

Paediatric ovarian lesions—the experience at Starship Children’s Hospital, New Zealand

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Abstract

Aim To review the experience of paediatric ovarian masses at Starship Children’s Hospital (Auckland, New Zealand). Primarily to assess the range of pathology, the presenting features, and the surgical management of these lesions.

Methods A search of the hospital surgical pathology database was carried out to identify patients less than 16 years in whom ovarian tissue was submitted for pathological analysis during the 12 year period from January 2000 to December 2011. A retrospective review of the medical records was carried out.

Results 244 ovarian masses in 219 patients were identified. 99 of these were neoplastic with 19 (7.8%) being malignant and an additional four (1.6%) borderline malignant lesions (borderline epithelial tumours). Mature cystic teratoma was the commonest neoplastic lesion (55.6%).

Patients who presented with acute abdominal pain were more commonly found to have non-neoplastic lesions than neoplastic lesions (71.5% vs 46.9%, $p < 0.0001$), and those that presented with a palpable mass were more commonly found to have a neoplastic lesion (24.0% vs 3.3%, $p < 0.0001$).

Laparoscopic surgery was performed in 41.6% of all patients. Ovary conserving surgery was performed in 56.6% of all patients, though only 32.3% of patients with neoplastic lesions.

Conclusion This study provides important insight into the range of ovarian pathology encountered in a New Zealand paediatric population. Most of the ovarian lesions in paediatric age groups are benign. Ovarian sparing surgery is recommended. In cases of ovarian torsion, malignancy in this series and in the literature is less than 2%. This review highlights that paediatric surgical units have vast experience to deal with ovarian pathology in paediatric age groups.

Background

Ovarian masses in children, whether solid or cystic, include a heterogenous group of lesions. Malignant neoplasms are rare in paediatric age groups with an estimated occurrence of 2.6 cases per 100,000 girls per year, and comprise approximately 1% of paediatric cancers.^{1,2}

The presentation of ovarian masses can be variable and non-specific. Ovarian masses are commonly encountered during acute laparoscopy for suspected appendicitis or ovarian torsion. Best practice regarding the management of ovarian masses remains uncertain.

Due to the low rate of ovarian malignancy and the generally good outcomes observed in these patients, many surgeons are opting for minimally invasive and ovarian sparing operative management.

The primary aim of this study was to assess the range of ovarian lesions encountered at Starship Children's Hospital and in particular to assess the range and volume of malignant lesions. We also set out to assess the presenting features and the management of these patients.

The authors reviewed the experience with paediatric ovarian masses at Starship Children's Hospital over a 12-year period to provide a New Zealand perspective on this challenging clinical entity.

Materials and methods

Regional ethics approval was not required for this study, therefore following hospital board approval a search of the surgical pathology database at Starship Children's Hospital was undertaken to identify all patients under 16 years, who had tissue submitted for pathologic analysis from the ovary or adnexa between 1 January 2000 and 31 December 2011. An extensive retrospective review of the patient's clinical records was performed.

Age at surgery, clinical presentation, imaging and investigations, operation type, operative findings and follow up of all patients were recorded and analysed.

Results

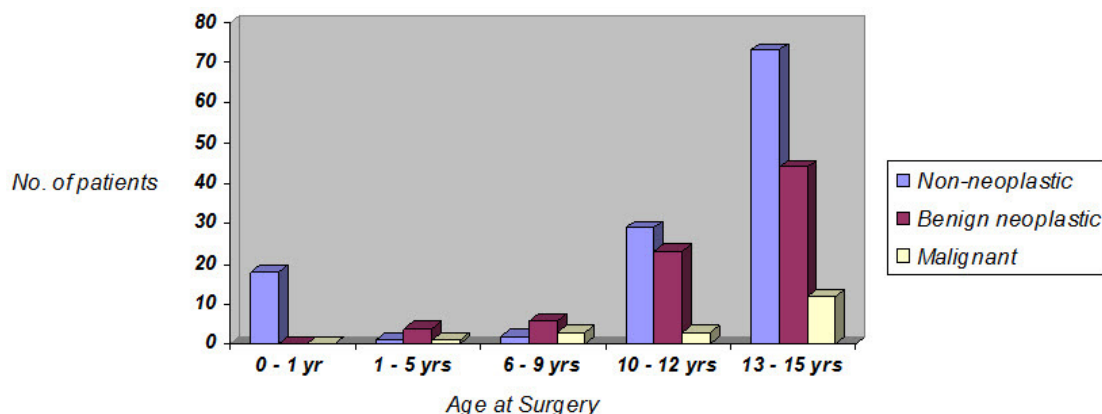
A total of 247 patients were identified from the surgical pathology database. 28 patients were excluded from this review as they had undergone ovarian biopsies alone, or had no ovarian mass or cyst.

