Chapter 14

Ultrasound evaluation of the female internal genitalia

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Introduction

To investigate the female pelvis by transabdominal sonography (TAS) the bladder should be kept distended by a sufficient amount of urine. In this way, the uterus can be clearly detected as a pear-shaped organ located in the middle of the pelvis. Owing to its dimensions and central position, the uterus is the point of reference from where to start a gynecological scan. The principal planes are the longitudinal (Figure 1) and the transverse planes.

Figure 1. Transabdominal longitudinal section of a female pelvis with a full bladder. The uterus can be easily seen as a pear-shaped organ behind the posterior bladder wall.

In some cases it is possible to also obtain a variety of intermediate planes, such as a semicoronal section. The version and flexion angles of the uterus are easy to recognise. Transvaginal ultrasound (TVS) can provide additional support for TAS because of the proximity of the probe to the pelvic organs and the use of high frequencies, which can produce high definition ultrasound images. The three main parts of the uterus clearly distinguished on TAS are the body, the isthmus and the cervix (Figure 2). The anterior surface of the uterine body is almost flat, while the posterior surface is generally convex.

Figure 2. Transabdominal section of an antverted uterus in the case of an empty bladder. The uterus can be measured in two orthogonal diameters (longitudinal and anteroposterior), and the body, the isthmus and the cervix can be easily recognised.
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The volume of the uterus varies depending on age, parity and the hormonal status of the patient. (1–3) (Table 1 and 2).

**Table 1. Normal dimensions of the uterus before puberty (Modified from Orsini, 1984).**

<table>
<thead>
<tr>
<th>Age (years)</th>
<th>No. Pts.</th>
<th>Longitudinal diameter</th>
<th>Anteroposterior diameter of the body</th>
<th>Anteroposterior diameter of the cervix</th>
<th>Uterine volume (cm$^3$)</th>
</tr>
</thead>
<tbody>
<tr>
<td>2</td>
<td>7</td>
<td>33.1±4.4</td>
<td>7.0±3.4</td>
<td>8.3±2.0</td>
<td>1.9±1.58</td>
</tr>
<tr>
<td>3</td>
<td>8</td>
<td>32.4±4.3</td>
<td>6.4±1.3</td>
<td>7.6±2.2</td>
<td>1.6±0.81</td>
</tr>
<tr>
<td>4</td>
<td>15</td>
<td>32.9±3.3</td>
<td>7.6±1.8</td>
<td>8.6±1.8</td>
<td>2.1±0.57</td>
</tr>
<tr>
<td>5</td>
<td>7</td>
<td>33.1±5.5</td>
<td>8.0±2.8</td>
<td>8.4±1.8</td>
<td>2.3±1.39</td>
</tr>
<tr>
<td>6</td>
<td>9</td>
<td>33.2±4.1</td>
<td>6.7±2.9</td>
<td>7.5±1.8</td>
<td>1.8±0.57</td>
</tr>
<tr>
<td>7</td>
<td>9</td>
<td>32.3±3.9</td>
<td>8.0±2.2</td>
<td>7.7±2.5</td>
<td>2.3±1.07</td>
</tr>
<tr>
<td>8</td>
<td>11</td>
<td>35.8±7.3</td>
<td>9.0±2.8</td>
<td>8.4±1.7</td>
<td>3.1±1.52</td>
</tr>
<tr>
<td>9</td>
<td>11</td>
<td>37.1±4.4</td>
<td>9.7±3.0</td>
<td>8.8±2.0</td>
<td>3.7±1.62</td>
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<tr>
<td>10</td>
<td>13</td>
<td>40.3±6.4</td>
<td>12.8±5.3</td>
<td>10.7±2.6</td>
<td>6.5±3.78</td>
</tr>
<tr>
<td>11</td>
<td>13</td>
<td>42.2±5.1</td>
<td>12.8±3.1</td>
<td>10.7±2.6</td>
<td>6.6±2.87</td>
</tr>
<tr>
<td>12</td>
<td>6</td>
<td>54.3±8.4</td>
<td>17.3±5.3</td>
<td>14.3±5.2</td>
<td>16.1±9.15</td>
</tr>
<tr>
<td>13</td>
<td>5</td>
<td>53.8±11.4</td>
<td>15.8±4.5</td>
<td>15.0±2.4</td>
<td>13.1±5.64</td>
</tr>
</tbody>
</table>

Before menarche the uterine body is approximately half the length of the cervix, at menarche the uterine body and cervix are similar in dimensions, and in women of fertile age the body is approximately double the length of the cervix.

