OPEN ACCESS Research Paper

Pathological Evaluation of Breast Cancer Surgical Specimens Following Neoadjuvant Chemotherapy in Iraqi Women

Farah Qais Matti[1], *Ayser Hameed Latif*[2]

ABSTRACT:

BACKGROUND:

Breast cancer remains the most common malignancy among women worldwide. Neoadjuvant chemotherapy (NACT) is increasingly used to downstage tumors and improve surgical outcomes. The Residual Cancer Burden (RCB) system has emerged as a reliable tool to quantify treatment response across various breast cancer subtypes.

OBJECTIVE:

This study aimed to assess clinicopathological features of breast cancer patients before and after NACT, evaluate treatment response using RCB class categories, and examine the associations between RCB classes and clinicopathological parameters. It also explored the impact of NACT on axillary lymph node retrieval and surgical trends in Iraq.

METHODS:

A retrospective cross-sectional study included 113 patients with primary invasive breast cancer who received NACT followed by surgical resection. Data were collected from Al-Yarmouk Teaching Hospital and private laboratories between January and October 2024.

RESULTS:

The mean patient age was 48.7 years. Invasive ductal carcinoma accounted for 92.9% of cases, and 77% of tumors were grade II. Hormonal receptor-positive/HER2-negative tumors were the most frequent subtype (57.5%). Post-NACT, 65.5% had residual invasive disease, and 23.9% had residual in situ carcinoma. RCB class II was the most common (34.5%). Significant associations were found between RCB classes and tumor grade, receptor subtype, in situ carcinoma, lymphovascular invasion, and pathological tumor/node stage ($p < 0.001$–0.032). No significant association was observed between tumor stage and age. Mastectomy (72.6%) and axillary dissection (90.3%) were predominant. RCB class correlated significantly with the number of retrieved lymph nodes ($p = 0.003$).

CONCLUSION:

RCB classification is a valuable indicator of treatment response and correlates with key pathological features. Surgical trends in Iraq still favor mastectomy and full axillary dissection.

KEYWORDS: Pathological, Surgical, Specimens, Neoadjuvant, Chemotherapy, Breast Cancer.

[1] Medical City Complex/ Baghdad Teaching Hospital.

[2] Assistant professor in Pathology, College of Medicine, University of Al-Mustansiriyah.

Iraqi Postgraduate Medical Journal, 2026; Vol.25 (2): 183-193
DOI: 10.52573/ipmj.2025.162706 *Received: July 12, 2025* *Accepted: august 28, 2025*

INTRODUCTION:

Breast cancer is one of the most common cancers worldwide and the most commonly diagnosed malignancy in women internationally [(1)]. The International Agency for Research on Cancer states that breast cancer represents one in four cancer types diagnosed in women, with an estimated 2,261,419 (24.5%) new breast cancer cases diagnosed in 2020 [(2)]. Cancer is the main cause of death in Eastern Mediterranean Region countries, including Iraq [(3)]. In 2023, breast cancer accounted for (20.5%) of all recently detected cancers, (34.8%) of female malignancies, and (24.2%) of cancer-related deaths among Iraqi female patients [(4)]. The lack of breast health care education in developing countries leads to the advanced stages of breast cancer. In Iraq, a majority of population is diagnosed at a later stage which is associated with poor prognosis [(3)]. Breast cancer management involves a multidisciplinary approach. Pre- therapeutic staging is based on a multitude of triple assessments of palpable breast lumps, including clinical examinations, imaging, and laboratory techniques [(5)]. Histological diagnosis and pathological evaluation of essential markers including hormone receptors

(HRs) and human epidermal growth factor receptor 2 (HER2), are critical for breast cancer treatment. The standard surgical procedures for breast cancer management after Neoadjuvant chemotherapy (NACT) have included either breast conserving surgery (BCS) or mastectomy with axillary dissection [5,6]. Neoadjuvant therapy (NAT) was first introduced in the 1970s and defined as the administration of chemotherapy before definitive surgery, which is now widely used for patients with early- and locally advanced-stage breast cancer [7]. NACT is usually followed by locoregional management and has been successfully used in clinical practice to minimize the extent of breast surgery, down staging, and shrinking tumor size [6,7]. Another benefit of NACT is the opportunity to de-escalate axillary nodal surgery [8]. Neoadjuvant treatment is becoming the standard approach in many institutes and is usually offered to younger patients, clinically large tumor sizes, and node-positive, multifocal, and multicentric breast cancer. In addition, patients with triple-negative or HER2-positive breast cancer are usually recommended to be treated with NACT [9]. Several classification systems have been developed for the assessment of pathological response to NACT. Although, collectively, they have their advantages and disadvantages, most have been validated as correlating with outcome (overall survival (OS), event-free survival, and/or distant relapse free survival). However, different staging systems yield different estimates of future risk. These systems, to name a few; including the Miller-Payne system, Residual Disease in Breast and Nodes, the Chevalier method, the Sataloff method, and Residual Cancer Burden system (RCB). The Residual Cancer Burden is an online tool for the quantification of residual disease that is simple to apply, reproducible, and has been clinically validated with long-term follow-up data [10]. RCB index and classification could help determine the most appropriate treatment plans for patients with all breast cancer subtypes [11]. The definition of pathological complete response (pCR) has not been uniform, making reporting and interpretation of data challenging [10]. pCR according to AJCC is now defined as no invasive disease in the breast (ypT0/ypTis or ypT0) and no disease in all sampled lymph nodes (ypN0). It is unclear if residual in situ carcinoma after NACT affects prognosis. The definition of pCR used may or may not include the absence of residual in situ carcinoma [12]. This study aims to analyze clinicopathological characteristics of breast cancer patients before and after neoadjuvant chemotherapy and their association with Residual Cancer Burden (RCB) class categories. It also evaluates tumor response using the RCB system and the correlation between pathological tumor stage and age. Additionally, it assesses the types of breast and axillary surgical specimens and the impact of treatment on axillary lymph node yield.