219 patients with 244 ovarian lesions underwent surgical procedures for ovarian masses in the period January 2000 to December 2011.

The age of patients ranged from 2 days to 15 years with a mean of 11 years at the time of surgery. In the patients over ten years, a higher proportion of the lesions were benign compared with those seen in the younger age groups (91.1% vs 87.1%).

As shown in Figure 1 the older age groups (10 to 15 years) accounted for the majority of the patients with ovarian masses in this series.

Figure 1. Age at surgery for different pathologic groups



Histopathology results—Neoplastic lesions accounted for 40.6% of the lesions (n=99). Mature cystic teratoma was the commonest neoplasm identified comprising 55.6% of the neoplastic lesions (n=55). Tumours of epithelial origin comprised 23.2% of the neoplastic group (n=23).

Nineteen patients had malignant tumours (8.7% of patients), two of which had metastatic disease at presentation.

Paratubal cysts accounted for the majority of the non-neoplastic lesions (42.1%), followed by corpus luteal cysts (21.4%) and simple follicular cysts (16.6%).

Table 1. Pathologic findings from 244 ovarian lesions in 219 patients

Neoplastic lesions (n=99)	
Surface epithelial – stromal tumours (n – 23)	
Serous cystadenoma	10 (4.1%)
Mucinous cystadenoma	9 (3.7%)
Borderline malignant tumour*	4 (1.6%)
Sex cord stromal tumours	
Juvenile granulosa cell tumour	3 (1.2%)
Sertoli-leydig cell tumour	1 (0.4%)
Ovarian fibroma	2 (0.8%)
Germ cell tumours (n – 68)	
Dysgerminoma	2 (0.8%)
Yolk sac tumour	5 (2.0%)
Mixed germ cell tumour	3 (1.2%)
Immature teratoma	3 (1.2%)
Mature cystic teratoma	55 (22.5%)
Miscellaneous tumours	
Small cell carcinoma, hypercalcaemic	1 (0.4%)
B cell lymphoma	1 (0.4%)
Non-neoplastic lesions (n=145)	
Paratubal cyst	61 (25%)
Corpus luteal cyst	31 (12.7%)
Follicular cyst	24 (9.8%)
Haemorrhagic pseudocyst	12 (4.9%)
Para-ovarian cyst	9 (3.7%)
Broad ligament cyst	3 (1.2%)
Tubo-ovarian cyst	3 (1.2%)
Fimbrial cyst	2 (0.8%)

*Borderline epithelial tumours.

Contralateral lesions—Bilateral lesions were found in 24 patients (11.0%). Five patients had neoplastic lesions on contralateral ovaries. Two patients with serous cystadenomas later developed lesions in the contralateral ovary on follow-up. Only one patient in this series underwent bilateral oophorectomy for which histology showed a borderline serous tumour.

One mature cystic teratoma was excised from the contralateral ovary during oophorectomy for a mixed germ cell tumour. The other patient with a contralateral mature cystic teratoma was excised during an open salpingo-oophorectomy for a large paratubal cyst with associated ovarian torsion.

Table 2. Pathologic findings from 28 contralateral ovarian lesions in 24 patients

Borderline serous tumour	1 (3.6%)
Serous cystadenoma	1 (3.6%)
Mucinous cystadenoma	1 (3.6%)
Mature cystic teratoma	2 (7.1%)
Paratubal cyst	10 (35.7%)
Follicular cyst	9 (32.1%)
Corpus luteal cysts	3 (10.7%)
Fimbrial cyst	1 (3.6%)

Presenting features—The presentation of patients with ovarian masses were variable. However, there were significant differences in the clinical presentation between the neoplastic and non-neoplastic groups of patients (see table 3 below).

The most common presenting symptom was acute abdominal pain (n=133, 60.7%). Presentation with acute abdominal pain was more common in patients with non-neoplastic lesions and this difference was statistically significant.

Presentation with an abdominal or pelvic mass was more common in patients with neoplastic lesions and this difference was also statistically significant.

Four children with non-neoplastic cysts presented with a palpable abdominal mass (two paratubal cysts, one corpus luteal cyst and one tubo-ovarian cyst).

