Posterior breast cancer – mammographic and ultrasonographic features

Prepektoralni karcinom dojke – mamografske i ultrazvučne osobine

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Abstract

Background/Aim. Posterior breast cancers are located in the prepectoral region of the breast. Owing to this distinctive anatomical localization, physical examination and mammographic or ultrasonographic evaluation can be difficult. The purpose of the study was to assess possibilities of diagnostic mammography and breast ultrasonography in detection and differentiation of posterior breast cancers. **Methods.** The study included 40 women with palpable, histopathological confirmed posterior breast cancer. Mammographic and ultrasonographic features were defined according to Breast Imaging Reporting and Data System (BI-RADS) lexicon. **Results.** Based on standard two-view mammography 87.5%, of the cases were classified as BI-RADS 4 and 5 categories, while after additional mammographic views all the cases were defined as BI-RADS 4 and 5 categories. Among 96 mammographic descriptors, the most frequent were: spiculated mass (24.0%), architectural distortion (16.7%), clustered microcalcifications (12.6%) and focal asymmetric density (12.6%). The differentiation of the spiculated mass was significantly associated with the possibility to visualize the lesion at two-view mammography ($p = 0.009$), without the association with lesion diameter ($p = 0.083$) or histopathological type ($p = 0.055$). Mammographic signs of invasive lobular carcinoma were significantly different from other histopathological types (architectural distortion, $p = 0.003$; focal asymmetric density, $p = 0.019$; association of four or five subtle signs of malignancy, $p = 0.006$). All cancers were detectable by ultrasonography. Mass lesions were found in 82.0% of the cases. Among 153 ultrasonographic descriptors, the most frequent were: irregular mass (15.7%), lobulated mass (7.2%), abnormal color Doppler signals (20.3%), posterior acoustic attenuation (18.3%). Ultrasonographic BI-RADS 4 and 5 categories were defined in 72.5% of the cases, without a significant difference among various histopathological types ($p = 0.109$). **Conclusion.** Standard two-view mammography followed by additional mammographic projections is an effective way to demonstrate the spiculated mass and to classify the prepectoral lesion as category BI-RADS 4 or 5. Additional ultrasonography can overcome the mimicry of invasive lobular breast carcinoma at mammography.

Key words:
breast neoplasms; mammography; ultrasonography; sensitivity and specificity.

Apstrakt

Uvod/Cilj. Prepektoralni karcinom dojke odnosi se na lokalizaciju tumora u posteriornim delovima dojke, u blizini zida grudnog koša, što ometa njegovo otkrivanje kliničkim pregledom, mamografijom ili ultrazvukom. Cilj rada bio je analiza dijagnostičke mamografije i ultrazvuka dojki u detekciji i diferencijaciji prepektoralnog karcinoma dojke. **Metode.** Ispitano je 40 žena sa patohistološki verifikovanim karcinomom. Analiza mamografskih i ultrazvučnih osobina sprovedena je u skladu sa leksikonom *Breast Imaging Reporting and Data System* (BI-RADS). **Rezultati.** Standardnom mamografijom iz dva pravca promene su definisane kao BI-RADS 4 i 5 kod 87,5% ispitanica, dok su posle primene dopunskih mamografskih projekcija sve promene bile BI-RADS kategorije 4 i 5. Od 96 mamografskih deskriptora, najveća učestalost bila je: stelatnih senki (24,0%), narušene arhitektonike (16,7%), grupisanih mikrokalcifikacija (12,6%) i fokalne asimetrije parenhima (12,6%). Diferentovanje stelatne senke bilo je povezano sa vizualizacijom promene iz dve mamografske projekcije ($p = 0,009$), bez uticaja veličine ($p = 0,083$) ili patohistološkog tipa karcinoma ($p = 0,055$). Mamografski znaci invazivnog lobularnog karcinoma razlikovali su se u odnosu na ostale patohistološke tipove karcinoma (narušena arihitektonika, $p = 0,003$; fokalna asimetrija parenhima, $p = 0,019$; udruženost četiri ili pet indirektnih znakova maligniteta, $p = 0,006$). Ultrazvučnim pregledom bilo je moguće otkrivanje svih promena, od kojih su kod 82,0% ispitanica diferentovane morfološke karakteristike prema tipu tumora. Od 153 ultrazvučnih deskriptora, najče-

