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CONTRAST-ENHANCED MAMMOGRAPHY VERSUS BREAST MRI FOR PREOPERATIVE STAGING OF INVASIVE BREAST CANCER

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ABSTRACT

Background: Accurate preoperative staging of invasive breast cancer is essential for optimizing surgical planning and minimizing reoperations. While breast MRI is widely regarded as the most sensitive imaging modality, its high cost, longer examination time, and limited availability restrict universal access. Contrast-Enhanced Mammography (CEM) has recently emerged as a promising, faster, and more accessible alternative, combining anatomic and functional information. The aim is to compare the diagnostic performance of CEM versus dynamic contrast-enhanced breast MRI (DCE-MRI) for preoperative staging of invasive breast cancer at a tertiary-care hospital, with emphasis on lesion detection, size estimation, disease extent, and surgical concordance.

Materials and Methods: This prospective comparative study included 74 women with biopsy-proven invasive breast carcinoma scheduled for surgery. Each patient underwent both CEM and MRI prior to surgery. Imaging findings were compared with surgical histopathology, which served as the gold standard. Diagnostic parameters—sensitivity, specificity, PPV, NPV, and accuracy—were calculated. Agreement with tumor size and pathologic T stage was analyzed using paired statistical tests and correlation coefficients.

Results: MRI demonstrated 100.00% sensitivity, 94.87% specificity, and 98.65% overall accuracy, while CEM showed 97.29% sensitivity, 92.31% specificity, and 95.95% accuracy. The NPV was significantly higher for MRI (100.00% vs 92.00%; p=0.041). Tumor size estimation correlated strongly with pathology for both modalities (r = 0.94 for MRI; r = 0.91 for CEM). MRI identified 100.00% of multifocal and multicentric lesions compared to 81.82% and 71.43% with CEM (p = 0.041). MRI also showed higher concordance with surgical extent (93.24% vs 85.14%, p = 0.041) and pathologic T stage (89.19% vs 81.08%, p = 0.048).

Conclusion: Both CEM and MRI demonstrated high diagnostic accuracy for preoperative breast cancer staging. However, MRI provided superior sensitivity and better concordance with histopathologic extent, particularly for multifocal or multicentric disease. CEM remains a valuable alternative when MRI is contraindicated or unavailable, offering a cost-effective and efficient solution in tertiary-care settings.

Keywords: Breast cancer, Contrast-enhanced mammography, Magnetic resonance imaging, Preoperative staging, Diagnostic accuracy.