All the infants in this study had non-neoplastic ovarian cysts which were diagnosed by antenatal ultrasound.

Patients presenting with endocrine disturbances were rare in this series. Four patients (1.8%) in our series presented with endocrine disturbances. Two patients with granulosa cell tumours and one with a serous cystadenoma presented with precocious puberty. One patient with a Sertoli-Leydig cell tumour presented with features of masculinisation.

One of the patients with an ovarian fibroma had clinical features of Gorlin-Goltz syndrome and is on surveillance for basal cell carcinoma.

Two patients (one 14 years old and the other 15 years old) had mature cystic teratomas that were found incidentally for investigation of encephalitis caused by anti-NMDA receptor antibodies.

Table 3. Clinical presentation of patients with ovarian masses

Presenting symptoms / signs	Non-neoplastic lesions (123)	Neoplastic lesions (total 96)	Fisher's exact test
Acute abdominal pain	88 (71.5%)	45 (46.9%)	p<0.0001
Abdominal or pelvic mass	4 (3.3%)	23 (24.0%)	p<0.0001
Chronic abdominal pain	9 (7.3%)	15 (15.6%)	p=0.08
Incidental finding	7 (5.7%)	9 (9.4%)	p=0.43
Antenatal ultrasound finding	18 (14.6%)	0	p<0.0001
Isosexual precocious puberty	0	3 (3.1%)	p=0.09
Masculinisation / deepening of voice	0	1 (1.0%)	p=0.45

Surgical management—91 patients underwent laparoscopic surgery (41.6%). The majority of patients with non-neoplastic lesions underwent laparoscopic surgery (60.2%, n=74). However, only 17.7% of those with neoplastic masses had laparoscopic surgery (see Table.4).

One borderline epithelial tumour and one malignant lesion were resected with laparoscopic surgery. This malignant lesion was an immature teratoma with associated ovarian torsion.

Table 4. Surgical procedures in 219 patients

Procedure	Non-neoplastic total=123	Neoplastic total=96
Laparoscopic cystectomy	45 (36.6%)	12 (12.5%)
Laparoscopic salpingo-oophorectomy	12 (9.8%)	4 (4.2%)
Open cystectomy	31 (25.2%)	18 (17.8%)
Open Salpingo-oophorectomy	18 (14.6%)	61 (63.5%)
Laparoscopic de-roofing of cyst	17 (13.8%)	1 (1.0%)

Operative findings—83 (62.4%) patients had ovarian torsion as the cause of their acute abdominal pain. Non-neoplastic cysts were associated with 72.3% of these tortured ovaries (n=60), while mature cystic teratomas were associated with 25.3% of these tortured ovaries (n=21).

There was one case of an ovarian fibroma in a 13 year old that presented with abdominal pain secondary to ovarian torsion. One malignant tumour presented with ovarian torsion. This was a grade 1 immature teratoma in a 13 year old who presented with abdominal pain.

29.6% (8/27) of patients who underwent surgery for a palpable mass were found to have ovarian torsion.

66.7% (n=12) of neonates with ovarian cysts had tortured ovaries.

Discussion

The experience with ovarian masses at Starship Children's Hospital over a 12 year period from 1 January 2000 to 31 December 2011 comprises of 244 ovarian lesions in 219 patients.

A review of the literature revealed this case series to represent the largest published series of ovarian lesions in a paediatric population from a single hospital institution.

Table 5 below shows three other large published series' of paediatric ovarian lesions from single institutions and table.6 demonstrates the pathological range of ovarian lesions reported in these studies.

To date there have not been any studies looking into the range of ovarian pathology seen in a New Zealand paediatric population. Therefore this series provides information which is important in the decision making process on the management of these lesions in a New Zealand context.

It has been reported in the literature that up to 64% of ovarian masses in children and adolescents are neoplastic.² The majority of these tumours arise from germ cells.² Other reports suggest that tumours arising from the surface epithelium comprise less than 20% of ovarian tumours in children and these are extremely rare before puberty.³

In this series, neoplastic lesions accounted for only 40.6% of ovarian masses out of which 23.2% were of epithelial origin. The rate of malignancy in this series was 8.7% of patients (19.2% of the neoplastic lesions), which is similar to the published data from other institutions.⁴

It is important to note that this study does not include patients with ovarian cystic lesions that did not have tissue submitted for pathological analysis, such as those patients who may have had laparoscopic de-roofing or drainage of a clinically benign cyst. Therefore, the true overall malignancy rate of ovarian lesions in this series is likely to be lower than the reported figure.

