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A matrix of morphology and distribution of calcifications in the breast: Analysis of 849 vacuum-assisted biopsies

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ABSTRACT

Objective: The purpose of this retrospective analysis was to evaluate the likelihood of malignancy in prospectively categorized BI-RADS 4 and BI-RADS 5 calcifications.

Material and methods: This analysis included 849 women who underwent vacuum biopsy for BI-RADS 4 (with the subgroups 4A, 4B and 4C) or BI-RADS 5 calcifications between February 2007 and May 2015. Calcifications were classified according to the morphology and distribution descriptors of the BI-RADS lexicon (BI-RADS 4th edition lexicon). A standardized scheme (matrix) was used to combine the characteristics of the grouped calcifications with the BI-RADS assessment category.

Results: Overall, 275/849 (32%) lesions were found to be malignant. 285/327/208/29 calcified lesions were prospectively classified as BI-RADS 4A/4B/4C/5 indicating a risk for malignancy of 16%/27%/55%/90%, respectively. The morphology descriptors predicted the risk for malignancy as follows: typically benign (n = 55): 2%; indeterminate (n = 676): 27%; typically malignant (n = 118): 80%. The distribution descriptors correlated with a malignant histology as follows: diffuse (n = 0); round or oval (n = 261): 22%; regional (n = 398): 33%; segmental (n = 106): 42%; linear or branching (n = 85): 55%. There was a significant difference between the descriptor categories (p < 0.0001).

Conclusion: A standard scheme combining the morphology and distribution characteristics proved to be a helpful tool in diagnosis of calcifications, bridging the gap between description and classification of these lesions.

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1. Introduction

The increasing use of mammography, especially in the screening situation, leads to an increasing detection of early-stage forms of breast cancer that frequently present as calcifications [1,2].

The "Breast Imaging Reporting and Data System" helps to characterize calcifications in a standardized manner and includes descriptors for their morphology and distribution [3,4]. Indeed, these descriptors assist to estimate the malignant potential of a suspicious lesion but they do not provide a guidance to the final BI-RADS assessment category [5]. Thus, the assessment of calcifications of the breast is a challenging aspect in the interpretation of mammography with known interobserver differences [6].

Linking the standardized BI-RADS morphology and distribution for calcifications in a matrix system, Müller-Schimpfle et al. recommended a standard assignment of morphology and distribution of calcifications to the BI-RADS assessment categories (Table 1) [7].

The aim of our analysis was to evaluate the likelihood for malignancy for clusters of calcifications that were prospectively categorized as categories 4 and 5 according to a standardized matrix scheme proposed before.
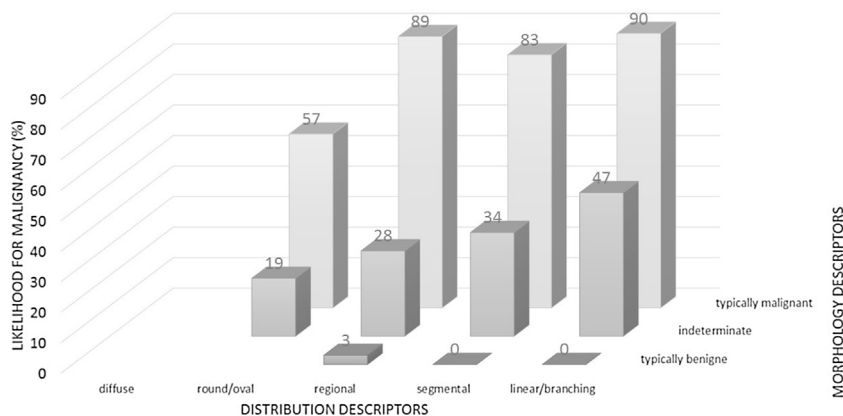
Fig. 1. Likelihood of malignancy (%) combining morphology and distribution descriptors (n = 849).

Table 1
Standardized scheme to combine the morphology and the distribution of micro-calcifications with the BI-RADS assessment category. Modified by Müller-Schimpfle et al.

Distribution	Morphology		
	Typically benign	indeterminate	Typically malignant
Diffuse	2	3	4B
Round/oval	3	4A	4B
Regional	4A	4B	4C
Segmental	4A	4C	4C
Linear/branching	4B	4C	5

Table 2
Characteristics of the patients eligible for VCB due to suspicious microcalcifications.

	n (%)
Age	
<50	165 (19)
50–59	330 (39)
60–69	250 (29)
≥70	104 (12)
Patient history	
Asymptomatic screening clients	244 (29)
Symptomatic or history of familial breast cancer	605 (71)
BI-RADS assessment category	
4A	285 (34)
4B	327 (39)
4C	208 (24)
5	29 (3)
Final outcome	
Non-malignant	574 (68)
Malignant (including DCIS)	275 (32)
DCIS alone	140 (16)

2. Material and methods

2.1. Study design

The present study represents a single center retrospective analysis with data from prospectively classified cases between February 2007 and May 2015. 849 patients (mean age 57.1 ± 10.4 years) with a vacuum-assisted biopsy (VCB) due to BI-RADS 4 (with the subgroups 4A, 4B and 4C) or BI-RADS 5 calcifications and available histopathological results were analyzed. Calcifications associated with masses were not included. Detailed patient characteristics are outlined in Table 2.

A two-view standard mammogram (mediolateral oblique and craniocaudal view), a mediolateral mammogram and two compression magnification images in mediolateral and craniocaudal view were available for all patients prior to the VCB. All patients gave written informed consent > 24 h prior to the biopsy.

The study was conducted in accordance with the principles of the Declaration of Helsinki.

2.2. Categorization of calcifications

Calcifications which qualified for further assessement had to have a diameter of less than or equal to 2 mm (= microcalcifications). Only groups that contained more than four microcalcifications were assessed according to morphology and distribution parameters of the BI-RADS lexicon (BI-RADS 4th edition lexicon) [3].

We classified the type of morphology into three groups:

I Typically benign: round, punctate, rod-like, lucent-centred.
II Indifferent: amorphous, coarse heterogeneous.
III Typically malignant: fine pleomorphic, fine linear/branching.

The distribution was classified into five groups:

I Diffuse.
II Round or oval.
III Regional.
IV Segmental.
V Linear or branching.

The distribution modifier "grouped/clustered" was translated as "round/oval" distribution, because "grouped" is not a distribution modifier in the German speaking countries but rather a general meaning for suspiciously distributed calcifications.

The classification according to the proposed matrix was generally performed in clinical routine by altogether three senologically experienced radiologists (3, 5 and 20 years of experience) with decision-making by consensus in case of discordant findings and final evaluation and supervision performed by the senior radiologist. A combined assessment of morphology and distribution of the grouped calcifications according to a standardized scheme (Table 1) was used to define the BI-RADS assessment category. BI-RADS 4 (4A/4B/4C) and BI-RADS 5 calcifications were eligible for VCB.

2.3. Biopsy procedure

For VCB we used a coaxial needle system (Vacora, 10G) with stereotactic guidance (panning angle $\pm 15°$). Twelve biopsy cylinders were sampled for each suspicious group of calcifications. Biopsy success was evaluated by a post-procedural radiograph of the specimens and a two-view standard mammogram.