# Mucinous carcinoma of the breast: iconographic essay with histopathological correlation*

*Carcinoma mucinoso da mama: ensaio iconográfico com correlação histopatológica*

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**Abstract** The present essay is aimed at describing the most characteristic imaging findings of mucinous carcinoma of the breast, with emphasis on the patterns related to better prognosis. The authors selected cases of mucinous carcinoma of the breast whose images were available, highlighting the imaging findings suggestive of this subtype of breast cancer, either at mammography, ultrasonography or magnetic resonance imaging.

**Keywords:** Breast neoplasm; Mucinous carcinoma; Mammography; Ultrasonography; Magnetic resonance imaging.

**Resumo** O objetivo deste artigo é descrever os aspectos de imagem mais característicos do carcinoma mucinoso de mama, destacando-se os padrões relacionados a melhor prognóstico. Foram selecionados casos de carcinoma mucinoso de mama enfatizando as características de imagem que sugiram esse subtipo de neoplasia mamária, seja na mamografia, ultrassonografia ou ressonância magnética.

**Unitermos:** Neoplasia mamária; Carcinoma mucinoso; Mamografia; Ultrassonografia; Ressonância magnética.

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## INTRODUCTION

Breast cancer is the most common malignant tumor in women. The Brazilian radiological literature has emphazised the importance of imaging methods in the improvement of breast cancer diagnosis[1–4].

Mucinous or colloid breast carcinoma (MBC) is an uncommon subtype of invasive ductal carcinoma (IDC), representing between 1% and 7% of all breast neoplasms. This tumor shows a wide age distribution, but with higher incidence in elderly[5].

Histologically, such variant is characterized by a tumor-like arrangement of neoplastic cells involved by extracellular mucin, in most cases associated with peripheral ductal carcinoma *in situ* (DCIS)[6]. Cellularity as well as the amount of mucin has large variation among mucinous tumors. The greater the amount of mucin, the better the prognosis is[6].

There are two histological presentations with different imaging features and prognoses: pure and mixed types. Pure type comprises tumors with a mucinous arrangement in their whole extent, with less than 10% of non-mucinous component, or even a poorly differentiated non-mucinous component[6,7]. The mixed type presents a greater amount of neoplastic cells not involved by mucin, generally in association with a smaller amount of extracellular mucin, which implies intermediate characteristics between the pure type and nonspecific invasive ductal carcinoma (NS-IDC), for this reason sometimes referred to as "IDC with mucinous differentiation"[6,7].

The present pictorial essay focus on the most typical imaging findings of such specific type of carcinoma and its subtypes, highlighting findings associated with prognostic prediction.

### Histological diagnosis

The diagnosis of mucinous neoplasm may be suspected at fine-needle aspiration biopsy (FNAB), although with low accuracy in the differentiation between benign (mucoceles) and malignant mucinous lesions (MMC).

Core biopsy exhibits high sensitivity and high positive predictive value (PPV) for the diagnosis of mucinous neoplasm, particularly in cases where such biopsy is imaging-guided, reaching values close to 100%[8,9]. However, the differentiation between pure and mixed types can only be established after excision and evaluation of the lesion in its whole extent[6,9].

### Prognosis

The better prognosis of MMCs, compared with NS-IDC, explains the diagnostic importance of these tumors[7]. Pure type shows indolent growth, while the mixed type presents variable biological behavior, sometimes similar to NS-IDCs[10].

Thus, MMCs, specially the pure type, demonstrated a lower histological degree (well differentiated tumors), higher hor-

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mone receptor (HR) expression, lower incidence of adverse oncogenes, lower rate of axillary lymph node involvement at diagnosis, and longer disease-free survival (with no significant difference in overall survival)[7,11,12].

## Imaging findings

MMC is part of a group of 10% to 20% of the malignant tumors which present as circumscribed lesions, sometimes initially interpreted as benign lesions, which delays the diagnosis and appropriate treatment[5,8,12] decisions.

In such a context, mammography, ultrasonography and magnetic resonance imaging represent fundamental tools in the attempt to recognize findings not only suggesting the diagnosis of MMC, but also helping to differentiate between the two histological types of the neoplasm directly related to different prognostic factors[11,13–15].

