ORIGINAL ARTICLE

CONTENTS

Initial experience with 3T breast MRI in Ukraine

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ABSTRACT

Aim: To assess the initial results of using 3 Tesla contrast-enhanced breast magnetic resonance imaging in Ukraine.

Materials and Methods: Our study included 498 diagnostic breast magnetic resonance imaging performed in Neuromed medical center in Kyiv, between March 2020 and December 2022. Patients were positioned prone, with breasts suspended in a dedicated 7-channel bilateral breast coil. MR-images were acquired with the PHILIPS Achieva 3.0Tesla x-series scanner. All studies were made by standard protocol: localizer, morphological and dynamic studies were performed.

Results: Our study revealed a statistically significant increase in problem-solving contrast-enhanced breast magnetic resonance examinations compared to other indications. Additionally, we observed a higher incidence of women with a greater amount of fibroglandular tissue (p-value<0.05).

Conclusions: The utilization of 3Tesla contrast-enhanced breast magnetic resonance imaging has become prevalent in Ukraine as a problem-solving tool for inconclusive findings in ultrasound (US) or/and mammography (MG). It is particularly useful in preoperative local breast cancer staging for women with a significant amount of fibroglandular breast tissue. However, the implementation of breast magnetic resonance imaging in Ukraine is in its nascent stages and requires further investigation, especially in middle-income country settings.

KEY WORDS: magnetic resonance imaging, breast cancer, problem-solving tool

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INTRODUCTION

Mammography (MG), ultrasound (US), and magnetic resonance imaging (MRI) constitute the primary methods for detecting breast cancer (BC) [1]. While MG and US are widely utilized imaging modalities in Ukraine, they may yield inconclusive results in certain cases, necessitating further examination [2]. Contrast-enhanced (CE) breast MRI, owing to its high sensitivity, serves as a valuable problem-solving tool in diagnostically challenging scenarios where conventional imaging falls short [2-6]. Furthermore, CE breast MRI complements MG screening for women at high risk of breast cancer [7-10].

Apart from its role as a problem-solving and high-risk screening tool, primary indications for breast MRI include preoperative staging of newly diagnosed BC (for excluding additional ipsilateral and contralateral cancer), assessing the effects of neoadjuvant chemotherapy, evaluating breast implants, investigating cancer of unknown primary localization, examining suspicious nipple discharge, and screening following breast-conserving surgery [11, 12].

AIM

Our study aimed to evaluate the initial outcomes of implementing 3T CE breast MRI in Ukraine.

MATERIALS AND METHODS

Our study encompassed 498 diagnostic breast MRIs conducted at Neuromed Medical Center in Kyiv from March 2020 to December 2022. Adhering to the principles of the Helsinki Declaration, this retrospective study posed no risks to patient safety or privacy. All examinations were conducted subsequent to patients' informed consent. To reduce background parenchymal enhancement (BPE), contrast-enhanced (CE) breast MRIs were specifically scheduled during the second week of the menstrual cycle for premenopausal women.

Patients assumed a prone position, with their breasts positioned in a dedicated 7-channel bilateral breast coil. MR images were acquired using a PHILIPS Achieva 3.0Tesla x-series scanner, employing standard protocol for localizer, morphological, and dynamic studies. Prior to scanning, a venous catheter was inserted into the patient's cubital

Table 1. Assessment of Contrast-Enhanced Breast Magnetic Resonance Findings According to BI-RADS Fifth Edition

	Mass	Non-mass enhancement	Focus	Total, № 487
BI-RADS-1	0 (0,0%)	0 (0,0%)	0 (0,0%)	48 (9,9%)
BI-RADS-2	246 (50,5%)	18 (3,7%)	0 (0,0%)	264 (54,2%)
BI-RADS-3	21 (4,3%)	36 (7,4%)	8 (1,6%)	65 (13,3%)
BI-RADS-4	47 (9,7%)	28 (5,7%)	0 (0,0%)	75 (15,4%)
BI-RADS-5	17 (3,5%)	3 (0,6%)	0 (0,0%)	20 (4,1%)
BI-RADS-6	11 (2,3%)	4 (0,8%)	0 (0,0%)	15 (3,1%)

