IMAGING-PATHOLOGICAL CORRELATION

Mucinous Breast Carcinoma: Magnetic Resonance Imaging and Pathological Correlation

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INTRODUCTION

Mucinous carcinoma (synonyms: colloid carcinoma, mucoid carcinoma, gelatinous carcinoma) of the breast is characterised by a proliferation of clusters of generally small and uniform cells floating in a large amount of extracellular mucus often visible to the naked eye.[1] It is a rare breast tumour, accounting for about 1% to 6% of all breast carcinomas.[2] It can be further divided into the pure form and the mixed form. This article illustrates three patients with the pure form of mucinous carcinoma, and focuses on the radiological (mainly magnetic resonance imaging [MRI]) and pathological features.

CASE PRESENTATION

A 40-year-old patient A and 48-year-old patient B presented with screen-detected left breast mass and self-detected left breast lump, respectively. The first-line investigations of mammogram and ultrasound in both patients showed the index lesion and multiple other cystic lesions. Ultrasound-guided fine-needle aspiration of the index lesions was performed in both and demonstrated mucinous carcinoma (C5 category) in patient A and 'suspicious of malignancy' (C4 category) in patient B. After subsequent surgical consultations, both patients opted for breast conserving therapy (BCT). Breast MRI was arranged for preoperative assessment.

In patient A, the index lesion was 2 cm and was located at the sub-areolar region at L12H. It had a lobulated border, hypointense T1 (Figure 1a), heterogeneous hyperintense T2 signal (comparable with a simple cyst) (Figure 1b) and elevated apparent diffusion coefficient (ADC) value (2.1 x 10^{-3} mm^2/s) [Figure 2].
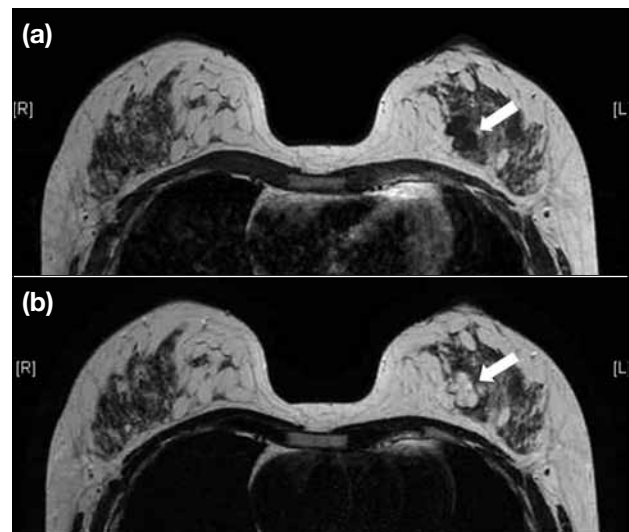

Figure 1. (a) T1-weighted and (b) T2-weighted images of left breast mucinous carcinoma (arrows) in patient A.
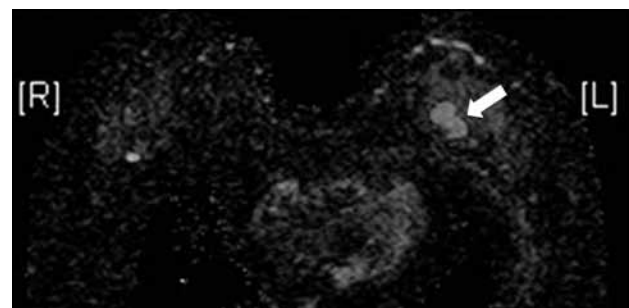

Figure 2. Apparent diffusion coefficient value of left breast mucinous carcinoma (arrow) in patient A.

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After contrast injection, heterogeneous enhancement (Figure 3) with a type I kinetic curve (rapid initial increase followed by persistent rise in delayed phase) was observed (Figure 4). In patient B, the index lesion measured 2.2 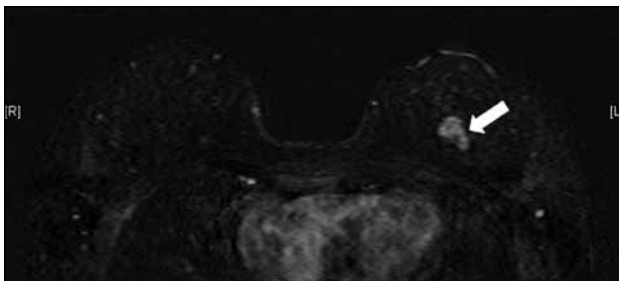cm and was located at L11H, 4 cm from the nipple. It showed the same characteristics regarding the margin, signal intensity (Figure 5) and ADC value (Figure 6) as those in patient A. In the dynamic phase, the index lesion demonstrated peripheral and septal enhancement (Figure 7) and a type I kinetic curve (Figure 8). In both cases there was no muscle or skin fixation, and no satellite lesions or metastatic axillary lymph nodes.

