical examination is often nonspecific in cases of ovarian torsion, it may help exclude alternative diagnoses. Vital signs are often normal; however, low-grade fever and tachycardia may be present in some patients. On palpation of the abdomen, many patients will have tenderness in the lower abdomen or pelvis. Signs of peritonitis are variably present. Upper abdominal tenderness should prompt a search for other causes, such as pancreatitis or cholecystitis. It may be possible to palpate a pelvic mass in patients in whom a large cyst or teratoma has caused the torsion. In females who are not sexually active, an internal pelvic examination should not be performed; however, inspection of the external genitalia to look for signs of abuse, trauma, tumor, or infection is warranted. A complete pelvic examination should be considered routine in the sexually active patient, especially when other signs or symptoms of pregnancy or pelvic infection are present.

Diagnostic Studies

Laboratory Testing

Pregnancy can be excluded by means of urine hCG pregnancy test; otherwise, unfortunately, routine
Of the various imaging modalities available for the diagnosis of ovarian torsion, pelvic ultrasound is the most useful because it can be performed quickly, provides good visualization of the pelvic organs, and does not incur the risks of radiation exposure. Furthermore, it is recommended by several guidelines as the first-line imaging modality in females with acute pelvic pain or a pelvic mass. In the prepubescent female who is not sexually active, transabdominal ultrasonography should be performed. In the older, sexually active patient, the transvaginal approach could be used after informed consent of the patient. Ultrasound can demonstrate adnexal masses that may present with ovarian torsion in children, such as teratomas or simple cysts (ovarian or para-ovarian).

The most common ultrasound finding is an enlarged heterogeneous ovary or adnexal mass with nonidentification of the ipsilateral ovary. According to one study, the median volume of a torsed ovary is 12 times that of the normal contralateral ovary, and this equates to a 2.3-times larger mean diameter. A similar report found that an adnexal volume less than 20 mL by ultrasound had a strong negative predictive value for ovarian torsion and that a volume more than 15 times that of the contralateral ovary was 100% specific but only 40% sensitive for ovarian torsion.

Pelvic Ultrasound

Plain Radiography

Plain radiography is unlikely to be useful in evaluating a young female for appendicitis or ovarian torsion. Most often, plain films are normal, but, rarely, they will give a clue to the diagnosis. In a study of plain radiography in children with abdominal pain, Rothrock et al concluded that it was normal or misleading in 77% of cases of appendicitis. Overall, plain radiographs are often misleading, incur additional costs, and should not be routinely performed.

Figure 1. Abdominal X-Ray Showing Calcification In The Right Pelvis

Arrow points to tooth inside a mature ovarian teratoma that has torsed. Image used courtesy of Marianne Gausche-Hill, MD.

Figure 2. Congested Ovary And Cyst With The Twisted Pedicle Clearly Visible

Photo is intraoperative photo of patient in Figure 1. Image used courtesy of Marianne Gausche-Hill, MD.
of an enlarged, edematous ovary is not specific to ovarian torsion, although in a nontorsed ovary it may be an indication of intermittent ovarian torsion or spontaneous detorsion. 63,64 (See Figure 3.)

Another finding that is highly suggestive of ovarian torsion is the presence of multiple peripheral cortical follicles diluted with transudative fluid from the congested ovary. 60,66 This is usually seen on ultrasound, but it has also been reported on computed tomography (CT) and magnetic resonance imaging (MRI). 67-71 However, similar peripheral follicles are often found in patients with PCOS or even in normal subjects. 72 Ipsilateral uterus deviation may also be seen with ovarian torsion, but this finding has not been widely investigated and is likely of limited sensitivity and specificity. 73