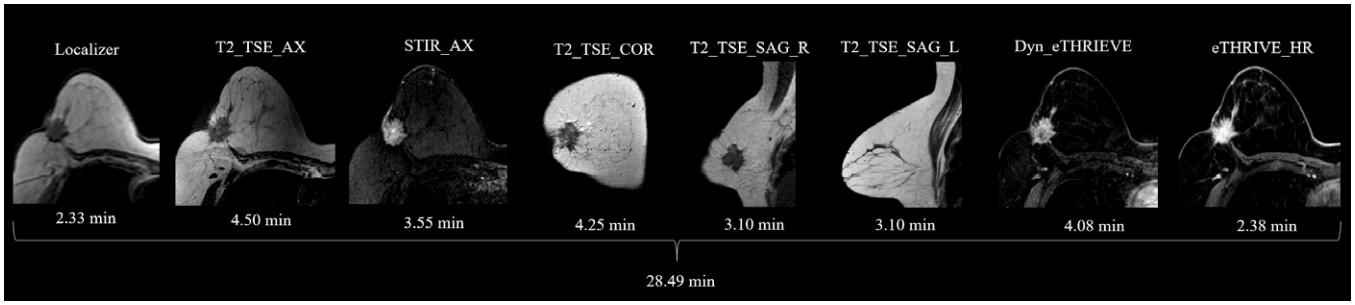

Fig. 1. Contrast-Enhanced Breast MRI Protocol. The scanning sequence started with Localizer and morphological sequences, followed by 6 series of THRIVE dynamic scanning, concluding with a delayed high-resolution THRIVE series. The default overall scanning duration was 28.49 minutes; however, for larger breasts, the scanning duration could extend by up to 10 minutes.

vein for the administration of the contrast agent (Gadovist) during dynamic CE. The contrast agent was injected as a bolus at a rate of 3 ml/s, followed by a 15ml saline flush via an automated MEDRAD injection system.

After conducting a localizer scan, we performed the following sequences:

- A morphological axial T2-weighted sequence with a slice thickness of 2mm and an acquisition time of 4.50 minutes. Parameters included a field of view (FOV) of 337x210mm, a repetition time (TR) of 4405 ms, an echo time (TE) of 120, a flip angle (FA) of 90, and a scan matrix (SM) of 264x285.

- An axial short-tau inversion recovery (STIR) sequence with a slice thickness of 4mm and an acquisition time of 3.55 minutes. Parameters comprised an FOV of 337x210mm, a TR of 11024 ms, a TE of 60, an FA of 120, and an inversion time (TI) of 230 ms.

- Coronal T2-weighted images with a slice thickness of 2.5mm and an acquisition time of 4.25 minutes. Parameters involved an FOV of 300x303mm, a TR of 4405 ms, a TE of 120, an FA of 90, and an SM of 376x285.

- Sagittal right and left T2-weighted images with a slice thickness of 3mm and an acquisition time of 3.10 minutes each. Parameters included an FOV of 240x240mm, a TR of 4757 ms, a TE of 120, an FA of 90, and an SM of 300x227.

The dynamic imaging utilized 3D T1-weighted low-angle shot [T1 High Resolution Isotropic Volume Excitation (THRIVE)] with the following parameters: TR/TE 3.8 /2.0 ms, flip angle 12, acceleration factor SENSE 3; matrix, 336x342 (reconstruction – 640x640); field of view, 330mm x 330mm; slice thickness, 1mm; and voxel size, 0.5 x 0.5 x 0.1mm. Depending on the breast volume and field of view, we obtained temporal acquisitions lasting less than 1 minute.

Following 1 series of pre-contrast THRIEVE and 6 series of THRIVE dynamic scanning lasting 4.08 minutes, we conducted a delayed high-resolution THRIVE with a slice thickness of 4.0mm and an acquisition time of 2.38 minutes. The default overall scanning time was 28.49 minutes; however, for larger breasts, the scan duration could extend up to 10 minutes longer (Fig 1).

Post-processing of the acquired images included subtraction series, MIP reconstruction, and construction of dynamic curves based on the Kuhl classification. These post-processed images were analyzed utilizing the Extended MR Workspace R3.2.3 workstation [13]. Lesions were categorized based on the pattern of the time-signal intensity curve and morphological appearance utilizing the Atlas BI-RADS fifth edition [1]. Data analysis was performed using Microsoft® Excel®

