CHAPTER 117
OVARIAN LESIONS

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Introduction

Ovarian lesions in paediatric patients require special considerations that may not be applicable in adult patients with comparable diseases. Importantly, these lesions do not follow the same histologic distribution as those seen in adults. They range from benign cysts that can regress spontaneously to bilateral malignancies that require aggressive treatment. Gynecological malignancies account for about 1–2% of all paediatric cancers, and roughly 60–70% of gynecological malignancies are ovarian in origin.[1,2] The diagnosis of ovarian malignancies can often be challenging. Early detection is vital not only for fertility preservation, but also for cure or disease-free remission. Early detection may be even more difficult in developing countries, where access to health care may be limited.

Demographics

Worldwide and African incidence of ovarian lesions has not been reported; however, the incidence of all ovarian masses in childhood in the United States is approximately 2.6 cases per 100,000 girls per year, and malignancy is reported in 16–55% of cases.[2] In North America, the frequency of ovarian cancer has actually decreased due to the identification of tumour markers, newer diagnostic imaging modalities, and reclassifying the pathology, which allows better identification of all gonadal masses.[3] Laboratory tests for tumour markers and the newer imaging modalities are not readily available or are too expensive to be commonly used in many African regions, however. The frequency of ovarian lesions is greatly influenced by age in North America. Table 117.1 provides the age of peak incidence for ovarian neoplasms in the paediatric population.[4]

Table 117.1: Age of peak incidence for common ovarian neoplasms.

Tumour	Age of peak incidence
Mature cystic teratomas	>5 years
Granulosa cell tumour	< 9 years
Yolk sac tumours	10–14 years
Surface epithelial tumours	>10 years

Aetiology/Pathophysiology

Ovarian lesions can arise from different cell types, so the aetiology can vary; however, there is a consistent trend of normal tissue underlying the abnormal lesions. Ovarian cysts arise from mature follicles, and neonatal and prepubertal children have been shown to have active follicular growth in the appropriate hormonal millieu. Neoplastic ovarian tumours can arise from germinal epithelium surrounding the urogenital ridge, stromal tissue comprising the urogenital ridge, or germ cells from the yolk sac. The cells dedifferentiate, proliferate, and then undergo malignant transformation. Surface epithelial tumours are more common in women who ovulate more frequently over their lifetime, whereas germ cell tumours are most common in younger children.

It is proposed that the more times a follicle ruptures, the more times the ovary epithelium repairs itself, which can increase cellular errors, in turn allowing for increased malignant transformation. This principle may explain why it is believed that pregnancy confers some protection against ovarian cancer, especially in women with high parity. The relevance of this theory in young children is unclear because they either have not begun to ovulate or have ovulated very few times. Sex cord-stromal tumours arise from mesenchymal stem cells below the surface epithelium of the urogenital ridge. These cells have not committed to a cell lineage; therefore, they can differentiate into different cell lines.[5]

A number of syndromes are associated with ovarian tumours. Examples include, but are certainly not limited to, Peutz-Jeghers syndrome and granulosa cell tumours, Ollier's disease and juvenile granulosa cell tumours, Sertoli-Leydig cell tumours, and Maffucci syndrome and fibrosarcoma.[6–8] In nonfamilial cases of ovarian malignancy, infertility and nulliparity have been shown to increase the risk.[8,9] Conversely, multiparity and the use of oral contraceptive pills have been shown to decrease the risk.[10] Other, more controversial, factors that increase the risk of ovarian cancer include the use of ovulation-induction medications and diets that include animal fats, dairy products, and lactose.[5] Genetics have been shown to predispose women to breast and ovarian cancer in roughly 5–10% of patients. The tumour suppressor genes BRCA1 and BRCA2 have been unequivocally linked to ovarian cancer.[11,12] Although other genes are likely responsible for hereditary ovarian cancer, they remain unknown.

Pathology

The term "ovarian lesion" encompasses a number of nonneoplastic and neoplastic lesions that can be distinguished based on histological features. Tables 117.2 and 117.3 list the nonneoplastic and neoplastic lesions, respectively. The neoplastic lesions comprise both benign and malignant tumours. Nonneoplastic ovarian cysts are included in the spectrum of ovarian lesions because they can produce symptoms mostly related to mass effect and endocrinopathies.[13]

Table 117.2: World Health Organization histologic classification of nonneoplastic ovarian lesions.

Solitary follicle cyst	Stromal hyperplasia
Multiple follicle cyst	Stromal hyperthecosis
Large solitary luteinised follicle cyst of pregnancy and puerperium	Massive oedema
Hyperreactio luteinalis	Fibromatosis
Corpus luteum cyst	Endometriosis
Pregnancy luteoma	Cyst, unclassified
Ectopic pregnancy	Inflammatory lesions

Source: Templeman C, Fallat M. Ovarian tumours. In: Grosfeld JL, O'Neill JA Jr, Coran AG, Fonkalsrud EW, Caldamone AA, eds. Pediatric Surgery, Sixth Edition. Mosby Elsevier, 2006, Pp 593–621.

Table 117.3: World Health Organization classification of tumours of the ovary.

