Using a Real-Time Artificial Intelligence Ultrasound System with Computer-Aided Detection and Diagnosis to Distinguish Ductal Carcinoma In Situ and Invasive Ductal Carcinoma

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Abstract

- Real-time AI-assisted ultrasound (CadAI-B®) provides immediate malignancy probability (POM) and BI-RADS classifications during scanning.
- This study evaluated CadAI-B's ability to differentiate DCIS from IDC, with IDC demonstrating significantly higher POM and BI-RADS values indicating diagnostic utility.

Introduction

- Conventional breast ultrasound is operator dependent, leading to variable diagnostic accuracy.
- AI-based systems like CadAI-B® may enhance objectivity and enable real-time decision support.
- We investigated whether CadAI-B® can distinguish DCIS from IDC based on POM and ultrasound features.

Methods and Materials

- Retrospective study of 34 breast cancers (DCIS = 12, IDC = 22) at a tertiary center.
- CadAI-B® analyzed ultrasound frames (0.04 s/frame) to generate POM (0–1) and BI-RADS (C1/2–C5).
- Compared shape, margin, echogenicity, and orientation
- Statistical tests: t-test, Mann–Whitney U, χ^2/Fisher's exact ($p < 0.05$).

Results

Table 1. Clinicopathologic characteristics of patients with DCIS vs IDC

	Total (n=34)	DCIS* (n=12)	IDC* (n=22)	p
Age, years (mean±SD)	56.5±10.3	49.7±6.2	61.4±11.6	0.001
Age				0.215
<50	11 (32.4)	6 (50.0)	5 (22.7)	
≥50	23 (67.6)	6 (50.0)	17 (77.3)	
BMI*, kg/m² (mean±SD)	23.1±3.1	22.7±4.0	23.4±2.7	0.633
Clinical size, mm (mean±SD)	14.5±9.2	9.8±4.9	17.0±10.2	0.009
Suspicious lymph node (n, %)				1.000
No	33 (97.1)	12 (100.0)	21 (95.5)	
Yes	1 (2.9)	0 (0.0)	1 (4.5)	
Breast surgery (n, %)				0.501
Mastectomy	13 (38.2)	6 (50.0)	7 (31.8)	
Breast conserving surgery	21 (61.8)	6 (50.0)	15 (68.2)	

All the data are expressed as numbers (percentages)
**BMI* body mass index, **DCIS* ductal carcinoma in situ
**IDC* invasive ductal carcinoma

Table 3. BI-RADS, n (%) – Changes after Applying CadAI-B® v1.5

BI-RADS	DCIS* (n=12)	POM (Mean±SD)	IDC* (n=22)	POM (Mean±SD)
C1, 2	1 (8.3)	0.009	2 (9.1)	0.006±0.002
C3	5 (41.7)	0.021±0.007	0 (0.0)	N/A
C4A	2 (16.7)	0.088±0.006	3 (13.6)	0.080±0.002
C4B	3 (25.0)	0.171±0.070	9 (40.9)	0.224±0.098
C4C	1 (8.3)	0.705	7 (31.8)	0.685±0.149
C5	0 (0.0)	N/A	1 (4.6)	0.963
Total	12	0.126±0.196	22	0.365±0.306

*DCIS ductal carcinoma in situ, *IDC invasive ductal carcinoma

Table 2. Comparison of Ultrasonographic Features and AI-Assessed Probability of Malignancy between DCIS and IDC

	Total (n=34)	POM (Mean±SD)	DCIS* (n=12)	POM (Mean±SD)	IDC* (n=22)	POM (Mean±SD)	P¹	P²
Mass type							1.000	
Solid mass	33 (97.1)	0.265±0.283	12 (100.0)	0.126±0.196	21 (95.5)	0.345±0.298		0.024
Mixed mass	1 (2.9)	0.784	0 (0.0)		1 (4.5)	0.784		-
Non-mass abnormalities							1.000	
Yes	2 (5.9)	0.154±0.075	1 (8.3)	0.1	1 (4.5)	0.207		-
No	32 (94.1)	0.288±0.300	11 (91.7)	0.128±0.206	21 (95.5)	0.372±0.311		0.019
Shape							0.378	
Round or oval	7 (20.6)	0.364±0.329	1 (8.3)	0.027	6 (27.3)	0.420±0.321		0.571
Irregular	27 (79.4)	0.259±0.286	11 (91.7)	0.135±0.203	16 (72.7)	0.344±0.308		0.032
Margin							0.862	
Circumscribed	1 (2.9)	0.082	0 (0.0)		1 (4.6)	0.082		-
Indistinct	9 (26.5)	0.216±0.235	3 (25.0)	0.012±0.003	6 (27.3)	0.318±0.226		0.017
Angular	6 (17.7)	0.122±0.120	3 (25.0)	0.071±0.038	3 (13.6)	0.173±0.164		0.400
Microlobulated	13 (38.2)	0.330±0.320	4 (33.3)	0.132±0.095	9 (40.9)	0.419±0.350		0.049
Spiculated	5 (14.7)	0.497±0.384	2 (16.7)	0.367±0.479	3 (13.6)	0.584±0.389		0.571
Echo pattern							1.000	
Hypoechoic	32 (94.1)	0.273±0.285	11 (91.7)	0.135±0.203	21 (95.5)	0.345±0.298		0.023
Complex	2 (5.9)	0.406±0.535	1 (8.3)	0.03	1 (4.5)	0.189		-
Isoechoic	0 (0.0)		0 (0.0)		0 (0.0)			-
Orientation to skin							0.476	
Parallel	15 (44.1)	0.278±0.286	4 (33.3)	0.044±0.037	11 (50.0)	0.362±0.290		0.021
Not parallel	19 (55.9)	0.283±0.306	8 (66.7)	0.166±0.233	11 (50.0)	0.367±0.335		0.138

