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Clinical, Histopathological Features and Management Outcomes of Ovarian Tumors in Pediatric Girls: A Retrospective Single-Center Study at Da Nang Hospital for Women and Children, Vietnam (2024)

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ABSTRACT

Background & Objective: To describe clinical presentation, ultrasound characteristics, histopathology, and management outcomes of ovarian tumors in pediatric girls at Da Nang Hospital for Women and Children, Vietnam, and to examine associations between selected clinical or ultrasound factors and adnexal torsion or malignant histology.

Materials & Methods: A retrospective chart review was conducted for girls aged≤15 years who underwent surgery for ovarian tumors at Da Nang Hospital for Women and Children between January and December 2024. Variables included presenting symptoms, ultrasound morphology, tumor size, tumor markers (Cancer Antigen 125 (CA-125), Lactate Dehydrogenase (LDH), and Alpha-Fetoprotein (AFP), when available), operative approach, surgical procedures, histopathology, and intraoperative adnexal torsion. Associations were evaluated using Chi-square or Fisher's exact tests and the Mann-Whitney U test, as appropriate.

Results: Twenty-nine girls (age 4-15 years; mean 11.6±2.9 years) underwent surgery. Abdominal pain was present in 96.6%, abdominal distension in 24.1%, and nausea/vomiting in 10.3%. All tumors were unilateral; 69.0% measured<10 cm on ultrasound. A solid component was identified in 20.7% of cases and was associated with malignant histology in exploratory analysis (P=0.036). Mature teratoma accounted for 58.6% of tumors, while immature teratoma accounted for 6.9%. Laparoscopy was performed in 93.1% of cases, with ovarian-sparing tumor excision achieved in 86.2%. Nausea/vomiting was associated with adnexal torsion in exploratory analysis (P=0.02).

Conclusion: Most pediatric ovarian tumors requiring surgery were benign and were successfully managed laparoscopically with high rates of ovarian preservation. The presence of a solid component on ultrasound may raise suspicion for malignant histology; however, this finding should be interpreted cautiously due to the small sample size.

Keywords: Adnexal torsion, CA-125, Laparoscopy, Pediatric ovarian tumor, Ultrasound, Teratoma

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1. Introduction

Ovarian masses in children and adolescents are uncommon, yet they may present as time-sensitive emergencies when complicated by adnexal torsion. These lesions range from functional cysts to benign neoplasms and, less frequently, malignant tumors. Because of the long reproductive horizon in this population, management prioritizes safe treatment while preserving ovarian tissue and future fertility whenever oncologically appropriate **(1-3)**.

Clinical symptoms are often non-specific—such as abdominal pain, vomiting, or abdominal distension—so early diagnostic decisions typically rely on transabdominal ultrasound morphology, supplemented by selected tumor markers when available. Benign lesions predominate in most series, with mature cystic teratoma and simple cystsbeing the most common. However, malignancy must remain in the differential diagnosis, particularly when ultrasound demonstrates solid tissue or complex architecture **(1-9)**.

Data on pediatric ovarian tumors in Vietnam remain limited. Therefore, we report our 2024 single-center experience from Da Nang Hospital for Women and

Children, describing clinical presentation, ultrasound characteristics, histopathology, and management outcomes among girls undergoing surgery for ovarian tumors. We also explore simple clinical and ultrasound factors associated with adnexal torsion or malignant histology.

2. Materials and Methods

Study design and setting

We conducted a retrospective, cross-sectional chart review at Da Nang Hospital for Women and Children (Da Nang, Vietnam). The study period spanned from 1 January 2024 to 31 December 2024.

Participants and eligibility

We included all girls aged ≤15 years who were diagnosed with an ovarian tumor and underwent surgical management during the study period. The sample size was consisted of all consecutive eligible surgical cases; therefore, no a priori sample size calculation was performed.

Records were considered eligible if they contained, at minimum: (i) an admission or emergency department note, (ii) an imaging report (ultrasound, and MRI/CT if performed), (iii) an operative note, and (iv) a histopathology report for the resected specimen. Cases were excluded if essential information was missing or unclear, if the mass was not ovarian in origin, or if the patient was managed conservatively without surgery.