**Table 2 Main uterine diameters during different stages of life (Modified from Platt, 1990.).**

<table>
<thead>
<tr>
<th></th>
<th>Longitudinal diameter</th>
<th>Anteroposterior diameter</th>
<th>Transversal diameter</th>
<th>Volume</th>
</tr>
</thead>
<tbody>
<tr>
<td>Prepubertal</td>
<td>1-3 cm</td>
<td>0.5-1 cm</td>
<td>0.5-1 cm</td>
<td>10-20 ml</td>
</tr>
<tr>
<td>Multiparous</td>
<td>8 cm</td>
<td>4 cm</td>
<td>5 cm</td>
<td>60-80 ml</td>
</tr>
<tr>
<td>Nulliparous</td>
<td>6 cm</td>
<td>3-4 cm</td>
<td>3-4 cm</td>
<td>30-40 ml</td>
</tr>
<tr>
<td>Post-menopausal</td>
<td>4-6 cm</td>
<td>2-3 cm</td>
<td>2-3 cm</td>
<td>14-17 ml</td>
</tr>
</tbody>
</table>

**Normal endometrium**

The endometrium is easily seen on TAS. The endometrium appears as a hyperechoic line in the middle of the anterior and posterior myometrial walls. To evaluate the endometrium accurately and measure its thickness, the optimal technique is TVS, which permits a better spatial and contrast resolution. On a longitudinal scan through the uterine corpus the entire length of the endometrium can be seen from the base to the internal uterine orifice. In this scan, with the uterus magnified to occupy >75% of the screen and the focus towards the endometrial stripe, the correct measurement of the endometrial thickness can be obtained by positioning the callipers proximally and distally at the level of the myometrial-endometrial junction. The probe should be then tilted laterally in both directions to see the endometrium from one tubal ostium to the contralateral. If the uterine cavity is deformed by myomas or adenomyosis the endometrial stripe may not be recognisable.

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**Pre-pubertal age**

In patients of pre-pubertal age, the study of the endometrium is only possible transabdominally, and therefore is always difficult. The endometrium of the neonate is thick and hyperechogenic because of the impact of maternal placental hormones. After the first week of life the endometrium becomes atrophic and appears as a thin line (<1 mm) until ovarian hormonal activity begins, when it begins to proliferate and thicken [4]. The study of the endometrium and ovarian volume and morphology are important during this period for diagnosing delayed or precocious puberty [5]. In cases of delayed puberty the endometrium appears atrophic and thin, indicating a lack of ovarian hormonal activity; in comparison, in cases of early puberty the endometrium appears thickened and hyperechogenic.

**Reproductive age**

In women of reproductive age the cyclical production of ovarian hormones induces histological modifications to the endometrium, which is shown on TAS as variations in thickness and echostucture.

During the menstrual phase, inhomogeneous material can be seen inside the uterine cavity (Figure 3) due to the presence of blood mixed tissue from the shedding of the functional layer. Therefore, this phase of the cycle is not recommended for the study of endometrial pathologies.

**Figure 3. Transabdominal section of a retroverted uterus. During menstruation the endometrium can be identified as an inhomogeneous stripe within the two myometrial layers.**

In the early proliferative phase, the endometrial cells increase in number and size and the endometrium appears as a well-defined median line, which is more echogenic than the surrounding myometrium.

In the late proliferative phase, and until ovulation, the endometrium is seen as a “trilaminar” structure (Figure 4) due to the presence of two adjacent hyperechogenic layers surrounded by hyperechogenic lines.
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Figure 4. Antverted uterus with a typical “trilaminar” endometrium.