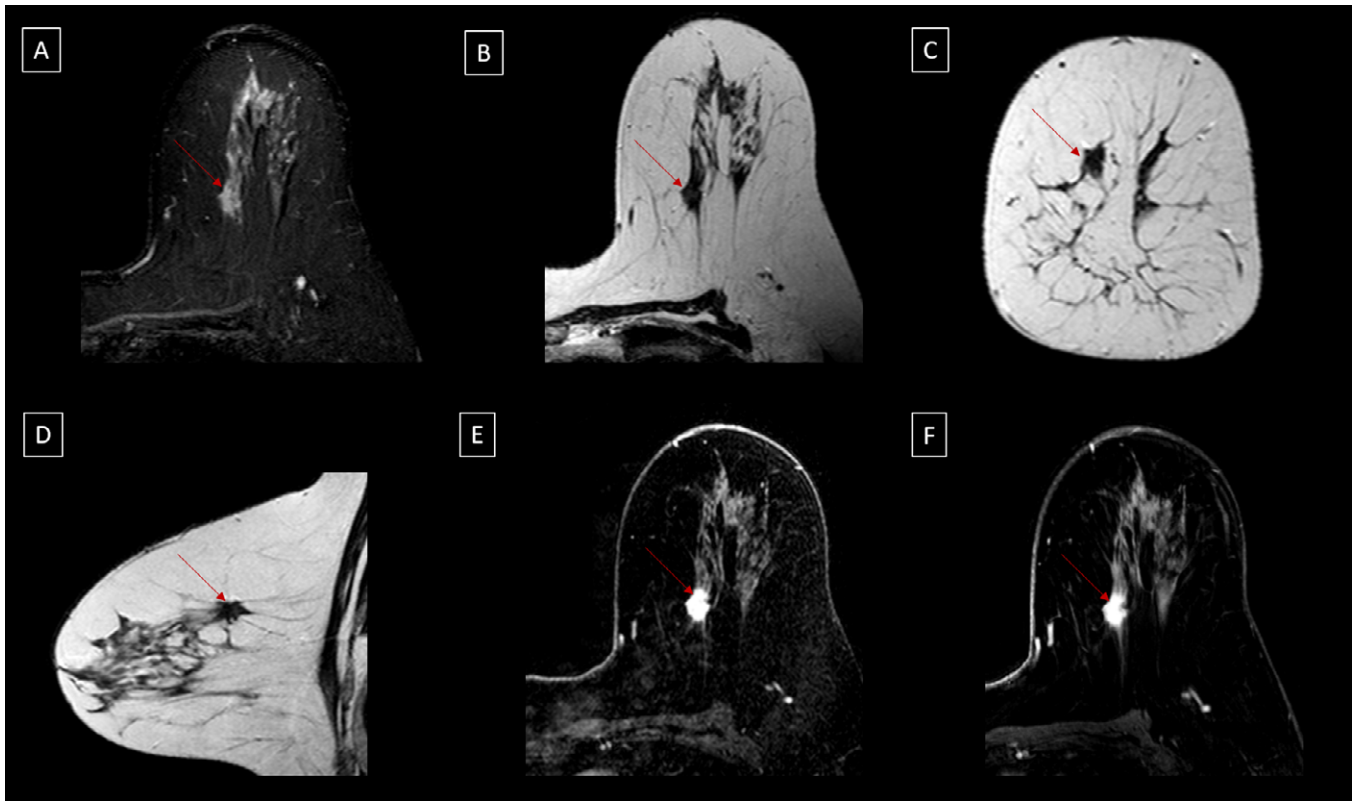

Fig. 2. A female patient diagnosed with histologically confirmed invasive breast carcinoma G1 (NST) who underwent diagnostic contrast-enhanced breast MRI to evaluate the local extent of the disease. The diagnostic MRI reveals a noncircumscribed, spiculated mass with washout and heterogeneous internal enhancement situated in the upper-inner quadrant of the left breast. The images include an axial short-tau inversion recovery image (A), axial T-2 image (B), coronal T-2 image (C), sagittal T-2 image (D), axial contrast-enhanced T-1fs THRIVE image (E), and axial T-1fs delayed high-resolution THRIVE image (F). The malignant mass is consistently marked with a red arrow across all images.

LTSC MSO, and correlations between the groups were assessed using the $\chi 2$ test.

RESULTS

Our study included data from 498 breast MRI examinations, consisting of 487 (97.8%) with contrast enhancement (CE) and 11 (2.2%) without CE, solely for assessing breast implants. The mean age of patients was 42.3 years (ranging from 19 to 78 years). CE breast MRIs were categorized into six BI-RADS (Breast Imaging Reporting and Data System) categories and eight examination indication categories [1, 11, 12]. Among these, biopsy-proven breast cancer (BI-RADS-6) accounted for 15 (3.0%) examinations, while those showing high suspicion for malignancy (BI-RADS-5) were 20 (4.0%). Cases indicating suspicion for malignancy (BI-RADS-4) totaled 75 (15.1%), probably benign findings (BI-RADS-3) were observed in 65 (13.1%) patients, benign findings (BI-RADS-2) in 264 (53.0%) examinations, and no pathological changes (BI-RADS-1) in 48 (9.6%) examinations. As mentioned earlier, 11 (2.2%) examinations focused solely on implant evaluation, thus BI-RADS assessment was not performed (Table 1).

The identified findings were categorized into three main groups: mass, non-mass enhancement (NME), and focus. The majority of CE breast MRIs exhibited solid and cystic masses (246; 50.5%), predominantly displaying benign characteristics and categorized as BI-RADS-2. However, those with suspicious morphology or kinetic curve were classified as suspicious for malignancy (BI-RADS-4; 47 cases) or highly suspicious with suspicions morphology and kinetic curve (BI-RADS-5; 17 cases). Additionally, 11 cases were histologically confirmed as breast cancer and were classified as BI-RADS-6 (Fig. 2). Solitary breast masses displaying benign morphology but with type II kinetic curve (plateau) in patients with a family history of breast cancer were categorized as BI-RADS-3 (21 cases) (Table 1).

We classified non-mass enhancement (NME) based on pattern and distribution within the breast parenchyma. Linear and segmental NME distributions with heterogeneous, clumped, or clustered ring internal enhancements were categorized as suspicious (BI-RADS-4 or BI-RADS-5) (Fig. 3). Focal NME without corresponding findings on other modalities or breast clinical examinations were considered probably benign, with recommendations for a follow-up CE breast MRI in 6 months. Multiple regions and diffuse distributions with homogeneous internal enhancements were categorized as benign NME (Table 1).