Mature cystic teratoma was the commonest tumour encountered and this was more than four times as common as all other malignant germ cell tumours (yolk sac tumour, mixed germ cell tumour, dysgerminoma and immature teratoma). Oophorectomy, salpingo-oophorectomy and ovarian cystectomy were performed for these lesions.

The current literature suggests that cystectomy only is the treatment of choice for patients with normal alpha-feto protein, a predominantly cystic appearance on ultrasonography, and no intraoperative features of malignancy (such as extracapsular extension and lymph node involvement).^{5,6}

As in other reports,^{2,3} most of the patients with malignancy had germ cell tumours. Age at presentation was not useful in distinguishing patients with benign from malignant lesions. The commonest presentation in those with malignant lesions was a palpable mass in the pelvis or abdomen. Also, two patients with juvenile granulosa cell tumours presented with precocious puberty, while one child with Sertoli-Leydig cell tumour presented with features of masculinisation.

In the adult population, imaging in malignancy predominantly shows an irregular or multilocular solid tumour. However, malignant ovarian lesions in children can be cystic. Gross cystic components are common in childhood with an incidence of 57%⁴ unlike in adults, where the quoted risk of malignancy in cystic ovarian lesions is only 2%.⁷

All childhood ovarian malignancies should be treated with salpingo-oophorectomy. Although most of these present as stage I lesions, complete staging during surgery

including lymph node sampling, peritoneal washings and omental biopsy is the gold standard.⁸

In this series there was one case of a grade I immature teratoma that presented with 360° torsion of the left ovary around a large ovarian cyst. Detorsion of the left ovary and excision of the left ovarian cyst was carried out laparoscopically. Malignancy was not suspected preoperatively.

Once the histology returned showing malignancy, an MRI was arranged. This showed no evidence of malignancy. A number of opinions were sought and following review by a multidisciplinary team a plan for observation, serial tumour markers and ultrasound imaging was made.

The commonest type of epithelial neoplasm in this series was benign cystadenoma (10 serous and 9 mucinous). Other studies have shown that epithelial tumours of the ovary are more commonly serous than mucinous.⁹

The proportion of mucinous tumours is reported to be 40% in children (47.4% in this series) compared to 12% in adults⁹. Of the 19 cystadenomas, 8 underwent cystectomies while the remaining had oophorectomies done.

Adenocarcinoma of the ovary is a rare entity in children. Three cases reported by Shankar et al had a poor prognosis¹⁰. A 43-year review published in 1992 reported only two cases.¹¹ There were no cases of adenocarcinoma in this series. Borderline epithelial ovarian tumours are defined as epithelial tumours with nuclear atypia without stromal invasion.¹² These tumours are reported to be more common in children than in adults.¹³

This series had four borderline epithelial tumours, all of which were serous. Unlike adenocarcinoma, which is managed aggressively according to the stage of the disease, borderline tumours can be treated by more conservative surgical procedures⁹.

Ovarian cysts have been reported to be seen in 30–68% of routine obstetric ultrasound scans.^{14,15} All neonatal ovarian masses are uniformly benign follicular cysts owing to maternal oestrogen stimulation⁴. Most of these resolve spontaneously, but can be complicated by ovarian torsion, intra-cystic haemorrhage or a mass effect.

Surgery has been advocated in cysts more than 5 cm in size or for those which increase in size after a 3-month follow up^{15,16}. Twelve out of the 18 infants in this series had associated ovarian torsion. Early laparoscopy to evaluate for ovarian torsion with aspiration or de-roofing of the cysts may increase the chance of preserving ovarian function in infants with ovarian cysts. Further studies are needed in this regard.

Approximately two thirds of the patients with non-neoplastic ovarian lesions presented with acute abdominal pain. Also, almost all of the patients with corpus luteal cysts presented with acute pain. It is difficult to differentiate pre-operatively those patients with uncomplicated ovarian cysts from those with ovarian torsion or acute appendicitis.