The two hypoechoic endometrial layers correspond to the mucosa that covers the anterior and posterior walls of the uterus, the external lines are determined by the acoustic interface of the endometrium and myometrium whereas the median line is determined by the juxtaposition of the two endometrial layers inside the uterine cavity.

In the secretory phase the endometrium becomes increasingly hyperechoic (Figure 5) due to the effect of progesterone.

Figure 5. Transabdominal section of an antverted uterus distorted by the presence of an intramural leiomyoma in the posterior uterine wall. During the secretory phase the endometrium is markedly hyperechoic

Post-menopause

With the cessation of ovarian hormonal activity, the endometrium becomes thinner and atrophic. It appears as a thin hyperechoic median line, contrasting with the myometrium. The normal thickness of the physiological post-menopausal atrophic endometrium is generally less than 5–6 mm [6–8].

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It is not unusual to see a moderate quantity of anechoic fluid inside the uterine cavity in such a way that the atrophic endometrial mucosa of the anterior and posterior walls assumes the appearance of two well distinct lines delimiting a central anechoic area. In these conditions, the two anterior and posterior endometrial layers are visible because of fluid acting as a contrast medium. The endometrial thickness can be calculated by adding the thicknesses of the two parts.

Pathology of the endometrium

Endometrial hyperplasia

Endometrial hyperplasia is characterised by a continuous spectrum of histological alterations in the number and histological structure of the glands, and the growth and morphology of the cells. On ultrasound, the endometrium usually appears as irregularly thickened and markedly hyperechoic in contrast to the surrounding myometrium. Sometimes small anechoic cystic spaces are visible in the endometrium due to the accumulation of mucus produced by the hyperplastic glands.

Endometrial polyps

Endometrial polyps are sessile ovoidal or pedunculated masses of varying size that extend out into the uterine cavity. They can be single or multiple, their consistency is gelatinous and they are compressed by the walls of the uterus to fill a part of the uterine cavity. They can be microscopic or very large, sometimes they fill the entire endometrial cavity, which makes a differential diagnosis with hyperplasia and endometrial cancer difficult. In the majority of cases it is possible to see the polyp as a hyperechoic focal lesion surrounded by endometrium of normal appearance. It is essential to use the maximum magnification of the ultrasound system to look for the oval profile of the polyp inside the, apparently uniformly thickened, endometrium. Visualising endometrial polyps is easier during the proliferative phase of the cycle because the endometrial mucosa is thinner and the surrounding endometrium is hypoechoic, which acts as a contrast agent. In the luteal phase the endometrium assumes the same echogenicity as the polyps, making their visualisation more difficult. The polyps are feed by vessels that can be easily detected on colour Doppler ultrasound as a colour line crossing the endometrial-myometrial interface. Submucous myomas should always be taken into consideration in the differential diagnosis of endometrial polyps. They are less echogenic than the surrounding myometrium and are round in shape, possibly with internal calcifications and a cone of shadow.

Endometritis

Endometritis can have variable ultrasound signs depending on the cause and severity of the condition. The endometrium can appear normal or, more commonly, thickened; sometimes a small amount of hypoechoic fluid is found in the uterine cavity, which is a sign of the presence of blood or pus. When the endometrial cavity is completely filled with pus this is known as pyometra (Figure 6).
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Figure 6. Pyometra: hypoechoic material distending the uterine cavity

Endometrial carcinoma

Endometrial carcinoma can as a polypoid endometrial mass with irregular borders, which are localised or diffused throughout the entire endometrial cavity. Sometimes the only ultrasound feature is a thickening of the endometrium, which is difficult to distinguish from endometrial hyperplasia or polyps. The first structures to be invaded by an endometrial carcinoma are the myometrium and cervical canal, which should be evaluated accurately. The echo-texture of the neoplastic tissue is variable: it is hyperechoic in well-differentiated carcinomas (G1 and G2) and is usually iso- or hypoechoic in moderately differentiated or anaplastic carcinomas (G3). Sometimes the mucus collects inside the uterus and acts as a hypo- or anechoic contrast agent that permits the better study of the endocavitary surface of the neoplasm.

