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DE-ESCALATION OF SURGERY IN BREAST CARCINOMA PATIENTS FOLLOWING NEOADJUVANT CHEMOTHERAPY

Original Research (ID: 1696)

Dr. Zufishan Ahmad, Dr. Irum Sabir Ali*, Dr. Mah Muneer Khan
[1]MBBS, FCPS, Department of Surgery MTI KTH, Peshawar
[2]MBBS, FCPS, MRCS (UK), Associate Professor G. Surgery, MTI KTH, Peshawar
[3]FCPS, FRCS (Edin), Professor, Chairperson, G. Surgery MTI, KTH, Peshawar
Corresponding Author: Dr. Irum Sabir Ali, irum.sabir.ali@kmc.edu.pk, MBBS, FCPS, MRCS (UK), Associate Professor G. Surgery, MTI KTH, Peshawar
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ABSTRACT

Background: Breast carcinoma remains a major cause of cancer-related morbidity among women, particularly in settings where patients often present with advanced disease. Neoadjuvant chemotherapy has become an important treatment approach because it can reduce tumor burden before surgery and increase the feasibility of breast-conserving procedures. Evaluating its role in surgical de-escalation is clinically relevant for improving oncological safety, cosmetic outcomes, recovery, and patient-centered breast cancer care.

Objective: To evaluate the role of neoadjuvant chemotherapy in facilitating surgical de-escalation among patients with breast carcinoma.

Methods: This comparative observational study was conducted in the Department of Surgery, Khyber Teaching Hospital, Peshawar, from 1 December 2025 to 31 May 2026. A total of 213 adult female patients with histologically confirmed breast carcinoma who received neoadjuvant chemotherapy followed by definitive surgery were included through consecutive sampling. Data regarding age, body mass index, symptom duration, laterality, clinical stage, histopathological type, tumor grade, response to neoadjuvant chemotherapy, and type of surgery were collected using a structured proforma. Data were analyzed using SPSS version 26.0. Associations were assessed using Chi-square or Fisher's exact test, and binary logistic regression was used to identify predictors of breast-conserving surgery. A p-value of <0.05 was considered statistically significant.

Results: The mean age was 41.5 ± 10.7 years, and the mean body mass index was 24.5 ± 3.1 kg/m². Most patients were aged ≤40 years (55.4%), presented within 3 months of symptoms (57.7%), and had Stage III disease (39.9%). Invasive ductal carcinoma Grade II was the most common histological type (57.3%), followed by invasive ductal carcinoma Grade III (41.3%). Complete response to neoadjuvant chemotherapy was observed in 28.6%, partial response in 58.2%, and no response in 13.1%. Breast-conserving surgery was performed in 57.3%, while 42.7% underwent mastectomy. Complete response was strongly associated with breast-conserving surgery, as 78.7% of complete responders underwent breast conservation compared with 14.3% of non-responders. On regression analysis, complete response, earlier clinical stage, younger age, shorter symptom duration, and Grade II tumors were independently associated with breast-conserving surgery.

Conclusion: Neoadjuvant chemotherapy supported surgical de-escalation by increasing the feasibility of breast-conserving surgery in selected patients with breast carcinoma. Treatment response, especially complete response, remained the most important factor guiding conservative surgical management. Careful patient selection, response assessment, and multidisciplinary planning may help reduce unnecessary mastectomy while maintaining oncological safety.

Keywords: Breast Carcinoma; Breast-Conserving Surgery; Clinical Stage; Mastectomy; Neoadjuvant Chemotherapy; Surgical De-escalation; Treatment Response.