METHOD:

This retrospective cross-sectional study reviewed 113 cases of primary invasive breast cancer treated with neoadjuvant chemotherapy (NACT) followed by surgical resection, drawing specimens from Al-Yarmouk Teaching Hospital and affiliated private laboratories between April 2024 and April 2025. Patient records dating back to 2021 were screened to identify those who met inclusion criteria: a confirmed diagnosis of invasive carcinoma on tru-cut biopsy and receipt of NACT as the first-line treatment. Patients presenting with inflammatory breast cancer (T4), prior surgical excision, incomplete biopsy records, metastatic disease at presentation, or local recurrence were excluded. Clinicopathological data were abstracted from archival histopathology reports, H&E-stained slides, and formalin-fixed, paraffin-embedded tissue blocks. Recorded variables included patient age at diagnosis; laterality of tumor involvement; histological subtype and grade; hormone receptor (ER/PR) and HER2 status; residual invasive and in situ disease; lymphovascular invasion; nodal status; and TNM staging according to the AJCC 8th edition (ypT0–ypT3, ypN0–ypN3). HER2 expression was determined by immunohistochemistry with scoring in accordance ASCO/ CAP guidelines. Scores 3+ were reported as strong positive, while score 1+/0 considered negative, score 2+ cannot be included in the study since it needs confirmatory testing by FISH and that was not available in our institute. Tumors were grouped as ductal carcinoma NST or lobular carcinoma, and graded by Nottingham grading system. Residual Cancer Burden (RCB) was calculated using the MD Anderson RCB calculator, incorporating primary tumor bed area, cellularity percentages, in situ component, number of positive lymph nodes, and largest nodal metastasis diameter; resulting scores were stratified into RCB-0 (pCR), RCB-I, RCB-II, and RCB-III. Surgical approaches were categorized as mastectomy (simple, modified radical, or skin/nipple-sparing) or breast-conserving surgery (wide local excision, lumpectomy, or quadrantectomy). Axillary procedures included full lymph node dissection or sentinel lymph node biopsy, with total retrieved nodes, treatment-effect nodes, involved nodes, and

uninvolved nodes recorded. Histopathological review was performed by a senior pathologist, who re-examined H&E slides at 4×, 10×, and 40× magnifications for treatment response and nodal metastases; photomicrographs were captured with a Galaxy S20 camera at 1440×3200-pixel resolution. Chemicals and equipment for sectioning and staining—ethanol, xylene, hematoxylin, eosin, microtome, hot air oven, and Leica light microscope—were sourced from recognized international manufacturers. Tissue processing followed standard deparaffinization, graded alcohol hydration, hematoxylin staining, acid-alcohol differentiation, eosin counterstaining, dehydration, xylene clearing, and DPX mounting. Continuous variables were summarized as means ± SD, and categorical variables as frequencies and percentages. Fisher's exact test assessed categorical associations, while one-way ANOVA compared continuous measures; statistical significance was set at $p < 0.05$. Analyses and visualizations were conducted in R (version 4.2.2) using dplyr, gt_summary, and ggplot2 packages. Ethical approval was granted by the Scientific Council of Histopathology, Iraqi Board of Medical Specialization (Issue No. Path47, 22 April 2024), and all data were used solely for research purposes.

RESULTS:

The study involved 113 breast cancer patients with a mean age of 48.7 ± 11.4 years. Invasive ductal carcinoma was the predominant type (92.9%), while invasive lobular accounted for 7.1%. Most tumors were Grade II (77.0%), followed by Grade III (21.2%) and Grade I (1.8%). Hormonal receptor (ER/PR) positivity was seen in 67.3% of patients. HER2 positivity was found in 31.0% of cases. The most common molecular subtype was hormone receptor-positive (57.5%), followed by HER2-enriched (21.2%), triple-negative (11.5%), and triple-positive (9.7%). Mastectomy was the most common surgery (72.6%), especially simple mastectomy (56.6%). Modified radical mastectomy was performed in 15.9% of cases. Breast-conserving surgeries included wide local resection (21.2%), lumpectomy (4.4%), and quadrantectomy (1.0%). As in table 1 and 2.