Finally, the ultrasound examination frequently includes Doppler interrogation. Arterial flow may be normal in as many as two-thirds of patients with ovarian torsion and thus is not useful in excluding the diagnosis. 20,56,61,65,74 This is because torsion initially obstructs only lymphatic and venous flow, with arterial occlusion occurring late in the course. Furthermore, the ovary receives blood from both the ovarian artery and branches of the uterine artery. In some studies, absence or abnormal flow in the ovarian vein was 100% sensitive for ovarian torsion. 75,76 Other researchers have found venous flow in one-third or more of patients with proven ovarian torsion. 61,62 Another study proposed a classification scheme based on flow, as seen by ultrasound, into 3 classes: Class 1: arterial and venous flow, Class 2: arterial flow without venous flow, and Class 3: neither arterial nor venous flow. 77 This study, and others, described worsening appearance of the torsed ovary at the time of surgery, with progression through the classes, and decreased likelihood of infarction when arterial flow was seen. 77-80 The Doppler signal is, technically, not specific, even when absent, since this finding is occasionally encountered in normal subjects. 81 Nevertheless, the absence of flow in a symptomatic patient should be interpreted as highly concerning for ovarian torsion. (See Figure 4.)

Another notable finding includes the pathognomonic sonographic “whirlpool sign” (also referred to by some authors as “coiling”), which directly detects the twisted vessels in the vascular ovarian pedicle. 79,82 This sign is rarely observed and requires that the sonographer use specific techniques to intentionally seek it out. 82-85

### Table 3. Possible Ultrasound Findings In Ovarian Torsion

<table>
<thead>
<tr>
<th>Finding</th>
<th>Comment</th>
</tr>
</thead>
<tbody>
<tr>
<td>Adnexal mass</td>
<td>Especially if &gt; 5 cm</td>
</tr>
</tbody>
</table>
| Enlarged, heterogeneous ovary  | Average diameter is 2.3 times the size of normal contralateral ovary  
                                | Ovarian volume < 20 mL has strong negative predictive value |
| Multiple peripheral cortical follicles | May also be seen on CT or MRI |
| Ipsilateral uterus deviation   | Limited sensitivity and specificity          |
| Abnormal Doppler flow          | Not sensitive, but may have prognostic value (see discussion on page 6) |
| Whirlpool sign                 | Pathognomonic, but often not seen            |
|                                | Requires expertise on part of sonographer    |

Abbreviations: CT, computed tomography; MRI, magnetic resonance imaging; OT, ovarian torsion.

### Figure 3. Ultrasound Image Showing Portions Of An Enlarged Right Ovary

![Image](https://example.com/image.png)

Arrows point to large septated ovarian cyst.
Image used courtesy of Marianne Gausche-Hill, MD.

### Figure 4. Doppler Ultrasound Image Of Right Ovary

![Image](https://example.com/image.png)

Arrows point to lack of blood flow in right ovary.
Image used courtesy of Marianne Gausche-Hill, MD.
In summary, most ultrasound diagnoses of ovarian torsion will be made on some combination of ovarian enlargement, dilated peripheral follicles, abnormal Doppler flow, or visualization of twisted ovarian vessels. The combination of lower abdominal pain and an abnormal ultrasound should trigger consultation with gynecology for consideration of laparoscopy to confirm the diagnosis of ovarian torsion.

**Computed Tomography And Magnetic Resonance Imaging**

In ovarian torsion, CT may corroborate some of the findings previously mentioned, including masses or cysts, ovarian enlargement, or peripheral follicles. CT may also be more suitable to demonstrate subtle deviation of the uterus and affected ovary toward each other. Nevertheless, CT is most helpful to exclude alternative diagnoses. It is not recommended as the initial diagnostic imaging test when ovarian torsion is suspected as the primary diagnosis. Some published guidelines list CT as being less appropriate than ultrasound and MRI. There are also multiple reports of MRI being used in the diagnosis of ovarian torsion, and concern for ovarian torsion is an accepted indication for MRI, according to one published guideline. The limited availability and the challenges associated with obtaining an MRI are likely to significantly limit its utility in the emergent setting; however, it may have a role for patients with an unclear diagnosis after ultrasound.

**Accuracy Of Diagnostic Imaging**

The true accuracy of imaging in pediatric ovarian torsion varies greatly between studies. In one series, 19 of 20 ultrasounds and 4 of 5 CT examinations were diagnostic, with the same single patient accounting for both false negatives. Another series had a false-negative rate of 7% (3 of 43) for ultrasound. In yet another series, ultrasound suggested torsion in only 29% to 40% of cases, although in nearly all cases the examination was abnormal in some fashion. Sonographer experience will also impact the diagnostic accuracy of ultrasound, with one group of experienced providers achieving a diagnostic accuracy of 74.6%. Further research and prospective studies are needed to elucidate the accuracy and best use of diagnostic imaging for ovarian torsion. Given the variable accuracy of imaging, there should be a low threshold for specialist consultation and strong consideration for diagnostic laparoscopy in patients with concerning clinical presentations, even when the imaging is not diagnostic.