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INTRODUCTION

Breast carcinoma remains one of the most important public health challenges worldwide because of its high incidence, mortality, and long-term impact on women's physical, psychological, and social well-being. It is the most commonly diagnosed malignancy globally and continues to contribute substantially to cancer-related deaths despite major advances in screening, imaging, systemic therapy, surgical techniques, and supportive care (1). According to GLOBOCAN estimates, more than 2.3 million new cases of breast cancer are diagnosed every year, representing nearly one in every eight newly diagnosed cancers worldwide (2). The disease is also responsible for approximately 670,000 deaths annually, with a considerable proportion occurring in low- and middle-income countries where delayed presentation, limited awareness, and restricted access to specialized cancer care remain persistent barriers (3). The global burden of breast cancer is expected to rise further because of increasing life expectancy, urbanization, obesity, late childbearing, reduced breastfeeding, and changing reproductive patterns (4). In Pakistan, breast cancer is the most frequently reported malignancy among women and is among the highest in Asia, creating a significant clinical and economic burden for patients, families, and health-care systems (5). Historically, the surgical treatment of breast carcinoma was based on the belief that more extensive surgery offered better disease control and survival. Radical mastectomy was therefore widely practiced for many decades, often at the cost of major physical deformity, functional impairment, and psychological distress (6). Over time, clinical evidence challenged this aggressive surgical approach and supported a gradual shift toward more conservative, individualized, and patient-centered treatment. Breast-conserving surgery followed by radiotherapy has demonstrated oncological outcomes comparable to mastectomy in appropriately selected patients, while providing better cosmetic results, body image, emotional recovery, and quality of life (7,8). This change reflects a broader principle in modern oncology: effective cancer control should be achieved with the least possible treatment-related morbidity.

Neoadjuvant chemotherapy has further changed the surgical landscape of breast carcinoma. Initially used mainly for locally advanced or inoperable breast cancer, neoadjuvant chemotherapy is now increasingly offered to patients with stage II and III disease and to those with biologically aggressive subtypes such as HER2-positive and triple-negative breast cancer (9,10). Its role is no longer limited to tumor shrinkage before surgery; it also provides valuable information about tumor biology, treatment response, and prognosis. In many patients, neoadjuvant chemotherapy can downstage the primary breast tumor and involved axillary lymph nodes, making less extensive surgery possible. Patients who were initially considered candidates for mastectomy may become eligible for breast-conserving surgery after a favorable clinical and radiological response (11,12). Similarly, axillary downstaging may reduce the need for more morbid procedures such as complete axillary lymph node dissection in selected cases. Surgical de-escalation after neoadjuvant chemotherapy has therefore become an important area of interest in contemporary breast cancer management. The concept refers to reducing the extent of breast or axillary surgery while maintaining oncological safety and adequate local disease control (11). This approach is clinically meaningful because extensive surgery may lead to wound complications, chronic pain, shoulder stiffness, lymphedema, altered body image, prolonged recovery, and reduced quality of life. De-escalation, when applied appropriately, may reduce these complications, improve patient satisfaction, shorten hospital stay, and support faster return to daily activities. However, the decision to reduce surgical extent after neoadjuvant chemotherapy requires careful judgment. A complete clinical or radiological response does not always indicate complete pathological eradication of disease, and current imaging methods cannot reliably exclude microscopic residual tumor in all patients. Therefore, de-escalated surgery must be guided by accurate pre-treatment assessment, tumor localization, response evaluation, multidisciplinary planning, and adherence to standardized oncological principles (12,13).

The issue is especially relevant in developing countries, where many patients present with larger tumors or locally advanced disease and frequently require neoadjuvant chemotherapy before definitive surgery. In such settings, treatment decisions are influenced not only by tumor stage and biology but also by availability of imaging, pathology support, radiotherapy access, surgical expertise, patient follow-up, and affordability of care. Although international evidence supports de-escalation in selected patients, local data are needed because patient characteristics, disease stage at presentation, tumor biology, health-care resources, and treatment pathways may differ substantially across institutions. Without institution-based evidence, clinicians may either continue overly aggressive surgery despite good response to chemotherapy or attempt de-escalation without sufficient evaluation of oncological safety. The central research question of the present study was whether neoadjuvant chemotherapy can facilitate safe surgical de-escalation in patients with breast carcinoma by reducing the need for more extensive breast surgery while maintaining appropriate oncological management. The study was based on the hypothesis that selected patients who show a favorable response to neoadjuvant chemotherapy can undergo less extensive surgical procedures without compromising the principles of cancer control. Therefore, the present study was conducted to assess the outcomes of surgical de-escalation in patients with breast carcinoma following neoadjuvant chemotherapy, with the aim of generating clinically useful local evidence to support safer, more individualized, and less morbid surgical decision-making.