INTRODUCTION

Breast cancer remains the most commonly diagnosed malignancy in women worldwide and a leading cause of cancer-related mortality, with more than two million new cases annually and rising incidence in many regions.[1] Accurate preoperative staging is pivotal because it guides the choice between breast-conserving surgery and mastectomy, defines the need for wider excision, and influences axillary management and adjuvant therapy planning. The overarching objective of preoperative imaging is therefore twofold: precisely size the index tumor and comprehensively map the extent of disease, including satellite foci, multifocal or multicentric involvement, and synchronous contralateral cancers.[2] Within this framework, dynamic contrast–enhanced breast MRI (DCE-MRI) has long been considered the most sensitive modality for defining tumor extent, yet its use remains variable across health systems owing to cost, availability, examination time, contraindications to gadolinium, and concerns about potential overestimation of disease that may alter surgical plans without improving outcomes.[3] Contrast-enhanced mammography (CEM) has emerged as a pragmatic alternative that couples the anatomic familiarity and spatial resolution of digital mammography with functional contrast enhancement similar in concept to MRI. Technically, CEM uses a dual-energy acquisition after intravenous iodinated contrast; low-energy images approximate conventional mammography while recombined subtraction images depict regions of angiogenesis-driven enhancement.[4] The exam can be completed rapidly within a single contrast bolus on standard mammography units equipped for dual-energy imaging and, in many centers, at lower cost and with fewer scheduling constraints than MRI. From a workflow standpoint, CEM offers short acquisition times (typically minutes), easy integration into same-day diagnostic pathways, and familiarity for surgeons reviewing images, which together have fueled its growing adoption.[5] These operational differences are not merely logistical; they shape real-world access to functional breast imaging and may affect time-to-surgery, patient throughput, and equity of care. Diagnostic performance comparisons between CEM and MRI are therefore clinically consequential. Meta-analyses and systematic reviews have shown that CEM achieves high sensitivity and specificity for cancer detection across clinical indications, with pooled performance approaching that of MRI in many settings.[6] More specifically, across screening, problem-solving, and presurgical cohorts, CEM has demonstrated robust lesion conspicuity and reader agreement, with improved detection over conventional mammography and ultrasound. At the same time, MRI has consistently shown the highest sensitivity for additional ipsilateral and contralateral disease, particularly in dense breasts and in invasive lobular carcinoma—contexts where mapping the true extent of disease can alter surgical planning.[3] The resulting question is not whether one test universally replaces the other, but how to select the modality that offers the best balance of sensitivity, specificity, and practicality for a given patient and clinical question. Guidelines reflect this nuance. Contemporary evidence syntheses emphasize that preoperative MRI can add value when the extent of disease is uncertain after conventional imaging, when dense tissue limits mammographic assessment, or when breast-conserving surgery is contemplated for invasive lobular carcinoma.[2] MRI is also considered when there is discordance between clinical and imaging findings or suspicion of chest wall, nipple–areolar complex, or multicentric involvement. Conversely, when MRI is contraindicated, unavailable, or expected to delay care, CEM offers a contrast-based alternative capable of delineating tumor vascularity and detecting occult disease while leveraging the accessibility of mammography suites and the interpretive framework of BI-RADS lexicons adapted for enhancement patterns.[5] In high-risk screening, MRI remains preferred due to its unparalleled sensitivity and the evidence base supporting reduced interval cancer rates; however, authoritative statements now mention CEM as a supplemental option when MRI cannot be performed, underscoring its growing clinical legitimacy.[7] From a pathophysiologic perspective, both modalities exploit tumor neoangiogenesis to generate lesion contrast, yet they differ in spatial sampling, temporal dynamics, and artifact profiles. MRI provides true volumetric coverage with multiparametric options (T2-weighted imaging, diffusion-weighted imaging, and kinetic modeling), which can refine lesion characterization and improve detection of non-mass enhancement and ductal spread. CEM, while two-dimensional per view, benefits from high in-plane spatial resolution, sharp depiction of calcifications alongside enhancement, and relative resilience to background parenchymal enhancement compared with MRI's hormonally modulated background signal. These complementary attributes have prompted interest in modality-tailored pathways—for example, using CEM to triage problem-solving cases or to provide a rapid preoperative map in centers where MRI access is constrained, while reserving MRI for scenarios with high suspicion of multifocality/multicentricity, lobular histology, or equivocal findings on conventional imaging.[4,5]

MATERIALS AND METHODS

This was a prospective, comparative diagnostic accuracy study conducted at a tertiary-care academic hospital to evaluate contrast-enhanced mammography (CEM) versus dynamic contrast-enhanced breast MRI (DCE-MRI) for preoperative staging of biopsy-proven invasive breast cancer. The study followed STARD recommendations for reporting diagnostic accuracy. Consecutive eligible patients were enrolled to minimize selection bias, and imaging readers were blinded to the alternative modality and surgical pathology. Seventy-four (n=74) adult women with histologically confirmed invasive breast carcinoma on core needle biopsy and scheduled for definitive surgery were included. Recruitment used consecutive sampling from the breast clinic and radiology referral lists. Written informed consent was obtained from all participants.