Typically, a MMC presents as an ovoid or round nodule with circumscribed margins. At mammography, the pure type correlates with circumscribed or micro-lobulated margins, which present a direct relationship with the amount of extracellular mucin[16], as demonstrated on Figure 1. The mixed type presents more indistinct or spiculated contours secondary to a higher degree of fibrosis and peripheral desmoplasia, similarly to a NS-IDC. Microcalcifications are not common, and when they occur, rarely represent psammomatous calcifications, most times associated with the presence of peripheral component of DCIS[6,16,17].

Ultrasonography has higher sensitivity than mammography in the detection of MMCs[16,18]. Characteristically, MMCs are visualized as an ovoid nodule with circumscribed or microlobulated margins, and may be either hypo- or isoechoic, with posterior acoustic shadowing in 37% to 71% of the cases, as demonstrated on Figure 2.

Similarly to morphological findings at mammography and ultrasonography, MMCs, at magnetic resonance imaging, are visualized as ovoid or lobulated masses with predominantly regular contours. The signal intensity is variable on T1-weighted images and with strong signal (similar to that of water or vessels) on T2-weighted images (Figure 3). Such high signal of the MMCs on T2-weighted images shows direct correlation with the degree of extracel-

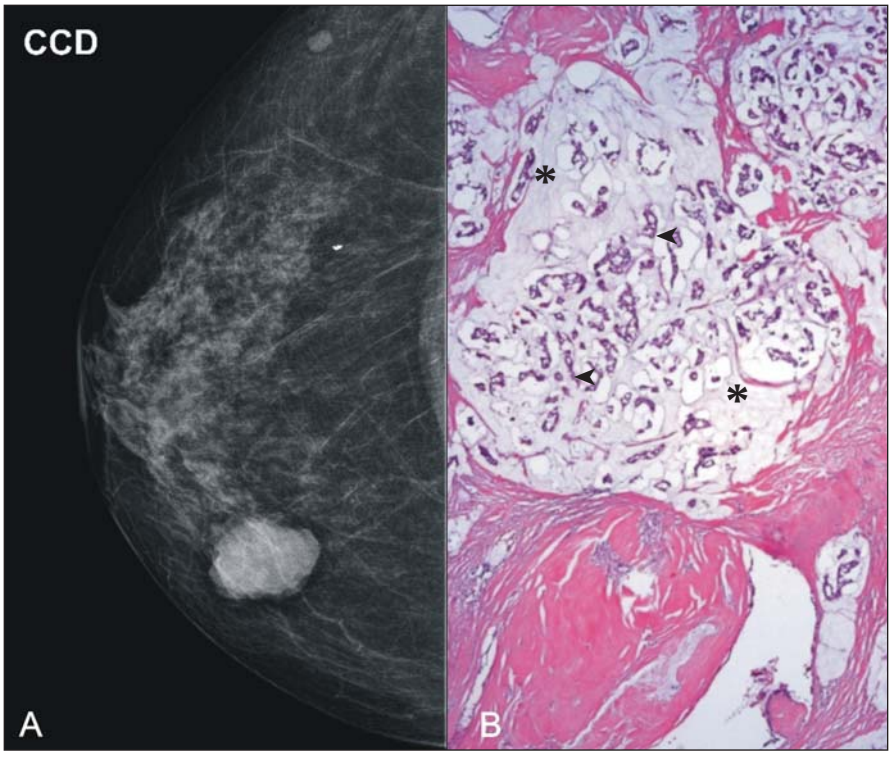


**Figure 1. A:** Female, 69-year-old patient. Craniocaudal view demonstrating nodule with microlobulated margins in the medial quadrant of the right breast, diagnosed as pure MMC. **B:** Histological section of the lesion, identifying mucinous tumor with neoplastic cells involved by moderate amount of extracellular mucin.