METHODOLOGY

A comparative observational study was conducted in the Department of Surgery, Khyber Teaching Hospital (KTH), Medical Teaching Institution (MTI), Peshawar, over a period of six months, from 1 December 2025 to 31 May 2026. The study was carried out after approval from the Institutional Research and Ethics Board (IREB), Khyber Medical College (KMC), Peshawar, vide approval number 870/DME/KMC, dated 01 December 2022. The study was conducted in accordance with ethical principles for human research. Written informed consent was obtained from eligible participants where direct patient interaction was required, and confidentiality was

maintained by assigning each patient a unique study identification number. Personal identifiers were not included in the study database, and the collected information was used only for research purposes. The sample size was calculated using OpenEpi software version 3.01. An anticipated frequency of successful conversion from planned mastectomy to breast-conserving surgery after neoadjuvant chemotherapy of 36.2% was used, with a 95% confidence level and an 8% margin of error (14). Based on these assumptions, the minimum required sample size was calculated as 213 patients. A non-probability consecutive sampling technique was used, and all eligible patients who fulfilled the selection criteria during the study period were included.

The study included adult female patients with histologically confirmed breast carcinoma who received neoadjuvant chemotherapy and subsequently underwent definitive surgical treatment at KTH. Patients with invasive ductal carcinoma or invasive lobular carcinoma were included if they had non-metastatic breast cancer and were considered suitable for neoadjuvant chemotherapy by the multidisciplinary breast cancer team. Patients were included regardless of whether they ultimately underwent breast-conserving surgery or mastectomy, as the main comparison was based on the type of definitive surgery performed after neoadjuvant chemotherapy. Patients with benign breast lesions, recurrent breast carcinoma, male breast cancer, metastatic breast cancer managed with palliative intent, and inflammatory breast carcinoma managed through individualized treatment pathways were excluded. Patients who underwent primary surgery without neoadjuvant chemotherapy, those who were medically unfit for surgery, and those with incomplete medical records were also excluded. Cases with missing histopathology reports, undocumented chemotherapy response, or insufficient operative details were not included in the final analysis to ensure completeness and reliability of the data.

After ethical approval, patient recruitment and data collection were performed in the Department of Surgery, KTH. Eligible patients were identified through the departmental breast cancer register, breast outpatient clinics, inpatient wards, breast tumor board records, operative registers, chemotherapy records, hospital electronic medical records, and the histopathology database. Data were collected using a structured proforma designed specifically for the study. The proforma included demographic details, clinical characteristics, tumor-related variables, chemotherapy response, and type of definitive surgery. The diagnosis of breast carcinoma was established by core needle biopsy before the initiation of neoadjuvant chemotherapy. Histopathological type and tumor grade were confirmed by consultant histopathologists. Demographic and clinical variables, including age, body mass index, duration of symptoms, laterality of the lesion, clinical stage at presentation, histological subtype, and tumor grade, were recorded from clinical notes, examination findings, and hospital records. Age and duration of symptoms were further categorized into groups for comparative analysis.

All patients received neoadjuvant chemotherapy according to institutional protocols approved by the multidisciplinary breast cancer team. Treatment planning was based on clinical stage, histological findings, tumor biology, patient fitness, and institutional practice. Response to neoadjuvant chemotherapy was assessed after completion of treatment through clinical examination and appropriate imaging modalities, including breast ultrasonography, mammography, and magnetic resonance imaging where indicated. Based on the documented clinical, radiological, and histopathological assessment, response was categorized as complete response, partial response, or no response. Following neoadjuvant chemotherapy, each patient was reassessed by the multidisciplinary team to determine the most suitable surgical approach. The decision to perform breast-conserving surgery or mastectomy was individualized and based on tumor response, residual tumor size, breast-to-tumor ratio, tumor multicentricity, feasibility of achieving clear margins, patient preference, and surgeon judgment in accordance with accepted oncological principles. Surgical specimens were sent for routine histopathological examination to confirm tumor type, grade, margin status, and treatment response.

The primary outcome of the study was the type of definitive breast surgery performed after neoadjuvant chemotherapy, categorized as breast-conserving surgery or mastectomy. Secondary variables included demographic characteristics, clinical stage, histological subtype, tumor grade, laterality, duration of symptoms, and response to neoadjuvant chemotherapy. Data obtained from operative notes, histopathology reports, chemotherapy records, tumor board records, and electronic medical records were cross-checked to improve accuracy. Before analysis, all data were reviewed for completeness, consistency, missing values, and coding errors. Data were analyzed using IBM Statistical Package for the Social Sciences (SPSS) version 26.0. The normality of continuous variables, including age, body mass index, and duration of symptoms, was assessed using the Shapiro–Wilk test. Normally distributed continuous variables were presented as mean ± standard deviation, while non-normally distributed variables were reported as median with interquartile range. Categorical variables, including age group, duration group, laterality, clinical stage, histological subtype, tumor grade, chemotherapy response, and type of surgery, were presented as frequencies and percentages.