Figure 3. Post-contrast subtraction image of left breast mucinous carcinoma (arrow) in patient A.
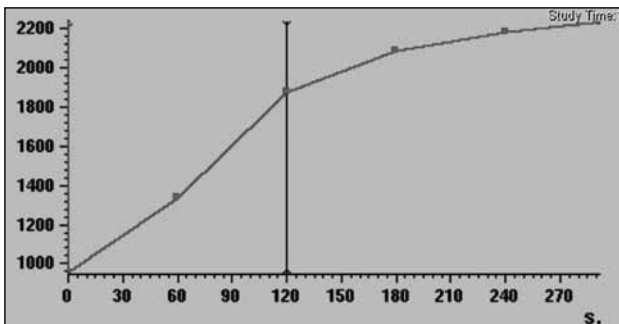

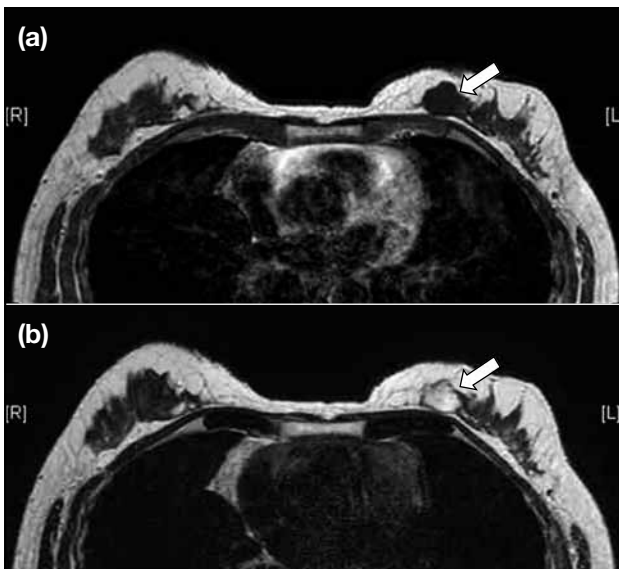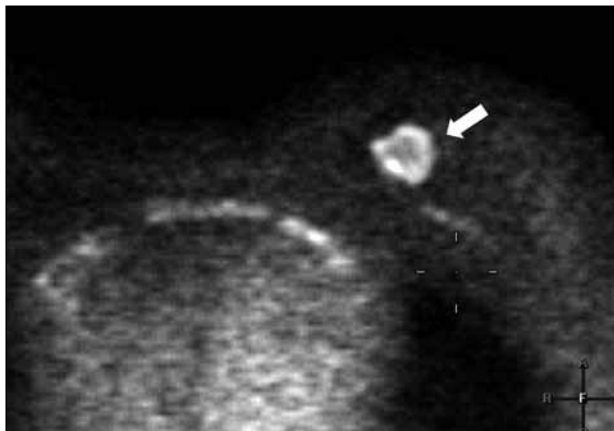**Figure 4.** Enhancement kinetic curve of left breast mucinous carcinoma in patient A.

Figure 5. (a) T1-weighted and (b) T2-weighted images of left breast mucinous carcinoma (arrows) in patient B.

Figure 6. Apparent diffusion coefficient value of left breast mucinous carcinoma (arrow) in patient B.
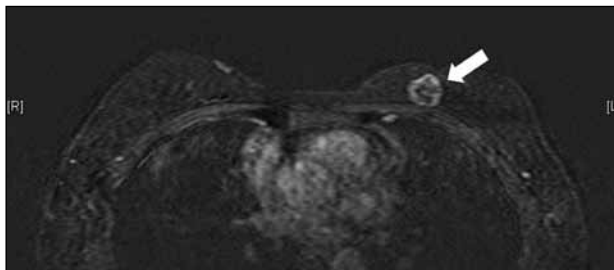

Figure 7. Post-contrast subtraction image of left breast mucinous carcinoma (arrow) in patient B.
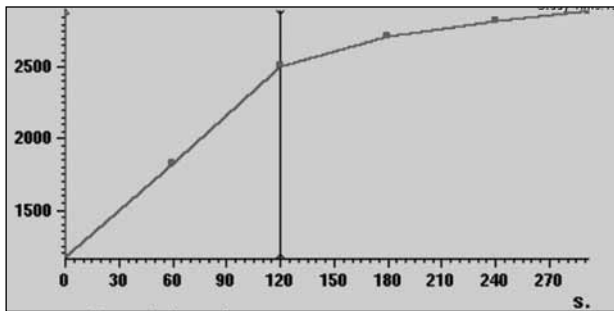

Figure 8. Enhancement kinetic curve of left breast mucinous carcinoma in patient B.

