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Imaging findings of primary breast sarcoma: Results of a first multicenter study

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ABSTRACT

Purpose: To investigate imaging findings in patients with primary breast sarcoma (PBS).
Materials and methods: A retrospective search in the databases of 10 radiological departments in Germany from 2000 to 2011 was performed. Only histologically proven cases of PBS were included into the study. Mammography was available in 31 patients (33 lesions), ultrasound images in 24 patients (24 lesions), and for 10 patients (14 lesions) magnetic resonance imaging (MRI) of the breast was performed. The breast findings were classified according to the American College of Radiology Breast Imaging Reporting and Data Systems (BI-RADS) 5th edition categories. Collected data were evaluated by means of descriptive statistics.
Results: Forty-two female patients (mean age 62.0 years, range, 30–86 years) were included in the study. Clinically, all women had painless lumps. Irregular (53.3% [16/30]) or oval (30.0% [9/30]) mass with indistinct (73.3% [22/30]) or microlobulated (10% [3/30]) margins were common findings on mammograms. Ultrasound revealed typically an irregular (79.2% [19/24]), hypoechoic (62.5% [15/24]) mass, with indistinct margins (79.2% [19/24]), and posterior acoustic shadowing (79.2% [19/24]). MRI showed irregular masses (81.8% [9/11]) with irregular or spiculated margins, and a rapid initial signal increase with a delayed washout in kinetic analysis.
Conclusion: Overall, PBS has no pathognomonic imaging features and can mimic those of invasive mammary carcinoma. Breast sarcoma should be taken into the differential diagnosis of breast findings described above.

1. Introduction

According to the literature, primary breast sarcomas (PBS) are very rare, accounting for less than 1% of all breast malignancies [1–4] and <5% of all sarcomas [5–7]. In most cases, breast sarcomas occurred secondary to radiotherapy [8]. As reported previously, primary angiosarcoma of the breast has been described as the most frequent subtype [3]. However, other breast sarcoma subtypes, such as fibrosarcoma, leiomyosarcoma osteosarcoma, liposarcoma, chondrosarcoma, malignant histiocytoma and Kaposi sarcoma have also been described in the literature [2,3,9–12].

Because of the rareness of PBS, its radiological features have been reported in small series [4,13–15]. Nevertheless, the imaging

Abbreviations: PBS, primary breast sarcoma; MRI, magnetic resonance imaging; MHz, megahertz; ROI, region of interest; BI-RADS, breast imaging reporting and data system; NME, non-mass enhancement; US, ultrasound.

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features are important to ensure a prompt diagnosis and treatment, especially due to the aggressiveness of these tumors.

In the present retrospective study, at the first time, multicenter data from mammographic, sonographic and magnetic resonance (MR) imaging features of PBS were analyzed.

2. Materials and methods

2.1. Data acquisition and patients

This retrospective multicenter study was initiated form the department of Radiology of the University Hospital Halle and has been approved by the Institutional review board.

A retrospective search in the databases of 10 radiological departments in Germany from 2000 to 2011 was performed. Only histologically proven cases of PBS were included into the study. Cases with radiotherapy induced breast sarcomas, breast metastases from non-mammary sarcomas, sarcomatoid carcinomas, and phylloid tumors (cystosarcoma phyllodes) were excluded from the study. Overall, 42 cases of PBS were identified. All patients were female with a mean age of 62.0 ± 10.4 years, median age, 63 years, range, 30–86 years. All images and clinical information including precise histopathological diagnosis and clinical signs were accumulated in digital format in the Department of Radiology of University Hospital Halle.

2.2. Imaging

Mammography was available in 31 patients (33 lesions). It was obtained on different dedicated mammographic equipments. In every case, standard mediolateral oblique and cranio-caudal mammograms were obtained.

Supplementary ultrasound images were available in 24 patients (24 lesions, horizontal and vertical images). Ultrasound imaging was performed using different linear-array transducers at a center frequency of 8–13 MHz.

In 10 patients (14 lesions) magnetic resonance imaging (MRI) of the breast was performed. In 3 cases MRI was obtained on a 1.0 T scanner and in 7 on a 1.5 T scanner.