**Conservative Treatment With Detorsion And Ovarian Salvage**

Ovarian salvage with detorsion was initially utilized in patients who had contralateral recurrence of ovarian torsion after a previous oophorectomy. Currently, laparoscopic detorsion and oophoropexy with excision of any cysts is increasingly being performed and advocated by many experts as the standard initial treatment for ovarian torsion. Although this approach is gaining in acceptance, it has not yet been universally adopted. In a series from one institution, conservative treatment with detorsion was only performed in 42% of patients before 2002 but in 79% of patients from 2002 forward. Guthrie found that the oophorectomy rate increased with younger age, zip codes with lower median income, and presence of benign neoplasm. Conservative management with detorsion and ovarian salvage has been shown in multiple case series to lead to good functional outcomes, helping to preserve a patient’s type of intervention is controversial. The majority of patients still undergo the traditional surgical management, which is salpingo-oophorectomy; however, this has a significant negative impact on future fertility, as it leaves the patient with only 1 ovary. This puts the patient at risk for infertility and castration if she should develop contralateral torsion or another disease process that necessitates removal of the remaining ovary. Given the well-described risk of contralateral torsion, it has been recommended that oophoropexy of the remaining ovary be performed when a torsed ovary is removed. Given the significant morbidity associated with oophorectomy, if concern for underlying malignancy in situ is one of the most serious. Nonetheless, there are no reports of malignancy in pediatric patients treated with detorsion alone, and given the extremely low rate of malignancy in pediatric ovarian torsion, a conservative approach seems most reasonable. There is also a theoretical risk that detorsion may release emboli from the ischemic ovary; however, Guthrie et al did not identify any cases of pulmonary embolism (PE) in their cohort, and this complication has never been reported in a pediatric patient. Furthermore, a review of the literature (including pediatric and adult patients) determined that detorsion does not carry an increased risk of PE when compared with oophorectomy. The only well-described complication from conservative surgery is fever, which is self-limited. The final argument for removal of the torsed ovary is concern for lack of viability, but recent evidence (discussed in the next section) has shown that this concern is overstated.
Clinical Pathway For Management Of Ovarian Torsion In Children

Pediatric female with acute or recurrent abdominal pain

- Perform appropriate history and physical examination
- Order UA and urine HCG
- Add GC/Chlamydia if sexually active

Does initial evaluation exclude OT or provides an alternative diagnosis?

YES

Treat alternative diagnosis accordingly

Ultrasound diagnostic for OT

Consult gynecology and prepare patient for surgery

NO

Perform pelvic ultrasound (Class II) (Transabdominal if prepubescent, transvaginal if sexually active)

Ultrasound abnormal, but not diagnostic

Discuss case with gynecology

Consider MRI or diagnostic laparoscopy (Class III)

Ultrasound completely normal or provides alternative diagnosis

Re-evaluate, consider, and treat alternative diagnoses

If patient is well-appearing and pain-free, consider discharge with close follow-up and strict return precautions

Abbreviations: GC, gonorrhea culture; MRI, magnetic resonance imaging; OT, ovarian torsion; UA, urinalysis.

Class Of Evidence Definitions

Each action in the clinical pathways section of Pediatric Emergency Medicine Practice receives a score based on the following definitions.