Patient C was aged 70 years and presented with a screen-detected left breast mass. The MRI features of the index lesion were the same as those of patients A and B (Figures 9 and 10), except that it had hyperintense T1 signal (Figure 11) and homogenous enhancement (Figure 12) with a type II kinetic curve (rapid initial increase followed by delayed plateau; Figure 13).
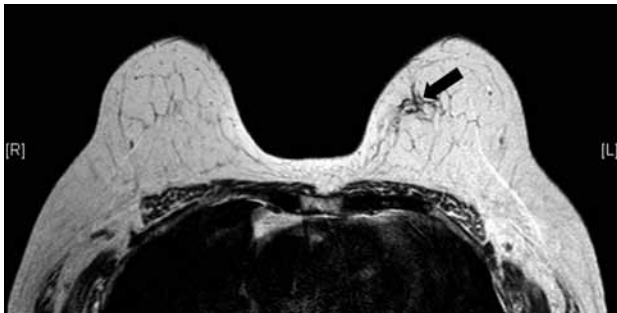

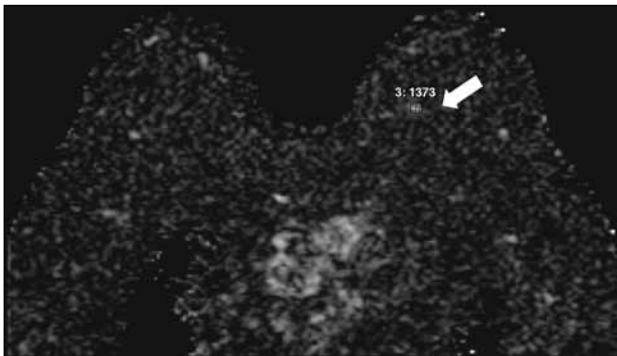**Figure 9.** T2-weighted image of left breast mucinous carcinoma (arrow) in patient C.

Figure 10. Apparent diffusion coefficient value of left breast mucinous carcinoma (arrow) in patient C.
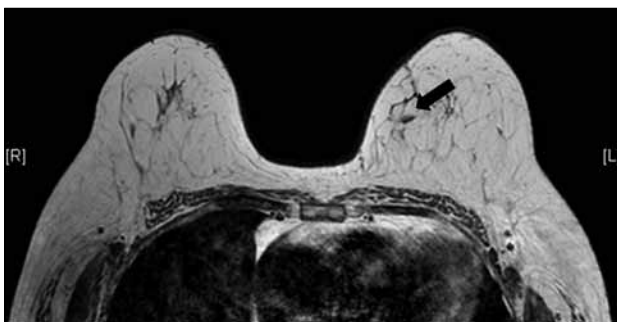

Figure 11. T1-weighted image of left breast mucinous carcinoma (arrow) in patient C.

Patients A and B underwent BCT followed by adjuvant radiotherapy and chemotherapy with tamoxifen. Pathology of pure mucinous carcinoma was confirmed in their surgical specimen (Figure 14). Both were grade I (Modified Bloom & Richardson grading score), stage pT1c (>1 mm but ≤20 mm) pN0. Patient C underwent modified simple mastectomy (MSM) followed by chemotherapy with tamoxifen. The choice of MSM was made due to concerns about her age. The pathology was that of pure mucinous carcinoma, grade II (Modified Bloom & Richardson grading score), stage pT1c, pN0.

