

Radiographic Evaluation of Ovarian Tumors

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Ovarian tumors are the leading cause of cancer-related deaths in gynecological malignancies. Additionally, they are the fourth leading cause of death related to cancer. Ovarian tumors can be epithelial, germ cell, sex cord-stromal, or metastatic. Germ cell tumors are the most common type of ovarian tumors in children. Young adults with ovarian tumors are equally susceptible to the epithelial, germ cell, or stromal variants. Middle-aged women and the elderly who develop ovarian tumors are usually diagnosed with epithelial ovarian tumors.



Introduction

Ovarian tumors are the leading cause of cancer-related deaths in gynecological malignancies. Additionally, they are the fourth leading cause of death related to cancer. The characteristics of benign and malignant tumors are as follows:

Benign tumors

1. Cystic enlargements/functional ovarian cysts
2. Ovarian cysts/adenomas, which include the following:
 - Epithelial cysts such as serous, mucinous, and endodermal cysts

- Benign tumors from germ cells, such as teratomas and dermoid cysts
- Benign tumors of sex cord-stromal origin such as thecomas and fibromas

Malignant tumors

Primary ovarian tumors include the following:

- Epithelial cell tumors such as serous, mucinous, clear cell, and transitional cell carcinomas
- Germ cell tumors, such as teratomas, dysgerminomas, endodermal sinus tumors, and embryonal cell carcinomas
- Sex cord-stromal tumors such as thecomas, fibromas, and granulosa cell tumors

Metastatic tumors can originate from the endometrium, breast, colon, and cervix.

Germ cell tumors are the most common type of ovarian tumors in children. Young adults with ovarian tumors can have either a germ cell or sex cord-stromal tumor. Middle-aged women and the elderly who develop ovarian tumors usually have epithelial ovarian cancer.

The presentation of ovarian tumors is often vague and symptoms involve abdominal pain or the presence of an abdominal mass. This condition has a protracted clinical course; thus, imaging studies are indicated for the initial examination of patients with suspected ovarian tumors. Ultrasonography is the imaging method of choice used to establish the malignancy risk index (RMI), together with the determination of CA 125 levels and postmenopausal status of the patient. High RMI scores are suggestive of malignant tumors and indicate the need for staging laparotomy. Surgery is still needed as a definitive treatment for benign tumors.

The staging of ovarian cancer is mainly based on surgical exploration (FIGO system) or the TNM system; however, computed tomography (CT) or magnetic resonance imaging (MRI) may be indicated for additional clarity.

The table below summarizes the main findings of ultrasonography used for ovarian tumor staging per the FIGO system.

| Stage | Ultrasonography Finding |
|-------|--|
| I | Tumor growth limited to the ovaries |
| Ia | Tumor confined to one ovary |
| Ib | Bilateral tumor |
| Ic | Ia or Ib but with rupture of the ovarian capsule or presence of a tumor on the ovarian surface |
| II | Ovarian tumor with pelvic extension |
| IIa | Involvement of the uterus or fallopian tubes |
| IIb | Involvement of pelvic structures rather than the uterus or fallopian tubes |
| IIc | IIa or IIb with ovarian capsule rupture, or tumor on the ovarian surface with malignant ascites |
| III | Unilateral or bilateral ovarian tumor with peritoneal implants, positive retroperitoneal or inguinal lymph nodes, or involvement of the small bowel or omentum |

| | |
|------|--|
| IIIa | Involvement of the small bowel or mesentery |
| IIIb | Metastasis to abdominal peritoneal surfaces and lesions < 2 cm |
| IIIc | Extrapelvic metastasis with tumors > 2 cm in diameter |
| IV | Ovarian tumor with distant metastasis, e.g., to the lungs |

Functional Ovarian Cysts

The **most common ovarian mass** in women of **reproductive age is a functional ovarian cyst**. A corpus luteum cyst or those that arise from the failure of follicular rupture or regression are possible examples of functional ovarian cysts. Such cysts are simple, thin-walled, and < 3 cm in diameter, or larger with more complex cells. A functional cyst that is > 1 cm in diameter is most likely a corpus luteum cyst.

Ultrasonography reveals a functional ovarian cyst to be anechoic and vascularized with thin, smooth walls.

