


Ovarian Torsion in Pediatric Patients: A Review of Eleven Years' Experience

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Abstract

Objectives. To examine associated clinical features and evaluate published criteria regarding volumetric diagnosis of ovarian torsion (OT). **Methods.** Retrospective case–control study of patients presenting to an emergency department who underwent pelvic imaging for acute abdominal or pelvic pain. Cases were found to have OT at surgery. Controls received clinical diagnosis of either acute pelvic pain or ovarian cyst. **Results.** The sensitivity for OT using a cutoff AV of <20 mL was 50% (95% confidence interval [CI] = 35% to 65%); specificity was 29% (95% CI = 15% to 43%). The sensitivity for OT using a cutoff AV of >75 mL was 18% (95% CI = 7% to 30%); specificity was 93% (95% CI = 85% to 100%). The ratio of affected-side to unaffected-side AV of >15 had a sensitivity of 16% (95% CI = 5% to 27%); specificity was 98% (95% CI = 93% to 100%). **Conclusions.** The published criteria regarding the volumetric diagnosis of OT were inadequately sensitive for detecting OT. However, an affected-side AV >75 mL and an AV ratio >15 were reasonably specific.

Keywords

ovarian torsion, pediatric patients

Introduction

Ovarian torsion (OT) occurs when the ovary twists on the axis of its vascular supply. As a result of the twist, the vascular flow to the ovary is interrupted. If unrecognized in a timely manner, the ovary infarcts and becomes functionless. If, however, torsion is recognized in time, the ovary can be surgically untwisted, normal blood flow can be restored, and ovarian function preserved.

Pediatric OT is a fairly uncommon diagnosis, with an estimated incidence of 4.9/100 000 in females aged 1 to 20 years.¹ Because of the painful nature of the condition, patients with OT often present to the emergency department. However, the diagnosis is difficult to make because the symptoms of OT are nonspecific and overlap with those of more common diagnoses such as acute pelvic pain and ovarian cysts.² Unfortunately, a missed diagnosis of OT can result in compromised fertility.²

Currently, the only manner in which to make a definitive diagnosis of OT is surgical exploration. Sonography has been studied as a diagnostic modality for OT, with mixed results, and its utility is a subject of controversy.^{3,4} In a study by Linam et al, one third of normal controls had absent Doppler flow. In this same study, the authors found that adnexal volume (AV) of <20 mL was strong evidence against adnexal torsion in postmenarchal

females.⁵ A volume of >75 mL was more common in cases than in controls. The AV ratio was larger in cases than in controls as well.

We sought to retrospectively evaluate the criteria published by Linam et al to a cohort of patients with surgically diagnosed OT as well as a cohort who received alternative diagnoses. We also collected clinical characteristics of each group to explore clinical and sonographic variables that differentiate OT from acute pelvic pain and ovarian cyst.

Materials and Methods

Study Population

A retrospective chart review was performed on all cases of suspected adnexal torsion at a 90000 visit/year

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bi-campus children's hospital between January 1, 2000, and December 31, 2010. This study was conducted with institutional review board approval. No consent was required.

One hundred twenty-four affected patients were identified using the International Classification of Diseases, Ninth Revision (ICD-9) code of 620.5, which includes torsion of ovary, ovarian pedicle or fallopian tube. Cases were excluded if OT was prenatally diagnosed, or if records did not include presenting history, exam, diagnostic studies, and an operative note. Eighty cases of acute OT met these criteria.

The controls were chosen by using ICD-9 codes for females presenting with symptoms that could also be consistent with OT and included 1097 unique patients with pelvic pain (625.9) and 1079 unique patients with ovarian cyst (620.2). Of these, there were 109 patients with imaging, from which 80 were selected at random to match the number of cases. There were multiple cases and controls that either had images that were missing or volume was not able to be calculated because of missing views.

Data abstracted from the medical record of each patient included age, duration of symptoms, presenting symptoms, medical/surgical history, menarchal status, lab work, imaging findings, operative report, and final diagnosis by a single author/reviewer. Torsion was based on intraoperative findings, which are the current gold standard of diagnosis.

Radiologic Review

Images were reviewed by a single pediatric radiologist who was blinded to whether the images were cases or controls. Examples of ultrasound (US) images are shown in Figures 1 and 2. If both computerized tomography (CT) and US were available for the same encounter, the US was used. Volumes were then calculated using the formula for a prolate ellipse (length \times width \times height \times 0.523). The AV ratio was calculated by taking the volume of the affected ovary and dividing by volume of the unaffected ovary.

