Review of ultrasound and pathological features of circumscribed solid lesions within the breast.

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Learning objectives

1. To review the different types of circumscribed solid lesions seen on breast ultrasound (US).
2. To summarize their main characteristics and to recognize the salient findings for each lesion and correlate those with histopathology.
Background

Ultrasound currently represents a fundamental part of the diagnostic imaging approach to breast pathology, together with mammography which is usually confined to women older than 40 years.

US is highly reliable when differentiating between solid or cystic lesions, but it maybe be more challenging for the final characterization of a solid lesion, which is consistent with the high rate of benign biopsy results reported in literature (around 90%) [1]. This data can partly be explained by the operator-dependent interpretation of US, but mainly are due to the fact that some US features may be overlapping between benign and malignant masses, such as well-circumscribed margins. Although a well-defined circumscribed mass is typically due to a benign lesion most commonly a fibroadenoma, up to 10%-20% of breast malignancies can also present this feature [2]. Malignant circumscribed masses may be due to papillary, mucinous, medullary and metaplastic carcinomas, as well as malignant phyllodes tumors.

However other than margins, there are other features that the radiologist needs to consider in order to predict the benign or malignant nature of the mass, such as: shape (round, oval, lobulated, irregular), orientation, margins (smooth, sharp, indistinct, irregular), internal echo pattern (homogeneous, heterogeneous), echotexture (hyperechoic, isoechoic, mildly hypoechoic, markedly hypoechoic), posterior shadowing or enhancement, internal vascularity, cystic spaces within the mass, calcification and surrounding parenchyma change (for example halo sign).

Keeping these in mind, the aim of this exhibit is to go through the most common types of well circumscribed lesions seen on US in order to highlight their typical features.
Findings and procedure details

In this exhibit we will demonstrate a variety of circumscribed lesions, focusing first on the US features according to the parameters mentioned above, as summarised on Table 1, and, secondly, on their histopathological characteristics.

**Fibroadenoma** (fig 1)

Fibroadenomas represent the third cause of breast abnormality seen on US, after cyst and benign cystic change; representing the most common cause of solid lesion in the breast, occurring in 25% of asymptomatic women [3].

They usually appear as well-defined, oval masses, lobulated, parallel orientated with homogeneous echo pattern and slightly hypoechoic echotexture compared to glandular tissue; the internal vascularity may vary according to the hormonal status of the patient, being more likely to be vascularized in fertile patients, they may have calcification within it (fig 1 c) as well as septation.

**Papillary lesions**

The two most common types of papillary lesions are benign intraductal papillomas (Fig 2) and papillary carcinomas, which can be further differentiated in invasive and not (Fig 3) [4]. These lesions may present with symptoms such as a palpable mass or nipple discharge. In literature there are no distinctive features reported which may help to differentiate benign and malignant papillary lesions on US. Papillary carcinoma can demonstrate some benign US features such as oval shape, slightly hypoechoic echo texture and parallel orientation to the chest wall. However larger lesion size, increased internal vascularity, the presence of posterior shadow and halo sign correlate well with a malignant nature [5]; further more irregular margins help to distinguish the invasive type [6].

**Invasive ductal carcinoma**

The other subtypes of invasive ductal carcinoma which may appear as well circumscribed lesions on US are: mucinous, medullary and high grade carcinoma.

-**Invasive Mucinous carcinoma** (Fig 4)

This represents a rare type of breast cancer accounting for less than 4% of all malignancies [7]. It usually occurs in an older age group, among women 75 years or older. It usually appears as a well-circumscribed mass, with homogeneous echotexture, and typically isoechoic appearance which correlates well with pure mucinous histology[8]. Invasive ductal cancer with mucinous features typically has a lower echogenicity compared to a pure mucinous tumor.
- *Invasive High grade ductal carcinoma (fig 5)*

This category includes all poorly differentiated invasive ductal carcinoma, which mainly occur in middle aged women and are characterized by a poor prognosis and fast growing lesions. This biological feature explains the complex internal echogenicity observed in some cases, with cystic components that are related to necrosis and cystic degeneration within the lesion (fig 5b) [9-10], as well as the halo sign on the surrounding parenchyma due to the inflammatory reaction.