Surface epithelial-stromal tumours	**Germ cell tumours**
Serous tumours	Primitive germ cell tumours
Mucinous tumours	Dysgerminoma
Endometriod tumours	Yolk sac tumour
Clear cell tumours	Embryonal carcinoma
Transitional cell tumours	Polyembryoma
Squamous cell tumours	Nongestational choriocarcinoma
Mixed epithelial tumours	Mixed germ cell tumours
Undifferentiated and unclassified tumours	Biphasic or triphasic teratomas
Sex cord–stromal tumours	Immature
Granulosa–stromal cell tumours	Mature
Granulosa cell tumour group	Monodermal teratomas
Tumours in thecoma-fibroma group	**Germ cell sex cord-stromal tumours**
Sertoli-stromal cell tumours	Gonadoblastoma
Sex cord–stromal tumours of mixed or unclassified cell types	Mixed germ cell–sex cord–stromal tumour of nongonadoblastoma type
Sex cord tumour with annular tubules	**Tumours of rete ovarii**
Gynandroblastoma	**Miscellaneous tumours**
Steroid cell tumours	Small-cell carcinomas, hypercalemic type
	Gestational choriocarcinoma
	Soft-tissue tumours not specific to ovary
	Tumourlike conditions
	Lymphoid and haematopoietic tumours
	Secondary tumours

Source: Templeman C, Fallat M. Ovarian tumours. In: Grosfeld JL, O'Neill JA Jr, Coran AG, Fonkalsrud EW, Caldamone AA, eds. Pediatric Surgery, Sixth Edition. Mosby Elsevier, 2006, Pp 593–621.

Clinical Presentation

The presentation of an ovarian lesion can vary depending on the pathological classification; however, benign and malignant lesions often will have similar clinical presentations.[14] Abdominal pain and/or distention are the most common symptoms in patients with an ovarian lesion regardless of the tumour pathology. Pain can be a result of torsion, rupture, or perforation (Figure 117.1). The most common initial diagnosis based on these symptoms is appendicitis, which must be carefully excluded. Some signs and symptoms can be more indicative of a benign or malignant lesion. Benign lesions will rarely cause vaginal bleeding, whereas malignant ones will often have early bleeding in their development due to hormonal imbalance. Other nonovarian lesions can cause bleeding, most commonly vulvo-vaginitis, but in children the presence of bleeding should prompt a work-up for an ovarian tumour.[15] Other symptoms relating to ovarian neoplasms include anorexia, nausea, vomiting, and urinary frequency.[5]

Endocrine disorders can be detected in roughly 10% of both neoplastic and nonneoplastic ovarian lesions and may be the first sign of disease. Isosexual precocious puberty occurs with ovarian cysts and sex cord–stromal tumours, most commonly granulosa cell tumours, but can also occur in Sertoli-Leydig cell tumours, due to the production of oestrogen. Patients with central precocious puberty or premature thelarche can also develop similar signs and symptoms.[16] Granulosa-theca cell tumours can be differentiated from true sexual precocious puberty, gonadotropin-secreting lesions, or feminising adrenal tumours by increased serum and urinary oestrogen levels, which are low in the other three conditions.[5] Precocious pseudopuberty can occur in patients with germ cell tumours that produce human chorionic gonadotropin. Heterosexual precocious puberty can be seen in Sertoli-Leydig cell tumours, dysgerminomas with syncytial trophoblastic giant cells, yolk sac tumours, steroid cell tumours, and polycystic ovaries.[5] Patients with heterosexual precocious puberty present with the following signs, depending on the stage of development: defeminisation then masculinisation, breast atrophy, oligomenorrhea then amenorrhea, voice-deepening, hirsuitism, male pattern hair growth, and clitoromegaly.[16]

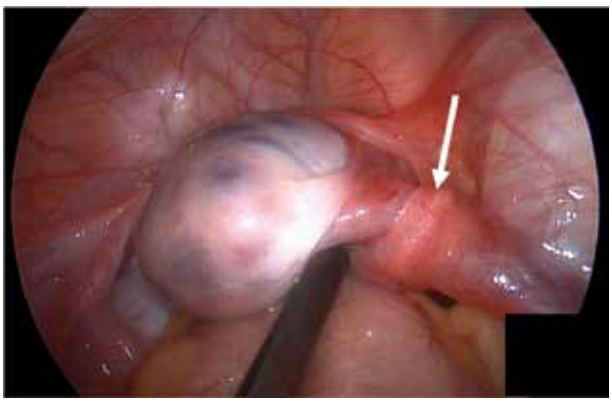

Figure 117.1: Laparoscopic view of torsion of the right ovary in a peripubertal female. Note the twisting of the fallopian tube (arrow).

A thorough physical exam should be the first step in evaluating any patient suspected of having a potential ovarian lesion. More than 60% of patients with ovarian tumours have a palpable abdominal mass below the pelvic brim, with or without tenderness.[14] A bimanual examination between the lower abdomen and rectum can assist in palpating smaller lesions. In general, vaginal examination is reserved for sexually active women.

Investigations

Laboratory tests consisting of specific tumour markers or hormones can be useful in the diagnosis and follow-up of an ovarian lesion; however, these tests may not be available in all regions. Although neither tumour markers nor hormones are specific to an ovarian lesion, they are inexpensive methods of evaluating a possible diagnosis. Tables 117.4 and 117.5 list the ovarian tumours with their associated tumour markers and serum hormone levels, respectively.