Class I
- Always acceptable, safe
- Definitely useful
- Proven in both efficacy and effectiveness

Level of Evidence:
- One or more large prospective studies are present (with rare exceptions)
- High-quality meta-analyses
- Study results consistently positive and compelling

Class II
- Safe, acceptable
- Probably useful
- Level of Evidence:
  - Generally higher levels of evidence
  - Non-randomized or retrospective studies: historic, cohort, or case control studies
  - Less robust randomized controlled trials
  - Results consistently positive

Class III
- May be acceptable
- Possibly useful
- Considered optional or alternative treatments
- Level of Evidence:
  - Generally lower or intermediate levels of evidence
  - Case series, animal studies, consensus panels
  - Occasionally positive results

Indeterminate
- Continuing area of research
- No recommendations until further research
- Level of Evidence:
  - Evidence not available
  - Higher studies in progress
  - Results inconsistent, contradictory
  - Results not compelling


This clinical pathway is intended to supplement, rather than substitute for, professional judgment and may be changed depending upon a patient’s individual needs. Failure to comply with this pathway does not represent a breach of the standard of care.

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future fertility. In the study by Aziz et al, all the patients who underwent detorsion and follow-up demonstrated normal ovaries based on either ultrasonographic appearance or biopsy. Other authors also report normal function after detorsion in the majority of patients, including 17 of 26 in a study by Galinier et al, 13 of 14 patients in a study by Celik et al, and 33 of 35 in a study by Wang et al.

**Viability Of The Torsed Ovary**

Of special note, a considerable number of the ovaries in the above studies that were found to be functional at follow-up had appeared grossly “black-bluish” immediately after detorsion. This has allowed several authors to conclude that the macroscopic appearance of the ovary at the time of surgery is not a reliable indicator of necrosis. Furthermore, prolonged symptom duration is not a reliable predictor of ovarian salvageability. In a retrospective case series of 22 patients by Anders and Powell, patients undergoing oophorectomy and those undergoing detorsion shared the same mean duration of pain prior to presentation, namely 76 hours. A study by Aziz et al had a similar finding, with both groups sharing a median duration of 48 hours. Interestingly, both of these studies (and others) found that patients undergoing oophorectomy had a longer time from initial evaluation to surgery. In the first series, the duration was 21 hours versus 11 hours (though not statistically significant); in the second series, the duration was 27 hours versus 14 hours.

The difference in time to surgery can probably be explained by the fact that patients undergoing detorsion were more likely to have received the correct preoperative diagnosis of ovarian torsion (94% vs only 47% of patients who underwent oophorectomy). Aziz et al also found that general surgeons performed 60% of oophorectomies but only 6% of detorsions. This suggests that the evaluating clinician can positively influence a patient’s course and outcome by making the correct initial diagnosis and involving the appropriate consultant.

In summary, the benefits of conservative management have been well demonstrated and appear to outweigh any risks, considering the exceedingly low risk for malignancy in the pediatric age group and the absence of any other complication.

**Special Circumstances**

Patients who have had a prior episode of ovarian torsion represent a unique group and deserve special attention, especially if they were previously treated with oophorectomy. It is known through numerous reports that ovarian torsion may recur on the side ipsilateral or contralateral to the side of an earlier episode of ovarian torsion, and torsion of an anatomic ally normal ovary seems to be a risk factor for subsequent contralateral torsion. Recurrent torsion is uncommon, but in one series, ovarian torsion recurred in 4 patients out of 76 who previously had ovarian torsion. Simultaneous bilateral torsion has also been reported but appears to be quite rare. When a patient whose past surgical history includes an episode of ovarian torsion presents for evaluation of abdominal pain, the emergency clinician must be vigilant for a recurrence and should have a very low threshold for consultation with gynecology and diagnostic laparoscopy to investigate the possibility of ovarian torsion.

Occasionally, the fallopian tube is torsed and the ovary is not involved. These patients will have a similar presentation to ovarian torsion, and the ultrasound examination is typically abnormal but not diagnostic. The symptoms and abnormal imaging should trigger a consultation with gynecology, and the diagnosis of isolated tubal torsion is usually made intraoperatively. Torsed tubes are usually treated with salpingectomy, although conservative treatment with detorsion might also be feasible.

**Controversies And Cutting Edge**

Ongoing efforts are focusing on improving our ability to accurately diagnose ovarian torsion, and several novel therapeutic interventions have been proposed. One study described the adjunctive use of ovarian “bivalving” (making a bivalve incision along the ovarian cortex) to facilitate reperfusion after detorsion. Although the cases in this series were reported to have had good functional outcome, it is unclear whether this technique adds any benefit to simple detorsion, and no other studies have looked at this technique.

