Imaging evaluation of ovarian masses.

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Learning objectives

To establish CT and MRI indications for evaluating ovarian lesions and to describe radiologic findings that allow their characterization.

Background

Ovarian cancer is the 6th most incident cancer in women, and the most lethal gynaecologic cancer. Nevertheless most ovarian lesions are benign in the reproductive age, and surgical removal, usually with laparoscopy, is all the treatment required. Differentiating benign and malignant ovarian lesion is crucial to choose the best treatment option.

Imaging findings OR Procedure details

Due to its availability, ultrasonography is the first imaging technique to evaluate adnexal lesions. When a suspicious of malignant lesion or advanced disease are found on US or other imaging techniques previously performed, CT is used to stage, and MRI is rarely needed. (Fig. 1 on page 3 and Fig. 2 on page 4).

In case the lesion is difficult to clearly asses with ultrasound, MRI is the modality of choice for further evaluation prior to surgery. Not only to evaluate malignant but also to diagnose benign lesions. In addition, MRI is useful to confirm ovarian origin of a pelvic lesion, and it is a precise tool for staging pelvic endometriosis.

Our standard protocol for adnexal MRI comprises axial, coronal and sagittal T2-weighted images, and axial native and fat-suppressed T1-weighted images, before and after the administration of intravenous gadolinium (Fig. 3 on page 5).

After identifying a pelvic lesion, defining its organ dependence is the first diagnostic step, and many radiologic findings may help us in this objective. We must look for ovarian parenchyma and follicles, and its relationship with the lesion. If ipsilateral ovarian parenchyma is separate from the lesion, this will not be an ovarian tumour. A lesion that distorts the edge of the ovary into a beak shape (beak sign) is likely to be an ovarian lesion (Fig. 4 on page 6). Large ovarian lesions typically displace the ureter posteriorly or laterally (as other intraperitoneal lesions), and iliac vessels laterally, while other origin lesions (lymphadenopathies, for example), can displace iliac vessels medially. Moreover,
we can track the suspensory ligament or the ovarian vessels emerging from a pelvic mass, confirming an adnexal origin (either tubarian or ovarian), and the presence of incomplete septa inside a cystic adnexal lesion helps us to determine its tubarian origin (Fig. 5 on page 7).

Next step is to determine the cystic or solid nature of the lesion (Table 1 on page 8 and Table 2 on page 9). Most frequent ovarian lesion corresponds to physiologic cysts, with entirely cystic architecture, thin walls and less than 3cm diameter (Fig. 6 on page 10). Bigger lesions without these characteristics, with thin septations, correspond to serous or mucinous cystadenoma, depending on its content (Fig. 7 on page 11). There are clinical and radiological criteria that help us to distinguish between benign and malignant cystic lesions. A lesion is most probably malignant in elderly patients, with elevated serum CA125, in the presence of thick wall or septation, solid or necrotic component (Fig. 8 on page 12) and, obviously, if there are associated lymphadenopathies or carcinomatosis.

Blood products inside a cystic lesion, with hyperintensity on T1-weighted sequences, and hipointensity on T2-weighted sequences (shading), either diffuse hipointensity or many times with a layered distribution, are radiologic characteristics of endometrioma (Fig. 9 on page 13). Nevertheless, if a thick wall or intracystic solid portion are shown, with enhancement after intravenous contrast injection, associated ovarian cancer has been described (usually clear cell or endometrioid carcinoma). Because of the hyperintense content of the lesion on T1-weighted images, substraction images are useful to look for enhancement (Fig. 10 on page 14).

Solid homogeneous lesions with low intensity on T2-weighted sequences correspond to lesions with fibrous components, and include fibroma, fibrothecoma and Brenner tumour (Fig. 11 on page 15). Non-fibrous solid or cystic heterogeneous lesions with fat component are mature teratoma (Fig. 12 on page 16), but if solid component is predominant, or capsule is irregular with infiltration signs, immature invasive teratoma must be suspected. Cystic solid mixed lesions, and solid lesions hyperintense on T2-weighted sequences are a heterogeneous group of tumours including immature teratoma, disgerminoma or metastasis (Fig. 13 on page 17 and Fig. 14 on page 18) and are considered probably malignant lesions, and must receive surgical treatment.

Concerning all these criteria, MRI sensitivity for malignant ovarian lesions according to previous studies is 91-100%, with a specificity of 90-92%.

Images for this section:
Fig. 1: Fig. 1. Cystadenocarcinoma. Ultrasonography shows an ovarian predominantly cystic mass, with prominent solid papila.
Fig. 2: Same patient CT shows bilateral mixed cystic and solid ovarian lesions, a large amount of ascites, and peritoneal thickening with solid implants mainly on diaphragmatic surface and both paracolic gutters, and omental cake, consistent with peritoneal carcinomatosis.
Fig. 3: Fig. 3. Standard protocol for adnexal MRI.
Fig. 4: Fig. 4. Endometrioma. The edge of the ovary is distorted into a beak shape, so the lesion is likely to be ovarian.
**Fig. 5:** Fig. 5. Hematosalpinx. Incomplete septa inside a cystic adnexal lesion indicate a tubarian origin.
**SCHEME 1**

Characterization of adnexal masses with MRI. AJR 2005;184:1004-1009

Table 1
Table 2: Scheme 2. Signal intensity of diverse ovarian tumours.
Fig. 6: Case 1. Bilateral ovarian lesions. The right one is hyperintense on T1-weighted sequences, and diffusely hypointense on T2-weighted images (shading). These characteristics correspond to an endometrioma. In the left ovary we can see two simple cysts, with a thin septa separating them.
Fig. 7: Case 2. Mucinous cystadenoma. A big ovarian lesion is identified, predominantly cystic, with many thin septa and without solid component. Cysts content presents variable signal intensity on T1-weighted sequences.
**Fig. 8:** Case 3. Mucinous cystadenocarcinoma. These images show a big ovarian tumour with a predominantly cystic component, with variable signal intensity, but with prominent solid contrast-enhancing elements.
**Fig. 9:** Case 4. Bilateral endometriomas and pelvic endometriosis. These images show bilateral ovarian lesions with high signal intensity content on T1-weighted sequences, and low signal intensity on T2-weighted sequences, with a layered distribution. Both ovaries are posteriorly displaced, as a consequence of pelvic endometriosis (kissing ovaries).
**Fig. 10:** Case 5. Endometrioid adenocarcinoma. Left ovarian tumour with haemorrhagic content similar to endometriomas. The left aspect of the lesion wall is irregular, with solid enhancing papila, best shown on substraction images.
Fig. 11: Case 6. Ovarian fibroma. These images show a right ovarian solid lesion, with low signal intensity on T2-weighted image and without enhancement after endovenous contrast administration.
Fig. 12: Case 7. Mature teratoma. These images show a left ovarian lesion, with cystic and fatty content, and a solid protuberance projecting inside the lesion (Rokitansky node).
Fig. 13: Case 8. Endometrioid adenocarcinoma. These three images show a left ovarian lesion, predominantly solid with cystic and necrotic component, and heterogeneous enhancement after endovenous contrast administration.
**Fig. 14:** Case 9. Gastric carcinoma metastasis. These images show bilateral ovarian tumours. Both lesions are predominantly solid with intense contrast enhancement.
Conclusion

Ultrasonography is the initial diagnostic tool for ovarian lesion characterization, but if a diagnosis cannot be made, further evaluation with MRI is required. CT can be used for malignant lesion staging.

Radiologist must be able to select the best diagnostic tool and must know each ovarian lesion's characteristics to approach a correct diagnosis.

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