Workflow: screened records → eligible surgical ovarian tumor cases → included (n=29) → analyzed (n=29).

Patients or the public were not involved in the design, conduct, reporting, or dissemination of this research.

Data collection and variables

Data were extracted from medical records, imaging reports, anesthesia and operative notes, and pathology reports using a standardized abstraction form. Baseline variables included age, weight, height (for BMI calculation), and menarche status (pre- and post-menarche). To reduce information bias, all data were cross-checked across multiple sources (admission notes, ultrasound reports, operative notes, and histopathology reports). Variables not explicitly documented were recorded as missing rather than inferred.

Clinical presentation variables included primary symptoms (abdominal/pelvic pain, abdominal distension, nausea/vomiting, fever), duration from symptom onset to hospital admission (hours), and whether acute abdomen or possible torsion was suspected at presentation.

Laboratory variables included serum tumor markers when available (CA-125, AFP, β-hCG, LDH) and routine admission laboratory tests.

Imaging variables were primarily derived from ultrasound reports: maximal tumor diameter, laterality (left/right), morphology (unilocular/multiloculated), presence of a solid component, internal echogenicity, doppler vascularity when reported, and associated findings such as free fluid. MRI was recorded when performed; however, in suspected torsion, advanced imaging was not pursued if it was expected to delay timely surgical management.

Surgical and pathology variables

Operative approach was categorized as laparoscopy or laparotomy. Surgical procedures were classified as ovarian-sparing (cystectomy/tumorectomy with preservation of ovarian tissue) or non-sparing (oophorectomy/adnexectomy). Intraoperative findings included adnexal torsion, macroscopic ischemia or necrosis, and spillage when documented. Histopathology was grouped into benign tumors, borderline lesions, and malignant tumors according to the final pathology diagnosis.

Outcomes

Primary descriptive outcomes included the distribution of clinical features, imaging characteristics, histopathology, and management strategies. Secondary outcomes included associations between selected clinical or imaging variables and torsion or malignancy.

Statistical analysis

Data were analyzed using MedCalc (MedCalc Software 23.3.7). Categorical variables are presented as frequencies and percentages, and continuous variables are summarized as mean (standard deviation) when approximately normally distributed or median (interquartile range) otherwise.

Group comparisons used the chi-square test or Fisher's exact test for categorical variables, and the Mann-Whitney U test for continuous variables, as appropriate. Statistical significance was defined as $P<0.05$ (two-sided). Analyses were conducted using available-case (complete-case) data for each variable; no imputation was performed. Tumor size was analyzed as a continuous variable and, for clinical interpretability, dichotomized at 10 cm (<10 vs. ≥10 cm), consistent with common pediatric surgical decision thresholds. Given the small sample size and the low number of malignant cases, all association analyses were exploratory and unadjusted, and the findings were interpreted cautiously.

3. Results

Twenty-nine girls underwent surgery for ovarian tumors during 2024. All consecutive eligible surgical cases were included (n=29) and no case meeting the

predefined criteria was excluded. Tumor markers were not available for all patients. Tumor markers were variably available (AFP: 3/29; LDH: 3/29; CA-125: 29/29; β-hCG: 3/29), and missing values were not imputed. Baseline characteristics, ultrasound findings, operative procedures, and bivariate comparisons are summarized in Tables 1 and 2. A solid component on ultrasound was associated with malignant histology in exploratory analysis (P=0.036). Nausea/vomiting was associated with adnexal torsion in exploratory analysis (P=0.02).

Tables 1. Baseline characteristics, clinical presentation, investigations, pathology, and management of pediatric ovarian tumors