The use of hyperbaric oxygen therapy for treatment of an ischemic ovary after detorsion has also been reported in a single case, and it may be worth further study.

Novel biomarkers that have shown promise in animal models may have a role in the diagnostic evaluation of patients with concern for ovarian torsion, but they need to be prospectively studied in humans. As more patients are being treated with detorsion and ovarian salvage, prospective long-term follow-up will need to be published to support the safety of this approach and to facilitate its universal adoption.

**Disposition**

All patients with concern for ovarian torsion based on findings from the history, physical examination, and pelvic ultrasound require emergent consultation with gynecology. Since the definitive diagnostic
and therapeutic intervention will be surgery, the emergency clinician should keep the patient nil per os (NPO), start IV maintenance fluid, and treat the patient’s pain while awaiting consultation. Patients presenting with abdominal pain in which the emergency department evaluation reveals an alternative diagnosis should be managed accordingly. Many patients who present to the emergency department with abdominal pain do not have a diagnosis determined after their evaluation. Patients who are well-appearing and have had relief of their pain can be discharged with strict return precautions and close follow-up arranged, and it is prudent to have these patients return within 24 hours for a recheck. In patients with ongoing symptoms despite a negative evaluation, the clinician must decide whether a surgical consultation or admission for observation will be beneficial.

### Summary

Ovarian torsion is an uncommon, but important, cause of abdominal pain in children, and a missed or delayed diagnosis can be catastrophic for the patient. There is significant overlap in the clinical manifestations between ovarian torsion and other more common causes of abdominal pain such as appendicitis; therefore, the clinician needs to maintain a high index of suspicion for this entity. Every patient suspected of having ovarian torsion should undergo a pelvic ultrasound. The ultrasound will be abnormal in essentially all cases of ovarian torsion, and it may reveal highly concerning findings such as a whirlpool sign or multiple peripheral follicles. More likely, it will show more nonspecific findings like ovarian enlargement or cysts. The clinician must

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### Risk Management Pitfalls For Ovarian Torsion In Children (Continued on page 11)

1. **“The patient was only 6 years old; I didn’t consider a gynecologic cause for her pain.”**
   Although gynecologic causes of abdominal pain are uncommon in children, ovarian torsion can occur at any age. The differential diagnosis for any patient with concerning symptoms needs to include ovarian torsion, regardless of age. Even premenarchal patients need a pelvic ultrasound, which can be done transabdominally.

2. **“Since the patient was previously found to have an ovarian cyst, I didn’t think we needed to reimage her.”**
   Ovarian cysts are known to predispose patients to ovarian torsion, especially when intermediate in size (eg, 5 cm). A patient with a previous history of an ovarian cyst and acute pelvic pain must be evaluated for ovarian torsion, and repeat ultrasound is indicated.

3. **“She had right lower quadrant pain with vomiting, a low-grade fever, and was tender on examination. It sounded like a classic case of appendicitis, so I called the surgeon. I was surprised when they called from the operating room to tell me that her ovary was torsed.”**
   Ovarian torsion is frequently misdiagnosed as acute appendicitis because there is significant overlap between the clinical presentations of these 2 disorders. Before making the clinical diagnosis of appendicitis in a female, ovarian torsion should first be excluded with a pelvic ultrasound.

4. **“She told me that the pain had been coming and going and that she’d had similar episodes of pain previously, so I didn’t think it was anything serious.”**
   Many patients with ovarian torsion will report previous episodes of similar pain. Intermittent torsion has been well-described, and patients can have spontaneous detorsion and may not seek medical attention until they have an episode that is prolonged or more severe than they have previously experienced. A history of prior pain should actually raise your suspicion for ovarian torsion and trigger further investigation.

5. **“She seemed to be in a fair amount of pain, but she didn’t have any tenderness on examination. I discharged her, and when she came back the next day, my partner diagnosed her with ovarian torsion.”**
   The hallmark of ovarian torsion is abdominal pain; all other symptoms and findings can be variable. A patient with ovarian torsion may not have a significant amount of tenderness on examination, but it may be possible to palpate a pelvic mass when there is a large cyst or teratoma predisposing to the torsion. The clinical history should be enough to raise the suspicion of ovarian torsion even in the absence of physical findings, and further evaluation with ultrasound is indicated, especially in the patient with ongoing pain.