Imaging plays a central role in the diagnosis of ovarian lesions. Ultrasound (US) is the gold standard imaging technique. It is quick and cost-effective with no radiation exposure. Transabdominal US should be used with a distended bladder. Alternatively, transvaginal US, which entails placement of a high-frequency transducer in the mid to upper portion of the vagina, is utilised in nonvirginal teenagers, but should not be used in children. Transperineal imaging—placement of a transducer directly on the introitus—may be used for children. The normal ovarian size fluctuates throughout a woman's life-span.[17] The structural appearance of the ovaries also varies. Both are important factors in evaluating the ovaries in different age groups. Children younger than 8 years of age usually have solid and ovoid ovaries with a homogeneous echogenic texture. During and after puberty the ovaries develop cystic structure, reflecting the ovulatory cyle. These normal follicular cysts appear anechoic and thin-walled and have strong acoustic enhancement.[18]

Table 117.4: Ovarian tumours and tumour markers.

Histological subtype	Tumour marker
Endometrioma	CA-125
Epithelial	
Borderline	CA-125
Carcinoma	CA-125
Germ cell (pure tumours)	
Dysgerminoma	b-hCG, LDH
Yolk sac	AFP, b-HCG
Immature teratoma	
Choriocarcinoma	b-hCG
Embryonal	AFP, b-hCG
Endodermal sinus	AFP
Sertoli-Leydig	AFP

Table 117.5: Ovarian tumours and hormones.

Histological subtype	Hormone
Ovarian cyst	
Simple	Increased estradiol
Follicular	Increased estradiol
Luteal	Increased estradiol
Sex cord–stromal	
Juvenile granulosa	Increased estradiol, increased testosterone
Sertoli-Leydig	Increased estradiol, increased testosterone
Luteinised thecoma	Increased estradiol, increased testosterone
Sex cord tumour with annular tubules	Increased estradiol
Steroid cell tumour	Increased testosterone, increased urinary 17-ketosteroid
Gonadoblastoma	Increased estradiol, increased testosterone, increased urinary 17-ketosteroid, decreased gonadotropins
Choriocarcinoma	Increased estradiol, increased gonadotropins

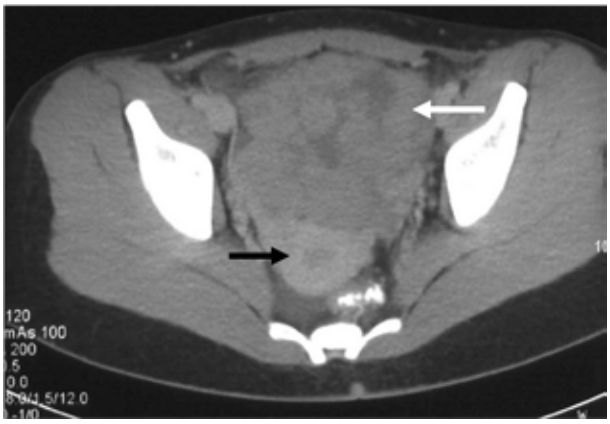

Figure 117.3: CT scan of the pelvis revealing a multilobulated mass (white arrow) in a 17-year-old girl. The mass is separate from the uterus (black arrow). Contrast is seen in the rectum. Final pathology revealed a dysgerminoma.

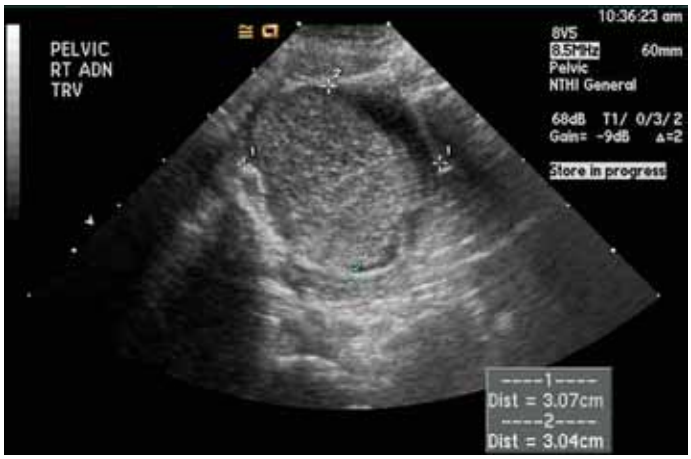

Figure 117.2: Ultrasound view of an in utero torsion of the right ovary diagnosed in a one-month-old infant. The mass is echogenic without any evidence of blood flow.

Ovarian masses have a variety of appearances on US. In general, benign tumours are complex hypoechoic masses with peripheral echogenic mural nodules that may produce acoustic shadowing. Specifically, classic benign cysts will have sharp posterior walls, have strong acoustic enhancement, and be echoless. Benign cysts can be distinguished from haemorrhagic cysts, which have diffuse, homogeneous, or complex internal echoes and decreased acoustic enhancement. Mature teratomas have a large cystic component in addition to at least one mural nodule. Additionally, they can be homogeneously echogenic due to the presence of calcifications, fat, sebaceous material, or matted hair. Teratomas are bilateral 25% of the time, so the contralateral ovary should be evaluated. Malignant ovarian tumours are usually complex masses with an average size of 15 cm, but are at least larger than 10 cm. The solid component is not hyperechoic and is usually nodular or papillary, and there are often thick septations. Color or power Doppler can be useful in identifying blood flow to the ovary to rule out torsion as well as in the solid component of the tumour (Figure 117.2). Other signs of malignancy include ascites, omental or peritoneal implants, lymphadenopathy, and hepatic metastases. Ovarian tumours can contain calcifications, which appear stippled in dysgerminomas and coarse in malignant teratomas.[17]

Other imaging modalities may play a role in the diagnosis of ovarian lesions. Computed tomography (CT) scans and magnetic resonance imaging (MRI) are superior to US for tumour staging, when the origin of the pelvic masses is unclear on US, or when the extent of a noncystic lesion cannot be fully assessed by US[17] (Figure 117.3). However, these modalities add cost to the evaluation and may not be necessary. Although CT does have utility (it easily identifies direct extension of tumours into other pelvic, abdominal, or chest structures), the benefits should be weighed against the risk of radiation exposure and the cost of the exam.