DISCUSSION

Pure mucinous carcinoma represents 1% to 4% of all breast cancers. They present in women across a broad age range, but usually in older women.[3]

Mucinous carcinoma is characterised by the production of abundant extracellular and / or intracellular mucin: the definition requires a mucinous component of >50% of the lesion.[4] The pathological diagnostic criteria of pure mucinous breast cancer include a macroscopically
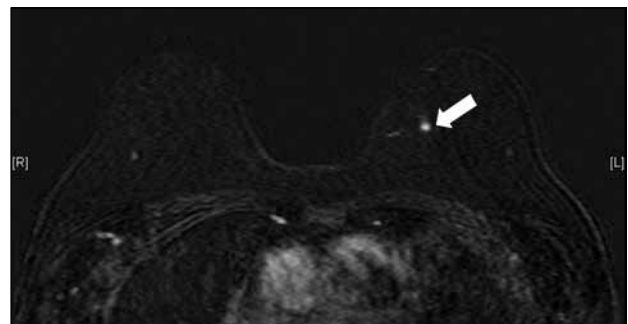

Figure 12. Post-contrast subtraction image of left breast mucinous carcinoma (arrow) in patient C.
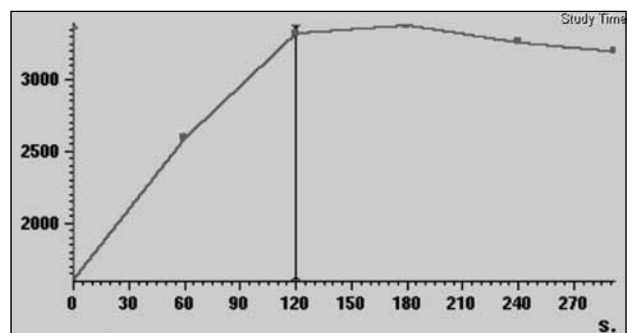

Figure 13. Enhancement kinetic curve of left breast mucinous carcinoma in patient C.
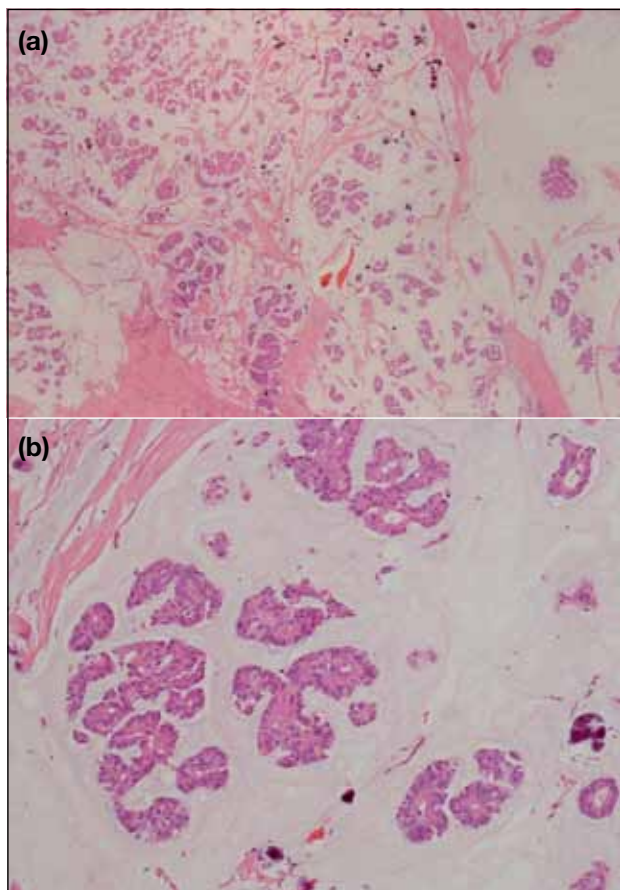
Figure 14. Mucinous carcinoma (H&E); original magnification: (a) x 20; (b) x 100. A moderately cellular carcinoma consists of neoplastic epithelial cells forming tubules and festoons with abundant extracellular mucin. The neoplastic cells possess intermediate-grade nuclei with vesicular chromatin and distinct nucleoli.

well-circumscribed and gelatinous tumour; and at least 90% of the tumor composed of mucin with small groups of well-differentiated tumour cells. A tumour that fulfils these criteria has an excellent prognosis.[5] Even if there is only a very small non-mucinous component, the tumour is classified as mixed form.[6] An abundance of mucin is responsible for many of the imaging features observed in MRI.

Most of the mucinous carcinomas have lobulated borders although a few demonstrate irregular borders, which is more commonly seen in the mixed type.[7] The protein concentration in mucin affects the T1 signal intensity that varies from low, isointense to high.[8] A high T2-weighted signal (same as water) and ADC values are attributed to the high mucin content and the low cellularity, respectively.[9] These were well

demonstrated in our three patients. The combination of high T2 signal and ADC value is of diagnostic significance. It gives the reporting radiologist a cue to differentiate mucinous carcinoma from other more common types of ductal cancer that typically show a less intense T2 signal and low ADC value.

