# A case of a giant pseudoangiomatous stromal hyperplasia of the breast: magnetic resonance imaging findings

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## Abstract

Pseudoangiomatous stromal hyperplasia (PASH) of the breast is a benign myofibroblastic process. We present the case of a 17-year-old girl who underwent diagnostic work-up due to an enlargement of her left breast. She was submitted to ultrasounds and magnetic resonance imaging (MRI) which depicted a 14 cm lesion in her left breast. The patient was later operated and histology revealed PASH. Although PASH may range from 0.6-12 cm, a few lesions over 12 cm have been described, the largest being 20 cm. Large series present mammographic and ultrasonographic features of PASH in the literature, but little has been reported on the MR characteristics of PASH up to today. Signal on the T1-weighted image (T1WI) and T2-weighted image (T2WI) may vary. Curves generated from dynamic contrast-enhanced magnetic resonance imaging (DCE-MRI) studies are mainly type I or less frequently type II. There are no reports about diffusion-weighted imaging and corresponding apparent diffusion coefficient (ADC) values for PASH in the literature. ADC values in our case lie within the range of values reported for other benign breast lesions. The presence of slit-like spaces within the lesion on MR imaging along with DCE-MRI type I curve and ADC values consistent with a benign lesion may favour the diagnosis of PASH. Tissue biopsy is necessary, however for the final diagnosis. This case report will further contribute to the understanding of MR imaging features of PASH, especially in cases where mammography is not indicated.

## Introduction

Pseudoangiomatous stromal hyperplasia (PASH) of the breast is a benign myofibroblastic process, first described by Vuitch *et al.*[1] The age of the diagnosis varies between 14 to 74 years. The size of PASH usually ranges between 0.6-12 cm,[2] with most cases ranging from small to medium size.

PASH clinically presents as a palpable unilateral, painless mass, freely movable, having a firm or rubbery texture. The mass usually grows slowly, whereas lesions growing rapidly are rare.[3-5] Bilateral involvement is not usual.[6]

A small number of giant and rapidly-growing PASH have been described in the literature, the largest in a 36-year-old woman, measuring 20 cm.[7] Our case is one of the largest in the literature and the largest in a teenage girl.[8] Little is reported in the literature about the magnetic resonance imaging features of PASH and is summarized in a relevant table. Our case demonstrated slit-like spaces, only mentioned once before,[8] which reflects pathologic findings. This is the first report about the diffusion-weighted imaging features of the tumour.

## Case Report

A 17-year-old adolescent girl, complaining for an enlargement of her left breast presented for diagnostic work-up. She mentioned that eight months ago she had palpated a tiny nodule near the nipple of her left breast which thereafter rapidly increased in size. She had an unremarkable previous personal and family history, with reported menarche at 14 years and a normal menstrual cycle.

Physical examination revealed an overall enlarged breast, with diffuse tenderness and firmness on palpation. There was no evidence of thickening of the breast skin, nor evidence of nipple retraction.

The patient was initially examined with breast ultrasound with a high frequency (8-10 MHz) linear array head, which showed an intensely edematous left breast, without any evidence of distinct focal lesions, while the breast parenchyma exhibited diffuse inhomogeneity. She was advised to stay on antibiotics for fifteen days and have a follow-up ultrasound after 1 month. On the follow-up ultrasound scan there was a mild decrease of the diffuse parenchymal inhomogeneity. At that time there was also evidence of a poorly delineated focal lesion, with imaging features which were thought to rather represent a giant juvenile fibroadenoma.

Further imaging with magnetic resonance imaging (MRI) was deemed necessary, as imaging with mammography was considered inappropriate, due to the patient's age.

MRI was performed with a 1.5T MR-scanner and a dedicated breast coil. The examination protocol consisted of T1-weighted image (T1WI), T2-weighted image (T2WI), short-tau inversion recovery (STIR) images in the sagittal and axial planes, as well as dynamic contrast-enhanced magnetic resonance imaging (DCE-MRI) after the administration of gadolinium with contrast uptake measurements. Diffusion weighted imaging with apparent diffusion coefficient (ADC) map images and ADC measurements of the lesion were also obtained.

MRI depicted a 14 cm lesion in the lateral part of the left breast, with smooth borders and compression of the surrounding normal breast parenchyma. On the T1 weighted images the lesion was isointense to muscle (Figure 1). On the STIR images the lesion exhibited a heterogeneous hyperintensity, while within the lesion there was evidence of multiple slit-like foci of high intensity (Figure 2). After gadolinium administration there was avid enhancement of the lesion (Figure 3), with the presence of dilated feeding vessels (Figure 4). Dynamic MR imaging after contrast administration revealed a slow persistent (type I) enhancement consistent with a benign lesion (Figure 5). ADC map measurements with diffusion images acquired with b value of 2055 sec/mm$^2$ were 1.34±4.3*10$^{-3}$ mm$^2$/sec on ROI1 and 1.38±7.4 *10$^{-3}$ mm$^2$/sec on ROI2. Values were in favor of a benign lesion (Figure 6). There was no evidence of enlarged lymph nodes in the left axilla.