MRI is useful, especially in patients with ample subcutaneous fat, but again, it is expensive and often unnecessary. MRI is extremely accurate in determining the origin of a lesion and can demonstrate specific characteristics. Even though MRI has no radiation exposure, it requires more imaging time, which can often be difficult in paediatric patients who necessitate the use of sedation.[5] Both CT and MRI are far more costly than US and may have limited use in African hospitals, where US is able to narrow down the differential diagnosis and guide care in a majority of cases.

Management

The management of ovarian lesions depends on the histological classification of the lesion. In paediatric patients, treatment of ovarian lesions should attempt to preserve the most reproductive function while also providing complete treatment of the lesion. These considerations are often irrelevant in adult patients with comparable disease because

childbearing has often been completed. Treatment can be modified to the individual patient to preserve reproductive and menstrual functions.[13] A general algorithm can be applied, with the caveat that the treatment depends on the aggressiveness of the specific histological subtype and, of course, on the individual patient.

Nonneoplastic Ovarian Lesions

The management of ovarian cysts is controversial. Nonneoplastic ovarian cysts should rarely be treated surgically in patients other then neonates; however, if surgical intervention is warranted, it should always be conservative.

Follicular cysts

Neonatally diagnosed follicular cysts will generally regress on their own, necessitating only observation with serial ultrasounds. The management of follicular cysts in prepubertal children with acute symptoms and endocrine activity may require more invasive treatment. Operative intervention has been indicated for acute, severe abdominal pain, symptoms persisting for more than 24 hours, imaging studies indicating a neoplasm, a cyst increasing in size, or failure to regress on follow-up ultrasound. The use of US has increased the detection of cysts in children. One study found that large cysts in children, defined as greater than 5 cm, can be followed with serial US due to the high rate of spontaneous regression. Surgical intervention should be based on US characteristics, symptomatology, evidence of a neoplasm, and failure of cyst to regress.[19]

Corpus luteum cysts

Corpus luteum cysts develop only in ovulating women and usually will regress spontaneously. Persistent corpus luteum cysts can rupture, undergo torsion, or cause menstrual irregularities or dysfunctional uterine bleeding. Surgical intervention is indicated if there are acute symptoms or if the cyst persists for 4–6 weeks after the initial diagnosis. Ovarian cystectomy is the procedure of choice; however, if the manipulation necessary to remove the lesion threatens either gonad, then the cyst should be unroofed, debulked, and excised to the extent possible. Unilateral oophorectomy is indicated only if there is no possibility of preserving normal tissue, but the ipsilateral fallopian tube should not be resected since it can still transport ova from the contralateral ovary.

Parovarian cysts

Parovarian cysts do not arise from gonadal tissue; however, their location generates the same concerns regarding treatment. Parovarian cysts are often small and asymptomatic. Cysts less than 3 cm can be treated with bipolar coagulation of the cyst wall, but those greater than 3 cm should be enucleated via the mesosalpinx.[20]

Neoplastic Ovarian Lesions

Neoplastic ovarian tumours have a range of treatment modalities based on the pathogenesis of the histological tumour type. In general, lesions limited to one ovary can be treated with a unilateral salpingo-oophorectomy. Lesions limited to both ovaries can be managed with a bilateral salpingo-oophorectomy (BSO), preserving the uterus for future fertility options. Unfortunately, assisted reproductive endocrinology is an expensive option and therefore may be limited in Africa. Extensive disease requires BSO with a total abdominal hysterectomy, omentectomy, lymph node sampling, and peritoneal washings. Adjuvant therapies are variable, providing the best outcomes in certain ovarian cancers.

Surface epithelial-stromal tumours

The stage of the tumour, as determined by the International Federation of Gynecology and Obstetrics for surface epithelial-stromal tumours,[5] dictates treatment (Table 117.6). Stage IA tumours (one ovary) are treated with unilateral salpingo-oophorectomy, whereas stage IB tumours require BSO. Hysterectomy is not necessary. Studies have shown that epithelial borderline tumours can be treated with fertility-sparing surgery in fertile woman without an increased risk of recurrence.[21] Unfortunately, more advanced stages of surface epithelial tumours require total abdominal hysterectomy with BSO along with omentectomy, intraperitoneal debulking, if necessary, and peritoneal washings. In addition, advanced stages require adjuvant chemotherapy.[22] The current recommended systemic chemotherapy regimen includes a platinum agent (cisplatin or carboplatin) and a taxane (paclitaxel or docetaxel).[23]

Tumours of low malignant potential

Epithelial tumours of low malignant potential generally occur in younger patients and have a better prognosis than epithelial tumours. Usually, these tumours behave in a benign manner; however, they do have the potential to recur as many as 10 to 15 years after the primary tumour and cause metastatic disease. Conservative therapy is recommended for stage I tumours, and more recently for advanced-stage disease. Surgical management should include unilateral salpingo-oophorectomy or cystectomy. The risk of recurrence following conservative therapy is greater than with a total abdominal hysterectomy with BSO; however,

Table 117.6: International Federation of Gynecology and Obstetrics surgical staging of ovarian carcinoma.