Clinical characteristics			n (%)	
Age			<9 years	17 (58.6%)
			≥9 years	12 (41.4%)
BMI (kg/m²)			Underweight (<18.5)	10 (34.5%)
			Normal (18.5–22.9)	13 (44.8%)
			Overweight/obese (≥22.9)	6 (20.7%)
Menarche status			Pre-menarche	13 (44.8%)
		Post-menarche (years)	<9	4 (13.8%)
			≥9	12 (41.4%)
Abdominal distension			No	22 (75.9%)
			Yes	7 (24.1%)
Abdominal pain			No	1 (3.4%)
			Yes	28 (96.6%)
Nausea/vomiting			No	26 (89.7%)
			Yes	3 (10.3%)
Time from symptom onset to hospital admission			Included 28 cases (96.6%). Mean: 24.1 ± 14 hours (min 8; max 72).	
Characteristic			n	%
Tumor size on ultrasound	<10cm		20	69.0%
	≥10cm		9	31.0%
Tumor side	Right		14	48.3%
	Left		15	51.7%
Ultrasound characteristics	Multiloculated	Yes	11	37.9%
		No	18	62.1%
	Solid component	Yes	6	20.7%
		No	23	79.3%
	Increased vascularity	Yes	2	6.9%
		No	27	93.1%
CA-125 (U/mL)	≤35U/mL		27	93.1%
	>35U/mL		2	6.9%
Histopathology	Simple cystic lesion		10	34.5%
	Mature teratoma		17	58.6%
	Immature teratoma		2	6.9%
Surgical characteristics			n	%
Surgical approach	Laparotomy		2	6.9%
	Laparoscopy		27	93.1%
Treatment modality	Adnexectomy		4	13.8%
	Ovarian-sparing		25	86.2%

BMI: Body Mass Index, CA-125, Cancer Antigen 125

Table 2. **Univariate comparisons by tumor size, histopathology (benign vs malignant), and adnexal torsion status**

Characteristic		Tumor size		P
		<10cm	≥10cm	
Surgical approach	Laparotomy	0(0%)	2(6.9%)	0.162
	Laparoscopy	20(68.9%)	7(24.2%)	
Histopathology	Benign tumor	19(65.5%)	8(27.6%)	0.834
	Malignant tumor	1(3.4%)	1(3.4%)	
Factors		**Characteristic histopathology**		**n(%)**	**P**
		Benign	**Malignant**		
BMI	Normal	12	1	13(44.8%)	0.2
	Underweight/overweight	15	1	16(55.2%)	
Menarche status	Yes	15	1	16(55.2%)	1
	No	12	1	13(44.8%)	
Solid component on ultrasound	Yes	4	2	6(20.7%)	0.036
	No	23	0	23(79.3%)	
Multiloculated on ultrasound	Yes	18	0	18(62.1%)	0.135
	No	9	2	11(37.9%)	
Increased vascularity on ultrasound	Yes	1	1	2(6.9%)	0.135
	No	26	1	27(93.1%)	
CA-125	≤35U/mL	26	1	27(93.1%)	0.135
	>35U/mL	1	1	2(6.9%)	
Factors		**Adnexal torsion**		**n(%)**	**P**
		No	Yes		
Abdominal pain	No	1	0	1(3.4%)	1
	Yes	19	9	28(96.6%)	
Nausea/vomiting	No	20	6	26(89.7%)	0.02
	Yes	0	3	3(10.3%)	
Tumor size on ultrasound	<10cm	13	7	20(69.0%)	0.674
	≥10cm	7	2	9(31.0%)	
Tumor side	Right	12	2	14(48.3%)	0.108
	Left	8	7	15(51.7%)	
Histopathology	Benign	19	8	27(93.1%)	0.532
	Malignant	1	1	2(6.9%)	

BMI: Body Mass Index; CA-125, Cancer Antigen 125

4. Discussion

In this 2024 single-center series (n=29), benign pathology predominated, with mature teratoma being the most frequent diagnosis (58.6%). Acute presentations were common: abdominal pain occurred in 96.6%, abdominal distension in 24.1%, and nausea/vomiting in 10.3%. Intraoperative adnexal torsion was documented in 9/29 cases. Laparoscopy was used in 93.1% of procedures, and ovarian-sparing excision was achieved in 86.2%, reflecting a consistent effort to preserve ovarian tissue. On preoperative ultrasound, the presence of a solid component was associated with malignant histology in exploratory analysis (P=0.036), while nausea/vomiting was associated with torsion (P=0.02).

Patient Profile, Presenting Symptoms, and Initial Clinical Impression

The cohort consisted largely of school-age girls and early adolescents (4-15 years; mean 11.6±2.9 years), with approximately half being post-menarche. This distribution is clinically relevant because the differential diagnosis, tumor marker interpretation, and operative goals differ between pre- and post-menarche patients, although fertility preservation remains a shared priority across ages **(1,2,4,5,7-9)**.

