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CLINICAL, RADIOLOGICAL AND HISTOPATHOLOGICAL CORRELATION IN BREAST CARCINOMA: A PROSPECTIVE STUDY FROM A TERTIARY-CARE CENTRE

Oncology

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KEYWORDS

INTRODUCTION

Breast cancer is the most frequently diagnosed malignancy and the leading cause of cancer death among women worldwide, accounting for 2.3 million new cases and 685 000 deaths in 2020 [1]. Incidence is rising steeply in low- and middle-income countries, propelled by urbanisation, lifestyle changes and improved, albeit uneven, access to diagnostic facilities [2]. In India breast cancer now surpasses cervical cancer as the commonest female malignancy, with age-standardised rates projected to increase by 40 % over the next decade [3]. Early detection substantially reduces mortality; five-year survival approaches 99 % for stage I but falls below 30 % for stage IV disease [4]. The "triple assessment" strategy combines clinical breast examination (CBE), imaging and histopathology to maximise diagnostic accuracy [5]. Mammography remains the primary imaging modality for women >40 years; however, its sensitivity drops from 85 % to <60 % in dense breasts common among Asian women [6]. Adjunct ultrasonography enhances lesion characterisation, guides biopsy and improves cancer detection in dense tissue [7]. Magnetic resonance imaging offers the highest sensitivity (>90 %) and is recommended for high-risk screening and evaluation of multifocal disease, but cost and availability limit its routine use in many regions [8]. Despite technological advances, discordance between preoperative staging and postoperative pathology persists. Over-staging may precipitate mastectomy or extensive axillary dissection, whereas under-staging risks inadequate margins or missed nodal metastases, adversely affecting prognosis. Few Indian studies have systematically quantified the agreement among clinical, radiological and pathological staging in a prospective framework. Understanding these discrepancies is critical for refining diagnostic algorithms, optimising resource allocation and tailoring treatment to individual tumour biology.

The present study prospectively evaluated the sensitivity, specificity and concordance of clinical and radiological T and N staging relative to histopathology in operable breast-cancer patients at a tertiary-care referral centre in North India. We also explored association between key sonographic and mammographic features and tumour grade, and we examined how pathological risk factors such as lymphovascular invasion (LVI), perineural invasion (PNI) and extracapsular extension (ECE) correlate with imaging-based stage. These data aim to inform evidence-based protocols for breast-cancer work-up in resource-limited settings.

MATERIALS AND METHODS

Study Design And Setting: A prospective observational study was conducted in the Department of Surgery, Sarojini Naidu Medical College, Agra, from May 2023 to April 2025. Institutional Ethics Committee approval and written informed consent were obtained (Annexure I & II).

Participants: Inclusion criteria were adult women (≥18 years) with biopsy-proven, operable, non-metastatic invasive breast carcinoma (cT1–3, N0–2, M0). Exclusions comprised inflammatory, ulcerated or fungating tumours, prior neoadjuvant therapy, distant metastasis or pregnancy.

Clinical Assessment: As per Protocol CBE was done, Tumor size was measured with Vernier callipers, Nipple changes and Axillary nodes were noted. Clinical stage was assigned as per AJCC 8th edition.

Imaging Protocol: Women <40 years received targeted breast-axillary ultrasound (12–15 MHz linear probe) as the first test; suspicious findings triggered supplementary breast MRI (1.5 T, dynamic contrast-enhanced). Women ≥40 years underwent bilateral digital mammography (craniocaudal and mediolateral-oblique views) and ultrasound. Lesions were categorised using BI-RADS-2022. Radiological T and N stages were derived from the composite imaging impression. All images were double-read by fellowship-trained radiologists.

Pathology: Ultrasound-guided core-needle biopsy (14-gauge) preceded definitive surgery. As per the stage of disease, modified radical mastectomy or breast-conserving surgery with sentinel-node biopsy/axillary dissection were done. The specimens were analysed as per College of American Pathologists guidelines. Tumour histotype, grade (Nottingham system), LVI, PNI, ECE and receptor status were documented.

Outcomes

Primary: sensitivity, specificity, positive predictive value (PPV), negative predictive value (NPV) and Cohen's κ for clinical and radiological T/N stages versus histopathology.

Secondary: associations between imaging features and tumour grade; correlation of LVI, PNI, ECE with imaging stage.