Associations between categorical variables and type of surgery, namely breast-conserving surgery versus mastectomy, were assessed using the Chi-square test or Fisher's exact test where appropriate. Binary logistic regression analysis was performed to identify independent predictors of breast-conserving surgery following neoadjuvant chemotherapy. Variables that were clinically relevant or statistically significant on univariate analysis were entered into the regression model. The strength of association was expressed as odds ratios with 95% confidence intervals. A two-tailed p-value of less than 0.05 was considered statistically significant throughout the analysis.

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RESULTS

A total of 213 women with breast carcinoma who received neoadjuvant chemotherapy and subsequently underwent definitive surgical management were included in the study. The mean age of the study population was 41.5 ± 10.7 years. Most patients were aged 40 years or younger, accounting for 118 cases (55.4%), while 95 patients (44.6%) were older than 40 years. The mean body mass index was 24.5 ± 3.1 kg/m². Based on body mass index categories, 113 patients (53.1%) had normal body weight, 83 patients (39.0%) were overweight, and 17 patients (8.0%) were obese. The median duration of symptoms was 3 months, with an interquartile range of 2–5 months. A symptom duration of 3 months or less was reported in 123 patients (57.7%), whereas 90 patients (42.3%) had symptoms for more than 3 months. Regarding tumor laterality, right-sided breast involvement was observed in 117 patients (54.9%), while left-sided disease was present in 96 patients (45.1%). Clinical staging showed that 21 patients (9.9%) had Stage I disease, 68 patients (31.9%) had Stage II disease, 85 patients (39.9%) had Stage III disease, and 39 patients (18.3%) had Stage IV disease. Stage III was the most frequently observed clinical stage in the cohort.

The most common histopathological diagnosis was invasive ductal carcinoma Grade II, which was found in 122 patients (57.3%). Invasive ductal carcinoma Grade III was present in 88 patients (41.3%), while invasive lobular carcinoma Grade II was identified in 3 patients (1.4%). Following neoadjuvant chemotherapy, complete response was documented in 61 patients (28.6%), partial response in 124 patients (58.2%), and no response in 28 patients (13.1%). Partial response was therefore the most frequently observed treatment response. Overall, breast-conserving surgery was performed in 122 patients (57.3%), while mastectomy was performed in 91 patients (42.7%). Among patients with invasive ductal carcinoma Grade II, complete response was observed in 35 cases (28.7%), partial response in 73 cases (59.8%), and no response in 14 cases (11.5%). In this group, breast-conserving surgery was performed in 77 patients (63.1%), while 45 patients (36.9%) underwent mastectomy. Among patients with invasive ductal carcinoma Grade III, complete response was observed in 24 cases (27.3%), partial response in 50 cases (56.8%), and no response in 14 cases (15.9%). Breast-conserving surgery was performed in 43 patients (48.9%) with Grade III invasive ductal carcinoma, while mastectomy was performed in 45 patients (51.1%). Among the 3 patients with invasive lobular carcinoma Grade II, 2 patients (66.7%) achieved complete response and 1 patient (33.3%) achieved partial response; breast-conserving surgery was performed in 2 patients (66.7%), while 1 patient (33.3%) underwent mastectomy.

Breast-conserving surgery was performed in 72 of 118 patients (61.0%) aged 40 years or younger and in 50 of 95 patients (52.6%) older than 40 years. According to body mass index, breast-conserving surgery was performed in 67 patients (59.3%) with normal body weight, 46 overweight patients (55.4%), and 9 obese patients (52.9%). In relation to symptom duration, breast-conserving surgery was performed in 76 patients (61.8%) who presented within 3 months and in 46 patients (51.1%) who presented after more than 3 months. According to laterality, breast-conserving surgery was performed in 68 patients (58.1%) with right-sided disease and 54 patients (56.3%) with left-sided disease. A clear difference in surgical management was observed across clinical stages. Breast-conserving surgery was performed in 19 patients (90.5%) with Stage I disease, 46 patients (67.6%) with Stage II disease, 47 patients (55.3%) with Stage III disease, and 10 patients (25.6%) with Stage IV disease. In contrast, mastectomy was performed in 2 patients (9.5%) with Stage I disease, 22 patients (32.4%) with Stage II disease, 38 patients (44.7%) with Stage III disease, and 29 patients (74.4%) with Stage IV disease. Clinical stage was significantly associated with the type of surgery performed.