Myometrium

The myometrium has a variable echogenicity during different stages of life due to the presence of a variable proportion of collagen fibre, this is in contrast to muscle cells, and is dependent on endocervical conditions and parity. Furthermore, a wide range of pathologies can affect the ultrasound appearance.

Leiomyomas

Leiomyomas are benign tumours that consist of connective tissue and smooth muscular cells. They can originate in any part of the uterus, they can be single or multiple and can vary from a few millimetre to several centimetres. Leiomyomas can have a wide range of echo-structures, depending on the quantity of muscle fibres and connective tissue present. Generally, the higher the proportion of collagen and calcium deposits, the greater the echogenicity of the mass. Typical ultrasound characteristics are the presence of a round or ovoid hypoechoigenic mass inside the uterus, which is distinct from the surrounding myometrium (Figure 7). Sometimes it is possible to visualise the interface between the pseudocapsule and the adjacent normal myometrium. Other characteristics of uterine myomas include deformity of the profile of the uterus, distortion of the endometrium, poor acoustic transmission and alterations in myometrial echogenicity. The myometrial echo-structure is often inhomogeneous, with hyper- and hypoechoic areas, and there is no possibility of clearly distinguishing individual nodules of the myoma. Generally, the uterus is increased in volume and assumes a globular morphology. Leiomyomas can be defined as subserous, intramural and sub-mucous in relation to their position in the uterine wall.

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Figure 7. Leiomyoma of the uterus: appearing as a round mass with distinct borders from the surrounding myometrium (callipers)

Table 3 Differential diagnosis of intramural myomas.

<table>
<thead>
<tr>
<th>Adenomyosis</th>
<th>Intramural myoma</th>
</tr>
</thead>
<tbody>
<tr>
<td>Echo-structure</td>
<td>Inhomogeneous</td>
</tr>
<tr>
<td>Posterior cone of shadow</td>
<td>Absent</td>
</tr>
<tr>
<td>Morphology</td>
<td>Indistinct edges</td>
</tr>
<tr>
<td>Hypoechoigenic lacunas</td>
<td>Present</td>
</tr>
<tr>
<td>Pseudocapsule</td>
<td>Absent</td>
</tr>
<tr>
<td>Doppler</td>
<td>Few scattered vessels in the myometrium</td>
</tr>
</tbody>
</table>

The differential diagnosis between intramural myomas and adenomyomas (the nodular form of adenomyosis) may be difficult using TAS (Table 3). The presence of a pseudocapsule and regular edges, the absence of hypoechoigenic lacunas [9], the presence of calcified areas, and occasionally association with posterior cones of shadow [10] favour the diagnosis of a uterine fibroid. Although the blood vessels in myomas run mostly in the periphery and parallel to the pseudocapsule, in the case of adenomyosis the flow is sparse in the myometrium [11]. Myomas can have unusual features due to degenerative phenomena, and have a wide range of sonographic aspects. Necrosis of part of or the entire myoma can manifest itself in unusual ways and can simulate malignant masses of adnexal origin. The most common degenerative form is calcification due to calcium deposits inside the mass.

Adenomyosis

Adenomyosis is a common condition characterised by growth of glands and endometrial stroma inside the myometrium. Frequency varies considerably depending on the studies, 5% to 70% have been reported [12]. Generally, the uterus has an increased volume on ultrasound, and has a globular appearance (Figure 8) [13] with hypoechoic areas of a few millimetres distributed throughout the myometrium. It is believed that these areas are a result of ectopic endometrial glands that are visible as internal focal haemorrhages or hidden modifications of the glands. Power Doppler ultrasound shows an absence of blood flow inside these adenomyotic nuclei; this criterion can help in the differential diagnosis with varicosity of the uterine vessels and adenomyosis. An-
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other ultrasound sign of adenomyosis consists in a poorly-defined endometrial stripe and very small multiple cones of shadow (hypoechoic stripes).