Table 1: **Description of the demographic and pathological tumor parameters pre-NACT.**

Age of the patients	Mean ± SD	48.7 ± 11.4
	Median (range)	48.0 (29.0 - 73.0)
Histological type	Invasive ductal carcinoma	105 (92.9%)
	Invasive lobular carcinoma	8 (7.1%)
Tumor grade	Grade I	2 (1.8%)
	Grade II	87 (77.0%)
	Grade III	24 (21.2%)
ER /PR status	Positive	76 (67.3%)
	Negative	37 (32.7%)
HER2 status	Negative	78 (69.0%)
	Positive	35 (31.0%)
Breast cancer receptor subtypes	Hormonal positive	65 (57.5%)
	HER2 enriched	24 (21.2%)
	Triple negative	13 (11.5%)
	Triple positive	11 (9.7%)

Table 2: Breast surgical specimen types and laterality post-NACT.

Type of surgical specimens	N = 113*
Modified radical mastectomy	18 (15.9%)
Simple mastectomy	64 (56.6%)
Lumpectomy	5 (4.42%)
Wide local resection	24 (21.2%)
Quadrantectomy	2 (1.0%)
Laterality	
Right	64 (56.6%)
Left	42 (37.2%)
Bilateral	5 (4.4%)

As shown in figure 1, breast conserving surgery (BCS) has increased over the last four years. In 2023, 24.8% of patients underwent BCS, followed by 2024, when 23% did, and 2021, when only 14.2% had mastectomies. Mastectomy was still the most common surgical approach to breast cancer after NACT.

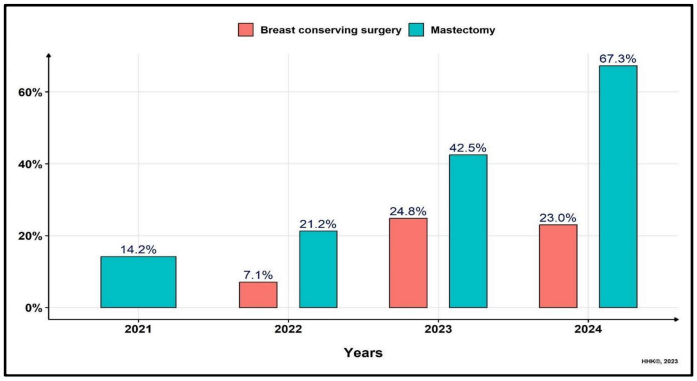

Figure 1: Bar-chart showing the trends in breast surgical specimens: breast- conserving surgery vs. mastectomy (2021–2024).

In 27 patients (23.9%), ductal carcinoma in situ was the most prevalent histological type (23 patients, 20.4%), followed by lobular carcinoma (4 patients, 3.5%). In 74 patients (65.5%), invasive ductal carcinoma was the most prevalent histological type (66 patients, 89.2%), while invasive lobular carcinoma was less common (8 patients, 10.8%). Tumour cells invaded lymphatic and vascular systems in 66 individuals (58.4%). Table (3) shows that RCB class II was the most common class for tumour response after NACT, followed by III (31.9%), pCR (RCB class-0) (30.5%), and I (8.1%).

Table 3: Histopathological characteristics in post-NACT biopsies.

Histopathological Characteristic			
Residual disease	**Residual in situ carcinoma 27 (23.9%) N=27 (100%)**	**Ductal carcinoma in situ**	**23 (20.4%)**
		Lobular carcinoma in situ	**4 (3.5%)**
	Residual invasive tumor 74 (65.5%) N =74 (100%)	**Invasive ductal carcinoma**	**66 (89.2%)**
		Invasive lobular carcinoma	**8 (10.8%)**
Lympho-vascular Invasion	**66 (58.4%)**		
Tumor response to NACT according to RCB class	**RCB-0**		**30 (26.5%)**
	RCB-I		**8 (7.1%)**
	RCB-II		**39 (34.5%)**
	RCB-III		**36 (31.9%)**

Regarding axillary surgical samples after NACT, most patients 102 (90.3%) underwent surgery with axillary lymph node dissection, while 7 patients (6.2%) had surgery with sentinel lymph node biopsy. Nodal involvement by tumor was seen in 65 patients (57.5%). The total number of lymph nodes examined had a mean value of 15.3 ± 5.8. Other lymph node characteristics were; lymph node showing treatment effect had a mean value of 1.3 ± 2.5, lymph node that were free from tumor had a mean value of 1.3 ± 2.5 and number of lymph node that were involved by tumor had mean value of 2.9 ± 4.2 as shown in table (4).

