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### **What are key imaging features of a hemorrhagic cyst?**

A hemorrhagic ovarian cyst occurs when the granulosa layer within a corpus luteum ruptures and bleeds. This is a common cause of acute onset pelvic pain although hemorrhagic cysts may also be asymptomatic. On ultrasound, the appearance can vary based on the age of blood products. Typical features on ultrasound include what has been termed lace-like reticular echoes within the cyst and typical posterior acoustic enhancement and lack of internal blood flow on color Doppler imaging. Alternatively, an intracystic clot with no internal blood flow may also be seen. Fluid-fluid levels are sometimes seen internally.

On MRI, one would expect a hemorrhagic cyst to be an adnexal mass with no internal enhancement, most commonly showing increased T1 and T2 signal.

### **When might a hemorrhagic cyst require follow-up?**

If on the Core Exam an ovarian cyst with features of a hemorrhagic cyst is greater than 5 cm in diameter if premenopausal, or of any size if postmenopausal, follow-up in 6-12 weeks with ultrasound or MRI is the best answer. Most hemorrhagic cysts resolve within about 8 weeks so follow-up can help distinguish between a benign hemorrhagic cyst, or another process.

### **What are key imaging features of an endometrioma?**

Endometriomas are the result of endometriosis of the ovaries with repeated bleeding of the endometrial tissues. Clinical symptoms of an endometrioma can include pain as well as infertility which can occur in at least 25% of cases. I usually think of an endometrioma as an ovary-specific process but technically these can occur elsewhere in the pelvis such as the pelvic cul-de-sac or broad ligament.

On ultrasound, a cyst with homogeneous echoes and posterior acoustic enhancement may be most classic but the ultrasound appearance is variable and can less commonly include multiple internal loculations, fluid-fluid levels, and a cystic and solid appearance.

MRI has the shading sign on T2 that is something you should know about. Look this up if you don't know what this looks like. Expect T1 hyperintensity, and low T2 signal in portions or the entirety of the cyst because of the recurrent hemorrhage with deposition of iron within the cyst. In some cases, near complete loss of T2 signal may be seen. A hemorrhagic cyst would be expected to be brighter on T2 in classic cases compared to an endometrioma which shows variable degrees of T2 shading.

An endometrioma may show wall enhancement on MRI but any enhancing mural nodule or mass raises concern for a malignant lesion.

### **Is follow-up indicated for an endometrioma?**

For the Core Exam, I would recommend choosing either surgical excision or annual follow-up for an endometrioma given a small risk of malignant transformation. Therapy with a gonadotropin-releasing hormone agonist may also be considered.

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**What is the most common ovarian neoplasm in an adolescent?**

Cystic ovarian teratomas which account for over 90% of ovarian neoplasms in this age range. Remember the large majority of these will be benign (about 90%), there is a risk of ovarian torsion which may be the presenting feature. In about 10-15% of cases these can be bilateral.

**What are key features of an ovarian dermoid cyst?**

A dermoid cyst of the ovary, at least for the Core Exam, is essentially the same as a mature cystic teratoma. It is important to remember that these contain tissue from multiple germ cell layers. Technically a dermoid has dermal and epidermal components whereas a teratoma has dermal, epidermal, mesodermal, and endodermal components, but that is likely beyond what is commonly tested on the Core Exam. These are bilateral in something like 10-15% of cases.

On radiography, an ovarian dermoid may manifest as adnexal calcifications due to components of teeth and bone in the mass. On ultrasound, a dermoid cyst may demonstrate posterior acoustic shadowing and may show echogenic interfaces from bone that obscure underlying tissues termed the tip of the iceberg sign. A Rokitansky nodule is a mural nodule that is frequently hyperechoic. Fluid-fluid levels can be seen. Internal echogenic bands can be a manifestation of hair contained within the cyst. No internal vascularity is expected on color Doppler imaging.

CT will often show an adnexal mass containing internal fat, calcification/ossification, and possible fat-fluid levels.

MRI shows an adnexal mass with internal fat which can be confirmed by fat suppression and or chemical shift due to microscopic internal fat. Solid components may show enhancement and raise concern for potential malignant transformation.

**What are some of the signs of ovarian dermoid cyst rupture?**

Fat and fatty fluid can be seen in anti-dependent spaces in the abdomen and pelvis following rupture of an ovarian dermoid cyst including below the right diaphragm which is a classic location for this finding. Clinical symptoms from a chemical peritonitis are common.

**What is typical management of an ovarian dermoid cyst?**

If larger than something like 7 cm, surgery is often indicated. If under 7 cm, 12-month follow-up may be performed to document stability or identify need for surgery if the mass significantly enlarges. These can be very large (>10 cm) at presentation.

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**A struma ovarii tumor of the ovary contains tissue from what non-pelvic organ?**

Struma ovarii contains thyroid tissue. This is in the family of ovarian teratomas and is often composed completely or majority of thyroid tissue (at least 50% thyroid tissue may be necessary for diagnosis) with internal colloid material. In up to about 10% of cases clinical hyperthyroidism may be present.