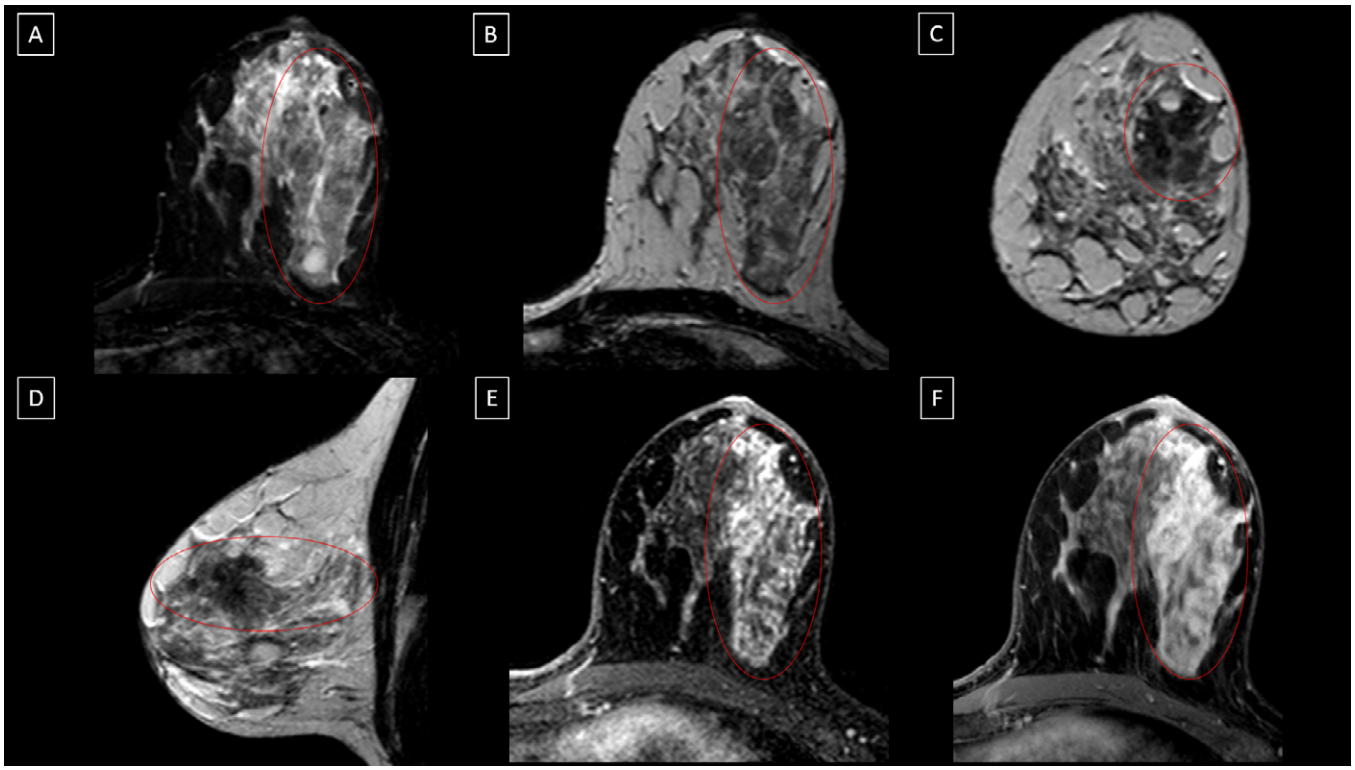

Fig. 3. A female patient presenting with bloody nipple discharge from the left breast underwent diagnostic contrast-enhanced breast MRI. The diagnostic MRI revealed suspicious heterogeneous segmental non-mass enhancement with a plateau dynamic curve in the upper-outer quadrant of the left breast. Subsequent core-needle biopsy under ultrasound guidance confirmed ductal carcinoma in situ. The imaging series comprised an axial short-tau inversion recovery image (A), axial T-2 image (B), coronal T-2 image (C), sagittal T-2 image (D), axial contrast-enhanced T-1fs THRIVE image (E), and axial T-1fs delayed high-resolution THRIVE image (F). The segmental non-mass enhancement was consistently demarcated with a red oval across all images.

Solitary focuses (<5 mm) without corresponding findings in morphological sequences and type II (plateau) and III (washout) kinetic curves were assessed as BI-RADS-3, with recommendations for a short interval (6 months) follow-up examination. Multiple bilateral focuses were categorized as background parenchymal enhancement (BPE) with BI-RADS-1 (Table 1).

All examinations adhered to structured reporting in accordance with BI-RADS Atlas recommendations. This involved comprehensive documentation encompassing the indication for examination, details of the MRI technique, a concise depiction of overall breast composition including the extent of fibroglandular tissue (FGT) and background parenchymal enhancement (BPE), a thorough description of important findings, a comparative analysis with previous examinations, and a comprehensive assessment guiding subsequent management decisions [1].