Statistical Analysis

Patient characteristics were tabulated separately for cases and controls. Associations with clinical features were evaluated using a *t* test (with unequal variances and Welch degrees of freedom) and χ^2 tests for continuous and categorical variables, respectively. Diagnostic criteria performance was evaluated using sensitivity and specificity with confidence intervals based on the exact binomial distribution.



Figure 1. Case example.



Figure 2. Control example.

Results

There were 80 unique cases of OT and 80 randomly selected controls. Clinical features that were associated with OT include duration of pain greater than 48 hours ($P < .001$), vomiting ($P < .001$), and heart rate greater than 100 beats per minute on physical exam ($P < .001$; Table 1). The average age of patients with OT was 10.8 years, and the controls had an average age of 15.4 years.

Table 1. Patient Characteristics for Cases and Controls^a.

Covariate	Case (N = 80)	Control (N = 80)
Sudden onset of pain	39 (48.8%)	44 (55.0%)
Vomiting	53 (66.2%)	21 (26.2%)
Heart rate >100 bpm	26 (32.5%)	12 (15.0%)
Lower abdominal unilateral tenderness	50 (62.5%)	59 (73.8%)
Age (years)	10.8 (4.15)	15.4 (1.96)
Duration of pain >48 hours	38 (47.5%)	18 (22.5%)
Volumes		
Unaffected volume	18.3 (56.5)	14.0 (19.7)
Missing unaffected volume	37 (46.2%)	39 (48.8%)
Affected volume	46.7 (71.2)	24.3 (29.2)
Missing affected volume	36 (45.0%)	39 (48.8%)
Affected ovary ≥20 mL	22 (27.5%)	12 (15.0%)
Affected ovary <20 mL	22 (27.5%)	29 (36.2%)
Missing affected volume of ovary	36 (45.0%)	39 (48.8%)
Affected ovary ≤75 mL	36 (45.0%)	38 (47.5%)
Affected ovary >75 mL	8 (10.0%)	3 (3.8%)
Missing affected volume	36 (45.0%)	39 (48.8%)
Ratio	8.3 (11.4)	3.44 (4.9)
Missing ratio	37 (46.2%)	39 (48.8%)
Ratio ≤15	36 (45.0%)	40 (50.0%)
Ratio >15	7 (8.8%)	1 (1.2%)
Missing ratio	37 (46.2%)	39 (48.8%)

^aValues expressed are mean (standard deviation) or n (%) where indicated.

Table 2. Diagnostic performance.

	Sensitivity (95% CI)	Specificity (95% CI)
Adnexal volume <20 mL	50% (35, 65)	29% (15, 43)
Adnexal volume >75 mL	18% (7, 30)	93% (85, 100)
Adnexal volume ratio >15	16% (5, 27)	98% (93, 100)

Abbreviation: CI, confidence interval.

The AV was unattainable on one or both sides in 76 patients (48%), leaving 43 cases and 41 controls for volume evaluation. The sensitivity for OT using a cutoff AV of <20 mL was 50% (95% confidence interval [CI] = 35% to 65%); specificity was 29% (95% CI = 15% to 43%). The sensitivity for OT using a cutoff AV of >75 mL was 18% (95% CI = 7% to 30%); specificity was 93% (95% CI = 85% to 100%). The AV ratio of affected-side volume to the unaffected-side volume of >15 had a sensitivity of 16% (95% CI = 5% to 27%); specificity was 98% (95% CI = 93% to 100%; Table 2). In our sample, a lower threshold for both volumes and the ratio would have resulted in a higher sensitivity without decreasing specificity (Figure 3A and B).

Discussion

Because ovarian salvage is time-dependent, torsion is an important diagnosis for emergency medicine clinicians to recognize in a timely matter. However, the diagnosis is difficult to make as the symptoms are nonspecific and can mimic other more common diagnoses.

Our study found that OT is more likely in patients with a duration of pain greater than 48 hours, vomiting, or a heart rate greater than 100 beats per minute. The cases were also younger on average than the controls. This would seem to indicate that patients who are perimenarchal are at higher risk for OT.