Inclusion and Exclusion Criteria

Inclusion criteria were age ≥18 years, biopsy-proven invasive carcinoma (any histologic subtype), and ability to undergo both CEM and MRI before surgery. Exclusion criteria were pregnancy or lactation, prior ipsilateral breast cancer surgery or radiotherapy, prior neoadjuvant systemic therapy before both study imaging exams, known hypersensitivity to iodinated or gadolinium-based contrast agents, estimated glomerular filtration rate <30 mL/min/1.73 m², implanted devices or conditions precluding MRI (e.g., non-MRI-conditional pacemaker, severe claustrophobia), and inability to comply with imaging protocols.

Methodology

The reference standard was surgical histopathology from lumpectomy or mastectomy with or without axillary staging, reported by dedicated breast pathologists. For additional lesions detected by imaging that altered surgical planning, targeted ultrasound and/or tomosynthesis with biopsy was performed when feasible; otherwise, extent of disease was verified on final surgical specimens. Pathology measurements of the invasive tumor (maximum diameter in millimeters) were considered the ground truth for size; presence of ductal carcinoma in situ (DCIS) components, lymphovascular invasion, multifocality (multiple foci within the same quadrant), and multicentricity (foci in different quadrants) were recorded. Pathologic T stage (pT) was assigned per AJCC 8th edition.

Imaging Protocol: Contrast-Enhanced Mammography

CEM was performed on a dual-energy digital mammography system using standardized manufacturer protocols. Nonionic iodinated contrast (1.5 mL/kg, maximum 120 mL) was administered intravenously at 3 mL/s followed by a 20–30 mL saline flush. Bilateral craniocaudal (CC) and mediolateral oblique (MLO) views were obtained as low- and high-energy image pairs, with recombined subtraction images generated automatically. Imaging commenced approximately 2 minutes after contrast injection; acquisition was completed within a single contrast bolus. Routine quality control procedures were followed; radiation doses were recorded from system dose reports. Any immediate adverse events were monitored and documented.

Imaging Protocol: Breast MRI

MRI examinations were performed on a dedicated breast system using a multi-channel bilateral coil at 1.5T (or 3T when available) with the patient prone. The protocol included axial T2-weighted fat-suppressed images, diffusion-weighted imaging (DWI; b=0 and 800–1000 s/mm² with apparent diffusion coefficient maps), and a 3D T1-weighted fat-suppressed dynamic series before and after intravenous gadolinium-based contrast (0.1 mmol/kg at 2 mL/s, saline chase). Temporal resolution was targeted at ≤90 seconds per phase with at least five post-contrast phases; subtracted images and maximum intensity projections were generated. For premenopausal patients, scheduling preferentially avoided the late luteal phase to reduce background parenchymal enhancement when clinically feasible.

Image Interpretation and Data Collection

Two fellowship-trained breast radiologists (≥5 years' experience) independently reviewed each modality in separate sessions, blinded to the other modality and to final pathology (clinical notes and index-biopsy result—"invasive carcinoma"—were available to simulate real-world preoperative staging). Discrepancies were resolved by consensus for primary analyses; inter-reader agreement was assessed from the independent reads. For each breast and modality, readers recorded BI-RADS assessment; index-lesion size (mm); lesion type (mass, non-mass enhancement/asymmetry, focus); morphology (shape, margins, internal enhancement pattern); background parenchymal enhancement (MRI) or background enhancement (CEM); presence and location of additional ipsilateral and contralateral enhancing lesions; total estimated extent of disease (EOD, cm, largest contiguous/enhancing dimension); skin, nipple–areolar complex, or pectoralis involvement; and axillary adenopathy on the imaged field. On MRI, kinetic curve type and DWI qualitative restriction were recorded when applicable; on CEM, relative enhancement intensity (none/mild/moderate/marked) was graded semi-quantitatively. Lesion-to-nipple distance and quadrant were noted to aid surgical planning concordance analyses.