In most cases, the amount of fibroglandular tissue (FGT) on T1W fat-saturated images was heterogeneous (278; 57.2%) (Fig. 4), and the level of background parenchymal enhancement (BPE) was predominantly mild (Fig. 5). A statistically significant number of CE breast MRIs were performed for women with heterogeneous and extreme FGT compared to women with almost entirely fat breasts and scattered FGT (p-value <0.05). Additionally, a significant proportion of BPE was observed to be minimal and mild in comparison with moderate and marked BPE, indicative of the appropriate timing of the study (second week of the menstrual cycle) (p-value <0.05).

The most common indication for CE breast MRI was problem-solving (352; 70.8%) for inconclusive findings on breast ultrasound or mammography, followed by preoperative breast MRI (68; 13.7%) for local breast cancer staging. The least number of breast MRIs were performed for detecting cancer of unknown primary localization (8; 1.6%) and non-contrast studies for breast implant evaluation only (11; 2.2%) (Table 2). A statistically significant higher number of problem-solving CE breast MRIs were noted compared to all other indications for examination (p-value <0.05).

DISCUSSION

The introduction of 3T CE breast MRI in Ukrainian breast imaging represents a novel diagnostic approach. Notably, we didn't discover any prior publications from Ukraine documenting the utilization of such technology in breast imaging. Given that breast MRI stands as the most sensitive diagnostic tool for detecting breast

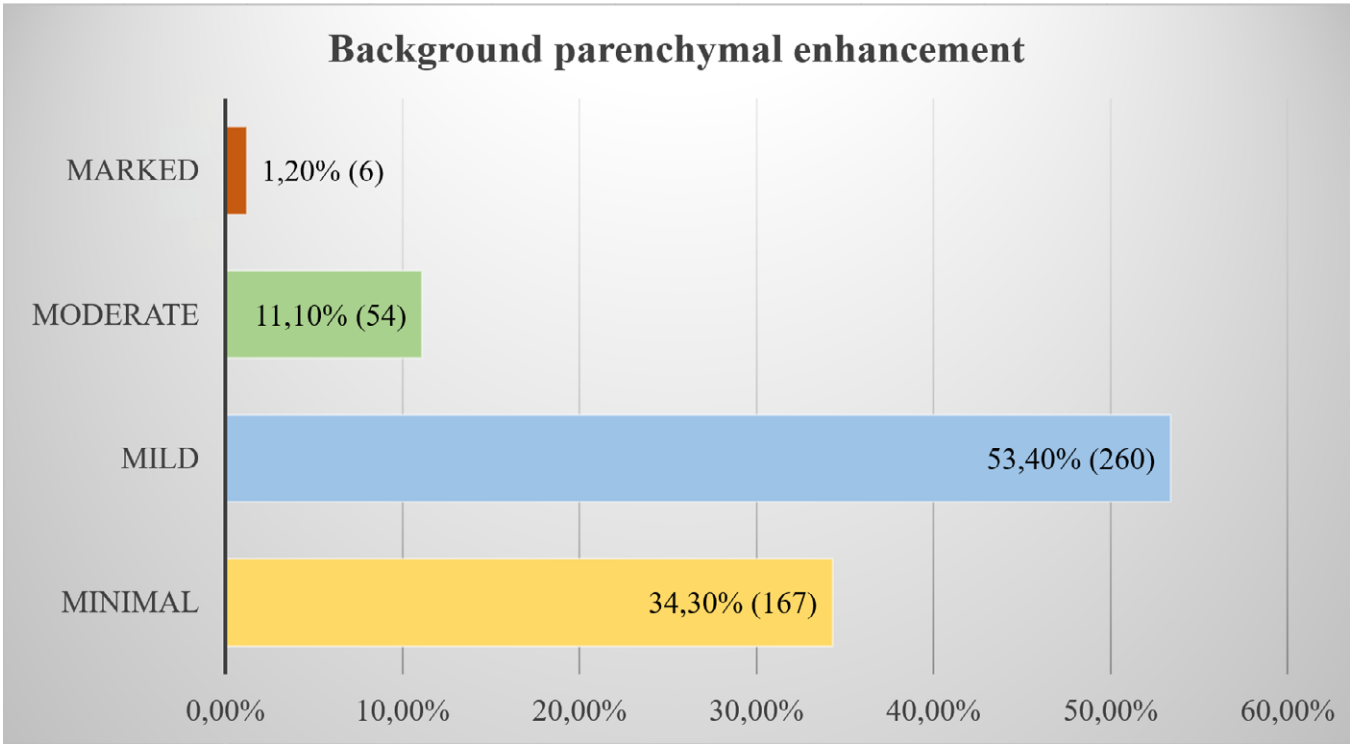

Fig. 4. Amount of fibroglandular tissue in patients which underwent contrast-enhanced breast magnetic resonance imaging according to BI-RADS fifth edition.