Peritonism and an elevated white cell count can be seen with both ovarian pathology and acute appendicitis. Although ultrasonography can be helpful in differentiating

conditions like acute appendicitis from ovarian lesions, laparoscopy remains the only definitive method to differentiate these with certainty.¹⁷

In this series, 29.6% of patients who underwent surgery for an ovarian mass were found to have ovarian torsion. These patients usually have acute abdominal pain with vomiting. Right-sided ovarian torsion, being more common, can mimic acute appendicitis preoperatively.¹⁴

An ovarian mass, solid or cystic, can result in a longer pedicle that predisposes the ovary to undergo torsion. Although preoperative ultrasonography plays a very important role in diagnosing ovarian torsion, false-negative results and delay in getting the imaging done emphasizes the role of diagnostic laparoscopy in the evaluation and management of these patients.^{5,17}

The recommended treatment for ovarian torsion is de-torsion and preservation of all ovaries, even those which appear frankly gangrenous. Cass et al has recommended simple de-torsion with aspiration of ovarian cysts followed by elective ovarian cystectomy if the cystic mass persists or alpha-feto protein levels remain high postoperatively.⁵ This recommendation has been based on the difficulty in assessing ovarian viability, potential damage associated with cystectomy in oedematous, friable tissue and also due to the very low rate of malignancy in these cases.^{18,19} Also, there have been reports of oophoropexy of the contralateral ovary.²⁰

Contralateral oophoropexy was not performed in any patients in this series. In this series there was one case of malignancy (immature teratoma) that presented with ovarian torsion. This equated to a 1.1% rate of malignancy associated with ovarian torsion in this series. A study by Oltmann et al in which they combined 14 series' of ovarian lesions in the paediatric population reported a 1.8% malignancy rate associated with ovarian torsion.²¹ Combining this large series with their study gives a malignancy rate of 1.7% of cases of ovarian torsion.

Conservative ovarian surgery in children is important for the development of normal puberty and future fertility²². In large ovarian cysts or mature teratomas there is very little or no tendency of malignant degeneration and with a bilateral incidence of 12%, conservative surgery is more appropriate than salpingo-oophorectomy.²³ Bilateral ovarian lesions were found in 11.0% of our patients.

In this series, 60.2% of non-neoplastic cysts were treated by laparoscopic surgery whereas 17.7% of the neoplastic lesions were managed laparoscopically. Laparoscopic cystectomy with ovarian preservation in benign ovarian lesions has been documented to be safe in children and adolescents.²⁴ The concerns of recurrence, spillage and malignancy seem to not be as significant as previously thought after laparoscopic surgery in children.²⁴

Two cases in this series (one borderline malignant tumour and one immature teratoma) were managed with laparoscopic surgery. No cases of malignancy recurrence were identified during data collection for this study.

Table.5: Summary of 4 large published series of ovarian lesions in paediatric patients from single institutions.

Authors	No. of cases (n)	Length of study (years)	Age range (years)	Average case per year
De Silva et al ²⁵ (Melbourne)	134	11	Up to 19	12.2
Cass et al ⁵ (Texas)	106	15	Up to 19	7.1
Brown et al ²⁶ (Philadelphia)	91	11	Up to 18	8.3
Starship experience	219	12	Up to 16	18

Table 6. Summary of the case mix from the 4 published series in Table 5

Authors	Non-neoplastic %	Neoplastic benign %	Neoplastic malignant %
De Silva et al ²⁵ (Melbourne)	59	32.8	8.2
Cass et al ⁵ (Texas)	46.3	44.3	9.4
Brown et al ²⁶ (Philadelphia)	38.5	40.6	21
Starship experience	59.4	32.8	7.8

Summary—Ovarian lesions in children and adolescents include a wide array of pathologic diagnoses and these lesions have varied clinical presentations. Although neoplastic lesions are seen commonly in this group, the incidence of malignancy is less. This case series suggests that the prognosis of children with ovarian masses is excellent.

In benign lesions, future fertility should be the primary consideration when deciding the extent of surgery. A minimally invasive approach with cystectomy and ovarian salvage is safe and should be considered in children with benign lesions. Complete staging and complete resection should be the goal in those with malignant lesions. Bilateral oophorectomy is rarely necessary in children.

However, as is often the case with ovarian masses it is usually not known if the lesion is benign or malignant and clinical assessment of this is difficult. Therefore, in the acute setting of paediatric ovarian masses the authors of this article favour ovary sparing and minimally invasive surgery where possible.

For a population of girls aged 0–15 years, with acute abdominal pain, ovarian lesions should be part of the differential diagnoses. The authors also suggest that referral of these patients to a paediatric surgical unit is preferable. This paper shows that paediatric surgical units have vast experience to deal with this condition.

At our institution, all malignant tumours are discussed at a multidisciplinary oncology meeting and the authors recommend this practice.

Competing interests: Nil.

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