Table 4: Axillary surgical sample types and lymph node characteristics post- NACT.

	N=113*	
Axillary surgical samples	Axillary lymph node dissection	102 (90.3%)
	Axillary sentinel lymph node	7 (6.2%)
Nodal involvement by tumor		65 (57.5%)
Lymph Node Characteristics	Total number of lymph nodes examined	15.3 ± 5.8
	Number of lymph nodes involved	2.9 ± 4.2
	Number of tumor-free lymph nodes	1.3 ± 2.5
	Number of lymph nodes showing treatment effect	1.3 ± 2.5

Tumor pathological (T) staging revealed that ypT1 was the most common stage, observed in 33 patients (29.2%), followed by ypT0 in 32 patients (28.3%) and ypT2 in 31 patients (27.4%). ypT3 was noted in 10 patients (8.8%), while ypT(is) was the least frequent stage, found in 7 patients (6.2%) as seen in table (3.5). In terms of pathological (N) staging, ypN0 was the most prevalent, seen in 47 patients (41.6%), indicating no residual nodal disease. ypN1 was observed in 32 patients (28.3%), followed by ypN2 in 25 patients (22.1%) and ypN3 in 8 patients (7.1%). Only one patient (0.9%) had an unknown nodal status (ypNx) as seen in table (5).

Table 5: Description of the pathological staging (ypT/ypN) after NACT.

Characteristic		N = 113*
Pathological (T) stage	ypT0	32 (28.3%)
	ypT(is)	7 (6.2%)
	ypT1	33 (29.2%)
	ypT2	31 (27.4%)
	ypT3	10 (8.8%)
Pathological (N) stage	ypN0	47 (41.6%)
	ypNx	1 (0.9%)
	ypN1	32 (28.3%)
	ypN2	25 (22.1%)
	ypN3	8 (7.1%)

The analysis across RCB classes (0–III) showed significant differences in tumor characteristics. Residual in situ carcinoma and invasive tumor presence increased with higher RCB class ($p = 0.022$ and $p < 0.001$, respectively). Lymphovascular invasion (LVI) and nodal involvement were absent in RCB 0 but reached 100% in RCB III ($p < 0.001$). Higher RCB classes were associated with advanced pathological T and N stages ($p < 0.001$). Grade III tumors were more frequent in RCB II and III ($p = 0.032$). HER2-enriched and triple-negative subtypes were predominant in RCB 0, while hormone-positive tumors were more frequent in RCB II and III ($p < 0.001$). as in table 6.

Table 6: Analysis of correlation between clinicopathological parameters and RCB class categories.

Characteristic	0,N = 30*	I,N = 8*	II,N = 39*	III,N = 36*	p-value**
Residual in situ carcinoma	2 (6.7%)	4 (50.0%)	11(28.2%)	10(27.8%)	**0.022**
Lympho-vascular Invasion	0(0.0%)	6(75.0%)	24(61.5%)	36(100.0%)	**<0.001**
Nodal involvement	0(0.0%)	6(75.0%)	23(59.0%)	36(100.0%)	**<0.001**
Pathological(T) stage					
ypT0	27(90.0%)	3(37.5%)	2(5.1%)	0(0.0%)	**<0.001**
ypT(is)	3(10.0%)	3(37.5%)	1(2.6%)	0(0.0%)	
ypT1	0(0.0%)	1(12.5%)	24(61.5%)	8(22.2%)	
ypT2	0(0.0%)	1(12.5%)	12(30.8%)	18(50.0%)	
ypT3	0(0.0%)	0(0.0%)	0(0.0%)	10(27.8%)	
Pathological(N) stage					
ypN0	30(100.0%)	2(25.0%)	15(38.5%)	0(0.0%)	**<0.001**
ypNx	0(0.0%)	0(0.0%)	1(2.6%)	0(0.0%)	
ypN1	0(0.0%)	6(75.0%)	14(35.9%)	12(33.3%)	
ypN2	0(0.0%)	0(0.0%)	7(17.9%)	18(50.0%)	
ypN3	0(0.0%)	0(0.0%)	2(5.1%)	6(16.7%)	
Characteristic	**0,N = 30***	**I,N = 8***	**II,N = 39***	**III,N = 36***	**p-value****
Tumor grade					
Grade I	1(3.3%)	0(0.0%)	1(2.6%)	0(0.0%)	**0.032**
Grade II	27(90.0%)	8(100.0%)	25(64.1%)	27(75.0%)	
Grade III	2(6.7%)	0(0.0%)	13(33.3%)	9(25.0%)	

Breast cancer receptor subtypes					
Hormonal positive	8(26.7%)	4(50.0%)	26(66.7%)	27(75.0%)	<0.001
HER2 enriched	14(46.7%)	3(37.5%)	3(7.7%)	4(11.1%)	
Triple negative	6(20.0%)	0(0.0%)	5(12.8%)	2(5.6%)	
Triple positive	2(6.7%)	1(12.5%)	5(12.8%)	3(8.3%)	
*Mean ± SD; n (%) **One-way ANOVA; Fisher's exact test					