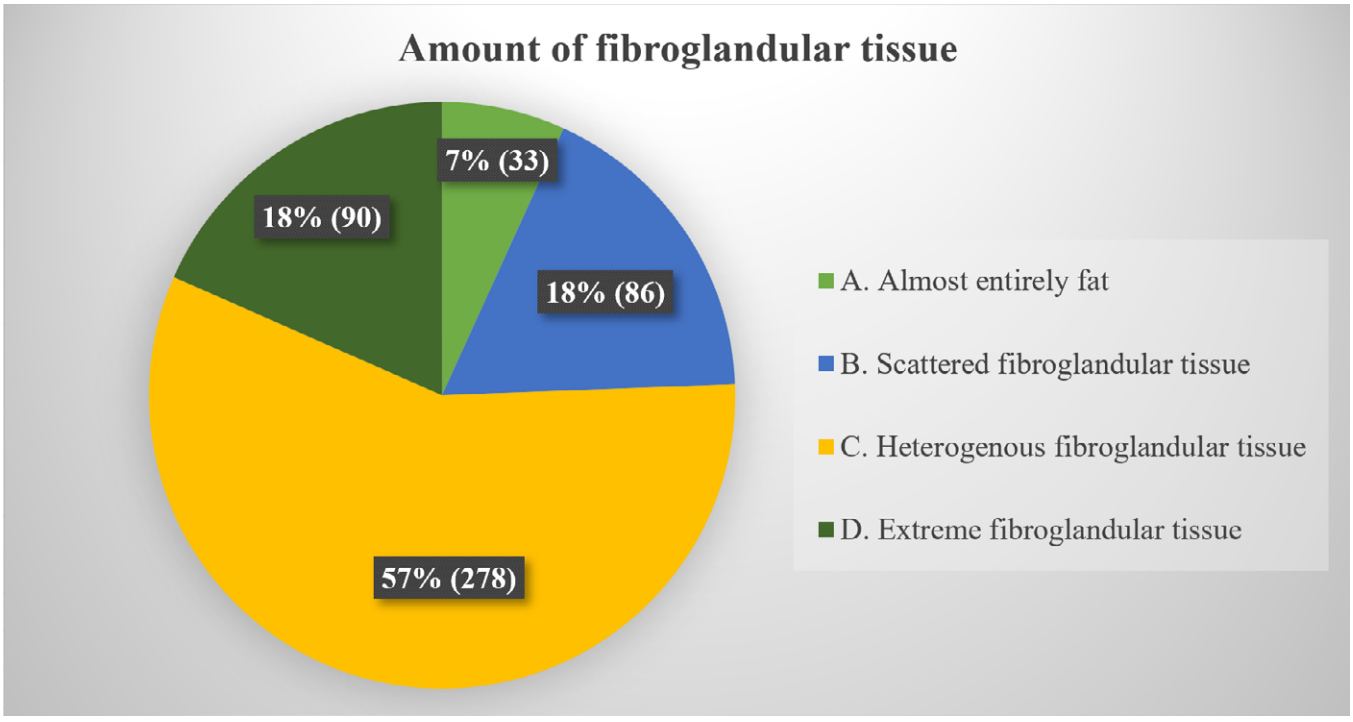

Fig. 5. Level of background enhancement of fibroglandular breast parenchyma in patients which underwent contrast-enhanced breast MRI according to BI-RADS fifth edition.

cancer, we embarked on analyzing our initial experience employing this imaging modality [14-18].

Our study unveiled that the primary indication for CE breast MRI was problem-solving, aligning with existing research demonstrating the efficacy of breast MRI in excluding malignancy when conventional breast imaging results are inconclusive [19-21]. Subsequently, the second most frequent indication was preoperative BC local staging. This finding resonates with studies indicating that preoperative breast MRI can identify additional disease in the ipsilateral breast in 20.0% of cases and in the contralateral breast in 5.5%, potentially reducing

Table 2. Indications for Breast MR Examinations in Our Study

Indications for breast MRI, № 487 (100%)	
Problem-solving	352 (70,8%)
Preoperative	68 (13,7%)
Screening after breast conserving surgery	17 (3,4%)
Monitoring of neoadjuvant chemotherapy	16 (3,2%)
Evaluation of nipple discharge	14 (2,8%)
High-risk screening	12 (2,4%)
Implant evaluation (non-contrast)	11 (2,2%)
Cancer of unknown primary localization	8 (1,6%)

reoperation rates by 3.0% while possibly increasing mastectomy rates by 11.0% [22-23].

Presently, MRI assumes a critical role in breast cancer screening among high-risk women, as well as mammography [24-26]. Despite the absence of a National BC screening program in Ukraine, conventional breast imaging methods, as previously mentioned in our studies, are widely utilized [27-30]. Consequently, one of the indications for CE breast MRI in our study involved high-risk screening for patients with BRCA1/2 mutations or a lifetime risk of BC development exceeding 20% based on genetic predisposition or family history, accounting for 2.4% of all our examinations.

Consistent with prior research and international recommendations, our utilization of CE breast MRI extended to detecting cancer of unknown primary localization, screening post-breast-conserving surgery, monitoring neoadjuvant chemotherapy effectiveness, evaluating patients with nipple discharge following conventional imaging, and conducting non-contrast studies for implant evaluation [31-35]. Notably, both 3T and 1.5T breast MRI systems exhibit comparable high diagnostic performance for breast cancer detection, with sensitivity and specificity values reflecting similar trends between the two systems [36].

