Urgency of Evaluation and Outcome of Acute Ovarian Torsion in Pediatric Patients

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**Objective:** To describe the symptoms, diagnostic studies, and rate of ovarian salvage among children and adolescents with ovarian torsion.

**Methods:** We reviewed the medical records of all children with acute ovarian torsion treated at a university-affiliated pediatric hospital from 1987 to 2002; prenatal cases were excluded. For each child we recorded the time from onset of symptoms to initial examination and the time from initial examination to operation. We reviewed diagnostic tests used, operative reports, and pathology reports.

**Results:** We identified 22 cases; the mean age was 10.2 years (range, 3-15 years). In 6 cases (27%), the ovary was salvaged. Prolonged duration of symptoms prior to initial examination was not significantly associated with ovarian necrosis. Mean time of symptoms prior to care was 76 hours for both salvaged and nonsalvaged ovaries (range, 7-159 hours). The mean time from initial examination to operation, 11 hours for salvaged ovaries (range, 1-23 hours) and 21 hours for nonsalvaged ovaries (range, 2-71 hours), was not significantly different between groups. Twenty-one patients underwent imaging; 19 of 20 ultrasounds and 4 of 5 computed tomographic scans suggested the diagnosis. Less than half (10 of 22) of the torsed ovaries contained cysts, teratomas, or other masses.

**Conclusions:** These data suggest pediatric ovarian torsion is a more salvageable condition than previously reported. Prolonged time of symptoms prior to initial examination does not preclude ovarian salvage. Ovarian tumor accounts for less than half of cases. Urgent imaging and surgical management may lead to improved outcomes.


THE OVARY LIES SUSPENDED IN the abdomen, with vascular and lymphatic structures forming an axis between the uterus and the abdominal wall. In ovarian torsion, the ovary twists on this pedicle resulting in obstruction of venous and lymphatic drainage. Over time, the arterial supply of the ovary becomes compromised, causing infarction of the ovary. If torsion is recognized before infarction, the ovary can be surgically detorsed and normal blood flow restored. Ovarian salvage depends on both early diagnosis and definitive surgical management.

Data about the characteristics of prepubertal and adolescent girls with ovarian torsion are limited. A 2001 review of 51 pediatric patients (16 years and younger) concluded that most ovarian torsion was caused by ovarian pathologic features and that salvage was unlikely after 8 hours of abdominal pain. No ovaries were salvaged in this series because all 51 patients underwent salpingo-oophorectomy.1 In 2 earlier reports, together describing 24 pediatric cases of postnatal ovarian torsion, 2 ovaries were fully salvaged and another was only partially resected.2,3 Those reports concluded that the poor salvage rate resulted from diagnostic and surgical delay due to the nonspecific manifestation of ovarian torsion. Adolescent women were included in the largest case series of women (aged 14-82 years) with ovarian torsion (n=87).4 In this 2001 adult case series, 8 ovaries (9%) were salvaged; the authors concluded that the diagnosis is difficult and salvage of the ovary rare.

The purpose of this study was to understand if acute ovarian torsion is a potentially salvageable condition in pediatric patients and to describe the initial symptoms, diagnostic tests used, and the influence of the timeline of evaluation on ovarian salvage.

**METHODS**

We reviewed the medical records of all children with the diagnosis of acute ovarian tor-
We reviewed the medical records of 22 cases of acute ovarian torsion among girls aged 3 to 15 years (mean, 10.2 years). Most (15 of 22) were premenarchal. All 22 girls had complaints of abdominal pain. Location of pain and other common signs and symptoms are presented in Table 1. Location and quality of pain varied widely. Two girls had difficulty walking because of pain; 2 reported intermittent pain; 3 girls reported dull, aching, or cramping pain; 2 reported sharp, localized pain; and 3 reported that pain began in a lower quadrant and radiated diffusely to flank or entire abdomen. Nausea and vomiting were reported in most patients. No patients had a history of gynecologic problems or ovarian cysts. None had positive pregnancy test results.