These cannot be differentiated on imaging from other ovarian neoplasms.

On MRI these often show heterogeneous signal intensity on both T1 and T2 weighted images and solid portions may show enhancement.

These are mostly benign tumors that are often treated with surgical resection.

**What are guidelines for ovarian cyst follow-up based on size of the cyst?**

For pre-menopausal patients:

Cysts at or under 3 cm may be considered physiologic such as a corpus luteum or ovarian follicle and require no specific follow-up.

If over 3 cm in size, but equal or less than 5 cm, and demonstrating a simple appearance, no follow-up is necessary, but these should generally be reported in the imaging report.

If over 5 cm some form of follow-up is generally needed which initially is often in the range of 2-6 months to see if it resolves, and subsequently, if not resolved or decreased in size, every 6 to 12 months to ensure stability.

For post-menopausal patients criteria are stricter and follow-up is generally needed for cysts that are over 3 cm in size, initially at 2-6 months for resolution and then every 6-12 months if similar in size.

Generally, 2 years of stability for larger cysts requiring follow-up per the criteria discussed is necessary before they may be considered benign, especially on the Core Exam.

If cysts are large or increase in size, surgery may be performed for resection and definitive characterization.

**What are findings of ovarian hyperstimulation syndrome?**

Often related to ovarian induction therapy for in vitro fertilization, this manifests as ovarian enlargement with some degree of fluid accumulation in the abdomen and pelvis that may include ascites and pleural effusions. Ultrasound shows bilateral symmetric enlargement of ovaries that may become very large such as over 10 cm in size with multiple internal cysts that sometimes show a spoke-wheel appearance.

Clinical symptoms include acute pelvic pain, abdominal distention, and in severe cases, hemodynamic instability from fluid shift and third spacing of large amounts of fluid.

This is more common in younger patients.

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#### Episode 2:

##### **What are some imaging features of an ovarian cyst that raise concern for malignancy?**

Thick or numerous internal septations, papillary projections, solid components within the cyst and larger size of lesion. Complex cystic and solid adnexal masses are concerning whether unilateral or bilateral including masses with thick septations, over something like 3 mm in thickness, as well as cystic lesions with solid nodules, mural nodularity or irregularity, papillary projections, and predominantly solid masses with internal necrosis.

##### **What ovarian findings can be seen with a molar pregnancy?**

A molar pregnancy often presents with a snowstorm and/or cystic appearance of the uterus and may have associated findings of ovarian hyperstimulation with theca lutein cysts or ovarian metastases. Other things to consider for the Core Exam are that if they give you a history of hemoptysis with molar pregnancy you should consider this a sign of possible pulmonary metastatic disease. With molar pregnancy beta-HCG will be elevated.

##### **What is Meigs syndrome?**

Meigs syndrome consists of the triad of pleural effusion, ascites, and a benign ovarian tumor which is commonly a fibroma. Fibromas are benign tumors that are most common in middle aged females. Imaging of a fibroma includes an ovarian mass that is hypointense on both T1- and T2-weighted images, sometimes with a peripheral band of T2 hypointensity. On ultrasound these will appear solid and hypoechoic. Interestingly, the ascites and pleural effusions typically resolve with resection of the benign ovarian tumor.

##### **If you are shown a solid ovarian mass in a young child, what should you consider first on the Core Exam?**

Sex chord stromal tumor of the ovary

##### **If you are shown a solid ovarian mass in an adolescent, what should you consider first on the Core Exam?**

Granulosa cell tumor. Note that this is an estrogen secreting tumor and as such can be associated with endometrial thickening as well.

##### **What other ovarian malignancy commonly presents with an ovarian mass and associated endometrial thickening?**

An endometrioid cancer of the ovary also commonly presents as an ovarian mass (bilateral in 20% or more of cases) with endometrial thickening which may represent endometrial hyperplasia or endometrial carcinoma. This tumor is also commonly associated with endometriosis.

##### **True or false: An endometrioid cancer of the ovary can arise from within an endometrioma?**

True, although a rare occurrence.

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**What is the most common ovarian malignancy?**

Serous ovarian tumors are the most common ovarian malignancy. A serous ovarian cystadenoma is the more benign version, and a serous ovarian cystadenocarcinoma is the malignant variety. These can be very large, predominantly cystic tumors, with only a few abnormal septations. Serous tumors in older females are more likely to be malignant. Bilateral serous tumors are also more likely to be malignant. Ascites with an associated ovarian cystic neoplasm essentially confirms metastatic disease and over half have peritoneal metastases at time of diagnosis.

**What is a classic clinical presentation of a juvenile granulosa cell tumor of the ovary?**

Precocious puberty due to tumoral estrogen secretion. These most commonly present in young females, mean age of around 12 years. Remember associations with Ollier disease (multiple enchondromas) and Maffucci syndrome (multiple enchondromas and hemangiomas/venous malformations).