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šći su bili: tumor nepravilnog oblika (15,7%), lobularni tumor (7,2%), patološki kolor dopler signali (20,3%) i posteriorno slabljenje akustičnog signala (18,3%). BI-RADS kategorije 4 i 5 su definisane ultrazvukom kod 72,5% bolesnika, bez značajne razlike između pojedinih patohistoloških tipova karcinoma ($p = 0,109$). **Zaključak.** Standardna mamografija iz dva pravca i dopunske mamografske projekcije omogućavaju diferentovanje stelatne senke i definisanje BI-RADS kategorije 4 i 5 za tumore prepektoralne lokalizacije. Dodatnim ultrazvučnim pregledom prevazilazi se mimikrija u mamografskom ispoljavanju invazivnog lobularnog karcinoma.

Ključne reči:
dojka, neoplazme; mamografija; ultrasonografija; osetljivost i specifičnost.

Introduction

Cancer is one of the major public health problems. Based on the global cancer epidemiology data, there are 12.7 million new cancer cases estimated per year and 7.6 million deaths from cancer per year, with 28 million cancer survivors within five years from the initial diagnosis. According to the South Eastern European Research Oncology Group (SEEROG) data, the most frequent type of cancer in women in Serbia is breast cancer; age-standardized incidence rate is 57.9 and age-standardized mortality rate is 19.3 [1].

Mammography and breast ultrasonography have defined and different roles in diagnosis of palpable lesions and screening of occult cancer. Specific diagnostic challenges for breast imaging methods are designated as "difficult cases". The posterior breast tumors (also known as the prepectoral tumors) are the lesions located in the posterior aspect of breast, close to the anterior chest wall. As the consequence of deep localization within the breast and the morphology of anterior chest wall, the evaluation of posterior breast tumors with conventional diagnostic methods can be difficult: physical examination is a subjective method of limited sensitivity, while mammography often visualizes only part of the lesion, even in the cases of large, palpable tumors [2]. Owing to this distinctive anatomical localization, the posterior breast tumors belong to the group of difficult breast imaging cases.

The purpose of this study was to evaluate possibilities of diagnostic mammography and breast ultrasonography in detection and differentiation of posterior breast cancer.

Methods

A total of 40 women diagnosed with a first primary invasive breast cancer were included in the study. Inclusion criterion was a palpable breast mass, located in the posterior third of the breast at mammography (Figure 1), based on the definition of Breast Imaging Reporting and Data System (BI-RADS) lexicon [3].

The women ranged in age from 28 to 83 years (mean age, 60.2 years), and 26 were postmenopausal, and 14 premenopausal. In 23 women the masses were in the right breast and in 17 women in the left breast. The localization of masses was as follows: the upper outer quadrant in 33 cases, the upper inner and lower outer quadrant in 6 cases, equally, and the lower inner quadrant in one case. The mean mass size was 3.3 ± 1.4 cm. All the patients underwent standard two-view mammography (CC, cranio-caudal and MLO, me-

dio-lateral oblique), either with the model SC Diagnost, Phillips mammography system (36 women, Clinical Hospital "Bežanijska kosa", Belgrade, Serbia), or with the model Selenia, Hologic mammography system (four women, Institute of Oncology and Radiology of Serbia, Belgrade, Serbia). Targeted breast ultrasonography (Hitachi EUB HV 7500) after mammography was performed using a high-frequency 13 MHz transducer in all patients in the Primary Health Care Center "Serbian Railways" Belgrade, Serbia. Histopathologic diagnoses of breast masses were 22 invasive ductal carcinomas (IDC), 13 invasive lobular carcinomas (ILC), four ductal/lobular carcinomas and one medullary carcinoma. After the surgery, the multifocality was confirmed in three patients. The infiltration of pectoralis major muscle was not found. To test the significance of differences, χ^2 test was used. Statistical significance was accepted at the level of $p < 0.05$.
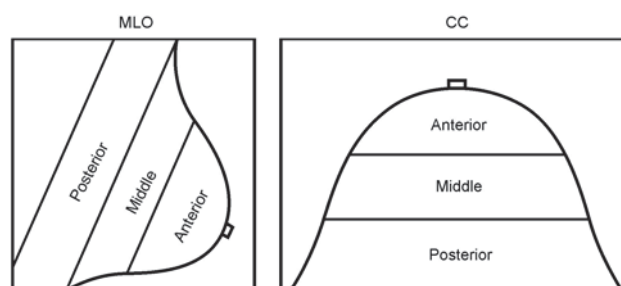

Fig. 1 – The depth of the lesion is assigned to anterior, middle, or posterior third of the breast and determined by two lines parallel to the edge of *pectoralis* major muscle at medio-lateral oblique (MLO) view, or to the edge of image at cranio-caudal (CC) view.