In the dynamic phase, the most common pattern of enhancement is early rim enhancement followed by slow filling-in of contrast in the form of type I kinetic curve (rapid initial increase and persistent delayed phase) as seen in two of our three patients. This may be due to gradual diffusion of contrast medium into the stroma rich in mucin.[10] Sometimes a type II kinetic curve (rapid initial increase and delayed plateau) is observed instead, as in patient C.[8] The pattern is in contrast to the type III kinetic curve (rapid initial increase and delayed washout) that is most commonly seen in other forms of breast cancer.

Mucinous carcinoma has a better prognosis than infiltrating ductal carcinomas and other tumours with specific differentiating features. It has a less aggressive growth pattern and lower chance of lymph node metastasis.[11] This is particularly true for the pure form of the tumour that has a reported frequency of axillary lymph node metastasis of 14% to 15% and 10-year survival rate of 87% to 90.4%.[12] Therefore, mucinous carcinoma is often treated with BCT, unlike other types of invasive breast cancer.[13] This confirms the importance of a preoperative diagnosis of mucinous carcinoma.

Finally, we would like to emphasise that although MRI is a useful diagnostic tool to distinguish mucinous carcinoma from other types of tumour, it is not a substitute for preoperative biopsy and histological analysis.

CONCLUSION

Mucinous carcinoma of the breast shows high T2 signals, high ADC value, and early rim enhancement with slow fill-in of contrast on MRI. These are important signs to distinguish it from other forms of breast cancer. BCT is the treatment of choice considering its less-aggressive nature.

REFERENCES

1. Tavassoli FA, Devilee P. Tumours of the breast. In: World Health Organization classification of tumours. Pathology and genetics: tumours of the breast and female genital organs. France, Lyon:

IARC Press; 2003. p 30-1.

2. Komaki K, Sakamoto G, Sugano H, Morimoto T, Monden Y. Mucinous carcinoma of the breast in Japan. A prognostic analysis based on morphologic features. Cancer. 1988;61:989-96. **cross**ref

3. Fischer U. Malignant changes. In: Practical MR mammography: high-resolution MRI of the breast. New York: Thieme; 2010. p 165-94.

4. Yerushalmi R, Hayes MM, Gelmon KA. Breast carcinoma — rare types: review of the literature. Ann Oncol. 2009;20:1763-70. **cross**ref

5. Tot T, Tabar L, Dean PB. Practical breast pathology. Stuttgart: Thieme; 2002. p 66-7.

6. Fentiman IS, Millis RR, Smith P, Ellul JP, Lampejo O. Mucoid breast carcinomas: histology and prognosis. Br J Cancer. 1997;75:1061-5. **cross**ref

7. Okafuji T, Yabuuchi H, Sakai S, Soeda H, Matsuo Y, Inoue T, et al. MR imaging features of pure mucinous carcinoma of the breast. Eur J Radiol. 2006;60:405-13. **cross**ref

8. Kawashima M, Tamaki Y, Nonaka T, Higuchi K, Kimura M, Koida T, et al. MR imaging of mucinous carcinoma of the breast. AJR Am J Roentgenol. 2002;179:179-83. **cross**ref

9. Woodhams R, Kakita S, Hata H, Iwabuchi K, Umeoka S, Mountford CE, et al. Diffusion-weighted imaging of mucinous carcinoma of the breast: evaluation of apparent diffusion coefficient and signal intensity in correlation with histologic findings. AJR Am J Roentgenol. 2009;193:260-6. **cross**ref

10. Isomoto I, Koshiishi T, Okimoto T, Okada H, Uetani M, Hayashi K. Gradually enhancing breast cancer on dynamic MRI. Nihon Igaku Hoshasen Gakkai Zasshi. 2000;60:514-9.

11. Kushwaha AC, Whitman GJ, Williamson JD. Radiologic-pathologic conferences of the University of Texas M.D. Anderson Cancer Center. Mucinous carcinoma of the breast. AJR Am J Roentgenol. 1999;173:290. **cross**ref

12. Monzawa S, Yokokawa M, Sakuma T, Takao S, Hirokaga K, Hanioka K, et al. Mucinous carcinoma of the breast: MRI features of pure and mixed forms with histopathologic correlation. AJR Am J Roentgenol. 2009;192:W125-31. **cross**ref

13. Anan K, Mitsuyama S, Tamae K, Nishihara K, Iwashita T, Abe Y, et al. Pathological features of mucinous carcinoma of the breast are favourable for breast-conserving therapy. Eur J Surg Oncol. 2001;27:459-63. **cross**ref