Posterior acoustic enhancement is usually observed. **Large cysts with reticular echoes might represent hemorrhage** within a corpus luteum cyst. Such large and complex cysts should be followed-up using MRI.

Ovarian cysts show low signal intensity on T1-weighted images. T2-weighted images typically reveal very high signal intensity due to the fluid content of the cyst. MRI studies usually reveal a thin and featureless wall that enhances the uptake of gadolinium. **T2 shortening is not seen in corpus luteum cysts in contrast to endometrial chocolate cysts.**

Endometriomas

Up to 80% of all cases of endometriosis involve the ovary, which is the most common site. These cysts are known as endometriomas; they are usually small and may have thin, thick, or irregular walls. Large endometriomas have been previously described and can have a diameter ranging from 15–20 cm.

In an ultrasound, endometriomas typically appear as a cystic mass with low-level echoes. Cysts that show diffuse low-level internal echoes, multilocularity, and hyperechoic wall foci are most likely endometriomas. **CT scans should not be performed in a patient suspected to have an endometrioma** owing to the high risk of a false-positive diagnosis of malignancy.

MRI studies are useful in the evaluation of complex endometriomas. T1-weighted images typically show high signal intensity within the cyst. The inside of the cyst and wall of endometriomas usually show low signal intensity on T2-weighted images.

Mature Cystic Teratomas

These tumors arise from ovarian germ cells and are more common in children and adolescents. They **are usually asymptomatic and discovered incidentally** during physical examinations of the pelvis for other indications. Ectodermal components are more common within these teratomas; hence, the term ‘dermoid cysts’ is occasionally used to describe them.

In an ultrasound, mature cystic teratomas typically show shadowing echogenicity, diffuse

echogenicity, hyperechoic lines and dots, and a fluid level within the cyst. In contrast to the two cystic ovarian lesions described earlier, **mature cystic teratomas can be readily confirmed using a CT scan**, which typically shows fat and dense calcifications within the teratomas.

MRI studies are also useful in the evaluation of mature cystic teratomas. The fluid component of the teratoma typically has high signal intensity on T1-weighted images and intermediate signal intensity on T2-weighted images. Palm tree-like protrusions and dermoid nipples are common findings of MRI studies involving mature cystic teratomas.

Fibrotic Tumors

Fibromas, thecomas, and fibrothecomas are the most common examples of fibrotic tumors of the ovaries. These tumors **are common in middle-aged women**. Fibrotic tumors are commonly associated with ascites or pleural effusions; however, they are considered as benign ovarian tumors. They arise from the stroma of the ovary and do not have any epithelial components.

Fibrotic tumors present as solid, hypoechoic masses on an ultrasound scan, and the sound attenuation is very strong. Hyperechoic masses can also be seen in fibrotic tumors. CT scans are useful in the evaluation of solid masses of the ovaries including fibrotic tumors. In a CT scan with contrast, fibromas typically present as hypoattenuating masses with very low enhancement.

MRI studies reveal homogenous masses with low signal intensity on T1-weighted images. T2-weighted images of these masses show a well-circumscribed mass with low signal intensity. Scattered areas of high signal intensity on T2-weighted images can be seen in fibromas, which represent areas of edema or cystic degeneration.

Epithelial Ovarian Tumors

Epithelial ovarian tumors are the most common type of malignant ovarian tumors and include the following types:

- Serous tumors
- Mucinous tumors
- Clear cell tumors
- Endometrioid tumors
- Undifferentiated tumors

Epithelial tumors can be benign, borderline, or malignant. This classification is based on a histological examination, rather than imaging studies. Unilocular thin-walled cysts that do not have papillary projections are more likely to be benign.

Ultrasound presentations that are suggestive of malignancy include the following:

- Bilateral tumor
- Multinodular tumor/presence of papillary projections
- Solid areas within the tumor
- Presence of ascites
- Abdominal involvement

The most important radiographic finding suggestive of malignancy is the presence of

papillary projections. These projections are better visualized using MRI. The presence of a thin, smooth, regular wall is usually not indicative of a malignant ovarian cyst.

MRI and CT scans usually reveal the following:

- Heterogenicity
- Faster contrast enhancement
- Calcification
- Multilocular cysts

References

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