Response to neoadjuvant chemotherapy was also associated with the extent of definitive surgical treatment. Among patients who achieved complete response, 48 patients (78.7%) underwent breast-conserving surgery and 13 patients (21.3%) underwent mastectomy. Among patients with partial response, breast-conserving surgery was performed in 70 patients (56.5%), while mastectomy was performed in 54 patients (43.5%). Among patients with no response, only 4 patients (14.3%) underwent breast-conserving surgery, whereas 24 patients (85.7%) required mastectomy. This association between chemotherapy response and type of surgery was statistically significant. Binary logistic regression analysis showed that age 40 years or younger, shorter symptom duration, earlier clinical stage, complete response to neoadjuvant chemotherapy, and Grade II tumor were independently associated with breast-conserving surgery. Patients aged 40 years or younger had higher adjusted odds of breast-conserving surgery compared with older patients (adjusted OR: 1.82; 95% CI: 1.04–3.18; p=0.036). Patients presenting within 3 months of symptom onset also had higher odds of breast-conserving surgery (adjusted OR: 1.91; 95% CI: 1.08–3.39; p=0.024). Earlier clinical stage, defined as Stage I–II, was associated with increased odds of breast-conserving surgery compared with more advanced disease (adjusted OR: 3.56; 95% CI: 1.96–6.47; p<0.001). Complete response to neoadjuvant chemotherapy was the strongest independent predictor of breast-conserving surgery (adjusted OR: 6.48; 95% CI: 3.05–13.76; p<0.001). Grade II tumors were also independently associated with breast-conserving surgery (adjusted OR: 1.69; 95% CI: 1.01–2.85; p=0.044). Body mass index of 25 kg/m² or higher was not independently associated with breast-conserving surgery (adjusted OR: 0.86; 95% CI: 0.48–1.54; p=0.612).

Table 1. Demographic and Clinical Characteristics of Study Participants

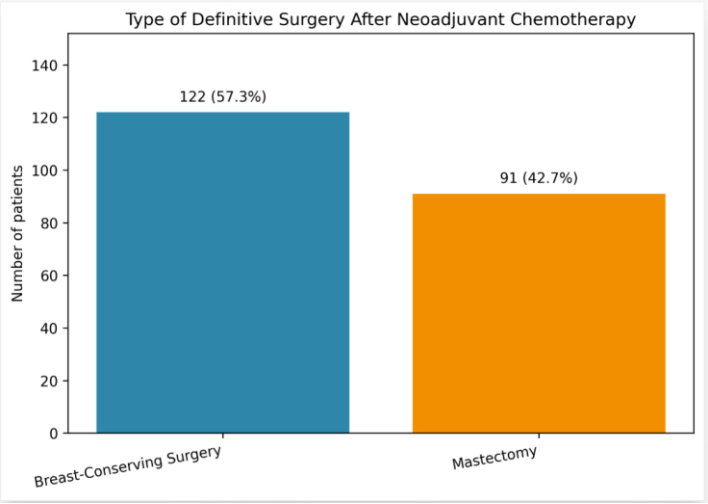
Variable	Frequency / Value
Total participants	213
Age, years	41.5 ± 10.7
≤40 years	118 (55.4)
>40 years	95 (44.6)
Body mass index, kg/m²	24.5 ± 3.1
Normal weight, 18.5–24.9 kg/m²	113 (53.1)
Overweight, 25.0–29.9 kg/m²	83 (39.0)
Obese, ≥30.0 kg/m²	17 (8.0)
Duration of symptoms, months	3 (2–5)
≤3 months	123 (57.7)
>3 months	90 (42.3)
Laterality	
Right breast	117 (54.9)
Left breast	96 (45.1)
Clinical stage	
Stage I	21 (9.9)
Stage II	68 (31.9)
Stage III	85 (39.9)
Stage IV	39 (18.3)