All patients underwent laparotomy performed by pediatric surgeons. The right ovary was torsed in 12 of 22 cases. The affected ovary was salvaged in 6 (27%) of 22 patients. Surgical reports for the salvaged ovaries noted 2 ovaries with cysts (1 underwent cystectomy) and an additional healthy ovary with edema (on which a biopsy was performed). One girl had a torsed and necrotic section of fallopian tube, which required salpingectomy. We excluded cases of prenatal ovarian torsion. This code identified 36 patient records. From the 36 records, we identified 22 cases of acute ovarian torsion. Fourteen potential cases were excluded: 1 record was not found; 4 ruled out ovarian torsion; 3 referred to prenatal ovarian torsion; 3 referred to a history of torsion; 2 cases had teratoma without torsion; and 1 case was diagnosed with intermittent torsion and not operated on.

We abstracted the medical records for data including patient age; symptoms at initial examination; duration of symptoms prior to initial examination; time of initial examination; time of operation; laboratory tests and imaging studies performed; surgical outcome; and pathology reports. Surgical outcome was defined as salvage if the ovary was detorsed and all or part of the ovary returned to the patient. Medical records were abstracted by a single investigator (J.F.A.), and a sample of 5 medical records was abstracted by a second investigator (E.C.P.); no significant disagreements were found between the investigators.

In Table 1, Abdominal Pain reports the symptoms and findings. Abdominal pain was the most common symptom, occurring in 22 of 22 patients (100%). Additionally, 12 of 22 patients (55%) had a palpable mass. The Table also indicates that the most common locations of pain were the left lower quadrant (LLQ) and pelvic area, occurring in 5 and 3 patients, respectively.

We describe herein the manifestation and outcome of pediatric ovarian torsion and the contribution of ultrasound and computed tomography (CT) in establishing the diagnosis. The Mann-Whitney U test was used to test differences between the salvaged and nonsalvaged groups. There was not a statistically significant difference between means crossing zero (−5 to 26 hours).

Four girls had 8 or fewer hours of symptoms prior to initial examination. Three (43%) of 7 ovaries were salvaged. Of the 4 nonsalvaged ovaries, 3 were infarcted and 1 contained a teratoma. A total of 18 girls had operative intervention within 24 hours of initial examination. Six (34%) of the 18 ovaries were salvaged. Of the 12 nonsalvaged ovaries, 4 contained additional pathologic features: 1 simple cyst, 2 teratomas, and 1 juvenile granulosa cell tumor. All cases with ovarian salvage (n=6) had operative intervention within 24 hours of initial examination. The mean time from initial examination to operative intervention in salvaged cases was 10.8 hours, while the mean time to operative intervention in oophorectomy cases was 21.2 hours. The difference was not statistically significant, with the 95% confidence interval for difference between means crossing zero (−5 to 26 hours).

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Four girls had 8 or fewer hours of symptoms prior to initial examination. Two underwent operative intervention within 8 hours of onset of symptoms, and 1 of these ovaries was detorsed and salvaged. One of the nonsalvaged ovaries contained a teratoma, 1 contained a simple cyst, and 1 was infarcted. A total of 8 girls had 24 or fewer hours of symptoms prior to initial examination; only 1 ovary was salvaged. Mean duration of pain prior to initial examination was 76 hours in both the salvaged and nonsalvaged groups. There was not a statistically significant difference in salvage rate at any designated time. Similarly, the likelihood of ovarian salvage was not associated with length of symptoms prior to operation.

Differences between salvaged and nonsalvaged groups in duration of symptoms prior to initial examination and urgency of operative intervention after initial examination are presented in Table 2.