Comparison of pathological T stage between patients ≥50 and <50 years showed no significant difference (p = 0.9). ypT1 and ypT0 were the most frequent stages in both age groups, with similar distribution patterns. ypT2 and ypT3 were slightly more common in older patients, but not significantly so. ypT(is) had nearly equal frequencies between age groups. Among 102 patients who underwent ALND, lymph node count significantly varied across RCB classes (p = 0.003). RCB 0 patients had the lowest mean lymph node count (13.2), while RCB III had the highest (18.2). as in table 7.

Table 7: Distribution of pathological (T) stage after NACT with age groups, Correlation between total lymph node number and RCB class categories among patients with ALND (N = 102).

Characteristic	≥50 years, N = 52	<50 years N = 61[1]	p-value		
Pathological(T) stage			0.9		
ypT0	14 (26.9%)	18 (29.5%)			
ypT(is)	3 (5.8%)	4 (6.6%)			
ypT1	14 (26.9%)	19 (31.1%)			
ypT2	15 (28.8%)	16 (26.2%)			
ypT3	6 (11.5%)	4 (6.6%)			
Parameter	**0,N = 2[1]**	I,N = 1	**II,N=36**	III,N=34	**p-value**
Total lymph nodes	13.2 ± 5.0	16.0 ± 5.1	15.6 ± 4.8	18.2 ± 5.2	**0.003**

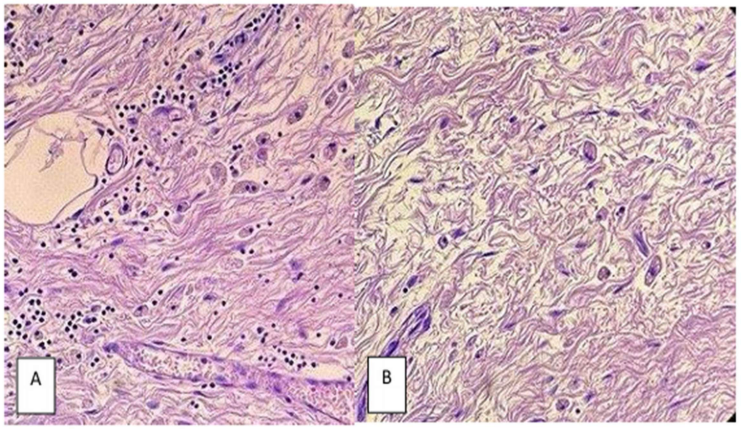

Figure 2: A & B Breast tissue showing no residual tumor in tumor bed and mainly showing fibrosis, histiocytes and lymphocytes infiltration, RCB class-0 (H&E 40x).

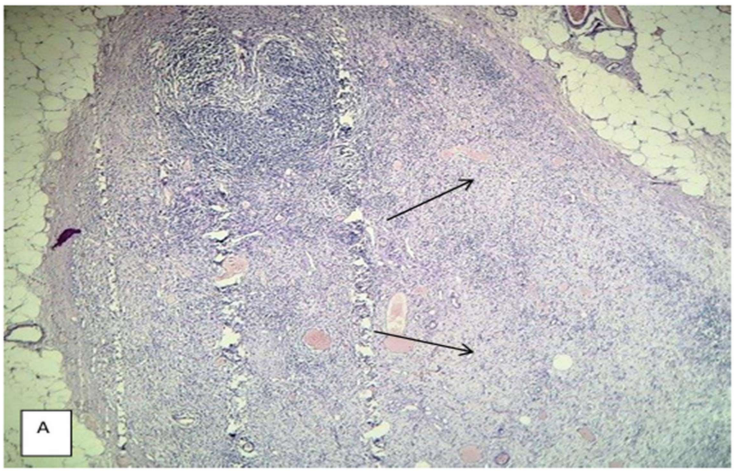

Figure 3: Axillary clearance showing one lymph nodes with treatment effect after NACT, mainly fibrosis (arrow) (H&E 40x).

