Original Article

Ovarian Dermoid Cyst Trajectory in Premenarchal Girls

Jasneet Aulakh, BS, Erin E. Isaacson, MD, Sarah D. Compton, PhD, MPH, Monica W. Rosen, MD*

University of Michigan Department of Obstetrics and Gynecology, Ann Arbor, Michigan

A B S T R A C T

Study Objective: Mature ovarian dermoid cysts (ODCs) are the most common benign ovarian tumors diagnosed in children. However, there is minimal data on management of ODCs in premenarchal patients. This study assesses characteristics associated with expectant (EM) vs surgical (SM) management in premenarchal patients and the growth rate of ODCs in EM patients at a single institution.

Methods: Forty-four premenarchal patients, either post-surgical with pathologically-confirmed ODC or having radiologic findings consistent with ODCs, were included. Data collected included demographics, cyst characteristics, imaging findings, presence of symptoms, surgical procedure performed, and ovarian torsion occurrence.

Results: Patient age at diagnosis was similar between groups (SM: 8.8 vs EM: 8.0, $P = .55$). At presentation, 36 patients (82%) underwent SM and 8 (18%) underwent EM. There was a significant difference in cyst size between groups (SM: 8.9 cm vs EM: 3.6 cm, $P = .004$). Of SM patients, 30% underwent oophorectomy vs cystectomy, with a significant difference in ODC size between procedures (11.8 cm vs 7.7 cm, $P = .016$). Of EM patients, 75% had at least one and 60% had three follow-up ultrasounds, with average follow-up timeframes of 3.7 and 27 months respectively. Average yearly ODC growth rate for the latter group was 0.8 cm.

Conclusion: The average yearly growth rate of ODCs in premenarchal patients within our institution was slower than in older cohorts, and both age and cyst size played significant roles in determining surgical procedure. Continued study on EM in premenarchal ODCs will help define parameters for recommending SM vs EM in this population.

Key words: Dermoid cyst, Ovarian cysts, Menarche, Diagnostic imaging, Gynecologic surgical procedures

Introduction

Ovarian dermoid cysts (ODCs) are the most common type of benign ovarian tumor found in the pediatric population, with an incidence of approximately 10%-25%. ODCs rarely undergo malignant transformation (1%-3%).[1-3] Surgical excision of ODCs is often recommended upon diagnosis in both the adult and pediatric populations to prevent possible adverse outcomes such as ovarian torsion, cyst rupture, hemorrhage, or infection, even though these complications are rare.[3,4] While previously most often performed via laparotomy and removal of the entire ovary, surgery in the adolescent population has moved toward an ovarian-sparing minimally invasive approach via laparoscopic cystectomy based on the benefits of fertility preservation and decreased surgical morbidity.[1,5-9]

While surgical management (SM) and outcomes for ODCs in pediatric populations have been previously studied, most of these studies did not specifically consider premenarchal patients as a unique cohort.[1,4,7] The few studies that do involve premenarchal patients suggest that younger patients may be more likely to have surgery converted to laparotomy and to undergo oophorectomy rather than cystectomy.[6,7]

Given this data, expectant management (EM) in the premenarchal population should be considered. Due to the long-standing practice of SM upon diagnosis, there is a lack of data on outcomes for pediatric patients who undergo EM.[1,4,7] Although surgical management has shifted toward OSS, ovarian surgery still carries the risk of removing normal ovarian tissue or adhesion formation—both of which carry infertility risk.[7] Studies on post-pubertal adolescents and adult patients have demonstrated the safety of EM without complications of torsion or rupture and found the average yearly growth rate of ODCs to be approximately 1.5-1.7 mm/year.[10,11] No current data exists regarding the ODC growth rate for premenarchal patients. This study aims to begin addressing the gaps in literature by studying a population of premenarchal patients with ODCs at a single institution and defining characteristics associated with initial management by SM or EM, determining the growth rate of ODCs if EM is chosen, and investigating current rates of oophorectomy versus cystectomy within this population.