Results

Breast pattern at mammography was fatty (ACR1 and ACR2) in 32 cases (80.0%) and dense (ACR3 and ACR4) in 18 cases. Mammography detected the lesion at both, crenio-caudal (CC) and mediolateral oblique (MLO) views in 33 patients (82.0%), while in seven patients the lesion was detected at one standard mammographic view only. In these seven patients, the additional mammographic projections were performed in concordance with the lesion localization (Figure 2).

Based on standard MLO and CC projections 87.5% of the cases were classified as BI-RADS 4 and BI-RADS 5 categories, while in the conjunction with additional mam-
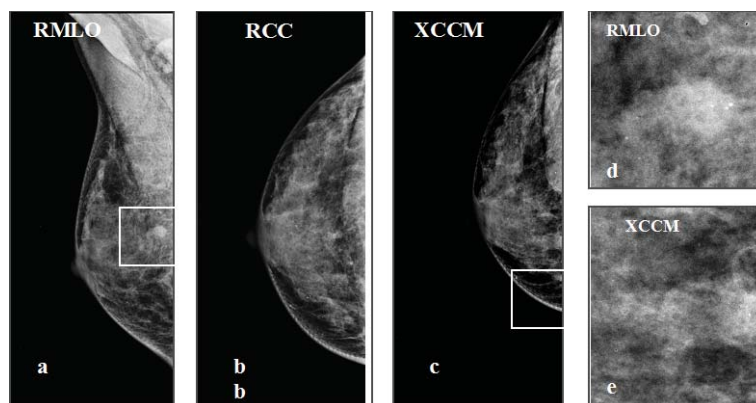
Fig. 2 – Work-up of a palpable, hard mass in the lower inner quadrant of the right breast. Spiculated mass with microcalcifications is visible in posterior third of the breast at RMLO view (a, d), and is not detectable at RCC view (b). Additional mammographic view (XCCM – medial extended cranio-caudal view) confirms the morfology and localization of the mass (c, e).

mographic projections all the cases were defined as BI-RADS 4 and BI-RADS 5 categories. A total number of mammographic BI-RADS descriptors were 96 (Table 1). Among them, the most frequent were: 23 of 96 (24.0%) spiculated masses, 16 (16.7%) architectural distortions, 12 (12.6%) clustered microcalcifications and 12 (12.6%) focal asymmetric densities.

The differentiation of the spiculated mass was significantly associated with the possibility to visualize the lesion at two-view mammography ($p = 0.009$), without the association with lesion diameter ($p = 0.083$) or histopathological type ($p = 0.055$). The mammographic features of ILC were significantly different from other histopathological types,

due to the most frequent following signs: architectural distortion ($p = 0.003$) and focal asymmetric density ($p = 0.019$), as well as to the association of four or five subtle signs of malignancy, such as non-spiculated masses, architectural distortions and focal asymmetric densities ($p = 0.006$).

All the lesions were detectable by ultrasonography: the mass lesions in 33 of 40 (82.0%) patients and the non-mass, hypoechoic lesion in 7 patients. The mass lesions were present in all 22 cases of IDC and in 8 of 13 cases of ILC ($p = 0.010$). Ultrasonographic examination detected a total of 153 signs (Table 2). Predominant abnormal ultrasonographic findings included: 24 of 153 (15.7%) irregular masses, 11 (7.2%) lobulated masses, 31 (20.3%) lesions with abnormal

Table 1

Posterior breast cancer – mammographic findings according to the BI-RADS lexicon

Mammographic descriptors*	Number (n)	Percent (%)
Spiculated mass	23	24.0
Lobulated mass	7	7.3
Ill defined mass	6	6.2
Architectural distortion	16	16.7
Clustered microcalcifications	12	12.6
Focal asymmetric density	12	12.6
Skin retraction	6	6.2
Skin thickening	5	5.2
Increased vascular markings	3	3.1
Marked peripheral ducts	2	2.0
Nipple retraction	1	1.0
Pathological axillary lymph nodes	3	3.1

*Total number of descriptors in 40 patients (n = 96).