The patient was finally operated and gross pathology revealed a well-defined lesion measuring 14 cm in its largest diameter having a smooth surface, with some surrounding fibrofatty tissue. The cut surface of the lesion exhibited a firm nodular outlook of a whitish colour and elastic consistence, with presence

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of slit-like spaces within the lesion. Histology showed breast parenchyma with fibrous matrix, pores and acinar units with the presence of extensive lesions of nodular pseudoangiomatous stromal hyperplasia.

## Discussion

The spectrum of appearance of PASH may range from solitary microscopic findings to a clinically and mammographically evident breast mass. Referring to the literature, not many cases of PASH have been reported, presenting as a palpable or mammographically detectable breast mass.[1,5,9] Presentation as an axillary mass has also been reported.[10] The massive enlargement of the lesion may be hardly differentiated from phyllodes tumor.[6,11,12]

All imaging modalities have no specific features to characterize PASH and distinguish it from other pathologic entities.[11-15] In asymptomatic patients it usually presents as a breast imaging-reporting and data system (BI-RADS) type 3 lesion, suggesting a probably benign lesion. Mammography reveals a round or oval non-calcified mass, with well circumscribed margins, usually ranging from 1-10 cm, but it can also present as an asymmetric appearance of the gland whose size or density increases over time.[16,17]

On ultrasound PASH has no characteristic appearance, including both its margins and echogenicity. It usually presents as a round or oval solid mass, mainly hypoechoic and rarely hyperechoic with a central hypoechoic area. The presence of acoustic shadow is not very often.[16,17]

Large series reporting mammographic and ultrasound imaging characteristics do exist[16,17] but little is reported in the literature about the MR imaging features of PASH.[8,14,15,18-22] The signal of the lesion reported in the literature may vary on T1WI and T2WI, as well as contrast uptake and resulting dynamic curves, which are usually type I and less frequently type II. The MR imaging features are summarized in Table 1. The presence of high signal slit-like spaces on T2WI and STIR was also found in our case and previously described for the first time by Teh *et al*.[8] This imaging feature may, if evident, be helpful for the diagnosis, as it represents the slit-like spaces found on pathologic examination. On the other hand our case did not exhibit cystic lesions as mentioned by others. Our case exhibited a type I curve on DCE-MRI, consistent with a benign lesion, as most of the previously reported cases. However up to now there have been no reports about the behaviour of PASH in diffusion-weighted imaging (DWI) and ADC map values in the lit-

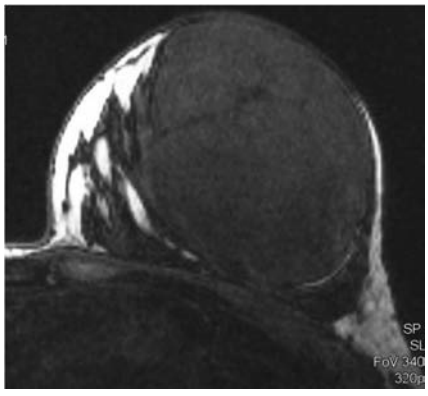

**Figure 1. Axial T1 WI. The lesion is isointense to muscle and well defined with normal breast parenchyma pushed at the periphery of the lesion. There is evidence of some hypointense lines within the lesion.**

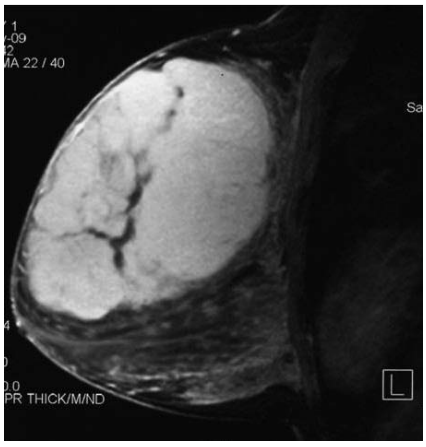

**Figure 3. Sagittal T1W, contrast-enhanced image with fat suppression (7min after IV contrast infusion): The lesion exhibits a fairly homogeneous contrast uptake. The internal lines do not enhance.**