Most girls presented with abdominal pain, while nausea/vomiting was less common and abdominal distension occurred in a minority. The average time from symptom onset to admission was about one day (mean 24.1 hours; range 8-72 hours), consistent with real-world patterns in which families often attempt home care before seeking emergency evaluation. In our dataset, nausea/vomiting was associated with adnexal torsion in exploratory analysis (P=0.02), though this should be interpreted cautiously given the small numbers. Other studies report similar symptom patterns: pain is the dominant complaint, and vomiting is more common in torsion or other acute presentations **(3,9)**.

In clinical practice, these symptoms do not reliably distinguish ovarian torsion from other causes of pelvic pain, especially in children who may struggle to describe pain clearly. For this reason, most clinical pathways treat acute pelvic pain in girls as a time-sensitive condition and recommend early ultrasound and prompt surgical consultation when torsion is suspected **(10-12)**. Recent pediatric data suggest that longer symptom duration is associated with a higher risk of ovarian loss, reinforcing the importance of minimizing delays from symptom onset to operative management **(12,13)**.

Laboratory Tests and Tumor Markers: Useful but Often Limited in Emergencies

Tumor markers were variably available, and CA-125 was usually within the reference range. In children, CA-125 is non-specific and may rise with peritoneal irritation including torsion or inflammation so it should not be interpreted as a cancer-specific marker **(14,15)**. When malignancy is a concern, markers aligned with pediatric tumor biology, such as AFP, β-hCG, LDH, and inhibin (when available), are more informative. However, emergency presentations may limit the ability to obtain these tests before surgery **(9)**.

Imaging and the "Missing MRI" Problem in an Emergency Pathway

Preoperative imaging relied mainly on transabdominal ultrasound, which is rapid, widely available, and generally sufficient to characterize cystic lesions, classic teratoma patterns, and concerning features such as solid tissue or marked vascularity **(14,15)**. In our cohort, most lesions measured <10 cm and predominantly cystic; solid components were uncommon but were associated with malignant histology in exploratory analysis (P=0.036).

MRI can be helpful when ultrasound findings are indeterminate and may reduce unnecessary oophorectomy in selected stable patients. However, in suspected ovarian torsion, the clinical priority is timely operative assessment. Waiting for MRI may introduce delays without altering the need for detorsion when torsion is likely **(11-13,16)**.

This explains why MRI was rarely used in our cohort. Many patients presented with an acute abdomen phenotype, prompting rapid progression to surgery to avoid ischemic injury. In such cases, ultrasound provides the essential information needed for immediate decision making presence of a mass, size, laterality, Doppler flow, and any overt malignant features. Cross-sectional imaging can be reserved for stable patients with equivocal ultrasound findings or suspected malignancy requiring staging **(2,3)**. For centers with limited MRI access, this emergency-first approach is reasonable as long as fertility-preserving principles (detorsion, cystectomy when feasible) remain the default and histopathology confirmation is obtained **(9,13)**.

Ultrasound remains central to risk assessment. The association between a solid component and malignant histology in our dataset aligns with international imaging principles: solid tissue, complex morphology, or concerning vascular patterns should raise suspicion. However, because only two malignant cases were observed, this finding should be interpreted cautiously. Solid components may also occur in benign teratomas, so morphology should be interpreted alongside the clinical picture and appropriate tumor markers.

An evidence-based pediatric work-up prioritizes ultrasound morphology and a biomarker panel aligned with pediatric histologies (AFP, β-hCG, LDH, inhibin) rather than CA-125 alone. Future multicenter studies should stratify by pubertal status, standardize ultrasound reporting, and evaluate multivariable models combining morphology with pediatric-appropriate markers **(2,3,17)**.

Study Limitations and Future Directions

The retrospective design introduces potential misclassification of symptoms and ultrasound descriptors and limits control over measurement timing. The small sample size reduces statistical power and limits the precision of effect estimates, particularly for uncommon outcomes such as malignant histology. A comprehensive pediatric tumor marker panel was not uniformly available, which may have limited characterization of malignant germ cell tumor signatures. Future multicenter prospective studies in Vietnam should standardize ultrasound reporting, apply a consistent marker panel (AFP/β-hCG/LDH/inhibin), stratify analyses by pubertal status, and capture longer-term outcomes including ovarian function and recurrence.