Methods

This was a retrospective cohort study of premenarchal pediatric patients who underwent EM or SM of an ODC at a single tertiary academic children's hospital from January 2012 to January 2023.

Imaging reports of all patients meeting criteria were reviewed. All patients received an initial ODC diagnosis based on radiologist assessment of their imaging. Patients were included if they had a pathological diagnosis of an ODC after surgical removal or, if they did not undergo surgery, a diagnosis of an ODC based on radiologic findings. Patients with pre-surgical diagnoses of an ODC with final

* *Address correspondence to*: Monica W. Rosen, 1500 E. Medical Center Dr., Ann Arbor, MI 48109-5276; Phone (734) 615-3773.

E-mail address: mwoll@med.umich.edu (Monica W. Rosen).

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pathologic diagnosis of other benign or malignant masses were excluded.

Chart abstraction of inpatient and outpatient medical records for included patients was performed. Data including demographics, initial cyst size, presenting symptoms, imaging modality, and specific documentation of cyst components was collected to assess if any of these diagnostic characteristics had predictive value in ODC management. Surgical approach, evidence of torsion, and cyst reoccurrence were documented for patients managed surgically at initial presentation or at any point during the follow-up period. Data was entered into a secure Research Electronic Data Capture (REDCap) database.

For patients managed expectantly, interval follow-up with subsequent imaging of cyst measurements was collected. Variables including race, ethnicity, age, and BMI at the time of diagnosis were analyzed using descriptive statistics. Outcomes were analyzed via cross-tab with Chi squared and Fisher's exact tests using Stata V16. The study was approved by the study institution's Institutional Review Board.

Results

Forty-four patients met inclusion criteria. Thirty-six patients (82%) underwent SM and eight (18%) underwent EM (Table 1). Patient age at diagnosis was similar between SM and EM groups (8.8 years vs 8.0 years, P <.55). Racial and ethnic distribution was similar between groups, with the majority of patients reporting as White (70% vs 75%, $P = .76$) and non-Hispanic (89% vs 100%, $P = .32$). Overall, most patients (n = 31, 70%) were diagnosed by a transabdominal pelvic ultrasound, with a higher proportion of the EM cohort diagnosed by this modality compared to SM patients (100% vs 64%, $P = .04$) (Table 1).

Twenty-two (50%) patients in the total cohort had imaging findings of calcifications and 17 (39%) had fat within the ODC. There was no significant difference in cyst composition between SM and EM groups (Table 1). All patients had unilateral cysts. Fourteen patients (39%) from the SM cohort were found to have ovarian torsion, but the average cyst diameter for SM patients with torsion did not significantly differ from those without torsion (7.7 (3.1) cm vs 9.8 (5.6) cm, P=.21).

There was a significant difference in cyst size between SM and EM groups (8.9 cm vs 3.6 cm, $P = .004$) (Table 1). The majority (n = 30, 83%) of the SM patients presented with symptoms of abdominal or pelvic pain, whereas only 2 (25%) of EM patients had any symptoms at time of diagnosis ($P < .001$). Within the SM group, 11 (30%) patients underwent unilateral oophorectomy and 25 (70%) patients underwent unilateral cystectomy. There was as a significant difference in ODC size between patients undergoing each procedure (11.8 cm vs 7.7 cm, $P = .02$) (Table 2). There was no significant difference in age at diagnosis between oophorectomy and cystectomy groups (9.0 years vs 8.8 years, $P = .83$).

Four of the 36 surgeries (11.1%) were performed by pediatric gynecologists and the remaining 32 surgeries (88.9%) were performed by pediatric surgeons. All oophorectomy cases (N = 11) were performed by pediatric surgeons. A similar proportion of patients undergoing each procedure had ovarian torsion (oophorectomy: 36% vs cystectomy: 40%, $P = .82$). None of the EM patients who underwent surgery during the follow-up period were found to have ovarian torsion. Within the SM group, only one patient experienced cyst recurrence, and that patient underwent a unilateral cystectomy for initial management (Table 2).