Statistical Analysis: Data were entered into SPSS v26. Categorical variables were expressed as frequencies, percentages and continuous data as mean ± SD. Differences between proportions were assessed with χ^2 or Fisher's exact test; means with ANOVA or t-test. κ values were interpreted as slight (0–0.20), fair (0.21–0.40), moderate (0.41–0.60), substantial (0.61–0.80) or almost perfect (>0.80). $P < 0.05$ denoted statistical significance.

RESULTS

Fifty women (mean age 52 ± 11 years; range 31–78) were analysed. The peak incidence (26 %) lay in the 51–60-year bracket (Figure 1). Seventy percent were post-menopausal; 12 % reported a first-degree family history. Median symptom duration was 4 months (IQR 2–6), and 60 % presented with palpable axillary nodes. Histopathology revealed invasive ductal carcinoma in 48/50 cases and invasive lobular carcinoma in two. Grade 3 tumours constituted 66 %, grade 2 constituted 22% and grade 1 constituted 12%. Pathological staging distribution was pT1 22 %, pT2 44 %, pT3 34 %; nodal status was pN0 36 %, pN1 44 %, pN2 20 %. Adverse features included LVI in 64 %, PNI in 24 % and ECE in 22 %. Clinical T staging correctly predicted pathologic T stage in 60 % of cases (κ = 0.13; Table 2). Over-estimation occurred in 18 %, under-estimation in 22 %. For nodal disease, CBE demonstrated 72 % sensitivity but only 61 % specificity, missing occult metastases in 29 % of clinically node-negative axillae (Table 3).

Composite imaging achieved higher concordance: accurate T staging in 68 % (κ = 0.26) and N staging in 66 % (κ = 0.13). Sensitivity/specificity were 77 %/79 % for T and 72 %/73 % for N,

respectively. MRI altered T stage in 6/18 (33 %) dense-breast patients initially scanned with ultrasound alone and identified multifocal disease in three. Irregular shape (90 %), non-circumscribed margins (microlobulated 42 %, spiculated 28 %, indistinct 26 %) and posterior acoustic enhancement (40 %) predominated. Margin type was strongly linked to tumour grade ($\chi^2 = 27.7$; $p < 0.001$), with microlobulation and indistinctness most frequent in grade 3 (Table 4). Echogenicity showed no significant association. Mass lesions appeared in 52 %, microcalcifications in 50 % and asymmetry in 29 %. Asymmetry correlated modestly with high-grade tumours ($p = 0.036$). Mammography detected 85 % of pT2–3 lesions but missed five pT1 cancers subsequently visualised on ultrasound. Radiological T2 and T3 stages exhibited higher LVI prevalence ($p = 0.049$), whereas PNI clustered in radiological T3 tumours ($p = 0.019$). ECE did not differ significantly across imaging stages. Overall, radiology outperformed clinical examination yet failed to detect one in four pathologically significant findings, underscoring the indispensability of systematic clinicoradiological–pathological correlation (Figure 2).

Table 1: Demographic And Baseline Clinical Characteristics

Characteristic	Value
Mean age ± SD (years)	52 ± 11
Age group, n (%)	31–40 y: 11 (22%) 41–50 y: 10 (20%) 51–60 y: 13 (26%) 61–70 y: 8 (16%) 71–80 y: 8 (16%)
Menopausal status, n (%)	Premenopausal: 15 (30%) Postmenopausal: 35 (70%)
Median symptom duration	4 months (IQR 2–6)
Family history positive, n (%)	6 (12%)
Palpable axillary nodes, n (%)	30 (60%)

Table 2: Concordance Of Clinical And Radiological T Staging With Pathology

	Pathologic T1	Pathologic T2	Pathologic T3
Clinical T1	6	3	2
Clinical T2	4	7	5
Clinical T3	1	6	10
Radiological T1	6	2	3
Radiological T2	3	9	3
Radiological T3	2	4	11

Table 3: Diagnostic Performance Metrics (Clinical vs Radiological)