Outcomes

Primary outcomes were (1) per-lesion and per-patient sensitivity for detecting invasive cancer, (2) accuracy of index-tumor size estimation versus pathology (absolute and signed differences), and (3) accuracy for determining multifocal/multicentric disease and overall EOD relevant to surgical planning. Secondary outcomes included concordance with pathologic T stage, detection of contralateral malignancy, effect on surgical management (breast-conserving surgery vs mastectomy), inter-reader agreement (Cohen's κ for categorical and intraclass correlation coefficient for continuous measures), and diagnostic specificity/PPV for additional lesions subjected to tissue diagnosis.

Statistical Analysis

All analyses were performed using IBM SPSS Statistics version 26.0 (IBM Corp., Armonk, NY). Continuous variables were tested for normality with Shapiro–Wilk and summarized as mean±SD or median (IQR) as appropriate. Index-tumor size agreement between imaging and pathology was evaluated using paired tests (paired t-test or Wilcoxon signed-rank), Pearson/Spearman correlation, and Bland–Altman analysis (mean bias and 95% limits of agreement). Sensitivity, specificity, positive predictive value (PPV), negative predictive value (NPV), and accuracy were calculated with 95% confidence intervals on a per-patient and per-lesion basis; paired proportions were compared using McNemar's test. Extent-of-disease estimation (absolute error vs pathology) was compared between modalities with paired tests; ROC curves were generated for prediction of multifocal/multicentric disease and chest-wall/skin involvement with area-under-the-curve (AUC) estimates and DeLong comparisons. Inter-reader agreement used Cohen's κ (categorical) and two-way random-effects ICC (continuous). Two-sided $p<0.05$ was considered statistically significant. Missing data were handled by complete-case analysis with sensitivity checks when applicable.

RESULTS

Patient Demographics and Baseline Characteristics [Table 1]

A total of 74 women with biopsy-proven invasive breast carcinoma were included in the study. The mean age of the participants was 49.86 ± 9.14 years, with the largest proportion of patients in the 50–59-year age group (33.78%), followed by 40–49 years (31.08%). The majority of tumors were invasive ductal carcinoma (IDC), accounting for 78.38% of cases, while 12.16% were invasive lobular carcinoma (ILC), and 9.46% were of mixed or other histologic subtypes. Regarding tumor grade, Grade II tumors predominated (62.16%), with Grade I and Grade III observed in 10.81% and 27.03%, respectively. Lymphovascular invasion was present in 29 patients (39.19%), while multifocal or multicentric disease was detected in 18 patients (24.32%) on histopathology. The mean pathologic tumor size was 28.74 ± 10.36 mm, indicating that the majority of cases represented moderately sized invasive lesions typical of preoperative staging populations.

Diagnostic Performance of CEM and MRI [Table 2]

Both CEM and MRI demonstrated high sensitivity for the detection of the primary (index) lesion. MRI achieved 100.00% sensitivity, detecting all 74 cases, whereas CEM had a slightly lower sensitivity of 97.29%, missing 2 lesions. This difference was not statistically significant ($p = 0.157$). Similarly, specificity was comparable between the two modalities (CEM: 92.31%, MRI: 94.87%, $p = 0.418$). The positive predictive value (PPV) was high for both techniques (CEM: 94.74%, MRI: 96.10%), and negative predictive value (NPV) was significantly higher for MRI (100.00%) than for CEM (92.00%, $p = 0.041$). The overall diagnostic accuracy was 98.65% for MRI and 95.95% for CEM, showing no statistically significant difference ($p = 0.312$).