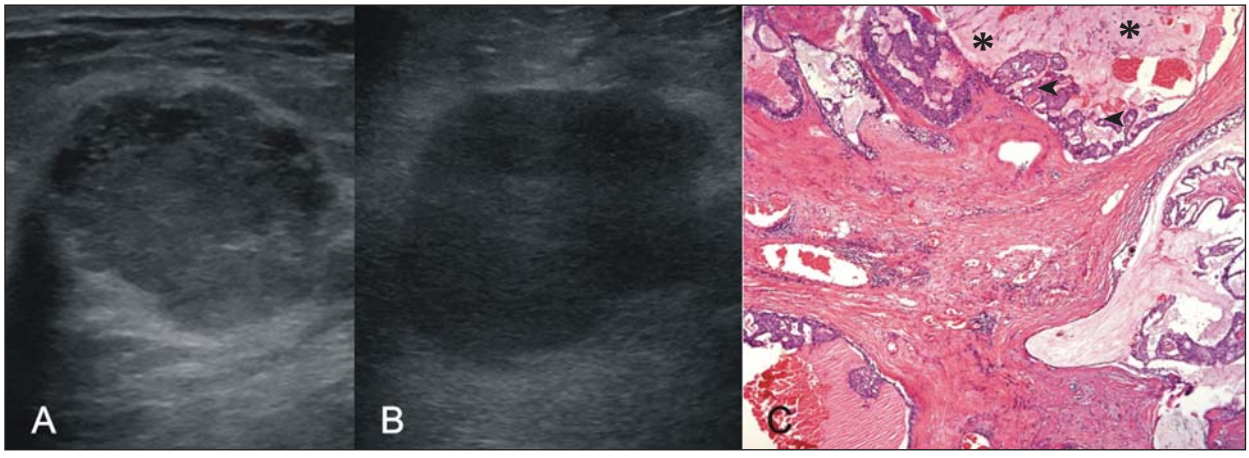


**Figure 2. A:** Female, 69-year-old patient with pure MMC, with typical sonographic findings: ovoid and microlobulated nodule, isoechoic to fat tissue and with posterior acoustic enhancement. **B:** Female, 58-year-old patient with an ovoid nodule with indistinct and angulated margins, with no noticeable microlobulation, with posterior acoustic enhancement, diagnosed as mixed MMC. **C:** Histology from this patient demonstrating mucinous neoplasia with peripheral DCIS foci at left.