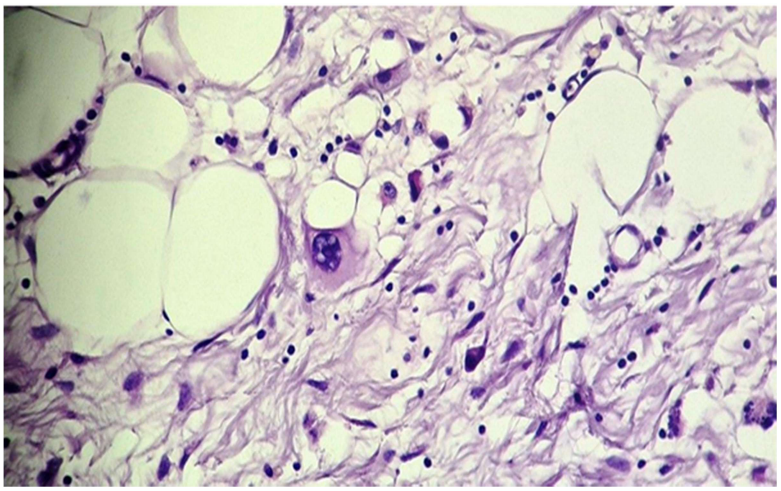

Figure 4: Breast tissue showing residual invasive ductal carcinoma Grade III according to NGS, mainly showing the effect of NACT on tumor cells: nuclear enlargement, prominent nucleoli, and cellular vacuolization (H&E 40x).

DISCUSSION:

Breast cancer remains the most frequently diagnosed malignancy in women worldwide. The use of (NACT) has evolved from being reserved for inoperable tumors to becoming a standard of care for many operable cases due to its potential to downstage tumors, improve operability, and provide early insight into treatment response [13]. In this retrospective study of 113 breast cancer cases, clinicopathological features and treatment responses were evaluated using the Residual Cancer Burden (RCB) system. The mean age of patients was 48.7 years, consistent with previous findings from Iraq and Egypt [7,14], but slightly lower than reports from Western countries [15]. Age, however, was not significantly associated with pathological tumor stage after NACT (p=0.9), aligning with previous studies [16], indicating that tumor downstaging with NACT is largely age-independent. Histologically, invasive ductal carcinoma was the predominant subtype (92.9%), in agreement with the Iraqi Cancer Registry [4], and similar findings were reported in Egypt and India [14,17]. All patients achieving pathological complete response (pCR) had ductal carcinoma, reaffirming the known chemoresponsiveness of this subtype [18]. Tumor grade II was most common (77%) and showed significant correlation with pCR (p=0.032). Although some international studies found grade III to be more responsive [15,19], the predominance of grade II in this sample may account for the variation. Tumor grade remains a crucial factor

influencing response to NACT due to its association with proliferative activity [20]. Regarding receptor status, 67.3% of cases were hormone receptor (HR) positive, consistent with regional studies [14,21], and 31.0% were HER2 positive [21,22]. HR+/HER2– was the most common molecular subtype (57.5%), matching reports from Iraq and the U.S. [16,22]. HER2-enriched tumors had the highest rate of pCR (46.7%), in line with findings from Xu X et al. [23] and Hamy et al. [19], highlighting their favorable response to NACT. Residual in situ carcinoma, primarily DCIS, was found in 23.9% of patients. While its presence does not preclude pCR under AJCC definitions, it does factor into RCB scoring. A significant correlation was observed between in situ carcinoma and RCB class ($p=0.022$), confirming findings from Osdoit et al. [22]. Lymphovascular invasion (LVI) was present in 58.4% of cases and significantly associated with higher RCB class ($p<0.001$). This supports the idea that LVI is rarely seen in patients who achieve pCR and is a negative prognostic factor [19,20]. Pathological tumor staging (ypT) after NACT showed that ypT1 (≤2 cm) was the most frequent (29.2%), unlike other studies where ypT0 predominated [11]. There was a strong association between ypT stage and RCB category ($p<0.001$), reinforcing the utility of RCB in integrating tumor size and burden [11]. Nodal status post-NACT revealed 57.5% with residual nodal disease, in agreement with previous findings [24], with ypN0 status seen in 41.6% of patients, similar to Iraqi and international data [11,16,19]. This highlights the prognostic relevance of axillary response, especially in achieving RCB-0 [19]. The average number of lymph nodes retrieved post-NACT was 15.3, similar to White et al. [25]. Patients with pCR had slightly fewer nodes (mean 13.2), supporting literature that NACT can reduce nodal yield due to fibrosis, without indicating inadequate dissection [26]. The RCB class was significantly associated with lymph node count ($p=0.003$). Surgically, mastectomy was more common (72.6%), reflecting local practices, as seen in previous Iraqi and Egyptian studies [7, 24], despite international trends favoring breast-conserving surgery [14,27]. Cultural preferences and fear of recurrence contribute to this pattern [21]. Finally, axillary lymph node dissection (ALND) was the dominant approach (90.3%), with sentinel lymph node biopsy (SLNB) underutilized. This diverges from international standards where SLNB is preferred post-NACT in downstaged axillae [15]. Despite global evidence favoring SLNB for minimizing morbidity without compromising outcomes, it remains underused locally, suggesting a need for practice change [28]. This study has several limitations that should be acknowledged. First, it was conducted at a single center with a retrospective design, which may limit the generalizability of the findings and introduce selection bias. Second, some RCB subgroups, particularly RCB-I, had a small sample size, reducing the statistical power to detect significant associations. Third, cases with equivocal HER2 status were excluded without confirmatory testing such as FISH, potentially affecting subgroup classification and treatment correlation. Additionally, there was underuse of sentinel lymph node biopsy (SLNB), which may reflect institutional or resource-related barriers; this underutilization may have influenced staging accuracy and limited the assessment of axillary involvement. Despite SLNB's advantages—such as reducing lymph node removal and minimizing complications without compromising survival—it was not uniformly applied across the study.