Six (75%) of the EM patients had at least one follow-up ultrasound performed, at an average time of 3.7 months from diagnosis (Figure 1). Four (60%) of the EM patients who had documented follow-up underwent SM; of these, one patient's cyst had grown significantly, from 7 to 15 centimeters, which led to the recommendation of surgery. The

Table 1
Demographics and Baseline Imaging Data.

Characteristic	Total (N = 44)	SM (n = 36)	EM (n = 8)	*P*-value
Age at diagnosis, years	8.6 (3.4)	8.8 (3.1)	8.0 (4.5)	.55
Race				
White	31 (70)	25 (70)	6 (75)	.76
African American	8 (21)	7 (19)	1 (13)	.64
Asian	1 (2)	1 (3)	0 (0)	.63
Did not disclose	4 (7)	3 (8)	1 (13)	.71
Ethnicity				
Non-Hispanic	40 (91)	32 (89)	8 (100)	.32
Hispanic	3 (7)	3 (8)	0	.39
Did not disclose	1 (2)	1 (3)	0	.63
Average cyst diameter at diagnosis, cm	8.0 (4.8)	8.9 (4.8)	3.6 (2.1)	**.004**
Unilaterality	44 (100)	36 (100)	8 (100)	
Imaging modality				
Pelvic ultrasound	31 (70)	23 (64)	8 (100)	**.04**
CT scan	10 (23)	10 (28)	0	.09
MRI	3 (7)	3 (8)	0	.39
Composition on imaging				
Fat	17 (39)	15 (42)	2 (25)	.38
Calcifications	22 (50)	20 (55)	2 (25)	.12
No distinguishing features	16 (36)	12 (33)	4 (50)	.37

Continuous data presented as mean (SD); categorical data presented as n (%). Bold indicates statistical significance.
EM, expectant management; SM, surgical management.

Table 2
Comparison of Surgical Patients Undergoing Oophorectomy vs Cystectomy.

Feature	Oophorectomy (n = 11)	Cystectomy (n = 25)	*P*-value
Age, years	9.0 (3.1)	8.8 (3.2)	.83
Cyst size, cm	11.8 (6.9)	7.7 (2.9)	**.02**
Symptoms at diagnosis	11 (100)	19 (76)	.07
Ovarian torsion	4 (36)	10 (40)	.82
Cyst recurrence	0 (0)	1 (4)	.51

Continuous data presented as mean (SD); categorical data presented as n (%). Bold indicates statistical significance.