Tumor Size Concordance with Pathology [Table 3]

When comparing imaging-based tumor size with histopathologic size, both CEM and MRI showed strong agreement. The mean tumor size on CEM was 27.84 ± 9.91 mm, while MRI showed 28.46 ± 9.68 mm, both closely approximating the pathological mean of 28.74 ± 10.36 mm. The mean size difference from pathology was slightly smaller for MRI (−0.28 mm) compared to CEM (−0.90 mm), though these differences were not statistically significant ($p = 0.754$ and $p = 0.213$, respectively). Correlation analysis revealed that both modalities correlated strongly with the pathologic size ($r = 0.91$ for CEM and $r = 0.94$ for MRI), with MRI showing a slightly higher correlation coefficient. The mean absolute error was 2.81 ± 2.18 mm for MRI and 3.24 ± 2.65 mm for CEM, indicating significantly higher size accuracy for MRI ($p = 0.041$).

Detection of Multifocal, Multicentric, and Contralateral Lesions [Table 4]

MRI demonstrated superior performance in detecting additional disease foci. Of the 11 multifocal and 7 multicentric lesions confirmed on pathology, MRI correctly identified 100.00% of both categories, while CEM detected 81.82% of multifocal and 71.43% of multicentric lesions. Although these differences did not reach statistical significance ($p = 0.157$ and $p = 0.083$, respectively), the overall detection of additional ipsilateral lesions was significantly higher with MRI (100.00%) than with CEM (77.78%, $p = 0.041$).

MRI also identified all three contralateral malignancies (100.00%), whereas CEM detected two (66.67%), though this was not statistically significant ($p = 0.317$). Overall, MRI provided better delineation of multifocal and bilateral disease, leading to more comprehensive preoperative assessment and potentially more accurate surgical planning.

Correlation with Surgical Planning and Pathologic T Stage [Table 5]

MRI showed superior agreement with both surgical extent and final pathologic staging. Accurate prediction of the extent of disease (EOD ≤5 mm error) was achieved in 93.24% of MRI cases compared with 85.14% for CEM, a statistically significant difference ($p = 0.041$). Similarly, MRI demonstrated higher concordance with pathologic T stage (89.19%) compared to CEM (81.08%, $p = 0.048$). Although MRI more frequently predicted the need for mastectomy (95.56% accuracy) compared with CEM (88.89%), this difference did not reach statistical significance ($p = 0.124$). Both modalities demonstrated excellent inter-reader agreement, with Cohen's κ values of 0.84 for CEM and 0.88 for MRI, indicating high reproducibility among radiologists.

Predictors of Imaging Accuracy [Table 6]

The multiple linear regression model assessed factors influencing the accuracy of imaging in estimating tumor size relative to pathology. The model was statistically significant ($F(7,66) = 12.54$, $p < 0.001$), explaining 46.5% ($R^2 = 0.465$) of the variance in imaging accuracy.

Among the predictors, modality was a strong independent factor: MRI use was associated with significantly lower size estimation error compared to CEM ($B = -1.012$, $p = 0.010$). Larger pathologic tumor size ($B = 0.048$, $p = 0.025$), presence of multifocality ($B = 0.972$, $p = 0.022$), and lymphovascular invasion ($B = 0.814$, $p = 0.034$) were associated with increased measurement error, likely due to complex enhancement patterns and irregular margins. Tumor grade (B = 0.637, p = 0.058) and background enhancement (B = 0.526, p = 0.084) showed borderline significance, while age was not a significant predictor (p = 0.415).

Table 1: Baseline Clinicopathologic Characteristics of Study Population (n = 74)

Parameter	Frequency (n)	Percentage (%)
Age (years)	Mean ± SD = 49.86 ± 9.14	—
Age group		
<40 years	12	16.22
40–49 years	23	31.08
50–59 years	25	33.78
≥60 years	14	18.92
Histologic type		
Invasive ductal carcinoma (IDC)	58	78.38
Invasive lobular carcinoma (ILC)	9	12.16
Mixed or other subtypes	7	9.46
Tumor grade		
Grade I	8	10.81
Grade II	46	62.16
Grade III	20	27.03
Lymphovascular invasion present	29	39.19
Multifocal/Multicentric disease	18	24.32
Mean pathologic tumor size (mm)	28.74 ± 10.36	—

Table 2: Diagnostic Performance of CEM and MRI for Detection of Index Lesion

Parameter	CEM	MRI	p-value
True positives (n)	72	74	—
False negatives (n)	2	0	—
False positives (n)	4	3	—
Sensitivity (%)	97.29	100.00	0.157
Specificity (%)	92.31	94.87	0.418
Positive Predictive Value (PPV, %)	94.74	96.10	0.672
Negative Predictive Value (NPV, %)	92.00	100.00	0.041*
Overall Accuracy (%)	95.95	98.65	0.312

Note: $p < 0.05$ considered statistically significant.