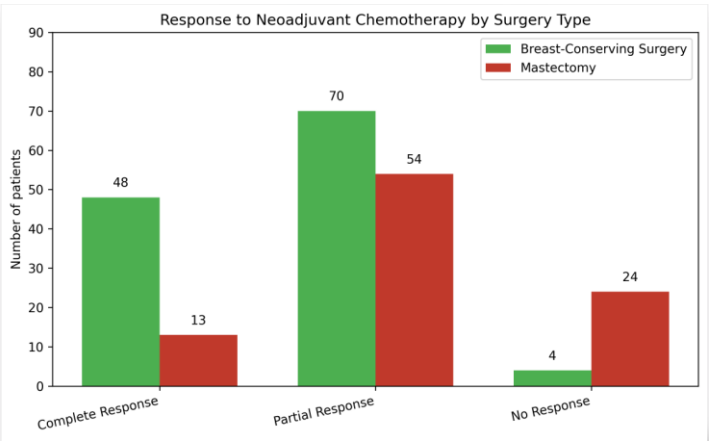
Table 2. Histopathological Characteristics, Response to Neoadjuvant Chemotherapy, and Definitive Surgery

Histological type and grade	Cases n (%)	Complete response n (%)	Partial response n (%)	No response n (%)	Breast-conserving surgery n (%)	Mastectomy n (%)
Invasive ductal carcinoma Grade II	122 (57.3)	35 (28.7)	73 (59.8)	14 (11.5)	77 (63.1)	45 (36.9)
Invasive ductal carcinoma Grade III	88 (41.3)	24 (27.3)	50 (56.8)	14 (15.9)	43 (48.9)	45 (51.1)
Invasive lobular carcinoma Grade II	3 (1.4)	2 (66.7)	1 (33.3)	0 (0.0)	2 (66.7)	1 (33.3)
Total	**213 (100.0)**	**61 (28.6)**	**124 (58.2)**	**28 (13.1)**	**122 (57.3)**	**91 (42.7)**

Table 3. Factors Associated with Breast-Conserving Surgery After Neoadjuvant Chemotherapy

Variable	Breast-conserving surgery n (%)	Mastectomy n (%)	Unadjusted p-value	Adjusted OR	95% CI	Adjusted p-value
Age group			0.276			
≤40 years	72 (61.0)	46 (39.0)		1.82	1.04–3.18	0.036
>40 years	50 (52.6)	45 (47.4)		Reference	—	—
Body mass index			0.622			
<25 kg/m²	67 (59.3)	46 (40.7)		Reference	—	—
≥25 kg/m²	55 (55.0)	45 (45.0)		0.86	0.48–1.54	0.612
Duration of symptoms			0.157			
≤3 months	76 (61.8)	47 (38.2)		1.91	1.08–3.39	0.024
>3 months	46 (51.1)	44 (48.9)		Reference	—	—
Clinical stage			<0.001			
Stage I–II	65 (73.0)	24 (27.0)		3.56	1.96–6.47	<0.001
Stage III–IV	57 (46.0)	67 (54.0)		Reference	—	—
Response to neoadjuvant chemotherapy			<0.001			
Complete response	48 (78.7)	13 (21.3)		6.48	3.05–13.76	<0.001
Partial/no response	74 (48.7)	78 (51.3)		Reference	—	—
Tumor grade			0.052			
Grade II	79 (63.2)	46 (36.8)		1.69	1.01–2.85	0.044
Grade III	43 (48.9)	45 (51.1)		Reference	—	—





DISCUSSION

The present study evaluated surgical de-escalation in women with breast carcinoma who received neoadjuvant chemotherapy before definitive surgical management. The findings showed that partial response was the most frequent treatment outcome, followed by complete response, while only a smaller proportion of patients showed no response to neoadjuvant chemotherapy. Overall, 58.2% of patients achieved partial response, 28.6% achieved complete response, and 13.1% had no response. These findings supported the established role of neoadjuvant chemotherapy in reducing tumor burden before surgery, although they also reflected that complete pathological response was not achieved in the majority of cases. Similar observations have been reported in previous literature, where partial tumor regression remained the most common response pattern after neoadjuvant chemotherapy, despite higher pathological complete response rates in selected biological subtypes such as HER2-positive and triple-negative breast cancer (15). Recent evidence has further suggested that advances in systemic therapy, targeted therapy, and subtype-directed treatment have improved pathological response rates and increased the feasibility of breast-conserving surgery in appropriately selected patients (16,17). One of the most important findings of the present study was the strong association between response to neoadjuvant chemotherapy and the extent of surgery. Patients who achieved complete response were more likely to undergo breast-conserving surgery, whereas non-responders were more likely to require mastectomy. In the present cohort, breast-conserving surgery was performed in 78.7% of patients with complete response, 56.5% of those with partial response, and only 14.3% of those with no response. This pattern emphasized that response to systemic therapy was a central factor in determining whether surgery could be safely de-escalated. Previous studies and reviews have also reported that favorable tumor response after neoadjuvant therapy increased the likelihood of breast conservation and helped convert selected patients from planned mastectomy to breast-conserving surgery (11,13,15,18). These findings were consistent with the broader oncological principle that surgical reduction should be guided by tumor biology, treatment response, and residual disease burden rather than by the initial tumor size alone.