The previously published diagnostic criteria from Linam et al stated that an AV of >75 mL was more common in cases than in controls; no cases had an AV of <20 mL and an AV ratio of >15 was not seen in any controls. When we evaluated these criteria regarding the volumetric diagnosis of OT in our care system, we found it to be inadequately sensitive for the diagnosis of OT. However, an affected-side AV >75 mL and an affected-side to unaffected-side AV ratio >15 were reasonably specific.

Unfortunately, our patients were unable to be analyzed by menarchal status as this information was only

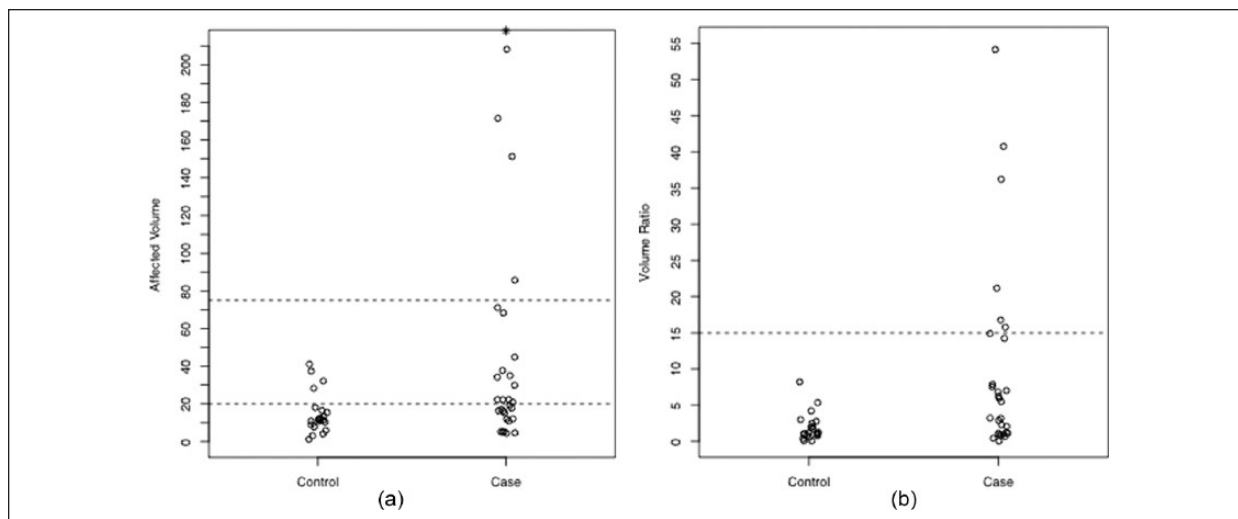


Figure 3. Affected volume (A) and affected to unaffected volume ratio (B) for cases and controls. Dashed lines indicate previously identified diagnostic thresholds.

rarely recorded in the medical record. This is an important distinction because ovarian volume size increases by age. However, this should not affect the utility of the AV ratio as 2 unaffected ovaries should be approximately the same size within an individual, unless there is a mass or cystic pathology involving one of the ovaries.

There are important limitations associated with this study. OT is ultimately a surgical diagnosis and our controls were not taken to the operating room so we do not know for certain if they truly did not have OT. However, due to the low prevalence of the diagnosis, it is unlikely that a significant number of cases were misclassified as controls. Also, our sample size was small due to the single-institution design of our investigation and due to the large number of cases that had inadequate imaging by which to apply volumetric criteria. Finally, because of our study's retrospective design, not all clinical variables were consistently documented in the medical record. However, the important variables related to the primary outcome (ie, the association of volumetric criteria with the diagnosis of OT) were uniformly and objectively recorded for all analyzed patients.

Further studies need to be done with more patients and at more clinical sites to further examine the diagnostic criteria. This information could ultimately be used to develop a clinical decision rule to help develop an algorithm to improve the diagnosis of OT for female patients of any age that present with acute abdominal or pelvic pain.

Conclusion

The previously published diagnostic criteria regarding the volumetric diagnosis of OT were inadequately sensitive for the diagnosis of OT in our patients. However, an affected-side AV >75 mL and an affected-side to unaffected-side AV ratio >15 were reasonably specific.

Declaration of Conflicting Interests

The author(s) declared no potential conflicts of interest with respect to the research, authorship, and/or publication of this article.

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