Twenty-one of 22 patients underwent pelvic ultrasound (n=20) and/or abdominal and pelvic CT scan (n=5).
prior to the operative procedure. Nineteen of the ultrasound studies prompted surgical intervention; 1 was unable to visualize the ovary or the appendix. Four of the CT studies suggested the diagnosis. One child accounted for both the normal ultrasound and CT results; her torsion was noted at laparotomy done for presumed appendicitis. There was no association between ovarian salvage and choice of diagnostic studies.

The ovarian salvage rate in this series, 27%, provides encouragement for urgent imaging and aggressive surgical management of acute ovarian torsion in pediatric patients. This series contrasts with the dismal rates previously reported, which range from 0% to 15%.1-3 We were also surprised by the lack of correlation between duration of symptoms prior to initial examination and ovarian infarction. It is hypothesized that pain arises from venous obstruction and edema, while infarction of the ovary occurs later when the arterial flow stops.3 There appears to be significant individual variation in time to infarction. Additionally, recall of pain is a highly subjective measure and perhaps especially unreliable in children. These data suggest that when a health care professional suspects the diagnosis of ovarian torsion, prolonged duration of pain prior to initial examination should not dissuade prompt imaging and urgent surgical consultation.

The salvage rate we report is more consistent with that reported in the adult literature. Several case series of adult women have suggested that most ovaries can be salvaged and that complications of detorsion are rare.6,7 Ovaries that appeared necrotic at the time of detorsion have been shown to function on long-term follow-up. A single large series (n = 58) of laparoscopic detorsion of blue-black or hemorrhagic torsed ovaries in adult women reported detorsion and salvage in all women without complication. Long-term ultrasound follow-up demonstrated 54 (94%) of 58 ovaries producing follicles.8 A small series of premenarchal girls (n = 8) reported laparoscopic detorsion of blue-black ovaries with functional outcome in 7 of 8.9 Novel techniques such as ovarian bi-valving to enable better intraoperative visualization have shown similar functional outcome.10

It is unclear why ovarian salvage rates between pediatric and adult patients are so variable and if patient or physician behaviors account for some of the differences. While data suggest that salvage of a necrotic-appearing ovary might result in a good outcome, this is not common practice. If surgery is delayed because the ovary is believed to be unsalvageable, the delay likely contributes to ovarian necrosis.

In the largest pediatric series, none of the 51 patients were seen within 8 hours of symptom onset and no ovaries were salvaged.1 It is possible that physician behavior lowered the salvage rate among these girls. Eighteen of the girls we report had symptoms for more than 8 hours and 5 (28%) of 18 torsed ovaries were detorsed with reperfusion noted in the operating room, suggesting that ovarian salvage may be possible long after 8 hours of symptoms. The median and mean durations of pain prior to initial examination or surgery were not different between girls whose ovaries were salvaged and those who were not.

Duration of symptoms prior to initial examination seems less important than expedient operative intervention. In our series, among those operated on within 8 hours of initial examination, the salvage rate was 40%; among those operated on within 24 hours of initial examination, the salvage rate was 33%; and among those with operative intervention more than 24 hours after initial examination, none had ovaries salvaged. While the differences were not statistically significant, the trend is striking. The only previous study describing the association between ovarian salvage and the urgency of surgical intervention included only adult women: 26 (30%) had surgery within 24 hours of initial examination, and 3 (12%) of those 26 ovaries were salvaged. Additional information is needed to better understand this association among pediatric patients.

It has been suggested that among prepubertal girls, the high incidence of ovarian pathologic features causing torsion accounts for the poor salvage rate. Prior published series report 40% to 84% of the torsed ovaries contained pathologic features beyond infarction.1-4 In our series, 10 (45%) of the 22 torsed ovaries contained some pathologic features beyond infarction. However, in our series, as in previous reports, the pathologic features were overwhelmingly benign. Only 1 malignancy (dysgerminoma) was reported in the prior case series of torsion in children (cumulative 97 cases).1-3 We report 1 additional malignancy (juvenile granulosa cell). Simple ovarian cysts and teratomas dominate in both pediatric and adult studies. In most large series, the removal of simple and dermoid cysts are reported as the reason for oophorectomy. Surgeons advocating salvage of torsed ovaries among adult women report good salvage rates with detorsion and removal of cysts.6,9 There is understandable reluctance to return a dark and edematous ovary to the abdomen since the surgeon cannot exclude pathologic