The present study also showed that breast-conserving surgery was performed more frequently than mastectomy after neoadjuvant chemotherapy, with 57.3% of patients undergoing breast-conserving surgery and 42.7% undergoing mastectomy. This finding suggested that neoadjuvant chemotherapy contributed meaningfully to surgical de-escalation in this cohort. However, the result should be interpreted with appropriate caution because de-escalation is best demonstrated when the initially planned surgical procedure before neoadjuvant chemotherapy is clearly documented. Without pre-treatment surgical intent, the proportion of patients receiving breast-conserving surgery after chemotherapy showed the final surgical pattern but did not fully quantify the conversion rate from mastectomy to breast conservation. This distinction is important because the true measure of surgical de-escalation depends on whether patients who were initially unsuitable for breast-conserving surgery became eligible after tumor downstaging (19,20). Clinical stage was significantly associated with the type of surgery performed. Patients with Stage I and II disease were more likely to undergo breast-conserving surgery, whereas those with Stage III and IV disease were more likely to require mastectomy. In this study, breast-conserving surgery was performed in 90.5% of patients with Stage I disease and 67.6% of patients with Stage II disease, compared with 55.3% of patients with Stage III disease and 25.6% of patients with Stage IV disease. This pattern was clinically expected, as lower tumor burden at presentation increases the probability of achieving operable residual disease suitable for breast conservation after neoadjuvant chemotherapy. Previous literature has similarly reported that initial tumor size, nodal burden, tumor-to-breast ratio, multicentricity, and degree of downstaging after neoadjuvant therapy were important determinants of surgical planning (21,22). Although modern systemic therapy has widened the opportunity for conservative surgery, advanced stage at presentation remains an important barrier to safe de-escalation.

Age was also associated with the likelihood of breast-conserving surgery. Women aged 40 years or younger had higher adjusted odds of undergoing breast-conserving surgery than older women. Age alone is not considered a direct indication for or against breast-conserving surgery, but it may influence treatment pathways through associated factors such as performance status, treatment tolerance, tumor biology, patient preference, and suitability for radiotherapy. Younger patients may also seek breast preservation more strongly because of concerns related to body image, psychosocial adjustment, and long-term quality of life. Previous studies have highlighted the importance of individualized treatment planning after neoadjuvant therapy, where age is considered within a broader clinical context rather than as an isolated surgical determinant (19,20). Therefore, the association observed in the present study should be interpreted as a marker of patient and disease profile rather than as an independent surgical rule. Duration of symptoms was another factor associated with surgical outcome. Patients who presented within 3 months of symptom onset had higher odds of breast-conserving surgery than those with delayed presentation. This finding had practical importance, particularly in settings where delayed diagnosis and late referral remain common. Shorter symptom duration may reflect earlier-stage disease, smaller tumor burden, and greater opportunity for tumor downstaging with neoadjuvant chemotherapy. In contrast, delayed presentation often results in larger tumors, skin involvement, nodal disease, and reduced feasibility of breast conservation. This finding supported the need for public awareness, early clinical evaluation, efficient referral pathways, and timely initiation of oncological treatment to improve the possibility of less extensive surgery.

Body mass index and tumor laterality were not significantly associated with the type of surgery. This finding was consistent with the concept that surgical planning after neoadjuvant chemotherapy is primarily driven by tumor response, residual tumor extent, breast-to-tumor ratio, stage, multifocality or multicentricity, margin feasibility, and patient preference rather than by the side of breast involvement or general anthropometric status. Previous research has also suggested that tumor biology and response to therapy carry greater importance in predicting surgical outcomes than laterality or body habitus (15,23). Nevertheless, body mass index may still influence