Table 2

Posterior breast cancer – ultrasonographic findings according to the BI-RADS lexicon

Mammographic descriptors*	Number (n)	Percent (%)
Irregular mass	24	15.7
Lobulated mass	11	7.2
Oval-shaped mass	3	1.9
Non-mass lesion	7	4.7
Hyperechoic peripheral zone	10	6.5
Posterior acoustic attenuation	28	18.3
Absent/mixed posterior acoustic attenuation	12	7.8
Pathological vascularization	31	20.3
Pectoralis fascia discontinuity	8	5.2
Pathological axillary lymph nodes	19	12.4

*Total number of descriptors in 40 patients (n = 153).

color Doppler signals, 28 (18.3%) lesions with posterior acoustic attenuation.

Using the combination of all ultrasonographic signs listed in Table 2, ultrasonographic BI-RADS 4 and BI-RADS 5 categories were defined in 29 of the 40 patients (72.5%), while for 11 patients BI-RADS classification was non-conclusive. Ultrasonographic BI-RADS classification did not differ among various histopathological types of breast cancer ($p = 0.109$). The frequency of mammographic and ultrasonographic BI-RADS 4 and BI-RADS 5 categories was significantly different ($p = 0.013$).

Additional mammographic projections are standardized and rely on the localization of tumor (Table 3, modified from Tucker AK [9]).

roareolar area. In Tabar's classification, the terms "milky way" and "no man's land" belong to the localization of posterior breast tumors at mammography.

Our analysis of posterior breast tumors emphasizes the importance of additional mammographic projections. Additional projections provide increased diagnostic information on routine two-view examinations when the results are inconclusive, or when a lesion is seen only in one view. Some posterior breast tumors may be visible at one of standard views, or non-detectable, even in the case of clinically obvious mass. In these cases, further work-up and additional mammographic projections are necessary, with the goal to visualize the lesion on at least two mammographic views. In our study, the differentiation of a spiculated mass depended

Table 3

Posterior breast tumors – recommendations for additional mammographic projections

Localization of the lesion at mammography	Additional projection
CC, lateral quadrants	XCCL, LO, L
CC, medial quadrants	XCCM, LO, L
MLO, axillary tail	XCCL, L
MLO, upper quadrants	XCCL, CC, L
MLO, central region	XCCL or XCCM
MLO, lower quadrants	XCCM, CC, L
MLO, inframammary sulcus	CC, L

CC – cranio-caudal; MLO – medio-lateral oblique; XCCL – lateral extended cranio-caudal, LO – lateral oblique, L – lateral, XCCM – medial extended cranio-caudal.

Discussion

We performed the analysis of mammographic and ultrasonographic features of palpable posterior breast cancers as a model of this distinctive cancer localization.

Localization of breast tumors in the posterior aspect of breast tissue, near the retromammary fat and the anterior chest wall, influences the line of pathophysiological, clinical and radiological specificities. According to the data published by Kopans [4] more than 70% of breast cancers develop in the parenchyma in the zone 1 cm wide, that lies immediately beneath the subcutaneous fat, or anterior to the retromammary fat. This is likely due to the fact that this is, geometrically, the volume where the most of breast tissue is found. Furthermore, fat acts as a reservoir for carcinogens, because of circulating androgens conversion to estrogens. Hence, there is the propensity for cancers to develop adjacent to these fat areas, including posterior breast tissue.

Brown et al. [5] confirmed this hypothesis in a clinical study of the 200 screening detected cancers, 354 true interval cancers and 122 false negative interval cancers. They concluded that the distribution of cancers across the breast is uneven, with clusters in the posterior breast tissue.