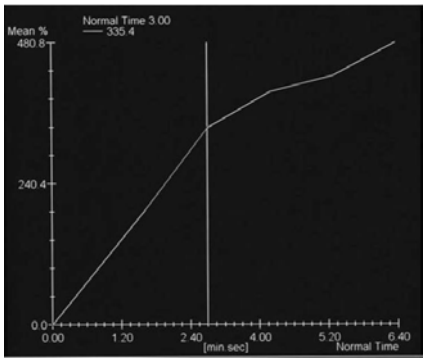


**Figure 5. On dynamic contrast-enhanced scan, the lesion shows a type I curve, consistent with the presence of a benign lesion.**

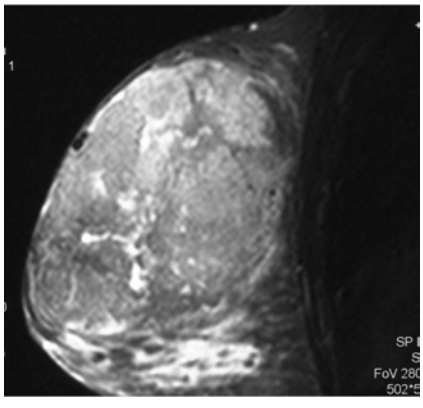

**Figure 2. Sagittal STIR image: the lesion is inhomogeneously iso-/hyperintense, while the linear slit-like spaces are markedly hyperintense.**

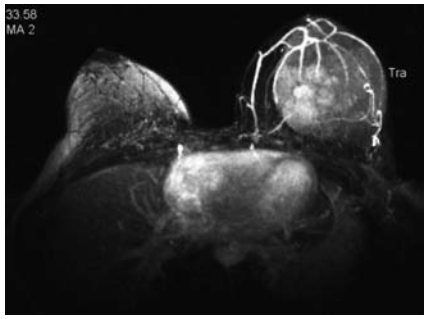

**Figure 4. Axial T1W, contrast enhanced image with maximum intensity projection (MIP) algorithm: There is evidence of engorged feeding vessels.**

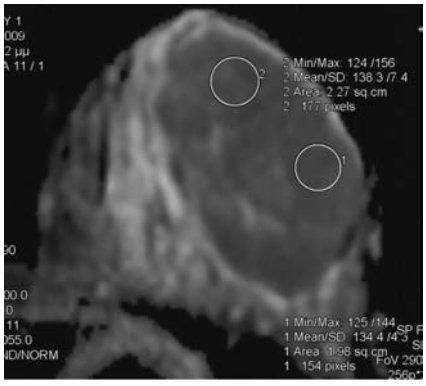

**Figure 6. Apparent diffusion coefficient (ADC) map with ADC measurements. The values are consistent with a benign lesion.**

**Table 1. Review of the magnetic resonance imaging features of pseudoangiomatous stromal hyperplasia, reported so far in the literature.**

| Study | Number of cases | T1-weighted image | T2-weighted image | T1-weighted image after IV gadolinium infusion | Dynamic curve | Diffusion-weighted imaging/ apparent diffusion coefficient map |
|---|---|---|---|---|---|---|
| Kirkpatric UJ *et al.* (2000) | 1 Case | Mixed signal pattern: isointense areas interspersed with hypointense islands | Mainly hyperintense with hypointense nodular areas Low signal capsule | Mainly isointense with hypointense(non-enhancing) islands Anterior cyst within the mass with an enhancing wall | NA | NA |
| Salvador R *et al.* (2004) | 1 Case | NA | NA | NA | Type I | |
| Okoshi K *et al.* (2006) | 1 Case | NA | Hyperintense lesions with hypointense surrounding septa | NA | Type I | NA |
| Baskin H *et al.* (2007) | 1 Case | NA | Heterogeneously hyperintense | Diffuse prominent enhancement | Type I | NA |
| Teh HS *et al.* (2007) | 1 Case | Isointense | Internal hyperintese linear reticular strands and scattered cystic spaces. | NA | Type I | NA |
| Navas Cañete, A *et al.* (2007) | 1 Case | NA | Hypointense to muscle on T2WI. | Homogeneous uptake | Type I | NA |
| Navas Cañete, A *et al.* (2007) | 1 Case | Hypointense | Hypointense | Heterogeneous enhancement in periphery and in central part | Type II | NA |
| Prasad SN *et al.* (2008) | 1 Case | Mainly hyperintense with hypointense septa. Well defined lesion | Inhomogeneously hypointense | Inhomogeneous enhancement, with small hypointense areas corresponding to small cystic lesions and hypointense septa. Delayed scan: only septa do not enhance. | Type I | NA |
| Ryu EM *et al.* (2010) | 1 Case | Nodular areas iso/ hyper intense to muscle and between them isointense to muscle spaces. | The nodular areas are hypointense and the spaces between them are hyperintense | Nodular enhancement, with between spaces (septa) remaining non-enhancing | NA | NA |
| Jones KN *et al.* (2010) | 7 Cases | NA | NA | Focal or segmental clumped, non mass-like areas, of enhancement | Type I or Type II | NA |