Stage	Extent of disease
I	Tumour limited to the ovaries
IA	Tumour limited to one ovary; no tumour on the external surface, capsule intact
IB	Tumour limited to both ovaries; no tumour on external surface, capsule intact
IC	Stage IA or IB but with tumour on surface of one or both ovaries, with ruptured capsule, or ascites or peritoneal washings containing malignant cells
II	Tumour involving one or both ovaries with pelvic extension or metastases
IIA	Extension and/or metastases to the uterus, fallopian tubes, or both
IIB	Extension to other pelvic tissues
IIC	Stage IIA or IIB but with tumour on the surface of one or both ovaries, with ruptured capsule, or ascites or peritoneal washings containing malignant cells
III	Histologically confirmed metastases outside the pelvis, superficial liver metastases, positive retroperitoneal or inguinal lymph nodes, or tumour limited to the true pelvis but with histologically verified malignant extension to small intestines or omentum
IIIA	Gross tumour limited to the true pelvis with negative lymph nodes but with histologically confirmed microscopic tumour outside pelvis
IIIB	Histologically confirmed abdominal peritoneal metastases that extend beyond the pelvis and are <2 cm in diameter with negative lymph nodes
IIIC	Abdominal peritoneal metastases that extend beyond the pelvis and are >2 cm in diameter and/or with positive retroperitoneal or inguinal lymph nodes
IV	Distant metastases, including parenchymal liver metastases; if pleural effusion is present, cytologic test results must be positive to signify stage IV

Source: Templeman C, Fallat M. Ovarian tumours. In: Grosfeld JL, O'Neill JA Jr, Coran AG, Fonkalsrud EW, Caldamone AA, eds. Pediatric Surgery, Sixth Edition. Mosby Elsevier, 2006, Pp 593–621.

Table 117.7: Children's Oncology Group staging of ovarian germ cell tumours

Stage	Extent of disease
I	Limited to the ovary
II	Microscopic residual disease, but peritoneal evaluation is negative
III	Lymph node involvement; gross residual or biopsy only; contiguous visceral involvement; peritoneal evaluation positive for malignancy
IV	Distant metastases

Source: Templeman C, Fallat M. Ovarian tumours. In: Grosfeld JL, O'Neill JA Jr, Coran AG, Fonkalsrud EW, Caldamone AA, eds. Pediatric Surgery, Sixth Edition. Mosby Elsevier, 2006, Pp 593–621.

salvage therapy has been shown to have good outcomes. Although controversial, the laparoscopic surgical approach has been shown to be effective in conservative management as long as there is no suggestion that the mass may be malignant. Initial surgery should include limiting staging, which involves peritoneal exploration, washings, and biopsies in addition to contralateral ovarian biopsy. Roughly 50% of tumours occur bilaterally; bilateral oophorocystectomy or salpingo-oophorectomy therefore would be appropriate in these situations.[21]

Sex cord–stromal tumours

Each subtype of sex cord–stromal tumour has specific management requirements. The juvenile form of granulosa-theca cell tumours must be treated differently from adult lesions, which are far more indolent. The juvenile type is very aggressive; the aggressiveness of each tumour can be determined by tumour size, stage of disease, whether the tumour has ruptured, and the amount of nuclear atypia and mitotic figures.

These tumours are staged following the same guidelines outlined in Table 117.6. If a patient is diagnosed with an early-stage lesion, unilateral oophorectomy or salpingo-oophorectomy is adequate due to the low rate of bilateral disease. Advanced-stage lesions are best treated with a multidisciplinary treatment plan, including hysterectomy with BSO, 3000 cGy whole-abdominal radiation with a boost to areas of residual disease, and multidrug chemotherapy including methotrexate, actinomycin D, cyclophosphamide, bleomycin, and vinca alkaloids. These agents may not be available in African regions, however. Generally, even patients who undergo this aggressive treatment plan will relapse.[5]

Patients with Sertoli-Leydig cell tumours are treated according to their stage. Stage IA tumours should be managed with unilateral salpingo-oophorectomy unless childbearing is complete, at which point the contralateral ovary should be removed. If more advanced disease is present, then a more aggressive approach similar to that used in granulosa cell tumours should be utilised.[16] Fibromas and steroid cell tumours are benign tumours that can be treated conservatively. Unilateral lesions can be managed with a unilateral oophorectomy; however, if there is bilateral ovarian involvement, the entire tumour should be removed while preserving normal-appearing tissue.[24]