However, a notable limitation in our setting, both at the national level and within our medical center, pertained to the unavailability of technical resources and requisite software for MR-guided biopsies. Furthermore, our study's limitations included its retrospective, single-institution design, interpretation of images by a single radiologist, and the absence of ongoing patient monitoring, although this was not the study's intended focus.

CONCLUSIONS

In summary, we can conclude that 3T CE breast MRI is widely used in Ukraine as a problem-solving tool for inconclusive findings in ultrasound or mammography, followed by preoperative local BC staging in women with a significant amount of fibroglandular breast tissue.

REFERENCES

1. D'Orsi CJ, Sickles EA, Mendelson EB et al. ACR BI-RADS® Atlas, Breast Imaging Reporting and Data System. Reston, VA, American College of Radiology. 2013.
2. Spick C, Szolar DHM, Preidler KW et al. 3 Tesla breast MR imaging as a problem-solving tool: Diagnostic performance and incidental lesions. PLoS One. 2018;13(1):e0190287. doi:10.1371/journal.pone.0190287. DOI
3. Gommers JJ, Voogd AC, Broeders MJ et al. Breast magnetic resonance imaging as a problem solving tool in women recalled at biennial screening mammography: A population-based study in the Netherlands. Breast. 2021;60:279-286. doi:10.1016/j.breast.2021.11.014. DOI
4. Taşkın F, Polat Y, Erdoğdu İH et al. Problem-solving breast MRI: useful or a source of new problems?. Diagn Interv Radiol. 2018;24(5):255-261. doi:10.5152/dir.2018.17504. DOI
5. Locke, R., Rubin, G. Role of MRI as a problem-solving tool in screening assessment. Breast Cancer Res. 2011;13(1):31. doi:10.1186/bcr2983. DOI
6. Pötsch N, Korajac A, Stelzer P et al. Breast MRI: does a clinical decision algorithm outweigh reader experience?. Eur Radiol. 2022;32(10):6557-6564. doi:10.1007/s00330-022-09015-8. DOI
7. Ren W, Chen M, Qiao Y, Zhao F. Global guidelines for breast cancer screening: A systematic review. Breast. 2022;64:85-99. doi:10.1016/j.breast.2022.04.003. DOI
8. Mann RM, Kuhl CK, Moy L. Contrast-enhanced MRI for breast cancer screening. J Magn Reson Imaging. 2019;50(2):377-390. doi:10.1002/jmri.26654. DOI
9. Lowry KP, Geuzinge HA, Stout NK et al. Breast Cancer Screening Strategies for Women With ATM, CHEK2, and PALB2 Pathogenic Variants: A Comparative Modeling Analysis. JAMA Oncol. 2022;8(4):587-596. doi:10.1001/jamaoncol.2021.6204. DOI
10. Ding W, Fan Z, Xu Y et al. Magnetic resonance imaging in screening women at high risk of breast cancer: A meta-analysis. Medicine (Baltimore). 2023;102(10):e33146. doi:10.1097/MD.0000000000033146. DOI
11. Clauser P, Mann R, Athanasiou A et al. A survey by the European Society of Breast Imaging on the utilisation of breast MRI in clinical practice. Eur Radiol. 2018;28(5):1909-1918. doi:10.1007/s00330-017-5121-4. DOI
12. Mann RM, Balleyguier C, Baltzer PA et al. Breast MRI: EUSOBI recommendations for women's information. Eur Radiol. 2015;25(12):3669-3678. doi:10.1007/s00330-015-3807-z. DOI