*Figure 8. Adenomyosis: the uterus has an increased volume and a globular appearance*

Ultrasound signs of adenomyosis

- Globular uterine morphology: the fundus of the uterus appears enlarged.
- Small irregular cystic spaces scattered in the myometrium.
- Inhomogeneous, irregular myometrial echo-texture.
- Indistinct endometrial-myometrial borders, shaggy endometrial stripe.
- Multiple tiny hypoechoic posterior cones of shadow

**Sarcomas**

Sarcomas are rare neoplasms that can develop from a leiomyoma or, more often, originate from the normal myometrium or endometrial stroma [14]. The diagnosis of a uterine sarcoma is essentially histological, and made on the basis of the mitotic index (more than 10 mitoses per high power field), nuclear atypia and the presence of mass necroses. Pre-operative ultrasound diagnosis is difficult, and at present there are no typical ultrasound characteristics for these sarcomas. The rapid volumetric increase of a known leiomyoma raises diagnostic suspicion, especially in postmenopausal women [15]. Generally, sarcomas are seen as highly vascularised parenchymatous masses with irregular outer borders. Some authors have suggested that the study of flow characteristics of uterine masses is useful in distinguishing between myomas and sarcomas.

**Ovaries**

The ovaries lie between the uterus and the lateral pelvic wall, they are anteromedial to the external iliac vessels, or, rarely, in the pouch of Douglas. In the presence of a full bladder, the ovaries lie close to the bladder wall, and are therefore easily visible on TAS (Figure 9).

*Figure 9. In the presence of a full bladder, the ovaries are easily visible on TAS lateral to the uterus, medial to the pelvic side walls*

The morphology of the ovaries is roughly ovoid, which means their volume can be calculated using the formula for an ellipsoid:

\[(d1 \times d2 \times d3) \times \frac{π}{6}\]

The volume of the ovaries varies over the course of life, and cyclically in women of reproductive age. Ultrasound studies have documented an increase in the average ovarian volume during the first two decades of life; from the fourth decade the average volume tends to diminish. The maximum ovarian volume is considered to be approximately 20 ml in the fertile period and 10 ml after menopause [16, 17].

During the fertile period the ovaries have a variable amount of small antral follicles. These appear as anechoic round areas with smooth regular walls of up to 30 mm in mean diameter, which are scattered in the ovarian parenchyma. During ovulation, the dominant follicle collapses and assumes the appearance of a hypoechogenic area in an eccentric position, which is not always distinct from the rest of the parenchyma. The corpus luteum normally measures 2–3 cm in diameter. Sometimes, owing to the internal accumulation of blood, it assumes a cystic appearance and can be larger. The ultrasound appearance of the contents of these cysts can vary from transonic to a greatly enlarged fine trabecular (or jelly-like) echo-structure that mimics the appearance of neoplastic ovarian masses. With colour or power Doppler ultrasound it is possible to observe their typical high-velocity, low-impedance peripheral vascularisation (known as the ring of fire) (Figure 10). A second, more frequent, functional swelling in the fertile period is caused by follicular cysts. These are unilocular transonic cysts of 3–8 cm in diameter.

After menopause, the ovaries become atrophic with the cessation of activity and are therefore small and are hardly visible on TAS.
Benign ovarian cysts

Every ovarian cyst must be studied, whenever possible, by TVS because the proximity of the transducer to the adnexal site allows the use of probes of a higher frequency (up to 12MHz) and, therefore, a better morphological evaluation of the tumour. TAS is always useful as an integration of TVS especially in the case of masses of large dimensions that extend beyond the confines of the true pelvis. Furthermore, TAS is indicated every time there is a suspected malignant adnexal pathology to better evaluate its extension into the upper abdomen.

A complete sonographic examination of the adnexa should be performed according to a standardised logical sequence that provides information about:

- the position, morphology, dimensions and internal echo-structure of the cysts;
- the origin of the adnexal masses, their nature and their relationship with the adjacent organs;
- the presence of anomalies associated with the pelvic organs;
- the presence of ascites and fluids of inflammatory or neoplastic origin in the abdomen.

