Ductal carcinoma in situ (DCIS): pictorial review

Poster No.: C-1986
Congress: ECR 2011
Type: Educational Exhibit
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Keywords: Oncology, Breast
DOI: 10.1594/ecr2011/C-1986

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Learning objectives

To describe mammographic and ultrasonographic characteristics in DCIS.
Background

EPIDEMIOLOGY

Diagnosis of DCIS was rare prior to the introduction of screening mammography in the mid 1970s.

The widespread adoption of mammographic screening dramatically altered the number of cases of DCIS, the size and extent of the in situ process within the breast, and the clinical presentation. DCIS now accounts for approximately 20-25 percent of all new breast cancers, over 90 percent of which are detected only on imaging studies.

The risk factors for DCIS and invasive breast cancer are similar, and include family history of breast cancer, prior breast biopsy, and nulliparity or late age at first birth. DCIS is a component of the inherited breast-ovarian cancer syndrome defined by mutations in the BRCA genes; mutation rates are similar to those for invasive breast cancer. DCIS tends to occur at a younger age in women with inherited BRCA mutations as compared to high familial risk women who are noncarriers.

The relationship between DCIS and hormone therapy is unclear; most reports do not support an association.

It is not uncommon for DCIS to be detected at an earlier age than is invasive breast cancer. This is particularly evident in families with a strong history of breast cancer, in which the risk in the current generation is often reflected by clinically occult DCIS, while their mothers and grandmothers more often presented with invasive disease.

PATHOLOGY

The term DCIS encompasses a heterogeneous group of lesions that differ in their clinical presentation, histologic appearance, and biological potential. They are all characterized by proliferation of presumably malignant epithelial cells within the mammary ductal system, with no evidence of invasion into the surrounding stroma on routine light microscopic examination.

Proposed classification schemes that divide DCIS histologically into a variety of subtypes have emphasized architectural features or growth pattern of the neoplastic cells, cytologic features, and cell necrosis, both singly and in combination. The traditional method for classifying DCIS lesions is primarily based upon the growth pattern (architectural features) of the tumor, and recognizes five major types:
• The **comedo type** is characterized by prominent necrosis in the center of the involved spaces. The necrotic material frequently becomes calcified and the calcifications may be detected mammographically, characteristically as linear, branching ("casting") calcifications. The comedo type is more often associated with invasion, and the degree of comedo necrosis in patients with DCIS appears to be a strong predictor for the risk of ipsilateral breast recurrence after treatment.

• The **cribriform type** is characterized by the formation of back to back glands without intervening stroma. Necrosis is limited to single cells or small cell clusters.

• The **micropapillary type** features small tufts of cells that are oriented perpendicular to the basement membrane of the involved spaces and project into the lumina. The apical region of these small papillations is frequently broader than the base, imparting a club-shaped appearance. The micropapillae lack fibrovascular cores.

• The **papillary type** shows intraluminal projections of tumor cells that, in contrast to the micropapillary variant, demonstrate fibrovascular cores and thereby constitute true papillations. A variant of papillary DCIS, intracystic papillary carcinoma, is characterized by tumor cells that are primarily or exclusively present in a single cystically dilated space.

• The **solid type** is not as well defined as the other subtypes. It features tumor cells that fill and distend the involved spaces and lack significant necrosis, fenestrations, or papillations.

Less common variants of DCIS include the "clinging" carcinoma, intraductal signet ring cell carcinoma, and cystic hypersecretory duct carcinoma. Similar to the comedo type, these variants may show calcifications that can be detected mammographically. However, the mammographic appearance of these microcalcifications is less distinctive than the pattern seen in comedo lesions and can resemble a number of benign processes.

A number of authors have proposed alternative classification systems for DCIS. Although they use different terminology, all are primarily based upon nuclear grade and/or the presence or absence of necrosis, and have in common the recognition of three main categories of DCIS: **high**, **intermediate**, and **low grade lesions**.

**PROGNOSIS**

The natural history of treated DCIS can be best estimated from series of women undergoing lumpectomy rather than mastectomy for DCIS. Although the studies differ markedly in design, the following general conclusions can be drawn:
• At 12 to 15 years follow-up, and regardless of histologic grade or use of radiation therapy (RT), the majority do not recur locally.
• Approximately one-half of all recurrences are invasive, regardless of the use of adjuvant therapy (ie, RT, tamoxifen).
• Nearly all patients with a noninvasive recurrence and more than 90 percent of those with an invasive recurrence survive their disease after subsequent treatment, usually mastectomy.
MAMMOGRAPHIC FEATURES OF DCIS

Mammography is the primary tool for detecting DCIS. The reported sensitivity is between 87% and 95%.

**Fig.** Mammographic Features of DCIS

**References:** Radiologia, IPO Porto, Instituto Português de Oncologia do Porto - Porto/PT

**Masses and Architectural Distortion**

In about 10% of cases, DCIS manifests as a dominant mass. This masslike appearance may be related to two different conditions: direct manifestation of a soft-tissue mass or...
the result of periductal fibrosis or elastosis producing an irregular or spiculated margin around a nonmasslike lesion.

Architectural distortion is observed in 7%-13% of cases and has been noted in 7% of patients with sclerosing adenosis.