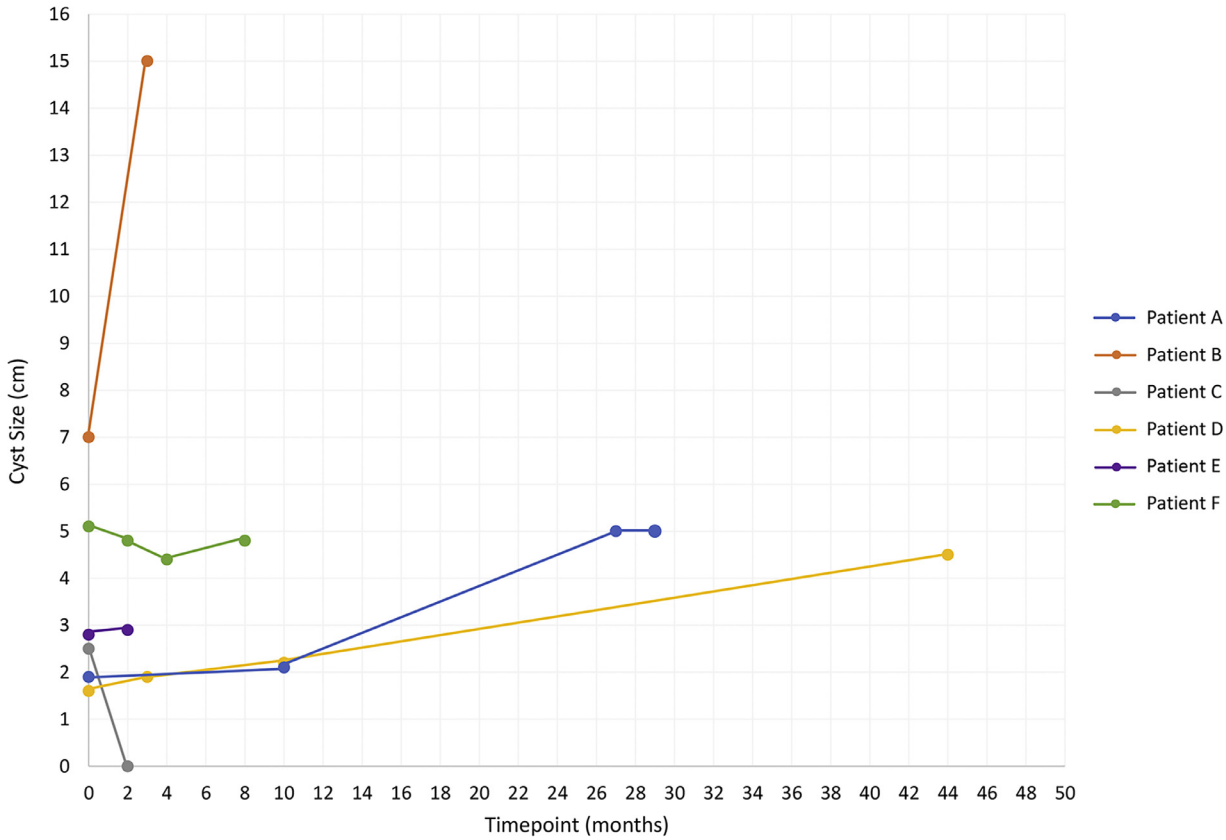

Fig. 1. Trajectory of ODC growth over time. ODC=ovarian dermoid cyst.

other three patients remained stable, with an average cyst size of 2.7 cm. Three (60%) of the EM patients had three follow-up ultrasounds, the farthest out of which was 44 months after diagnosis, with an average follow-up time of 27 months. In this timeframe, these patients' ODCs had an average yearly growth rate of 0.8 cm.

Discussion

In this study, we describe the outcomes at a single institution of undergoing EM and SM in premenarchal patients diagnosed with ODCs. In line with other studies, the majority of patients (82%) in this study underwent SM, which has long been the mainstay recommendation for ODCs regardless of age.[8]

In the general pediatric population, an ODC that is >5 cm or is growing more than 2 cm/year will typically be surgically removed to avoid complications, including cyst rupture or ovarian torsion.[12] Our study found that the SM group had a larger average cyst size at presentation. Additionally, six asymptomatic patients with cyst size <5 cm underwent SM without repeat ultrasounds to measure further cyst growth.

Literature on the growth trajectory of ODCs specifically in premenarchal patients is lacking, resulting in poorly supported guidelines for ODC management. Only a few studies over the last 20 years have attempted to define the average growth rate for ODCs, and the majority of the patients in these studies were adults.[9,10] Although our sample size was small, our yearly average cyst growth rate for ODCs in premenarchal patients was 0.8 cm—less than half of the previously published number in the adult population.[8,10] Although no definitive conclusions should be made from this sample at a single institution, this discrepancy warrants further large-scale study to create more appropriate and applicable recommendations for the pediatric population and to further investigate EM in appropriate patients.

Previous studies have shown that EM of ODCs can be safely done in premenopausal patients with ODC <6 cm in diameter; however, our study is the first to specifically

examine expectant management within a premenarchal population.[10] Avoiding surgery on the ovary—even ovarian-sparing procedures—is advantageous, as literature demonstrates that any surgical procedure involving the ovary carries a risk of impairing future fertility secondary to decreased ovarian reserve.[13] EM of ODCs for appropriate patients, therefore, should be considered to have fertility-sparing potential for the pediatric population, along with the benefits of avoiding costly and invasive surgery.