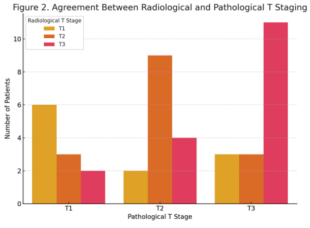
Metric	T Stage Clinical	T Stage Radiological	N Stage Clinical	N Stage Radiological
Sensitivity (%)	80	77	72	72
Specificity (%)	65	79	61	73
Positive Predictive Value (PPV) (%)	88	80	77	96
Negative Predictive Value (NPV) (%)	76	76	55	75
Cohen's κ	0.13	0.26	0.06	0.13

Table 4: Association of Ultrasound Margin with Tumour Grade

Margin Pattern	Grade 1 (n = 6)	Grade 2 (n = 11)	Grade 3 (n = 33)	p value
Circumscribed	0	2 (18%)	0	
Microlobulated	2 (33%)	3 (27%)	16 (49%)	<0.001
Spiculated	4 (67%)	6 (55%)	2 (6%)	
Indistinct	0	0	13 (39%)	

Figure 1: Agreement Between Radiological and Pathological T Staging

This grouped bar chart make it easier to compare how each radiological T stage aligns with the pathological T stages:



DISCUSSION

This prospective study demonstrates that, while clinical examination remains indispensable for initial breast-cancer evaluation, composite imaging—mammography plus ultrasound with selective MRI—offers superior, albeit still imperfect, prediction of pathological stage. Radiological staging achieved sensitivities of 77 % (T) and 72 % (N), comparable to Western series reporting 70–85 % for tumour size and 65–75 % for nodal assessment [9,10]. However, κ values indicated only fair agreement, underscoring persistent under- and over-staging, particularly in dense breasts and in detecting micrometastatic nodes. Our finding that one-third of clinically node-negative axillae harboured metastases parallels sentinel-node biopsy trials, which report occult nodal disease in 20–40 % [11]. Conversely, 27 % of clinically node-positive axillae were pathologically negative, echoing Majid et al. who documented low CBE specificity [12]. These discrepancies justify universal image-guided core-biopsy of suspicious nodes or routine sentinel-node mapping even when ultrasound is negative. Ultrasound margin characteristics emerged as powerful surrogates of tumour grade, with microlobulation and indistinct margins strongly linked to grade 3 tumours ($\chi^2 = 27.7$). Similar associations have been described by Mokhtari [13] and Bae [14], reflecting the infiltrative growth pattern of high-grade cancers. Posterior acoustic enhancement, traditionally attributed to cellular, vascular tumours, also correlated with grade 3, lending support to its inclusion in risk stratification algorithms. Mammography detected all pT2–3 tumours but missed 10 % of pT1 lesions; supplemental ultrasound mitigated this limitation, confirming recommendations for combined screening in dense-breast populations [6]. Asymmetrical density rather than microcalcification was the mammographic marker most predictive of high grade, aligning with Berg's observation that non-calcified asymmetries often represent aggressive, interval cancers [15]. Adverse pathological features—LVI, PNI and ECE—were prevalent (64 %, 24 %, 22 %) and associated with higher imaging stages, corroborating their established prognostic impact [16]. Radiological T2–3 tumours exhibited significantly more LVI, suggesting that apparent size on imaging may reflect biologic aggressiveness beyond physical dimensions. Our study's strengths include prospective design, uniform imaging protocol and double-reader interpretation. Limitations encompass single-centre setting, modest sample size and lack of molecular subtyping, which may influence imaging-pathology correlations. Nevertheless, the data emphasise the need for meticulous clinicoradiological conferences; any discordance should prompt repeat biopsy or advanced imaging to avert mismanagement. Future research should integrate diffusion-weighted MRI, contrast-enhanced mammography and AI-driven radiomics to refine non-invasive staging. Incorporating genomic assays with imaging biomarkers could yield composite nomograms predicting pathological stage and treatment response, particularly relevant for neoadjuvant decision-making in resource-limited environments

CONCLUSION

In this cohort of operable breast-cancer patients, radiological staging outperformed clinical examination yet misclassified one in four tumours or axillae when benchmarked against histopathology. Ultrasound features—especially non-circumscribed margins—and mammographic asymmetry reliably indicated high-grade disease. Routine integration of composite imaging with prompt core-biopsy, followed by systematic clinicoradiological–pathological correlation, is essential to optimise staging accuracy, tailor therapy and improve outcomes, particularly in settings where advanced imaging resources are constrained.

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