6. **“She had an elevated CRP and her WBC count was up, so I ordered a CT to look for appendicitis. I wasn’t expecting the radiologist to call and tell me that the scan showed she had a pelvic mass.”**
be aware that in the majority of cases, some amount of Doppler flow is actually present and hence cannot be used to exclude the diagnosis. Thus, a combination of findings (history, physical examination, and an abnormal ultrasound) must be used to establish the diagnosis of ovarian torsion. Consultation with gynecology is mandated in all cases of suspected ovarian torsion with an abnormal ultrasound, since all patients will need operative intervention. Surgeons are increasingly turning away from oophorectomy in favor of conservative procedures with detorsion. There are 3 reasons for this: (1) the risk of malignancy is exceedingly small in children with ovarian torsion, (2) the duration of symptoms and macroscopic appearance do not predict irreversible ischemia, and (3) there is a growing body of literature to support good functional outcomes and lack of complications after detorsion. By maintaining reasonable vigilance for ovarian torsion and recognizing the suggestive clinical findings, the emergency clinician can avoid missing a serious condition that carries a significant burden of morbidity.

**Case Conclusion**

The urine pregnancy test was negative, and the other lab tests that were ordered were unremarkable. The patient was given pain medication and taken for pelvic ultrasound, which revealed a normal uterus and a left ovary that was not enlarged. It contained 1 small, simple dominant follicle, and demonstrated low-resistance parenchymal blood flow. In contrast, the right ovary measured 8 x 7 x 15 cm and was dominated by an 8 x 7 x 10 cm complex cyst with thick internal septations. There was no

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**Risk Management Pitfalls For Ovarian Torsion In Children**

(Continued from page 10)

Elevated WBC and CRP are nonspecific and may be seen in many different causes of abdominal pain, including ovarian torsion. Although they are statistically higher in appendicitis than in ovarian torsion, they are not useful in differentiating the etiology in an individual patient. Ultrasound should always be considered in the pediatric female with lower abdominal pain, since it is noninvasive, does not expose the patient to radiation, and has reasonable diagnostic accuracy for appendicitis as well as other causes of pain.

7. “I ordered the ultrasound, but the ovary had Doppler flow, so I thought the ovary couldn’t be torsed.”

Doppler flow is not sensitive to exclude ovarian torsion, and it may actually be present in as many as two-thirds of patients with ovarian torsion. Abnormal venous flow may be more sensitive than lack of arterial flow, but it is not always reported. The ultrasound diagnosis of ovarian torsion is usually made on the basis of a combination of findings, none of which have high sensitivity individually.

8. “The ultrasound showed a significant ovarian enlargement, but it was bilateral, so I didn’t think it could be torsion.”

Ovarian enlargement in ovarian torsion is a common finding and likely has the highest sensitivity of the various possible ultrasound abnormalities. Bilateral torsion is rare, but not unheard of. Any concerning ultrasound findings in the setting of a suspicious clinical history should trigger a consultation with gynecology. Diagnostic laparoscopy is the definitive diagnostic modality and should be considered in patients without a clear diagnosis after imaging.

9. “The ovary didn’t have flow on the ultrasound, and my patient had been having pain constantly for 3 days. It was the middle of the night and I figured that, after this much time, there was no chance of saving the ovary, so I waited until the morning to call the gynecologist.”

Duration of symptoms has not been correlated with irreversible ischemia in ovarian torsion, and should not be used as a prognostic factor. Many patients have had their ovary salvaged even after multiple days of symptoms. With a definitive ultrasound diagnosis, the gynecologist should be called immediately and the patient prepared for the operating room, even if she has had prolonged symptoms.

10. “After the ultrasound showed ovarian torsion, I went to talk to the patient and her family and tell them the plan. They asked me what would happen, so I told them that she’d need to have her ovary removed.”