Germ cell tumours

Germ cell tumours encompass a number of tumour subtypes; however, their treatment can be generalised. As with all other ovarian lesions in children, the primary goal of germ cell tumour management is to preserve reproductive function. Surgery is performed to evaluate disease extent, remove the tumour, and preserve uninvolved reproductive organs. Benign lesions can be treated with ovarian cystectomy or unilateral oophorectomy. Staging is recommended for any tumour that is either known to be or may be malignant. This includes cytologic evaluation of ascitic fluid or peritoneal washings with lactated Ringer's solution, careful inspection of the contralateral ovary and other pelvic and abdominal organs, and biopsy of suspicious omental or liver lesions and retroperitoneal lymph nodes. The affected ovary should be removed, and if a lesion is found in the contraleral ovary, a BSO should be performed. Omentectomy is indicated if tumours are found on the omentum, and debulking of retroperitoneal adenopathy should be performed, if necessary. Peritoneal disease should also be removed if possible. If the extent of disease is so overwhelming that debulking will cause more harm, then neoadjuvant chemotherapy (if it is available) should be offered prior to surgical intervention. Postsurgical treatment depends on the stage of the tumour (Table 117.7).[5] Patients with stage I tumours may be managed with observation alone. Although a significant number may relapse, salvage treatment is effective. The chemotherapy regimen of choice for all stages is cisplatin, etoposide, and bleomycin (PEB), which has been shown to be extremely effective, especially in stage I and II tumours.[25]

Postoperative Complications

Any surgery to the abdomen or pelvis has associated postoperative complications. Wound infection and fluid imbalances can occur and should be monitored in all surgical patients. Intraabdominal surgery can also produce adhesions that can cause pain, impair fertility, cause bowel obstruction, and make reoperative procedures more difficult.

Rupture of a malignant ovarian tumour during initial surgery can change the prognosis. A stage IA tumour becomes a stage IC if the tumour is ruptured at the time of surgery. One study found that the survival of patients with stage IC due to a ruptured tumour is 20%, versus 3% in patients with stage IA for epithelial ovarian tumours.[26] While stage IA tumours may not require chemotherapy, stage IC tumours usually do, so special care should be taken to avoid tumour rupture.

Patients who receive a BSO initial surgery, which can eventually produce pelvic pain or a pelvic mass. The incidence of ovarian remnant syndrome (ORS) has not been determined, although it has been shown to be rising over the past four decades. The residual ovarian tissue generally requires surgical removal; however, premenopausal patients can be treated with medications suppressing ovarian function. Blunt dissection of ovarian adhesions should be avoided during the initial BSO because it has been shown to increase the development of ORS. Additionally, failure to open the retroperitoneum during adnexectomy increases the risk; therefore, making an incision in the peritoneum lateral to the ovarian vessels to ensure access to the retroperitoneum is recommended.[27] Obviously, in any patient where all of the ovarian tissue is removed, postoperative hormone replacement may be required, depending on the age of the patient.

Prognosis and Outcome

Patients with nonneoplastic ovarian lesions have extremely favorable outcomes, with little, if any, long-term sequelae. The prognosis for neoplastic lesions depends on the specific type of tumour and the stage at which the tumour was diagnosed. In the African setting, many patients present late in the course of their disease, which negatively impacts outcome. The prognosis of surface epithelial tumours can vary. Although low-stage tumours have promising long-term survivals, for advanced stages requiring chemotherapy, the prognosis is very poor. Only about one-third of the patients with stage IA have long-term survival. Tumours of low malignant potential have extremely good outcomes, producing >90% 10-year disease-free survivals, which is considerably better than their carcinoma counterparts.[21] Patients with early stages of juvenile granulosa cell tumours have a favorable outcome, whereas the prognosis of patients with stage II or greater lesions is very poor. These patients will usually die regardless of the treatment plan. The prognosis for fibromas is very good, with little chance of tumour recurrence. The prognosis of Sertoli-Leydig cell tumours highly depends on patient age, degree of tumour differentiation, and stage of tumour. Most of these tumours are diagnosed at stage IA and have an excellent prognosis.[5] The prognosis for stage I and II germ cell tumours treated with surgery and adjuvant chemotherapy is very high, with a 6-year event-free survival much greater than 90% for both stages I and II.[25]

Prevention

Little can be done to prevent ovarian lesions in paediatric patients or even in adults. However, one of the most important factors for long-term survival is early diagnosis. Early-stage diseases can often be treated with surgery alone; in many instances, some fertility can be preserved. This may be difficult to achieve in any community, but may be even more difficult in Africa, where access to imaging may be limited. Therefore, it is important to have a high index of suspicion for ovarian lesions. An ovarian lesion should be on the differential for a young girl who presents with abdominal pain and a clinical picture that is consistent with appendicitis. Endocrine disorders, anorexia, weight loss, and other vague symptoms may guide the practitioner to consider ovarian pathology. If US is available and there is the suspicion of a pelvic or abdominal mass, early use is recommended because most lesions can be well characterised with this relatively inexpensive modality.

Ethical Issues

Fertility can be affected by both the extent of the initial disease as well as the treatment course. Studies have shown that conservative treatment is an option for many paediatric lesions, but there is still a risk of recurrence, which can increase the cost of treatment overall. In Africa, therefore, it may be more cost effective to treat the disease with aggressive surgery. In such cases, patients may thus sacrifice their future fertility, unless the ova can be stored for assisted conception. Additionally, sparing the uterus in hopes of future in vitro fertilisation may not be reasonable. Each practitioner must take into account local regional factors when deciding which surgical option is best.

Evidence-Based Research

Although no prospective, randomised studies exist on the role of conservative management versus aggressive therapy, large retrospective studies have produced valuable information. Tables 117.8 and 117.9 present two such studies on the role of conservative management in ovarian germ cell tumours and in large ovarian cysts, respectively.