CONCLUSION:

Invasive breast cancer occurred in patients aged 29–73 years, with ductal carcinoma showing better response to NACT than lobular type. Grade II tumors were most likely to achieve pathological complete response (pCR), particularly in HER2-enriched subtypes. Residual Cancer Burden (RCB) class was significantly associated with in situ carcinoma, pathological tumor and nodal stages, nodal involvement, and lymphovascular invasion. No significant link was found between tumor stage post-NACT and age. NACT may reduce lymph node yield in ALND specimens. Mastectomy and ALND remain the predominant surgical approaches in Iraq. Future research should focus on large-scale studies to evaluate the impact of neoadjuvant therapy on breast cancer, with standardized pathological evaluation and reporting. Multidisciplinary long-term follow-up is essential for assessing treatment response and recurrence. Integration of clinical, radiological, and pathological data is crucial. Exploration of various treatment regimens and predictive biomarkers can help personalize therapy and improve outcomes.

Conflict of Interest: The authors declare no conflict of interest.

Funding: This research received no external funding.

Authors' Contributions

Authors' Contributions: The 1st author contributed to the study design and data collection; The 2nd author performed the

statistical analysis; All authors reviewed and approved the final version.

REFERENCES:

1. Siegel RL, Miller KD, Jemal A. Cancer statistics, 2020. CA Cancer J Clin. 2020;70(1):7–30. doi:10.3322/caac.21590.
2. Sung H, Ferlay J, Siegel RL, et al. Erratum: Global cancer statistics 2018: Globocan estimates of incidence and mortality worldwide for 36 cancers in 185 countries. CA Cancer J Clin. 2020;70(4):313. doi:10.3322/caac.21609.
3. Alwan NAS. Tumor characteristics of female breast cancer: Pathological review of mastectomy specimens belonging to Iraqi patients. World J Breast Cancer Res. 2018;1(1):1006.
4. Ministry of Health, Iraq. *Cancer Registry of Iraq: Annual Report 2024*. Baghdad: Ministry of Health; 2024 [cited 2025 Jul 22]. Available from: https://storage.moh.gov.iq/2024/11/24/2024_1
5. Ditsch N, Untch M, Kolberg-Liedtke C, Jackisch C, Krug D, Friedrich M, et al. AGO recommendations for the diagnosis and treatment of patients with locally advanced and metastatic breast cancer: Update 2020. Breast Care. 2020;15(4):294–309. doi:10.1159/000508736.
6. Puig CA, Hoskin TL, Day CN, Habermann EB, Boughey JC. National trends in the use of neoadjuvant chemotherapy for hormone receptor-negative breast cancer: A national cancer data base study. Ann Surg Oncol. 2016;24(1):1242–50. doi:10.1245/s10434-016-5733-y.
7. Namiq KS, Sulaiman LR. Neoadjuvant Therapy in Nonmetastatic Breast Cancer in Kurdistan, Iraq. JCO Glob Oncol. 2023 ;9:e2200276. doi: 10.1200/GO.22.00276. PMID: 37216625; PMCID: PMC10497289.
8. Van der Noordaa ME, van Duijnhoven FH, Straver ME, Groen EJ, Stokkel M, Loo CE, et al. Major reduction in axillary lymph node dissections after neoadjuvant systemic therapy for node-positive breast cancer by combining PET/CT and the Mari procedure. Ann Surg Oncol. 2018;25(6):1512–20. doi:10.1245/s10434-018-6404-y.
9. Graham PJ, Brar MS, Foster T, McCall M, Bouchard-Fortier A, Temple W, et al. Neoadjuvant chemotherapy for breast cancer, is practice changing? A population-based review of current surgical trends. Ann Surg Oncol. 2015;22(10):3376–82. doi:10.1245/s10434-015-4714-x.
10. Provenzano E, Bossuyt V, Viale G, Cameron D, Badve S, Denkert C, et al. Standardization of pathologic evaluation and reporting of postneoadjuvant specimens in clinical trials of breast cancer: Recommendations from an international working group. Mod Pathol. 2015;28(9):1185–201. doi:10.1038/modpathol.2015.74.
11. Xu X, Zhao W, Liu C, Gao Y, Chen D, Wu M, et al. The residual cancer burden index as a valid prognostic indicator in breast cancer after neoadjuvant chemotherapy. BMC Cancer. 2024;24:1. doi:10.1186/s12885-023-11719-z.
12. International Collaboration on Cancer Reporting (ICCR). *Breast - Neoadjuvant Therapy Dataset* [Internet]. Sydney: ICCR; [cited 2025 Jul 22]. Available from: https://www.iccr-cancer.org/datasets/published-datasets/breast/breast-neoadjuvant-therapy/
13. Park CK, Jung W-H, Koo JS. Pathologic evaluation of breast cancer after neoadjuvant therapy. J Pathol Transl Med. 2016;50(3):173–80. doi:10.4132/jptm.2016.02.02.
14. Zaher HA, Fathy H, Abozeid M, Faisal M. Neoadjuvant chemotherapy for Stage II–III breast cancer: A single-center experience. World J Surg Oncol. 2023;21(1):1. doi:10.1186/s12957-023-03199-z.
15. Verdial FC, Mamtani A, Pawloski KR, Sevilimedu V, D'Alfonso TM, Zhang H, et al. The effect of age on outcomes after neoadjuvant chemotherapy for breast cancer. Ann Surg Oncol. 2022;29(7):3810–9. doi:10.1245/s10434-022-11367-w.
16. Mohamed Al-Hakkak SM, Mijbas SA, Salman Al-Bdiri NA, Abadi AL-Aquli HA. Evaluation of locoregional recurrence in patients with early breast carcinoma post-breast-conserving surgery with and without the use of preoperative chemotherapy. Int J Res Pharm Sci. 2020;11(2):1824–30. doi:10.26452/ijrps.v11i2.2087.
17. Bhati S, Bhatia G, Shrey, Goyal N. Evaluation of histomorphological changes in post-neoadjuvant chemotherapy MRM specimens – a tertiary care centre study. J Med Sci Health. 2023;9(3):288–95. doi:10.46347/jmsh.v9i3.23.151.
18. The Classification of Tumours Editorial Board. WHO classification of tumours: Breast tumours. 5th ed. Lyon: International Agency for Research on Cancer; 2019. p. 82–118.