Although ovarian torsion has traditionally been treated with oophorectomy, recent studies have shown very good outcomes after detorsion and ovarian conservation. While this approach has not yet gained universal acceptance, an increasing number of patients are having their ovary salvaged, and this is likely to become the future standard of care.
Doppler flow to the right ovary, and the exam was therefore interpreted as torsion of an enlarged ovary containing a large complex cyst. Gynecology was consulted, and approximately 6 hours after ED presentation, the patient was taken to the operating room, where the right ovary was found to be torse twice and contained a 13-cm cyst. The patient was treated with detorsion and cysenteomy, and she was discharged from the hospital on the following day. Upon hearing of the patient’s positive outcome, you are glad that you had ovarian torsion on your differential diagnosis. At the end of the day, you considered whether she would have done so well had you not made a timely diagnosis.

Cost-Effective Strategies For Managing Ovarian Torsion In The Emergency Department

1. Resist the temptation to order “abdominal labs” in all patients. Indiscriminate ordering of “routine” laboratory tests is likely to be of little utility in most cases of lower abdominal and pelvic pain. A urine pregnancy test is the only laboratory test that should sent routinely. Rather, a focused evaluation based on those tests (if any) will be helpful to narrow the differential diagnosis. In many cases, an ultrasound will be the appropriate diagnostic tool and no laboratory tests will be necessary.

2. Always consider ultrasound when imaging is required to evaluate abdominal pain in female children. Ultrasound is easily performed and does not carry the risk of radiation exposure. Compared to CT, it has superior diagnostic accuracy for gynecologic pathology, and it is effective at identifying abdominal processes such as appendicitis and intussusception.

3. In a patient with an unclear diagnosis after ultrasound, consider consultation with a specialist before further imaging. CT and MRI have both been used in the diagnosis of pediatric abdominal pain and may be considered in the female child who does not have a clear diagnosis after ultrasound. Nonetheless, it is unclear whether diagnostic accuracy is improved by performing one of these studies after an indeterminate ultrasound. Since diagnostic laparoscopy is the definitive diagnostic tool, it is reasonable to consult with a specialist prior to pursuing additional imaging.

References

Evidence-based medicine requires a critical appraisal of the literature based upon study methodology and number of subjects. Not all references are equally robust. The findings of a large, prospective, randomized, and blinded trial should carry more weight than a case report.

To help the reader judge the strength of each reference, pertinent information about the study, such as the type of study and the number of patients in the study will be included in bold type following the references, where available. The most informative references cited in this paper, as determined by the author, will be noted by an asterisk (*) next to the number of the reference.

3. American College of Radiology. ACR practice guideline for the performance of magnetic resonance imaging (MRI) of the soft-tissue components of the pelvis. [online publication]. Reston (VA): American College of Radiology (ACR); 2010. (Consensus guidelines)
16. Kokoska ER, Keller MS, Weber TR. Acute ovarian torsion in chil-


4. The laboratory workup for a suspected case of ovarian torsion should include which of the following?
   a. Complete blood count
   b. D-dimer level
   c. Interleukin-6 level
   d. Urine hCG

5. The most common ultrasound finding in ovarian torsion is:
   a. Absence of Doppler flow
   b. Multiple dilated peripheral follicles
   c. An enlarged, edematous ovary
   d. Twisting of the ovarian vessels

6. In a patient with possible ovarian torsion, an abdominal/pelvis CT should be ordered:
   a. Routinely, because it has better diagnostic accuracy than other modalities
   b. First-line, if appendicitis is considered a more likely diagnosis
   c. In consultation with the surgeon if ultrasound is inconclusive and MRI is unavailable
   d. Never, because it cannot detect ovarian abnormalities

7. The only well-described complication of conservative surgical procedures with detorsion and ovarian salvage is:
   a. Abdominal sepsis
   b. Fever
   c. Pulmonary embolism
   d. Need for future surgery

8. During surgical intervention for a child with ovarian torsion:
   a. The appearance of the ovary can be used to predict irreversible ischemia.
   b. Symptom duration can be used to determine the need for oophorectomy.
   c. Oophoropexy can reduce the risk of recurrence in a detorsed ovary.
   d. Empiric oophorectomy should be performed because it has been shown to decrease the patient’s risk of malignancy.

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