Other pathologic conditions that may lead to architectural distortion include radial scarring and sclerosis in the interstitium around the DCIS and carcinomatous invasion of the Cooper ligament.

Most DCIS lesions classified as low grades appear as masses or asymmetries at imaging. Low-grade DCIS lesions without necrosis are more likely than lesions of higher grades to manifest as noncalcified abnormalities.

**Microcalcifications**

Found in 50-75% of cases, they may show a significant correlation to histologic grade of DCIS.

Generally, calcifications forming in breast cancers are pleomorphic and vary in size, shape, and density.

Linear, branching, or pleomorphic calcifications develop in DCIS growing in branching, tubular-like ducts ("fine linear or fine linear branching (casting) calcifications" term used in ACR BI-RADS). These calcifications form an irregular cast of the duct and are often seen in the comedo form of DCIS. The calcifications may look like little broken needles with pointy ends or may have a "dot-dash" appearance with both round and linear shapes. X-, Y- or Z-shaped calcifications may be seen because of calcific casts of necrotic tumor in branching ducts.

Another suspicious calcification form described by the ACR BI-RADS lexicon is "pleomorphic or heterogeneous calcifications (granular)". This term reflects more rouded, but very tiny, irregularly shaped calcific particles that look like bizarre broken glass shards formed in small rouded pockets of necrotic tumors such as micropapillary or cribriform DCIS. The individual calcification forms are roughly round in shape but are irregular and can be faint, are smaller than 0,5mm, and vary in size and density. A cluster containing granular calcifications may not exhibit casting or linear forms but should still be considered suspicious even in their absence.

Although comedo-type DCIS calcifications are often "casting" and the calcifications in micropapillary and cribriform DCIS are often "granular", calcification forms and DCIS architectural type can overlap.
ULTRASONOGRAPHIC FEATURES OF DCIS

Given a known mammographic location, US can depict breast masses associated with malignant microcalcifications in most cases.
The main benefit of identifying a US abnormality in women with mammographically detected DCIS is to allow the use of US to guide interventional procedures (eg, needle biopsy, needle localization).

US may also be helpful in detecting DCIS without calcification and in evaluating disease extent in women with dense breasts.

**DCIS with calcifications**

At US, DCIS with mammographic calcifications often manifests as a microlobulated, hypoechoic mass with ductal extension and punctate calcifications. No DCIS lesions have echogenic pseudocapsule. Normal acoustic transmission is typical, but posterior shadowing may be seen in high-grade comedo-type DCIS lesions. US findings seem to be nonspecific and similar findings may also be seen in some benign lesions such as sclerosing adenosis, atypical ductal hyperplasia, and radial scar.

**DCIS without calcifications**

About 10% of all DCIS lesions manifest as soft-tissue masses or asymmetric densities at mammography, whereas up to 16% can be mammographically occult. At pathologic analysis, they are non-comedo-type lesions (cribiform, micropapillary, papillary, or solid). This lesions tend to spread without tumor cell necrosis and calcification.

At US, most of these lesions manifest as single or multiple hypoechoic masses without a pseudocapsule. Ductal extension is sometimes seen. They can be misinterpreted as benign nodules due to their roundness and well-circumscribed margins. Posterior acoustic enhancement may be seen in large masses.

DCIS lesions without calcification may manifest as a solid and cystic mass.

US findings in DCIS without calcifications are nonspecific and may also be seen in benign diseases such as papilloma, mammary duct ectasia, fibrocystic change, and atypical ductal hyperplasia.
Fig. 0: Case 1 - Craniocaudal and mediolateral oblique mammograms of the left breast obtained during needle localization procedure. Intermediate-grade DCIS. Solid nodule at the end of the wire.

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**Fig. 0:** Case 1 - US. Solid hypoechoic nodule.

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Fig. 0: Case 2 - Low-grade DCIS. Mediolateral oblique (a) and craniocaudal (b) mammogram of the right breast shows a nodule in the upper outer quadrant. US (c) reveals a solid hypoechoic nodule.

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Fig. 0: Case 3 - Mediolateral oblique (a) and craniocaudal (b) mammograms of the left breast obtained during needle localization procedure. Micropapilar DCIS. Heterogeneous granular calcifications (c).

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Fig. 0: Case 3 - Specimen radiograph shows calcifications.

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**Fig. 0:** Case 4 - Photographic magnification. Cluster of fine linear (pleomorphic) calcifications in DCIS (mixed type).

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**Fig. 0:** Case 5 - Cribiform DCIS. Photographic magnification of linear branching (casting) calcifications (a). Specimen radiograph (b).

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Fig. 0: Case 6 - Comedo DCIS. Mediolateral oblique (a) and magnification mammography (b) of the right breast. Pleomorphic calcifications.

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Fig. 0: Case 7 - Intermediate/high-grade DCIS. Mediolateral oblique (a), craniocaudal (b) and magnification (c) mammograms. Fine linear branching (casting) microcalcifications.

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Fig. 0: Case 8 - High grade DCIS. Photographic magnification. Heterogeneous/granular microcalcifications.

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Ductal carcinoma in situ of the breast encompasses a wide spectrum of disease with a variety of mammographic and ultrasonographic presentations.

The categorization of DCIS by means of mammographic and histologic features will increase our understanding of the natural history of DCIS and aid in the development of clinical criteria for the selection of patients for appropriate treatment.
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