Follow-up Considerations

In pediatric ovarian tumors, short-term operative success represents only one dimension of outcome. Long-term priorities include recurrence surveillance particularly for mature teratoma ovarian function, and reproductive health. Although our retrospective dataset does not include long-term follow-up, international reviews emphasize that conservative surgery should be paired with appropriate follow-up imaging and counseling. For torsion, counseling should include symptoms of recurrence and the need for prompt evaluation if pain recurs. When feasible, documenting postoperative ovarian volume and Doppler flow at follow-up can provide reassurance and support local audit of ovarian salvage.

A Pragmatic Clinical Algorithm for Similar Settings

Based on our findings and international principles, we propose an imaging-led, risk-stratified approach: (i) assess hemodynamic stability and torsion suspicion; (ii) perform standardized ultrasound morphology reporting; (iii) order a pediatric-appropriate marker set (AFP/β-hCG/LDH±inhibin; CA-125 selectively); and (iv) prioritize early laparoscopy for suspected torsion or for masses with concerning morphology. Intraoperatively, default to ovarian-sparing excision when feasible, using specimen containment to minimize spillage and ensuring adequate tissue for histopathology. For masses with strong suspicion of malignancy, decisions regarding extent of resection should be individualized, ideally with oncology input and adherence to principles that avoid intraoperative rupture. Such a pathway is compatible with resource-constrained environments and can be implemented through checklists and shared decision support across emergency, radiology, pediatric surgery/anesthesia, and gynecology teams.

The Role and Limitations of Serum Tumor Markers

International reviews recommend tumor markers as adjuncts rather than definitive tests, as they cannot reliably confirm or exclude malignancy on their own **(8,14)**. In pediatric ovarian tumors, a biologically coherent marker panel depends on suspected histology:

- AFP and β-hCG for malignant germ cell tumors
- LDH for dysgerminoma
- Inhibin for sex-cord stromal tumors
- CA-125, mainly for epithelial pathology, which is rare in children and more typical after menarche **(8,16)**.

A practical implication for local protocols is that a "pediatric adnexal mass panel" should prioritize AFP/β-hCG/LDH (and inhibin where available) and reserve CA-125 for selected scenarios, such as post-menarche patients with imaging features suggestive of epithelial origin. This approach improves biological coherence and reduces misinterpretation **(2,5,9,14,15)**.

Fertility Preservation and the High Ovarian-Sparing Rate

A notable strength of management in our cohort is the high rate of ovarian-sparing tumor excision. Contemporary pediatric and adolescent gynecology literature emphasizes that ovarian conservation is desirable whenever oncologically safe, as unnecessary oophorectomy may reduce ovarian reserve and have psychosocial consequences. This focus aligns with broader fertility preservation principles, including those highlighted by Arab in a review of fertility preservation in adolescent and young adult cancer patients **(18)**. In torsion, multiple reviews and professional guidelines support detorsion and conservative management even when the ovary appears dark or edematous, as macroscopic appearance may underestimate functional recovery **(10,19)**. In our series, adnexectomy was reserved for malignant histology or clearly non-viable adnexa, consistent with a fertility-sparing philosophy. For hospitals aiming to optimize ovarian preservation, a structured torsion pathway rapid ultrasound access, early laparoscopy, and default detorsion with reassessment may be more impactful than any single biomarker **(7,8,20,21)**.

Management and Surgical Treatment

Surgery was the primary treatment modality in our cohort, with a strong preference for minimally invasive techniques and ovarian preservation. Laparoscopy was performed in 93.1% of cases, whereas laparotomy was used in 6.9%, typically when malignancy was suspected or when technical considerations limited a laparoscopic approach. This preference aligns with the prospective observational study by Nouri et al., which found that laparoscopy resulted in less pre-discharge pain and shorter hospital stay compared with laparotomy for adnexal masses, despite longer operative and anesthesia time in the laparoscopic group **(22)**. It is also consistent with recent international series showing that laparoscopy is increasingly the default for

pediatric and adolescent adnexal masses when appropriate expertise and anesthesia support are available, offering reduced postoperative pain, shorter hospitalization, and excellent visualization for careful cystectomy **(4,7,8,21)**.