Kinetic analysis of contrast enhancement was performed in 7 cases. Time-signal intensity curves were drawn using operator-defined region of interest (ROI). The ROI was smaller than the lesion size. The initial signal increase (Initial SI) from the precontrast value (SI_p) to the maximum peak within the first 3 min after the administration of contrast medium ($SI_{1\text{-}3\,min}$) was calculated as reported previously [16]:

$$\text{InitialSI}(\%) = (SI_{1-3\,min} - SI_p)/SI_p \times 100\%$$

The postinitial behavior of the signal curve (Postinitial SI) from the maximum peak (SI_{peak}) to the end of the examination (SI_{end}) was also analyzed:

$$\text{PostinitialSI}(\%) = (SI_{peak} - SI_{end})/SI_{peak} \times 100\%$$

All signal intensity/time curves were classified according to shape in 3 types as reported previously [16]: type I with continuous increase in signal intensity on each successive contrast-enhanced image more than 10% in comparison with initial enhancement; type II with a plateau pattern, in which an initial increase in signal intensity is followed by a flattening of the enhancement curve (deviation of the signal curve between −10% and +10% in comparison with initial enhancement); type III with a wash out enhancement pattern, involves an initial increase and subsequent decrease in signal intensity more than 10% in comparison with initial enhancement.

Table 1
Identified primary breast sarcomas (PBS).

PBS	No. (%) of patients
Angiosarcoma	17 (40.5)
Fibrosarcoma	11 (26.2)
Leiomyosarcoma	6 (14.3)
Chondrosarcoma	3 (7.1)
Liposarcoma	1 (2.4)
Malignant histiocytoma	1 (2.4)
Dermatosarcoma	1 (2.4)
Undifferentiated sarcoma	2 (4.7)

2.3. Imaging analysis

Lesion size was determined by measuring the maximum diameter. All available images were reviewed by two radiologists (S.W. and A.H. with 6 and 3 years experience in breast imaging, respectively). Consensus of the investigators was obtained regarding imaging features of the identified breast lesions. The breast findings were classified according to the American College of Radiology Breast Imaging Reporting and Data Systems (BI-RADS) 5th edition categories [17,18].

2.4. Statistics

For statistical analysis the SPSS statistical software package was used (SPSS 17.0, SPSS Inc., Chicago IL, USA). Collected data were evaluated by means of descriptive statistics (absolute and relative frequencies). Continuous variables were expressed as mean ± standard deviation (SD), and categorical variables as percentages.

3. Results

3.1. Diagnosis and clinical signs

Most frequently, primary angiosarcoma (40.5%), followed by fibrosarcoma (26.2%) and leiomyosarcoma (14.3%) were diagnosed (Table 1). Other histopathological subtypes of PBS were rare. The right breast was involved in 22 patients (52.4%) and the left breast in 20 patients (47.6%). Clinically, all PBS manifested as painless breast lumps.

3.2. Mammographic findings

The ACR density types of the mammographic images were classified according to the BI-RADS lexicon [17,18]. In 10 cases (32.3%) a density type b, in 12 cases (38.7%) a density type c and in 9 cases (29.0%) a density type d was seen. Two patterns of PBS were identified on mammography: architectural distortion (3 patients, 9.7%) and intramammary masses (28 patients, 90.3%).

Architectural distortion was found in patients with primary angiosarcoma and manifested in all cases as diffuse increased opacity of the affected breast.

The detected intramammary masses were most commonly irregular (53.3% [16/30]) or oval (30.0% [9/30]) in shape with indistinct (73.3% [22/30]) or microlobulated (10.0% [3/30]) margins (Table 2, Figs. 1–3). The lesions showed equal or high density. Grouped macrocalcifications were identified in one case (3.3%). In most patients (n = 26, 92.8%), the masses were solitary, and in 2 patients PBS presented as double masses.

Skin thickening was shown in 7 patients, and axillary lymphadenopathy in 3 cases.

All cases with architectural distortion (n = 3) were interpreted as BI-RADS 5. Of the findings in the patients with intramammary