**Phyllodes tumours (fig 6)**

Phyllodes tumours are rare epithelioid lesions of the breast accounting for 1% of all lesions, and tend to manifest in younger patients. They can be differentiated into benign, border line and malignant type according to the grade of cellular mitosis. The US features are similar to those described for fibroadenomas, although they tend to present as larger lesions and may have a mixed echogenicity. Cystic areas are seen more often in malignant phyllodes tumor than in benign phyllodes tumor [2-11].

**Rare lesions**

Rare lesions in the breast can include also vascular tumours such as hemangioma (FIG 7). Usually they appear as lobulated hypoechoic well circumscribed mass, which may contain cystic areas and calcification. It is important to differentiate those from the malignant version: angiosarcoma, in which case ill-defined margins and increased Doppler flow may be helpful [12].

At last other malignant rare lesions should be considered in this category such as : lymphoma and metastasis.

<table>
<thead>
<tr>
<th>Lesions</th>
<th>Shape</th>
<th>Orientation</th>
<th>Margins</th>
<th>Echotexture</th>
<th>Echogenicity</th>
<th>Other features</th>
</tr>
</thead>
<tbody>
<tr>
<td>Fibroadenoma</td>
<td>Oval</td>
<td>Parallel</td>
<td>Lobulated</td>
<td>Homog</td>
<td>Mildly hypo</td>
<td>Internal calcification, 20% multifocal</td>
</tr>
<tr>
<td>Papilloma</td>
<td>Round</td>
<td>NA</td>
<td>sharp</td>
<td>Homog</td>
<td>Mildly hypo</td>
<td>Usually retroareolar region, and associated with nipple discharge</td>
</tr>
<tr>
<td>Papillary CA</td>
<td>Oval / round</td>
<td>Parallel</td>
<td>Microlobulated</td>
<td>Homogenous</td>
<td>Mildly hypo</td>
<td>larger size, posterior shadowing, halo sign</td>
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</tr>
<tr>
<td>Phyllodes</td>
<td>Oval</td>
<td>Parallel</td>
<td>Lobulated</td>
<td>Heterogeneous (when malignant)</td>
<td>Hypo-iso</td>
<td>Cystic area, larger size, posterior shadowing</td>
</tr>
<tr>
<td>Invasive mucinous CA</td>
<td>Round</td>
<td>Taller than wider</td>
<td>Smooth</td>
<td>Homogenous</td>
<td>Isoechoic</td>
<td>Elderly women, posterior shadowing, halo sign</td>
</tr>
<tr>
<td>Invasive high grade CA</td>
<td>Round</td>
<td>Taller than wider</td>
<td>Smooth</td>
<td>Heterogeneous</td>
<td>Markedly hypoechoic</td>
<td>Rapidly growing, posterior shadowing, halo sign</td>
</tr>
</tbody>
</table>
Fig. 1: Three different types of fibroadenomas. Appreciate the bilobated shape in a), the internal calcification in b) and the cystic area in c).

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Fig. 2: three different types of Intraductal papilloma

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Fig. 3: papillary carcinoma

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**Fig. 4:** invasive mucinous carcinoma. Appreciate the isoechoic appearance, and the hyperechoic halo sign highly suspicious for malignancy.

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**Fig. 5:** Three different types of invasive High grade ductal carcinoma. Appreciate the cystic degeneration within the lesion in b) and the altered echogenicity of the surrounding parenchyma in c).

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**Fig. 6:** Phyllodes. Appreciate the heterogeneous echotexture.

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**Fig. 7:** Cavernous Hemangioma.

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Conclusion

Well-defined masses seen on breast US may be due to varying pathology. In this exhibit we discussed the most common types of lesions, giving to the viewer an overview of their main US features.
References


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