NA, not answered.

erature. DWI has been increasingly used in oncologic imaging in the last years. Image contrast in DWI is generated by the difference of motion of water molecules in different tissues. There is no need for administration of contrast medium to generate images. Differences in DWI reflect tumor cellularity and cell membrane integrity.[23] In particular tissue cellularity and membrane integrity are inversely correlated with the degree of restriction of water diffusion.[24-27] This means that in tissues with high density of intact cell membranes (*i.e.* tumor) the motion of water molecules will be restricted. Quantitative analysis of DWI data can yield calculations of the ADC and generate ADC maps. Regions of interest (ROI) can then be drawn on these maps in order to calculate the ADC values of different tissues. Higher ADC values will be found in less cellular areas and lower ADC values will be calculated in areas with high cellularity.[23]

ADC values have proven to be higher in benign breast lesions. Guo *et al.*[25] reported values of $1.57\pm0.23\times10^{-3}$ mm²/second for benign lesions and $0.97\pm0.20\times10^{-3}$ mm²/second for malignant breast lesions. They also reported that the mean ADC values correlated well with tissue cellularity.

Pereira *et al.* also reported that the ADC value was significantly higher in benign breast lesions in all b-value combinations (mean value = $1.44\text{-}1.77\pm0.31\text{-}0.44\times10^{-3}$ mm²/second), while the mean ADC values for malignant breast lesions were significantly lower (mean value = $0.68\text{-}1.25\pm0.25\text{-}0.28\times10^{-3}$ mm²/second).[28] Moreover, Kul *et al*. found out that median ADC values were also significantly lower for malignant lesions, stating that a cut-off value of $0.92\times10^{-3}$ mm²/second contributed to a sensitivity of 91.5% and a specificity of 86.5%, in the differentiation between benign and malignant lesions. In the same study the combination of ADC values and dynamic contrast-enhanced MRI significantly improved the specificity of MRI, but with no statistically significant effect concerning sensitivity.[29] In our case ADC values of DWI-MR were in favor of a benign lesion. This would exclude the diagnosis of phyllodes tumour and high grade angiosarcoma, or another mesenchymal tumor. Benign lesions like hamartoma and fibroadenoma would still be in the differential. A hamartoma however should typically show gross intralesional fat, except in the rare case of a lipid-poor hamartoma. Giant fibroadenomas have been reported to sometimes have multiple interdigitating septa but slit-like spaces have only been reported with PASH.[8] So the presence of slit-like spaces on MRI, as in our case favours the diagnosis of PASH.

Aspiration biopsy is useful in distinguishing benign from malignant lesions but cannot establish the exact diagnosis of PASH as cytology may be similar to fibroadenoma. Only tissue biopsy, with histologic examination can definitely diagnose PASH. It is the rarity of PASH that also plays a significant role in the difficulty of establishing the diagnosis and the preoperative diagnosis in many reported cases was often fibroadenoma.[3,4,9]

Gross pathologic features of the lesion include well demarcated margins, with a smooth outer surface sometimes having the form of a capsule on gross pathology. The cut surface is usually homogenously grey in colour with translucid tissue, without cystic, hemorrhagic or necrotic areas. If cysts are present, they are small; up to 1 cm.[5,30] On histology PASH is characterised by collagenous proliferation of the stroma, with small groups of spindle-shaped myofibroblasts. These spindle-shaped cells are arranged along non-vascular slit-like spaces, which are created from disruption and separation of stromal collagen fibers. The term pseudoangiomatous was used in order to emphasise that histologically the lesion is not a vascular proliferative disease. Myofibroblastic proliferation in the mammary stroma, however can also be observed in other diseases such as phyllodes tumour, fibroadenoma, gynaecomastia, invasive carcinomas and even normal breast tissue.[5] The most successful and effective treatment is a wide local excision. The prognosis is excellent; only some cases of local recurrence have been reported. Tamoxifen has also been administered with promising results.

In conclusion we report a case of a giant, rapidly growing PASH in a 17-year-old girl, with emphasis on the MR, DCE-MRI and DWI/ADC features. The lesion reported is one of the largest in the literature and the largest in a teenage girl. The presence of high signal slit-like spaces within the lesion is reported for the second time in the literature and reflects the underlying histology. There are no previous reports about the DWI features of PASH. Our case exhibited a benign (type I) DCE-MRI curve and ADC values also consistent with a benign lesion, which along with the presence of slit-like spaces may favour the diagnosis of PASH.

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