Table 117.8: Evidence-based research.

Title	The influence of conservative surgical practices for malignant ovarian germ cell tumours
Authors	Chan JK, Krishnansu ST, Sarah W, et al.
Institutions	Department of Obstetrics, Gynecology, and Reproductive Sciences, University of California, San Francisco School of Medicine, San Francisco, California, USA; Department of Obstetrics and Gynecology and Department of Medicine, University of California, Orange, California, USA; Department of Obstetrics and Gynecology and Department of Radiation Oncology, Stanford University School of Medicine, Stanford, California, USA
Reference	J Surg Oncol 2008; 98:111–116
Problem	Role of conservative management in ovarian germ cell tumours.
Intervention	Fertility-sparing surgery, standard surgery.
Comparison/ control (quality of evidence)	Patients with germ cell tumours from 1988 to 2001 (n=760) on the Incidence-SEER 9 Regs Public-Use Database from February 2006 were compared based on standard surgical treatment (n=222) versus fertility-sparing surgery (n=313).
Outcome/ effect	The difference in survival rates for patients who received fertility-sparing surgery was not statistically significant when compared to the rates for patients who received standard therapy (97.6% versus 95.6%, p=0.26).
Historical significance/ comments	Although this manuscript is specific for germ cell tumours, it serves as an example of how fertility-preserving surgery can be utilised without decreasing survival. In addition, germ cell tumours are the most common ovarian malignancies in the paediatric age group. Fertility-sparing surgery in this study included ovarian cystectomy, unilateral salpingo-oophorectomy with or without hysterectomy, and bilateral salpingo-oophorectomy. Even though a number of cases did preserve at least one ovary and the uterus, some patients were left with only a uterus or an ovary. This implies that there is access to assisted reproduction techniques. As common as in vitro fertilisation is in Western countries, there is very limited access to it in African countries. Thus, the definition of fertility-sparing surgery may need to be redefined for Africa due to the lack of access to expensive fertility methods. In this study, 76% of the patients presented with stages I–II whereas 24% presented with stages III–IV. The 5-year disease-free survival for patients with stages I–II was 97.6%, and the survival in the same time period for patients with stages III–IV was 85.5%. Finally, this study found that the improved survival over time with fertility-sparing surgery is partially a result of in-depth surgical staging. Thus, staging should be utilised in all surgeries regardless of the presumed stage.

Table 117.9: Evidence-based research.

Title	Conservative management of large ovarian cysts in children: the value of serial pelvic ultrasonography
Authors	Warner BW, Kuhn JC, Barr LL
Institution	Department of Surgery and Radiology, University of Cincinnati, Cincinnati, Ohio, USA
Reference	Surgery 1992; 112:749–755
Problem	Role of conservative management in large ovarian cysts.
Intervention	Conservative management, surgical intervention.
Comparison/ control (quality of evidence)	Three groups of patients were compared based on indications for ultrasonography (US), menarchal status, age, average cyst volume, and type of cysts. Group 1 (n=10) comprised patients who received surgery with neoplastic findings, group 2 (n=13) comprised patients who had surgery with nonneoplastic findings, and group 3 (n=46) comprised patients who had no surgical intervention and on follow-up had cysts that decreased in size or completely resolved.
Outcome/ effect	No statistical significance was found among the three groups in the indications for US, menarchal status, or age. The cyst volume in the neoplastic cyst group (group 1) was significantly greater than for the cysts in group 3. There was no statistical difference between cyst volume in the two groups that underwent surgery or between groups 2 and 3. There were no differences in the type of cyst in all groups.
Historical significance/ comments	This study found that large cysts (greater than 4–5 cm), could not be distinguished based on the character of the cyst, patient age, or mencharchal status. Even though cyst volume in neoplastic lesions tended to be larger, this finding was not universal. As a result, there is no clear way to distinguish neoplastic from benign lesions that will regress. Of 51 patients who did not receive surgical management and received follow-up within 1 to 2 weeks of diagnosis, 46 were noted to have either a decrease in cyst size or complete regression. Of the remaining five patients, two were found to have an increase in size and three had unchanged. Furthermore, this study concluded that large ovarian cysts in paediatric patients can be safely followed with serial pelvic ultrasounds to monitor for decrease in size and eventual resolution. Surgical intervention should be based not only on size but on a number of clinical observations, which includes symptoms that do not resolve after 12–24 hours of observation, signs and symptoms of a large mass associated with complications, evidence of neoplasm, ovarian cause uncertain, and increase or failure to decrease in size on follow-up US. The study recommends US follow-up after 1 to 2 weeks. It is important to consider observation in large ovarian cysts because spontaneous regression eliminates surgery and its complications as well as the possibility of future fertility problems, although this may not be applicable to regions where resources are limited.

Key Summary Points

1. Ovarian lesions are uncommon in children.
2. Children with ovarian neoplasms are often first diagnosed with appendicitis; thus, ovarian lesion should be included on the differential for any child who presents with a history consistent with appendicitis.
3. The presence of a lesion can represent either benign or malignant pathology—both of which need to be considered.
4. Management of ovarian lesions is multimodal and depends on the extent of the disease—early identification is vital to decreasing mortality and preserving future fertility.
5. Ovarian cysts that are incidentally identified without notable symptomatology, even if they are larger than 5 cm, can be managed with serial ultrasounds. Symptoms consistent with torsion, lack of regression, and possibility of a neoplasm are all indications for surgery.
6. Low-grade malignant ovarian tumours can often be managed with fertility-sparing surgery, whereas high-grade lesions require aggressive surgery followed by radiation and chemotherapy.
7. The prognosis depends on the specific tumour type and grade.