Both in pre- and post-menopausal women, adnexal masses have a varied morphological appearance that reflects the different histological types of ovarian lesions and pelvic organs that can produce swellings in the ovaries.

Firstly, the sonologist has to differentiate between benign and malignant pathologies; this must be based not only on their ultrasound characteristics but also on clinical data and the evolution of the mass during follow-up.

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Figure 10. A large corpus luteum cyst showing a typical high-velocity, low-impedance peripheral vascularisation (ring of fire) at Doppler evaluation

Ultrasound criteria for the differential diagnosis of adnexal masses.

- Dimensions in the three planes of the space
- Mono/bilaterality
- Margins (internal and external)
- Contents (cystic/cystic with solid parts/prevalently solid)
- Echo-structure (anechoic, hypoechoic, mixed)
- Presence of septa and papillae (thickness and number)
- Site of the anatomical mass and its relationship with the pelvic organs
- Morphology (spherical, ovoid, elongated, irregular)
- Posterior echoes of the mass (i.e. cone of shadow, acoustic reinforcement)
- Cleavage plane, invasion of the adjacent organs
- Mobility of the mass
- Presence of ascites
- Presence or absence of blood flow at power/colour Doppler
- Flow quantitative parameters (colour score)

The morphology of the cyst is directly linked to the risk of malignancy: a fairly schematic classification can distinguish between unilocular, unilocular solid, multilocular, multilocular solid and solid ovarian masses [18].

Serous ovarian cysts

Serous ovarian cysts can be single or, rarely, multiple and are characterised by their anechoic content and smooth well-defined internal walls. Generally they are unilocular cysts without internal solid projections. Their dimensions can vary in women of fertile age in who anechoic cysts of diameter <3 cm cannot be distinguished from ovarian follicles. Unlike pre-ovulatory follicles, the persistence of cysts over time represents the most important parameter to be considered in the differential diagnosis.

Endometriotic cysts

The majority of endometriomas are unilocular cysts with a thick wall and a homogeneous low-level echoes (known as the ground-glass appearance) due to the collection of old blood. An ultrasound sign found in 45% of endometriomas, which can help in their differential diagnosis from other masses with similar echo-texture, is the presence of small hyperechogenic wall foci (Figure 11). Rarely, endometriotic cysts are multilocular, with regular septations that divide different locules and can demonstrate echoic internal projections that mimic true solid parts or papillary projections. Generally the internal projections consist of clots or debris that has adhered to the walls of the cyst. Moreover, the ectopic endometrial mucosa that covers the cyst can undergo acute or chronic inflammatory phenomena, oedema and decidualisation, which occurs during pregnancy. In such cases, the walls of the cyst become irregular and thickened and thus the differential diagnosis with neoplastic ovarian tumours can be very difficult. Moreover, endometriomas can appear as an inhomogeneous internal echo-texture, because of the presence of hyperdense or hypoechoic areas mixed together owing to the presence of a different density of the liquid content.
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**Figure 11. Unilocular endometriotic cyst with a ground glass content and few hyperechogenic wall foci**

Ovarian dermoid cysts, cystadenomas and cystic corpora lutea should be taken into consideration in the differential diagnosis of endometriotic cysts because these swellings can have a similar ultrasound characteristic (Table 4). In fact, mucinous cystadenomas often have a slightly hypoechoic content when the mucus produced is particularly dense; the cystic corpora lutea have very small internal echoes due to the presence of blood and clots, whereas some dermoid cysts can be internally hypoechoic owing to the accumulation of sebum without hair and hair fragments.