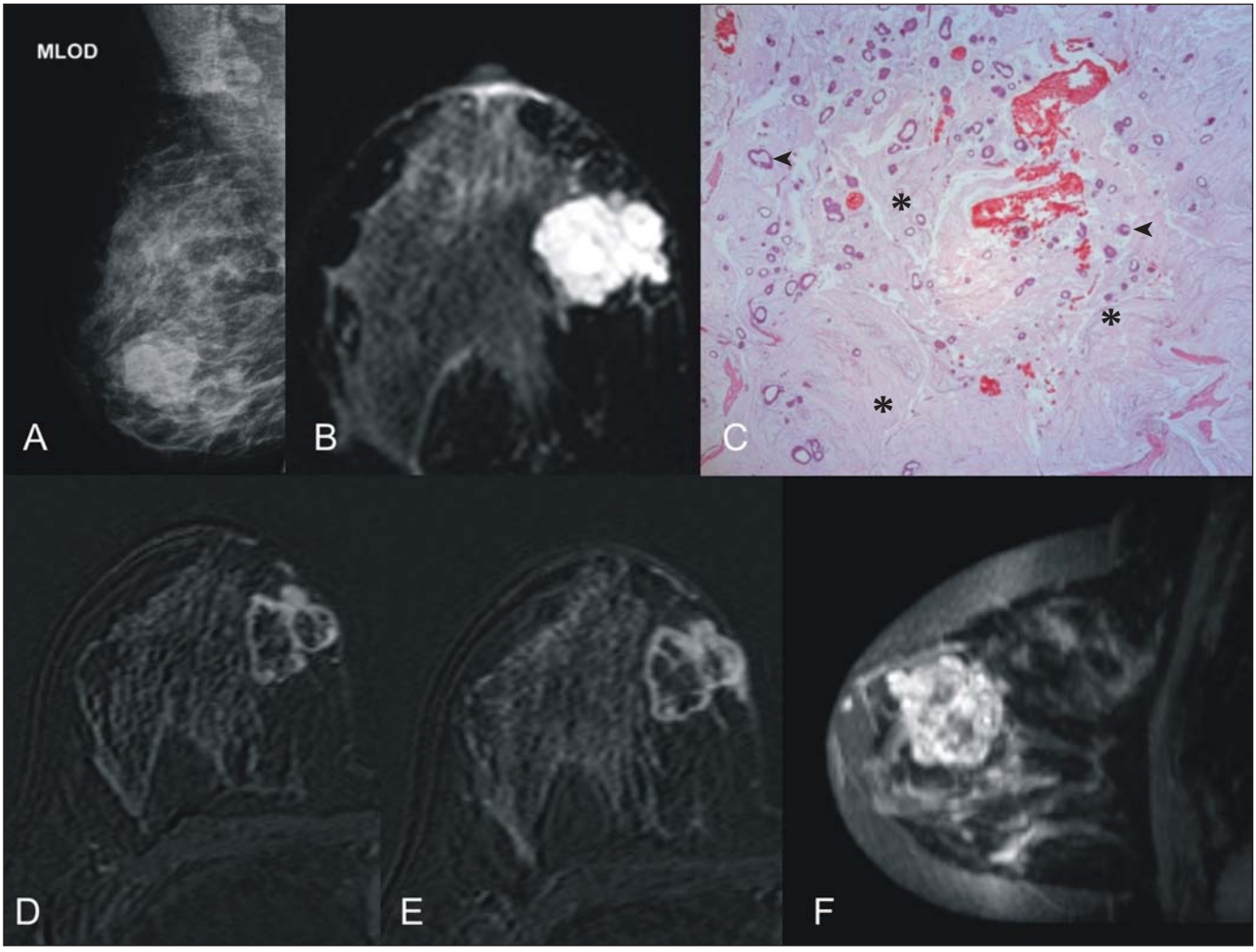


**Figure 3.** Female, 32-year-old patient with pure MMC. **A:** Mediolateral, oblique mammographic view demonstrating microlobulated ovoid nodule at the junction of the medial quadrants of the right breast. **B:** Axial MRI STIR image of the described nodule, demonstrating intense hypersignal onT2-weighted sequence with hypointense septa, common findings in mucinous carcinomas. **C:** Histological section at microscopy identifying mucinous tumor with a remarkable amount of mucin and little cellularity. **D,E:** Dynamic contrast-enhanced, T1-weighted images with fat suppression and subtraction, at the second and fifth minutes, demonstrating predominantly ring-shaped and progressive enhancement, and also marked enhancement of the septa within the lesion. **F:** Sagittal 3D reconstruction.

lular mucin and has high diagnostic sensitivity, although not pathognomonic, since it is also found in other lesions (secondary to necrosis, hemorrhage, edema, myxoid matrix or cystic component)[19]. In addittion, the presence of intermediate signal on T2-weighted images suggests the mixed type of MMC.

On dynamic contrast-enhanced sequences, any enhancement morphology may occur, however, peripheral, ring-shaped or heterogeneous enhancement are more characteristic, and progressive along time (Figure 3). The pure type of MMC generally presents mild to moderate enhancement at the early phases, with centripetal tendency determining type 1 (progressive) curves, a feature demonstrated on Figure 4, or type 2 curve (plateau)[19]. The progressive enhancement pattern is related to the tumor cellularity, nuclear grading, and amount of extracellular mucin. Thus, an intense enhancement in the first two minutes after gadolinium injection, or a type 3 curve (washout) must raise suspicion of mixed type MMC or, an even rarer pure tumor with high cellularity[10].

As compared with other subtypes of breast cancer, MMCs, in general, present low signal intensity on diffusion-weighted images. The quantitative analysis with measurement of the apparent diffusion coefficient (ADC) demonstrates high ADC values in relation to NS-IDCs. High ADC values may be associated with the presence of extracellular mucin and low tumor cellularity. However, such characteristic seems to be related to a larger extent to pure MMCs, which show high ADC value, similar or greater than benign lesions. Mixed mucinous tumors may exhibit lower ADC values, similarly to other breast cancer subtypes. Diffusion-weighted sequences and ADC calculation represent additional tools to increase the specificity of magnetic resonance imaging[19–21] (Figure 5).