19. Hamy A-S, Darrigues L, Laas E, De Croze D, Topciu L, Lam G-T, et al. Prognostic value of the residual cancer burden index according to breast cancer subtype: Validation on a cohort of BC patients treated by neoadjuvant chemotherapy. PLoS One. 2020;15(6):e0234191. doi:10.1371/journal.pone.0234191.

20. Si J, Guo R, Pan H, et al. Axillary Lymph Node Dissection Can Be Omitted in Breast Cancer Patients With Mastectomy and False-Negative Frozen Section in Sentinel Lymph Node Biopsy. *Front Oncol*. 2022;12:869864. Published 2022 Apr 14. doi:10.3389/fonc.2022.869864

21. Alwan N, Shawkat MM. Treatment options and follow-up among Iraqi patients with breast carcinoma. Eur J Med Health Sci. 2020;2(2). doi:10.24018/ejmed.2020.2.2.171.

22. Osdoit M, Yau C, Symmans WF, Boughey JC, Ewing CA, Balassanian R, et al. Association of residual ductal carcinoma in situ with breast cancer recurrence in the neoadjuvant I-SPY2 trial. JAMA Surg. 2022;157(11):1034. doi:10.1001/jamasurg.2022.4118.

23. Xu X, Zhao W, Liu C, et al. The residual cancer burden index as a valid prognostic indicator in breast cancer after neoadjuvant chemotherapy. *BMC Cancer*. 2024;24(1):13. Published 2024 Jan 2. doi:10.1186/s12885-023-11719-z

24. abo al-ela, H., Safwat, K., Gharib, O., Habeeb, T. Evaluation of Early Outcome of Breast Surgery after Neoadjuvant Chemotherapy. *Zagazig University Medical Journal*, 2022;28(6):1198-204. doi: 10.21608/zumj.2020.31942.1872

25. White RL, Palmer PP, Trufan SJ, Sarma D. Does neoadjuvant chemotherapy for breast cancer affect lymph node harvest rates? Am Surg. 2019;85(7):690–94. doi:10.1177/000313481908500724.

26. Taylor CD, Wang T, Sinco BR, Pilewskie M, Hughes TM, Dossett LA. National Variation in Implementation of Sentinel Lymph Node Biopsy for Clinically Node-Positive Patients Undergoing Neoadjuvant Therapy. Ann Surg Oncol. 2025;32(7):4874-82. doi: 10.1245/s10434-025-17293-x. Epub 2025 Apr 18. PMID: 40251367; PMCID: PMC12130160.

27. Shah P, Desai S, Shet T. Gross evaluation of breast carcinomas post–neoadjuvant chemotherapy without radio-opaque clip insertion. Arch Pathol Lab Med. 2024. doi:10.5858/arpa.2023-0464-oa.

28. Sun Y, Liao M, He L, Zhu C. Comparison of breast-conserving surgery with mastectomy in locally advanced breast cancer after good response to neoadjuvant chemotherapy. Medicine (Baltimore). 2017;96(13):e8367. doi:10.1097/MD.0000000000008367.