Table 2. Comparison of Duration of Symptoms and Urgency of Workup in Salvaged and Nonsalvaged Ovaries

<table>
<thead>
<tr>
<th></th>
<th>Salvaged Ovaries</th>
<th>Nonsalvaged Ovaries</th>
<th>Difference Between Means (95% CI)</th>
</tr>
</thead>
<tbody>
<tr>
<td>No. of ovaries</td>
<td>6</td>
<td>16</td>
<td></td>
</tr>
<tr>
<td>Mean duration of pain prior to initial examination (range), h</td>
<td>76 (1-144)</td>
<td>76 (2-336)</td>
<td>No difference</td>
</tr>
<tr>
<td>Mean duration of pain prior to operation (range), h</td>
<td>87 (7-159)</td>
<td>97 (7-357)</td>
<td>10 (-63 to 84)</td>
</tr>
<tr>
<td>Mean hours from initial examination to operation (range), h</td>
<td>11 (1-23)</td>
<td>21 (2-71)</td>
<td>10 (-5 to 23)</td>
</tr>
</tbody>
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Abbreviation: CI, confidence interval.
features by gross inspection of the ovary. There may be a bias to cure by removal. Preoperative imaging that demonstrates the presence or absence of ovarian pathologic features may help inform the decision to try to salvage the ovary. In our series, 2 ovaries with abnormalities were salvaged. In both cases, the abnormalities were simple cysts; 1 ovary underwent cystectomy, the other was detorsed. A biopsy was performed on 1 edematous ovary that was salvaged. Additional pathologic features made no difference in salvage rate. The decision to salvage is surgical, but nonsurgical health care professionals can assist by efficiently securing appropriate preoperative imaging.

There are several limitations to this study. While we included 15 years of data, the sample size was small. This may account for why we observed no statistically significant association between duration of symptoms and the expediency of operative intervention and the rates of salvage. A second issue is the limited definition of salvage in this study. We counted an ovary as saved if the surgeon detorsed the ovary, saw return of circulation, and judged it salvaged. We have no information about the function of the salvaged ovaries. However, the adult laparoscopic detorsion literature argues strongly that detorsed ovaries do well. Even among hemorrhagic or blue-black ovaries, more than 90% functioned normally after detorsion.

There is no reason to believe that ovaries that appeared pink after detorsion fared worse. Finally, our series includes cases diagnosed before and after Doppler ultrasound became available. Too few cases fell in each group to detect any influence on salvage. However, the effect of Doppler ultrasound has generally been to improve diagnostic accuracy and to expedite surgical intervention and should therefore contribute to improving salvage rates.

Ovarian torsion has received scant attention in the common pediatric texts. While the disease is uncommon, the diagnosis of ovarian torsion must be considered in girls with abdominal pain. The ovary is difficult to palpate or isolate. Most girls with acute abdominal pain are managed by a family physician, pediatrician, or emergency medicine physician. It is these generalists who must entertain the diagnosis, perform serial abdominal examinations, obtain appropriate imaging, and advocate for urgent surgical consultation. Unlike most literature on the topic, this series provides evidence for the possibility of ovarian salvage. While the duration of symptoms prior to initial examination does not appear to affect success in salvage, diagnostic and surgical urgency after initial examination does appear to have an impact on ovarian salvage. Further research to better understand the factors relevant to ovarian salvage is warranted. We conclude that pediatric care professionals should obtain urgent ultrasound in girls with a possible diagnosis of ovarian torsion and advocate for emergent surgical evaluation and operative detorsion in those with an abnormal ultrasound finding.

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REFERENCES