## CONCLUSION

Lesions suspicious for mucinous neoplasia prompt a careful evaluation of imag-

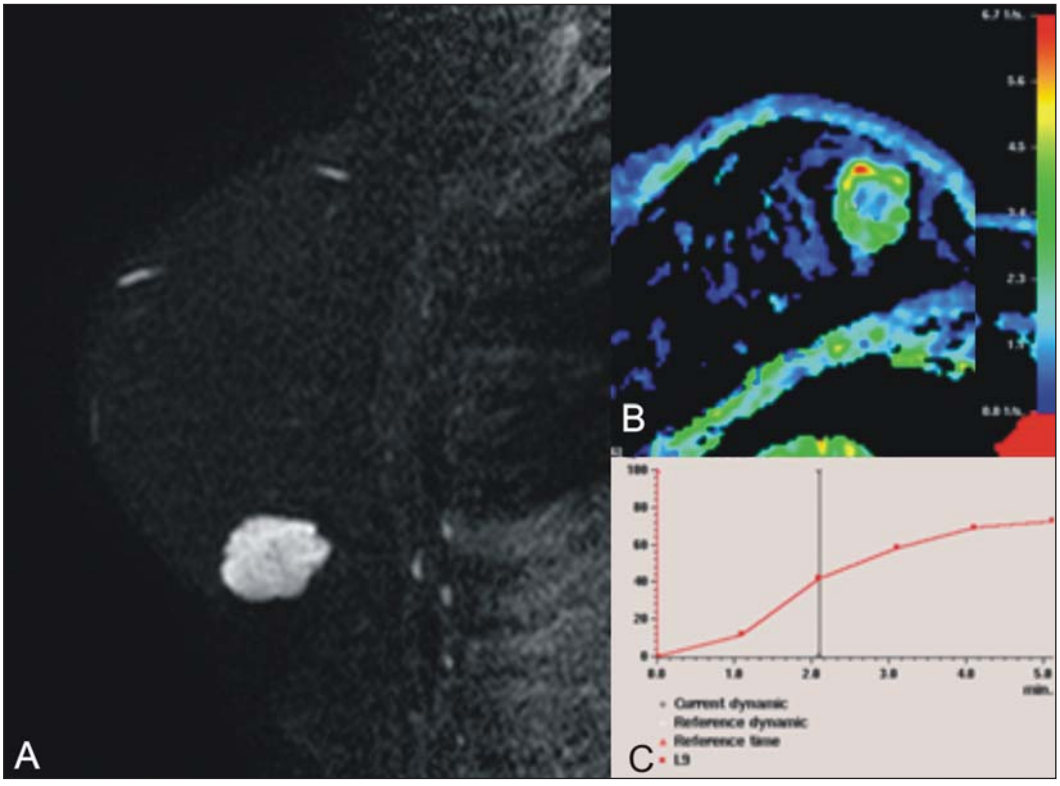


**Figure 4.** Female, 54-year-old patient with anatomopathological diagnosis of pure MMC. **A:** Sagittal T2-weighted SPAIR image demonstrating lobulated lesion with high signal on T2-weighted sequence. Color mapping of wash-in (**B**) and kinetic curve (**C**) showing slight enhancement at the early phase with progressive enhancement pattern.

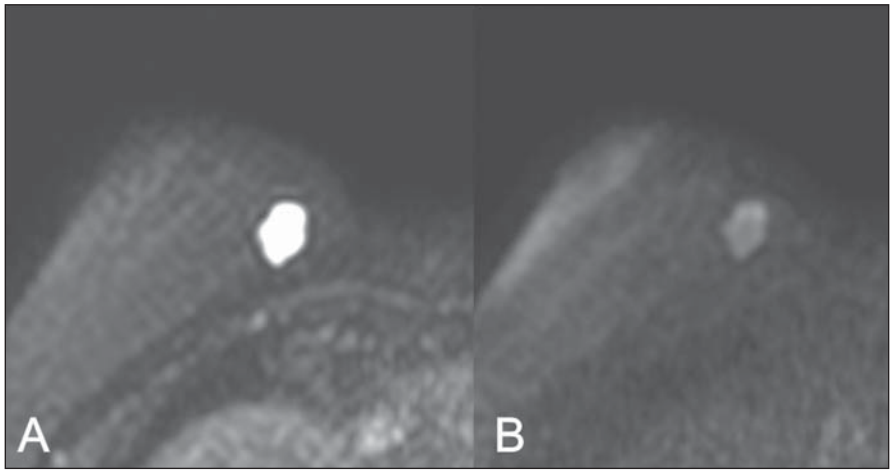


**Figure 5.** Female, 54-year-old patient with pure mucinous tumor represented on diffusion-weighted images, with b value = 0 on **A** and b = 700 on **B,** revealing minimum restriction, corroborated by the high signal intensity on **C** (ADC map).

ing findings, as the good correlation with histopathology has important implication in patient's prognosis.

The imaging findings may suggest both subtypes of MMCs, pure and mixed ones. Mammography and ultrasonography allow a satisfactory evaluation of the lesion's morphology, but magnetic resonance imaging, besides providing data on morphology, also provides clues about tissue composition and along with the enhancement pattern after administration of gadolinium-based contrast medium, contribute to a better characterization of the lesion and to improve diagnostic accuracy.

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