According to Tabar et al. [6] the majority of breast cancer will be found in one of the following four regions of the mammogram, so-called "forbidden areas" [5]. These regions require special attention of the radiologist and include: the area parallel with the edge of the pectoralis major muscle at the MLO view (a so-called "milky way"); the retroglandular, clear space at the CC view ("no man's land"); the medial half of the breast, best seen at the CC projection and the ret-

on the visualization of the lesion at two mammographic projections, without influence of tumor size and histopathological type. It is crucial to detect spiculated masses, since they have a much higher risk of malignancy than other, indirect signs of malignancy, such as non-spiculated masses, calcifications, architectural distortions or focal asymmetric densities [7]. According to that, after additional mammographic projections, we obtained the correction of BI-RADS 4 and BI-RADS 5 mammographic categories from initially 87.5% to 100%. In comparison to mammography, ultrasonographic BI-RADS 4 and BI-RADS 5 categories were defined in a significantly lower percentage (72.5%). Consequently, standard two-view mammography is not a *cul-de-sac* of breast radiological exploration. Therefore, the diagnostic mammography followed by additional mammographic projections appear superior to ultrasonography in differentiation of palpable posterior breast tumors [8, 9]. Nevertheless, the case-by-case, skillful and inventive approach to the selection of additional projections and patient positioning is imperative. This teamwork of radiologist and radiologic technologist in effort to solve the problem of posterior breast tumors detection and differentiation is an art of radiology.

The same principles of work-up are applicable to screening mammography. According to data of Majid et al. [10] even though mammography is the gold standard for the detection of occult breast carcinoma, 10–30% of breast cancers may be missed at screening mammography. Authors recommend a number of steps that will significantly enhance the accuracy of image interpretation at screening mammography: do not rely on standard views alone to diagnose a detected abnormality and complete the evaluation with additional

mammographic projections; review clinical data and use ultrasonography to help assess a palpable or mammographically detected mass; be strict about positioning and technical requirements to optimize image quality; be alert to subtle features of breast cancer; compare current images with multiple prior studies to look for subtle increases in lesion size; look for other lesions when one abnormality is seen; judge a lesion by its most malignant features.

Additional diagnostic challenge in the group of posterior breast tumors is ILC, because of the subtle and atypical mammographic and ultrasonographic features. ILC is the second most common breast malignancy after IDC [11]. ILC is derived from small, uniform tumor cells with round nuclei and narrow cytoplasm. ILC infiltrates the stroma in single-file cell strands along ductuli (a so-called "Indian-file" pattern) and has a tendency to spread diffusely or between the collagen fibers of the breast, without a significant desmoplastic reaction. The explanation of these pathological features at molecular level is the absence of a cell adhesion molecule, E-cadherin, in 84%–100% of ILCs [12]. Characteristic pathological growth pattern of infiltrative linear columns of discohesive cells, rather than the discrete mass of cohesive cell, influences the appearance of ILC at imaging, with often reduced conspicuity at both mammography and ultrasonography [13]. In our group of patients the indirect mammographic signs of malignancy as well as the association of 4 or 5 indirect mammographic signs more frequently appeared in cases of ILC than in other histopathological types of cancer. We also found nonspecific, focal hypoechoic areas to be a more frequent ultrasonographic feature of ILC than IDC. Owing to the combination of numerous ultrasonographic BI-RADS lexicon descriptors, ultrasonographic BI-RADS classification of ILC and IDC was not significantly different. According to the references, the sensitivity of ultrasonography for ILC detection ranges from 68% to 85.7% and the additional use of ultrasonography increases the overall ILC detection [14].

Discontinuity of pectoralis major muscle fascia was detected by ultrasonography in 8 patients. This finding, suggestive of pectoralis major muscle infiltration, was not confirmed after the surgery. According to literature data, a dynamic contrast-enhanced magnetic resonance imaging (MRI) has specific advantage in detection of the posterior breast tumor extension in underlying musculature [15]. Highly suspicious MRI sign of pectoralis muscle involvement is an abnormal enhancement in these structures, while violation of the fat plane between the tumor and the muscle, without other findings, does not indicate tumor involvement of these deep structures. The routine use of breast MRI should be considered for preoperative surgical planning in women with posterior breast tumors [2].

Conclusion

Our study shows that diagnostic mammography and breast ultrasonography offer specific benefits in the evaluation of palpable posterior tumors. Standard two-view mammography followed by additional mammographic projections is an effective way to demonstrate the spiculated mass and to classify the lesion as category BI-RADS 4 or BI-RADS 5. Meticulous ultrasonographic examination using multiple descriptors can overcome the mimicry of invasive lobular breast carcinoma at mammography.

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