Ovarian-sparing excision was achieved in 86.2% of cases. Adnexectomy was performed in four patients (13.8%): two with immature teratomas requiring oncologic resection and two torsion cases with non-viable adnexa. Among nine torsion cases, seven underwent detorsion with adnexal preservation, reinforcing that an emergency pathway can remain fertility-preserving when the default approach is detorsion and cystectomy, with careful specimen handling minimize spillage **(7,10,12,13,19,20)**.

When Laparotomy May be Preferred

Laparotomy remains appropriate in selected situations: strong preoperative suspicion of malignancy requiring intact specimen retrieval and staging; very large tumors where safe laparoscopic extraction would require morcellation or uncontrolled spillage; hemodynamic instability or extensive adhesions; or limited access to experienced pediatric minimally invasive surgeons during emergency hours. In these contexts, an open approach may better support oncologic safety and definitive management **(2,3,12-14,20)**.

In our dataset, tumor size was not clearly associated with malignancy and did not dictate the operative approach. This is plausible because benign cysts and mature teratomas may grow large before detection, whereas malignant tumors may be smaller. Practically, size influences technical planning port placement, controlled decompression, specimen extraction more than biologic risk. When laparoscopy is used for larger masses, attention should focus on safe retrieval and spillage prevention.

Ultrasound remains the cornerstone of evaluating pediatric adnexal masses. Standardized reporting of morphology (size, locularity, internal echogenicity, septations, mural nodules/solid tissue, vascularity) is more informative than reliance on any single feature **(8,14)**. In our series, the presence of a solid component increased concern and was associated with malignancy, but solid-appearing elements also occur in benign teratomas. Therefore, the main value of this finding is to guide triage and operative planning rather than mandate non-conservative surgery **(3,17)**.

Nearly all girls presented with abdominal pain, and only a minority had nausea/vomiting. In practice, this symptom pattern should still prompt early pelvic ultrasound and timely surgical input, as delays can reduce the likelihood of ovarian salvage in torsion pathways **(10-13,19,23)**.

Mature teratoma was the most frequent diagnosis, which is reassuring for counseling because it is typically benign and amenable to ovarian-sparing excision. The presence of immature teratoma in our cohort nonetheless reinforces that malignancy is not negligible, and systematic risk assessment is required to balance fertility preservation with oncologic safety **(4-8,14)**.

This study contributes to the limited Vietnamese evidence on pediatric ovarian tumors by describing a full pathway from presentation to ultrasound, biomarkers, histopathology, and operative management in a tertiary women-and-children hospital. Despite the modest sample size, the cohort reflects routine care where emergency and semi-elective cases coexist. Overall, our findings support three practical points: benign disease predominated, torsion was a common presentation, and ovarian preservation should remain the default goal when oncologically safe **(1,10,24)**. As a single-center study including surgically managed cases only, these findings may not represent girls treated conservatively or those managed in lower-level facilities; however, they do reflect routine practice in a tertiary LMIC setting.

5. Conclusion

Most pediatric ovarian tumors in our surgical series were benign, underscoring that management should prioritize minimally invasive and ovarian-sparing surgery whenever oncologically safe. In emergency presentations particularly acute abdominal pain adnexal torsion should remain a key consideration and surgery should not be delayed for advanced imaging when ultrasound and clinical findings support the diagnosis. The observed associations between a solid component and malignant histology, and between nausea/vomiting and torsion, should be interpreted cautiously and require confirmation in larger, multicenter studies.

6. Declarations

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Ethical Considerations

The study used retrospective, de-identified hospital data. Institutional approval was obtained from the Medical Ethics Committee of Da Nang Hospital for Women and Children (315/BVPSN-ĐN/HĐYĐ/2025). The requirement for informed consent was waived due to the retrospective design.

Authors' Contributions

All authors approved the final version of the manuscript. The first author collected the data and drafted the manuscript. The co-authors reviewed the data, contributed to interpretation of the findings, revised the manuscript, and approved the final version.

Conflict of Interest

The authors declare no conflict of interest.

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