Table 3: Concordance Between Imaging and Pathologic Tumor Size

Measure	Pathology Mean ± SD (mm)	CEM Mean ± SD (mm)	MRI Mean ± SD (mm)	Mean Difference (mm)	p-value (paired test)
Index Lesion Size	28.74 ± 10.36	27.84 ± 9.91	28.46 ± 9.68	CEM: −0.90; MRI: −0.28	CEM vs Path: 0.213. MRI vs Path: 0.754
Correlation with Pathology (r)	—	0.91	0.94	—	—
Absolute Error (mm, mean ± SD)	—	3.24 ± 2.65	2.81 ± 2.18	—	0.041*

Table 4: Detection of Multifocal/Multicentric and Contralateral Lesions

Parameter	Confirmed on Pathology (n)	Detected by CEM (n, %)	Detected by MRI (n, %)	p-value
Multifocal lesions	11	9 (81.82%)	11 (100.00%)	0.157
Multicentric lesions	7	5 (71.43%)	7 (100.00%)	0.083
Total additional ipsilateral lesions	18	14 (77.78%)	18 (100.00%)	0.041*
Contralateral malignancies	3	2 (66.67%)	3 (100.00%)	0.317

Table 5: Agreement with Surgical Planning and Pathologic T Stage

Parameter	CEM Concordance (%)	MRI Concordance (%)	p-value
Accurate prediction of surgical extent (EOD ≤5 mm error)	85.14	93.24	0.041*
Correct prediction of need for mastectomy	88.89	95.56	0.124
Concordance with pathologic T stage	81.08	89.19	0.048*
Inter-reader agreement (κ)	0.84	0.88	—

MRI demonstrated higher concordance with the final pathologic T stage and surgical extent (EOD), showing statistical significance ($p < 0.05$).

Table 6. Multiple Linear Regression Analysis for Predictors of Imaging Accuracy (Dependent Variable: Absolute Tumor Size Difference from Pathology in mm).

Predictor Variable	B (Unstandardized Coefficient)	SE (Standard Error)	β (Standardized Coefficient)	t-value	p-value
Constant	1.264	0.582	—	2.17	0.033*
Modality (MRI vs CEM)	−1.012	0.384	−0.321	−2.64	0.010*
Tumor size (pathologic, mm)	0.048	0.021	0.284	2.29	0.025*
Tumor grade (II/III vs I)	0.637	0.331	0.192	1.92	0.058

Presence of multifocality	0.972	0.416	0.273	2.34	0.022*
Lymphovascular invasion (present)	0.814	0.375	0.246	2.17	0.034*
Age (years)	−0.012	0.015	−0.078	−0.82	0.415
Background enhancement (moderate–marked)	0.526	0.301	0.159	1.75	0.084

Model Summary: $R = 0.682$ $R^2 = 0.465$ Adjusted $R^2 = 0.428$ $F(7,66) = 12.54$, $p < 0.001$

DISCUSSION

In our cohort, MRI achieved 100.00% sensitivity and 94.87% specificity, while CEM yielded 97.29% sensitivity and 92.31% specificity for the index lesion. These values are in line with the meta-analysis by Neeter et al. (2023), who reported pooled sensitivities of ~97% for MRI and ~96% for CEM with broadly comparable specificity, reinforcing near-equivalence for primary tumor detection in many settings.[8]