**Table 4. Differential diagnosis of endometriotic cysts.**

<table>
<thead>
<tr>
<th></th>
<th>Endometrioma</th>
<th>Cystic corpus luteum</th>
<th>Cystadenoma</th>
<th>Dermoid</th>
</tr>
</thead>
<tbody>
<tr>
<td>Septations</td>
<td>Rare</td>
<td>No</td>
<td>Frequent</td>
<td>Rare</td>
</tr>
<tr>
<td>Echogenic areas</td>
<td>Rare</td>
<td>Yes</td>
<td>Rare</td>
<td>Frequent</td>
</tr>
<tr>
<td>Shadow cone</td>
<td>No</td>
<td>No</td>
<td>No</td>
<td>Frequent</td>
</tr>
<tr>
<td>Hyperechogenic spots</td>
<td>Frequent</td>
<td>No</td>
<td>No</td>
<td>No</td>
</tr>
</tbody>
</table>

**Ovarian cystadenomas**

Serous cystadenomas are bilateral in a fifth of cases; they are completely transonic or hypoechoic with a smooth, regular external surface. Papillary projections are generally absent or very small. Mucinous cystadenomas are frequently multilocular due to the internal presence of numerous thin septations that are usually parallel and sometimes constitute a very dense network. These tumours can reach large dimensions, up to 30 cm. The internal surface is smooth, and only rarely is it possible to observe hypoechoic papillae. The internal echo-structure is hypo- or anechoic (Figure 12).

**Figure 12. A large mucinous multilocular cystadenoma showing several thin internal septations**

**Para-ovarian and paratubal cysts**

Para-ovarian and paratubal cysts represent approximately 10% of all adnexal masses and for this reason are included in this chapter. They are normally transonic single unilocular anechoic cysts with thin outer walls. They rarely contain septations or papillae. Useful diagnostic criteria include the visualisation of a close but distinct ipsilateral ovary, the absence of a pericystic ovarian parenchyma, the movement of the cyst from the contiguous ovary when exercising a light pressure with the probe [19].

**Dermoid cysts**

The ultrasound appearance of dermoid cysts varies widely according to the histological differentiation of the tissues they contain (cutis, hair, fat, bones, teeth and so on). They are round or oval masses with a mixed internal structure due to the presence of mixed hypoechoic, anechoic and hyperechoic areas. Often a posterior cone of shadow is visible. The use of colour or power Doppler ultrasound is crucial to reveal absence of blood vessels inside the echo portions of the dermoid.

The three most common ultrasound characteristics of dermoid cysts are [20]:

- Hypo- or anechoic cysts containing one or more hyperechoic nodules ("dermoid plug") with a posterior cone of shadow;
- Cysts containing hyperechoic thin stripes and spots on a hypo- or anechoic background ("starry sky" appearance);
- Cysts with uniformly hypoechoic content.

It should be remembered that the presence of closely packed hairs inside a dermoid cyst can give it an ultrasound appearance similar to an intestine full of faeces or gas. However, a meticulous scan permits the visualisation of peristaltic movements in the bowel loops, and not inside the dermoid. Occasionally, an interface develops between the serous fluid and fat inside the cyst due to the difference in density ("fat-fluid level").
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Malignant ovarian tumours

Malignant tumours can present a variety of ultrasound features. Furthermore, their morphology is influenced by histology and stage of growth. Whereas ultrasound characteristics of neoplasms at an advanced stage are fairly easy to recognise (large masses with solid portions, extensions into surrounding organs, presence of ascites, and so on), considerable experience is needed to distinguish benign cysts from malignant ones at a very early stage in development. Malignant neoplasms are frequently bilateral, contain one or more papillae or solid parts that make the internal wall irregular (Figure 13). The solid portions of the mass can become the major part of the cyst and in many cases ovarian carcinomas appear as mostly solid masses, containing scarce, small cystic spaces (“Swiss cheese” appearance) due to the accumulation of fluid secreted by the neoplastic cells or produced by intratumoural haemorrhage and necrosis (Figure 14). Septations are usually thick and the internal and external walls of the tumour are irregular. On Doppler ultrasound, malignant ovarian neoplasms generally have a rich internal vascular network, with frequent arterovenous anastomoses, vascular lakes and an irregular flow distribution.

Figure 13. Ovarian serous-papillary carcinoma with a large internal solid projection. Power Doppler shows vascularisation of the solid part.

Figure 14. Ovarian adult granulosa cell tumour with a so-called swiss-cheese appearance. The tumour is predominantly solid with small internal cystic areas.

References

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