References

1. Piver MS, Patton T. Ovarian Cancer in Children. Semin Surg Oncol 1986; 2:163–169.
2. von Allmen D. Malignant lesions of the ovary in childhood. Semin Pediatr Surg 2005; 14:100–105.
3. Gribbon M, Ein SH, Mancer K. Pediatric malignant ovarian tumours: a 43-year review. J Pediatr Surg 1992; 27:480–484.
4. Lack EE, Young RH, Scully RE. Pathology of ovarian neoplasms in childhood and adolescence Pathol Annu 1992; 27:281–356.
5. Templeman C, Fallat M. Ovarian tumours. In: Grosfeld JL, O'Neill JA Jr., Coran AG, Fonkalsrud EW, Caldamone AA, eds. Pediatric Surgery, Sixth Edition. Mosby Elsevier, 2006, Pp 593–621.
6. Dozois RR, Kempers RD, Dahlin DC, Bartholomeew LG. Ovarian tumours associated with the Peutz-Jeghers syndrome. Ann Surg 1970; 172:233–238.
7. Ablin AR, Krailo MD, Ramsay NKC, et al. Results of treatment of malignant germ cell tumours in 93 children: a report from the Children's Cancer Study Group. J Clin Oncol 1991; 9:1782–1792.
8. Christman JE, Ballon SC. Ovarian fibrosarcoma associated with Maffucci's syndrome. Gynecol Oncol 1990; 37:290–291.
9. Weiss NS. Measuring the separate effects of low parity and its antecedents on the incidence of ovarian cancer. J Epidemiol 1988; 128:451–455.
10. Hartge P, Devesa S. Ovarian cancer, ovulation and side of origin. Br J Cancer 1995; 71:642–643.
11. Modan B, Hartge P, Hirsh-Yechezhel G, et al. Parity, oral contraceptives, and the risk of ovarian cancer among carriers and noncarriers of a BRCA1 or BRCA2 mutation. N Engl J Med 2001; 345:235–240.
12. Easton DF, Ford D, Bishop DT. Breast and ovarian cancer incidence in BRCA1-mutation carriers. Breast cancer linkage consortium. Am J Hum Genet 1995; 56:265–271.
13. Breen JL, Maxson WS. Ovarian tumours in children and adolescents. Clin Obstet Gynecol 1977; 20:607–623.
14. Brown MF, Hebra A, McGeehin K, Ross AJ III. Ovarian masses in children: a review of 91 cases of malignant and benign masses. J Pediatr Surg 1993; 28:930–933.
15. Imai A, Furui T, Tamaya T. Gynecologic tumours and symptoms in childhood and adolescence: 10-years' experience. Int J Gynaecol Obstet 1994; 45:227–234.
16. Sachdeva P, Arora R, Dubey C, Sukhija A, Daga M, Singh DK. Sertoli-Leydig cell tumour: a rare ovarian neoplasm. Case report and review of literature. Gynecol Endocrinol 2008; 24:230–234.
17. Ratani RS, Cohen HL, Fiore E. Pediatric gynecologic ultrasound. Ultrasound Q 2004; 20:127–139.
18. Siegel MJ, Surratt JT. Pediatric gynecologic imaging. Obstet Gynecol Clin North Am 1992; 19:103–127.
19. Warner BW, Kuhn JC, Barr LL. Conservative management of large ovarian cysts in children: the value of serial pelvic ultrasonography. Surgery 1992; 112:749–755.
20. Darwish AM, Amin AF, Mohammad SA. Laparoscopic management of paratubal and paraovarian cysts. JSLS 2003; 7:101–106.
21. Crispens MA. Borderline ovarian tumours: a review of the recent literature. Curr Opin Obstet Gynecol 2003; 15:39–43.
22. Ayhan A, Celik H, Taskiran C, Bozdag G, Aksu T. Oncologic and reproductive outcome after fertility-saving surgery in ovarian cancer. Eur J Gynaecol Oncol 2003; 24:223–232.
23. Markman M. Antineoplastic agents in the management of ovarian cancer: current status and emerging therapeutic strategies. Trends Pharmacol Sci 2008; 29(10):515–519.
24. Howell CG Jr, Rogers DA, Gable DS, Falls GD. Bilateral ovarian fibromas in children. J Pediatr Surg 1990; 25:690–691.
25. Rogers PC, Olson TA, Cullen JW, et al. Treatment of children and adolescents with stage II testicular and stages I and II ovarian malignant germ cell tumours: a pediatric Intergroup Study—Pediatric Oncology Group 9048 and Children's Cancer Group 8891. J Clin Oncol 2004; 22:3563–3569.
26. Sainz de la Cuesta R, Goff BA, Fuller AF Jr, Nikrui N, Eichhorn JH, Rice LW, Prognostic importance of intraoperative rupture of malignant ovarian epithelial neoplasms. Obstet Gynecol 1994; 84:1–7.
27. Magtibay PM, Magrina JF. Ovarian remnant syndrome. Clin Obstet Gynecol 2006; 49:526–534.