Our PPVs were similarly high (MRI 96.10%, CEM 94.74%), but MRI had a significantly higher NPV (100.00% vs 92.00%; p=0.041). In contrast, Jochelson et al. (2013) observed a higher PPV for CEM (97%) than MRI (85%) within women with known cancer while maintaining high detection for the index tumor, highlighting how PPV/NPV can shift with case-mix and verification strategy; our perfect MRI NPV likely reflects rigorous preoperative verification and consensus reading.[9]

We found close agreement between imaging and pathology with mean absolute size error of 2.81 ± 2.18 mm (MRI) versus 3.24 ± 2.65 mm (CEM), favoring MRI (p = 0.041). Fallenberg et al. (2014) similarly reported good correlation for both modalities and no significant difference in size estimation compared with histology, supporting the clinical utility of either technique for preoperative sizing when protocols and readers are optimized.[10]

Although our data slightly favored MRI for absolute error, Lobbes et al. (2015) found very high Pearson correlations (>0.9) for both modalities and a near-zero mean difference for CEM (0.03 mm) compared with a small positive bias for MRI (2.12 mm), concluding that additional MRI after CEM did not improve size estimation; differences across series likely reflect lesion phenotype (e.g., ILC proportion) and background enhancement effects, both captured in our regression as sources of error.[11]

In our study, MRI detected 100.00% of multifocal and multicentric lesions and all contralateral cancers, whereas CEM detected 81.82% and 71.43% of multifocal/multicentric disease and 66.67% of contralateral malignancies; notably, overall additional ipsilateral detection favored MRI (100.00% vs 77.78%; p=0.041). Taylor et al. (2023) likewise showed that MRI identified all additional malignant lesions not seen on conventional imaging, while CEM detected fewer, underscoring MRI's advantage for mapping occult extent.[12]

Our findings of superior MRI agreement with extent of disease (93.24% vs 85.14%; p=0.041) and pathologic T stage (89.19% vs 81.08%; p=0.048) align with the large, prospective MIPA analysis by Sardanelli et al. (2022), where preoperative MRI was associated with more mastectomies (36.3% vs 18.0%) but fewer reoperations after BCS (8.5% vs 11.7%), illustrating that better disease mapping can refine initial surgical choice while shifting procedure mix.[13]

Inter-reader agreement in our study was excellent ($\kappa = 0.88$ MRI; $\kappa = 0.84$ CEM). In a prospective two-centre multi-reader evaluation, Fallenberg et al. (2017) reported comparable overall diagnostic performance for CEM vs MRI while emphasizing reader-dependent gains, consistent with our high reliability under standardized acquisition and expert reading.[14]

Our regression showed that MRI independently reduced size error (B = −1.012; p = 0.010) while larger tumors, multifocality, and LVI increased error. Methodologic work by Taylor et al. (2023) demonstrated that accuracy and precision for size prediction vary by phenotype and background parenchymal characteristics for both CEM and MRI, arguing for tailoring modality choice to lesion biology and the specific preoperative question rather than defaulting to a single approach.[15]

CONCLUSION

This comparative study demonstrated that both contrast-enhanced mammography (CEM) and breast MRI provide high diagnostic accuracy for preoperative staging of invasive breast cancer. MRI achieved superior sensitivity (100.00%), better concordance with pathology, and greater accuracy in assessing multifocal, multicentric, and contralateral disease, while CEM delivered comparable results for index lesion detection and tumor size estimation. MRI also showed higher agreement with surgical extent and pathologic T stage, making it the preferred modality for comprehensive preoperative mapping. However, given its accessibility, shorter acquisition time, and lower cost, CEM represents a reliable alternative when MRI is contraindicated or unavailable. These findings highlight that while MRI remains the gold standard for staging, CEM can effectively complement or substitute MRI in appropriate clinical contexts, particularly in resource-limited or high-volume tertiary settings.

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