13. Kuhl CK, Mielcareck P, Klaschik S et al. Dynamic breast MR imaging: are signal intensity time course data useful for differential diagnosis of enhancing lesions?. Radiology. 1999;211(1):101-110. doi:10.1148/radiology.211.1.r99ap38101. DOI
14. Chen HL, Zhou JQ, Chen Q, Deng YC. Comparison of the sensitivity of mammography, ultrasound, magnetic resonance imaging and combinations of these imaging modalities for the detection of small (≤2cm) breast cancer. Medicine (Baltimore). 2021;100(26):e26531. doi:10.1097/MD.0000000000026531. DOI
15. Berg WA, Gutierrez L, NessAiver MS et al. Diagnostic accuracy of mammography, clinical examination, US, and MR imaging in preoperative assessment of breast cancer. Radiology. 2004;233(3):830-849. doi:10.1148/radiol.2333031484. DOI
16. Aristokli N, Polycarpou I, Themistocleous SC et al. Comparison of the diagnostic performance of Magnetic Resonance Imaging (MRI), ultrasound and mammography for detection of breast cancer based on tumor type, breast density and patient's history: A review. Radiography (Lond). 2022;28(3):848-856. doi:10.1016/j.radi.2022.01.006. DOI
17. Vourtsis A, Berg WA. Breast density implications and supplemental screening. Eur Radiol. 2019;29(4):1762-1777. doi:10.1007/s00330-018-5668-8. DOI
18. Houser M, Barreto D, Mehta A, Brem RF. Current and Future Directions of Breast MRI. J Clin Med. 2021;10(23):5668. doi:10.3390/jcm10235668. DOI
19. Taşkın F, Polat Y, Erdoğdu İH et al. Problem-solving breast MRI: useful or a source of new problems?. Diagn Interv Radiol. 2018;24(5):255-261. doi:10.5152/dir.2018.17504. DOI
20. Mann RM, Cho N, Moy L. Breast MRI: State of the Art. Radiology. 2019;292(3):520-536. doi:10.1148/radiol.2019182947. DOI
21. Shimauchi A, Machida Y, Maeda I et al. Breast MRI as a Problem-solving Study in the Evaluation of BI-RADS Categories 3 and 4 Microcalcifications: Is it Worth Performing?. Acad Radiol. 2018;25(3):288-296. doi:10.1016/j.acra.2017.10.003. DOI
22. Plana MN, Carreira C, Muriel A et al. Magnetic resonance imaging in the preoperative assessment of patients with primary breast cancer: systematic review of diagnostic accuracy and meta-analysis. Eur Radiol. 2012;22(1):26-38. doi:10.1007/s00330-011-2238-8. DOI
23. Sardanelli F, Trimboli RM, Houssami N et al. Magnetic resonance imaging before breast cancer surgery: results of an observational multicenter international prospective analysis (MIPA). Eur Radiol. 2022;32(3):1611-1623. doi:10.1007/s00330-021-08240-x. DOI
24. Mann RM, Kuhl CK, Moy L. Contrast-enhanced MRI for breast cancer screening. J Magn Reson Imaging. 2019;50(2):377-390. doi:10.1002/jmri.26654. DOI
25. Vreemann S, Gubern-Mérida A, Schlooz-Vries MS et al. Influence of Risk Category and Screening Round on the Performance of an MR Imaging and Mammography Screening Program in Carriers of the BRCA Mutation and Other Women at Increased Risk. Radiology. 2018;286(2):443-451. doi:10.1148/radiol.2017170458. DOI
26. Saadatmand S, Obdeijn IM, Rutgers EJ et al. Survival benefit in women with BRCA1 mutation or familial risk in the MRI screening study (MRISC). Int J Cancer. 2015;137(7):1729-1738. doi:10.1002/ijc.29534. DOI
27. Babkina TM, Gurando AV, Kozarenko TM et al. Detection Of Breast Cancers Represented As Architectural Distortion: A Comparison Of Full-Field Digital Mammography And Digital Breast Tomosynthesis. Wiad Lek. 2021;74(7):1674-1679. doi: 10.18370/2309-4117.2021.62.86-91. DOI
28. Kovtun AY, Hurando AV, Telnyi VV et al. Clinical Case: Pregnancy-Associated Breast Cancer. Reproductive Endocrinology. 2021;62:86-91. doi: 10.18370/2309-4117.2021.62.86-91. DOI
29. Gurando AV, Babkina TM, Dykan IM et al. Digital breast tomosynthesis and full-field digital mammography in breast cancer detection associated with four asymmetry types. Wiad Lek. 2021;74(4):842-848. doi: 10.36740/WLek202107121. DOI
30. Babkina TM, Dykan IM, Gurando AV et al. Detection of breast cancer presenting as a mass in women with dense breasts - digital breast tomosynthesis versus full-field digital mammography. Exp Oncol. 2020;42(3):215-219. doi:10.32471/exp-oncology.2312-8852.vol-42-no-3.14898. DOI
31. de Bresser J, de Vos B, van der Ent F, Hulsewé K. Breast MRI in clinically and mammographically occult breast cancer presenting with an axillary metastasis: a systematic review. Eur J Surg Oncol. 2010;36(2):114-119. doi:10.1016/j.ejso.2009.09.007. DOI
32. Gigli S, Amabile MI, Di Pastena F et al. Magnetic Resonance Imaging after Breast Oncoplastic Surgery: An Update. Breast Care (Basel). 2017;12(4):260-265. doi:10.1159/000477896. DOI
33. Reig B, Lewin AA, Du L et al. Breast MRI for Evaluation of Response to Neoadjuvant Therapy. Radiographics. 2021;41(3):665-679. doi:10.1148/rg.2021200134. DOI
34. de Paula IB, Campos AM. Breast imaging in patients with nipple discharge. Radiol Bras. 2017;50(6):383-388. doi:10.1590/0100-3984.2016.0103. DOI
35. Expert Panel on Breast Imaging:, Lourenco AP, Moy L, et al. ACR Appropriateness Criteria® Breast Implant Evaluation. J Am Coll Radiol. 2018;15(5S):S13-S25. doi:10.1016/j.jacr.2018.03.009. DOI
36. Dietzel M, Wenkel E, Hammon M et al. Does higher field strength translate into better diagnostic accuracy? A prospective comparison of breast MRI at 3 and 1.5 Tesla. Eur J Radiol. 2019;114:51-56. doi:10.1016/j.ejrad.2019.02.033. DOI

CONFLICT OF INTEREST
The Authors declare no conflict of interest

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