All the data are expressed as numbers (percentages). P¹ P-value of frequency, P² P-value of probability of malignancy
**DCIS* ductal carcinoma in situ, **IDC* invasive ductal carcinoma

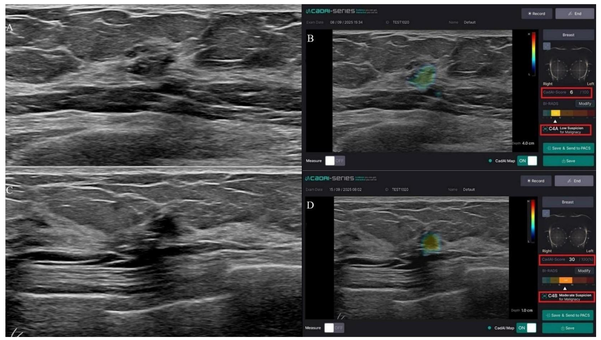


Figure 1. CadAI-B® AI Platform Output Examples for DCIS and IDC.
A. Ultrasound image of a lesion later confirmed as DCIS.
B. Corresponding CadAI-B® output for the same lesion, suggesting a 6% malignancy risk and BI-RADS category 4A (red box), with heatmap overlays highlighting suspicious regions.
C. Ultrasound image of a lesion later confirmed as IDC.
D. Corresponding CadAI-B® output for the same lesion, suggesting a 30% malignancy risk and BI-RADS category 4A (red box), displayed in the same format as in (B)

Discussion

- IDC showed higher POM in features such as irregular shape, indistinct or microlobulated margins, and hypoechoic pattern.
- AI-derived POM may capture subtle signs of stromal invasion beyond visual BI-RADS assessment.

Conclusions

- CadAI-B® distinguished IDC from DCIS using quantitative POM and BI-RADS outputs.
- Real-time AI support may enhance diagnostic confidence and workflow efficiency, warranting prospective multicenter validation.

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References

1. Lee J, Kim WH, Kim J, Kim HJ, Moon JS, Kang B, et al. Efficacy of a Real-Time Artificial Intelligence Ultrasound System With Computer-Aided Detection and Diagnosis for Breast Cancer: A Feasibility Study. J Breast Cancer. 2025;28(3):206-14.
2. Kwon M-R, Youn I, Lee MY, Lee H-A. Diagnostic Performance of Artificial Intelligence-Based Computer-Aided Detection Software for Automated Breast Ultrasound. Academic radiology. 2023.
3. Kim J, Kim HJ, Kim C, Lee JH, Kim KW, Park YM, et al. Weakly-supervised deep learning for ultrasound diagnosis of breast cancer. Sci Rep. 2021;11(1):24382.
4. Mango VL, Sun M, Wynn RT, Ha R. Should We Ignore, Follow, or Biopsy? Impact of AI Decision Support on Breast US Lesion Assessment. AJR Am J Roentgenol. 2020;214(6):1445-1452.
5. Dicle O. Artificial intelligence in diagnostic ultrasonography. Diagn Interv Radiol. 2023;29(1):40-5.
6. Tanaka K, Masuda N, Hayashi N, Sagara Y, Hara F, Kadoya T, et al. Clinicopathological predictors of postoperative upstaging to invasive ductal carcinoma (IDC) in patients preoperatively diagnosed with ductal carcinoma in situ (DCIS): a multi-institutional retrospective cohort study. Breast Cancer (Tokyo, Japan). 2021;28:896-903.
7. Casasent AK, Almekinders MM, Mulder C, et al. Distinguishing progressive vs non-progressive DCIS. Nat Rev Cancer. 2022;22(12):663-678.
8. Rakha EA, Miligy IM, Gorringe KL, Toss MS, Green AR, Fox SB, et al. Invasion in breast lesions: the role of the epithelial-stroma barrier. Histopathology. 2018;72(7):1075-83.
9. Niu Q, Li H, Du L, Wang R, Lin J, Chen A, et al. Development of a Multi-Parametric ultrasonography nomogram for prediction of invasiveness in ductal carcinoma in situ. European journal of radiology. 2024;175:111415

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