There is currently no standardized guideline for expectant management of ODCs within a pediatric population. However, a created guideline should include a stepwise repeat imaging approach, with imaging timeframes to be adjusted based on cyst size stability and continued monitoring of symptoms that would prompt a discussion of transitioning to an SM strategy. However, further studies are needed to establish safe and accurate guidelines on frequency of interval follow-up, appropriate ODC growth rate, and indications for surgery.

Ovarian torsion is a known complication of ovarian cysts. Younger patients have higher rates of ovarian torsion, and larger cyst sizes are thought to increase their risk.[14] Our study, however, did not demonstrate a statistically significant difference in average cyst diameter between premenarchal patients with and without ovarian torsion. This suggests that age may be a more significant predictor of torsion risk in the premenarchal population than cyst size; however, further multi-site studies are needed to establish this relationship.

In this single-institution study, the average cyst diameter in oophorectomy patients was significantly higher than in cystectomy patients, suggesting that cyst size was a significant determinant in procedure choice for SM of ODCs in premenarchal patients. This aligns with previous studies investigating SM of ODCs in the general gynecologic population, which show a consistent pattern of oophorectomy chosen over cystectomy for larger cyst sizes.[15] Although gynecologic surgery in the adolescent population has shifted toward an ovarian-sparing minimally invasive approach, many benign ovarian masses in the pediatric population continue to be managed with oophorectomy.[16] Pediatric surgeons are more likely than gynecologists to perform oophorectomy for benign adnexal indications, as the addition of a gynecologist to the surgical staff has been shown to decrease oophorectomy rates.[17] This is consistent with the current study, where all oophorectomies for SM patients were completed by pediatric surgeons. However, as ovarian reserve and fertility preservation are important aspects of pediatric gynecologic care, further investigation on whether oophorectomy is ever indicated in premenarchal patients is needed. The retrospective methods of this study limit experimental investigation of the impacts of cystectomy on larger cyst sizes in premenarchal patients. Considering that there was no significant difference in recurrence rates between the two surgical procedures in this study, it is possible that cystectomy could have similar outcomes to oophorectomy in this population.

Limitations of this study include the retrospective collection of data on symptoms, as well as the small sample size—specifically for EM patients. The limited size of the EM group prevents the development of statistically significant conclusions and shows the need for future studies that will likely require a multi-institution patient population that allows for a larger, more representative cohort. Additionally, it is hard to make comparisons in this population to current published data, as much of the literature on ovarian cysts in children do not focus on ODCs, but rather on simple cysts in general. The retrospective nature of this study limited our ability to reexamine the ultrasound images to further confirm a diagnosis of an ODC. This is because some patients had imaging performed at outside institutions that were not available to us, while others had imaging performed prior to the adoption of our institution's current electronic medical record system. The retrospective nature of this study did not allow for implementation of a consistent follow-up protocol in EM patients, as seen by the varying number of follow-up visits and intervals. However, this study does provide important initial insight into progression of ODCs in this population. It adds to the literature by calculating the growth rate of ODCs when expectantly managed and studying how many patients undergoing EM eventually need SM.

Despite a small sample size in the EM cohort, the data outlined suggests further consideration of EM as a safe treatment option for appropriate patients. However, the possible risks of EM should not be ignored, including the cost and time burden of repeat ultrasounds and follow-up visits in addition to risk of losing patients to follow-up over time. Rather, these factors should be considered alongside the known risks of adolescent ovarian surgery to help patients and caregivers determine the best plan.

Continued study on ODCs in premenarchal patients is needed to better define an average yearly growth rate and to create evidence-based recommendations for EM in this population.

Meeting Presentation

This research was presented at the North American Society for Pediatric and Adolescent Gynecology in Orlando, Florida at the Annual Clinical and Research Meeting on April 5, 2024.

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Conflicts of Interest

The authors have no conflicts of interest to disclose.

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