**What are key features of a Brenner tumor of the ovary?**

Brenner tumors are rare ovarian tumors that can also occur in the testis in males. These are most common in middle-aged females. 1 in 3 cases will have another ovarian neoplasm (same or other ovary). These are usually small in size, look like mixed multicystic and solid masses, most commonly with some calcifications, appear hypointense on T2-weighted MRI, and have a tendency not to metastasize.

**What is a Krukenberg tumor of the ovary?**

This is an ovarian metastasis with a characteristic “signet ring” morphology, most commonly from colon, gastric, breast and lung malignancies with gastric most common. These are mucin secreting tumors. These account for half of ovarian metastases, most common in young to middle aged females. Presenting features include dyspareunia and irregular uterine bleeding. These are commonly bilateral. If you see this on pathology you then need systemic imaging to look for a potential primary with consideration as well for colonoscopy and upper endoscopy.

**What is the most common ovarian neoplasm?**

An ovarian serous cystadenoma. These are most common in middle aged females. On imaging these are classically large or somewhat large often unilocular cystic lesions without wall thickening/irregularity, solid components, or papillary projections. A few thin septations may be present. The beak sign can help confirm ovarian etiology. If no beak sign is present, this could be a paraovarian cyst. Due to potential risk of malignant degeneration these are usually surgically excised.

**What is the most common malignant ovarian tumor?**

A serous cystadenocarcinoma comprises up to 75% of malignant epithelial ovarian tumors. This is the malignant version of an ovarian cystadenoma. Imaging features are that of a cystic ovarian mass with at least one solid component that would typically enhance and show restricted diffusion on MRI. Papillary projections may also be seen as well as wall irregularity. These may be bilateral. If ascites is present, assume metastatic disease and evaluate on imaging for peritoneal nodularity and masses.

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**True or false: Ovarian serous tumors are typically larger than ovarian mucinous tumors?**

False. Ovarian mucinous tumors are typically larger than ovarian serous tumors.

**True or false: Ovarian mucinous tumors are more likely to be bilateral compared to ovarian serous tumors?**

False. Ovarian serous tumors are more likely to be bilateral in comparison to ovarian mucinous tumors.

**True or false: Peritoneal carcinomatosis is more common with ovarian serous tumors compared to ovarian mucinous tumors?**

True. Serous tumors more commonly have associated peritoneal carcinomatosis.

**True or false: The median survival for an ovarian mucinous cystadenocarcinoma is worse compared to an ovarian serous cystadenocarcinoma?**

True. The median survival is worse by about 2-3 years for advanced ovarian mucinous cystadenocarcinoma compared to an ovarian serous cystadenocarcinoma.

**True or false: Ovarian mucinous tumors are more likely to be multilocular compared to ovarian serous tumors?**

True. Ovarian mucinous tumors commonly are multilocular with more numerous small cystic components.

**What is the “stained glass appearance” of an ovarian mucinous tumor?**

Different signal intensities within the cystic spaces on MRI, resulting from different concentrations of mucin within the cystic fluid, results in a mixed signal intensity imaging appearance termed the “stained glass appearance”.

**What are key imaging features suggesting an ovarian mucinous cystadenocarcinoma?**

Thickened septations, mural thickening and irregularity, solid enhancing nodular components, and a very large adnexal mass with possible “stained glass appearance” are some of the classic imaging features of an ovarian mucinous cystadenocarcinoma. Note that these may be early stage, even when very large.

**True or false: an ovarian clear cell carcinoma develops in patients with endometriosis in one-fourth of cases?**

True. Also remember that ovarian clear cell carcinomas are very frequently malignant.

**What is an ovarian collision tumor?**

When two histologically unique tumors are present within an ovary, with no mixing at the tumoral interfaces, this is termed an ovarian collision tumor. These are rare, and most commonly consist of an ovarian cystadenoma/cystadenocarcinoma and an ovarian teratoma.

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### **What is pseudomyxoma peritonei?**

Mucinous ascites that occurs after rupture of a mucinous neoplasm is termed pseudomyxoma peritonei. The most common cause of this is a ruptured appendiceal mucinous tumor, but other mucinous tumors in the abdomen and pelvis can also do this. Ovarian mucinous tumors can also cause pseudomyxoma peritonei if they rupture. This can occur from rupture of benign mucinous tumors, not only the malignant varieties. On imaging, look for loculated fluid collections throughout the peritoneal cavity, scalloping of abdominal organs most commonly the liver, omental caking, and a primary mucinous tumor, most commonly involving the appendix. Bowel involvement with recurrent bowel obstructions is a late manifestation of disease. This can be fatal, and treatment requires surgical debulking, IV or intraperitoneal chemotherapy.

Ovarian tumors more commonly cause peritoneal carcinomatosis, as well as GI cancers to include gastric, esophageal, and colon cancers, as well as other cancers that include melanoma, breast, and lung cancer. Imaging often does not depict the full extent of disease, so disease is typically worse on surgery with direct inspection, compared to CT or MRI. Omental caking is part of peritoneal carcinomatosis and occurs when the omentum becomes invaded and thickened with tumor cells. Ascites typically results as well. If you see calcifications, consider first an ovarian cystadenocarcinoma as the primary tumor.