operative risk, wound complications, anesthesia planning, and postoperative recovery, even if it does not independently determine the choice between breast-conserving surgery and mastectomy. Histological grade was associated with response to neoadjuvant chemotherapy and the likelihood of breast-conserving surgery. Grade II tumors showed higher rates of breast conservation than Grade III tumors. In the present study, breast-conserving surgery was performed in 63.1% of patients with invasive ductal carcinoma Grade II and 48.9% of patients with invasive ductal carcinoma Grade III. This finding may reflect differences in tumor behavior, treatment response, residual tumor burden, and operability after chemotherapy. However, histological grade alone does not fully explain chemotherapy sensitivity, as molecular subtype, hormone receptor status, HER2 status, Ki-67 index, and genomic features are also important predictors of response. Literature has increasingly emphasized that intrinsic molecular subtype is a major modifier of pathological complete response and should be incorporated into response prediction and surgical planning whenever possible (15). The limited availability of molecular data in the present analysis therefore restricted deeper interpretation of the relationship between grade, response, and surgical de-escalation.

The findings of this study had relevant clinical implications. The strong association between chemotherapy response and breast-conserving surgery supported the value of neoadjuvant chemotherapy as a strategy for reducing the extent of surgery in selected patients with breast carcinoma. This is particularly important in tertiary care settings where many patients present with larger tumors or locally advanced disease. If response assessment is performed carefully, neoadjuvant chemotherapy may allow more patients to avoid mastectomy and its associated physical and psychological consequences. Breast-conserving surgery, when oncologically appropriate and followed by indicated radiotherapy, can improve cosmetic outcomes, body image, emotional well-being, and quality of life without compromising local control in selected patients. The results also highlighted the importance of multidisciplinary decision-making, because safe de-escalation requires integration of surgical assessment, imaging response, pathology, systemic therapy response, radiotherapy planning, and patient preference. The study had several strengths. It included a clearly defined cohort of women with histologically confirmed breast carcinoma who received neoadjuvant chemotherapy and underwent definitive surgery in a tertiary care setting. The sample size was adequate for describing surgical outcomes and exploring clinicopathological factors associated with breast-conserving surgery. Data were collected from multiple hospital sources, including clinical records, operative notes, chemotherapy records, tumor board documentation, and histopathology reports, which improved the completeness and reliability of information. The use of multivariable logistic regression also allowed adjustment for important clinical factors and helped identify independent predictors of breast-conserving surgery after neoadjuvant chemotherapy.

Despite these strengths, certain limitations were present. First, the study was conducted at a single tertiary care center, which may limit the generalizability of the findings to other hospitals, regions, or health-care systems. Second, the observational design did not allow causal conclusions regarding the relationship between clinicopathological factors and surgical outcomes. Third, although the overall sample size was reasonable, some subgroups were small, particularly invasive lobular carcinoma, which limited meaningful subgroup analysis. Fourth, molecular tumor characteristics such as estrogen receptor status, progesterone receptor status, HER2 status, Ki-67 index, and triple-negative phenotype were not included in the main analysis, despite their known influence on chemotherapy response and pathological complete response. Fifth, details of chemotherapy regimens, targeted therapy, radiotherapy planning, margin status, re-excision rate, axillary surgery, nodal response, and postoperative complications were not fully assessed. Sixth, long-term oncological and patient-centered outcomes, including local recurrence, disease-free survival, overall survival, cosmetic satisfaction, and quality of life, were not evaluated. In addition, the inclusion of patients with very advanced disease required careful clarification, particularly where metastatic disease was managed with palliative intent, as such cases may differ substantially from patients undergoing curative surgical treatment. Future studies should address these limitations through prospective, multicenter designs with larger and more diverse patient populations. Pre-treatment surgical intent should be documented clearly so that the true conversion rate from planned mastectomy to breast-conserving surgery can be measured. Future research should also include molecular subtype, receptor status, Ki-67 index, standardized chemotherapy regimens, targeted therapy use, imaging response, pathological complete response, nodal downstaging, and axillary management. Longer follow-up is needed to determine whether surgical de-escalation after neoadjuvant chemotherapy maintains acceptable local control and survival outcomes. Assessment of cosmetic results, patient satisfaction, psychosocial recovery, and quality of life would further strengthen the clinical relevance of future work. As breast cancer treatment continues to move toward more personalized care, response-guided surgery, refined imaging, minimally invasive axillary approaches, and selective omission of more extensive procedures may further expand the role of safe surgical de-escalation in carefully selected patients.

CONCLUSION

Neoadjuvant chemotherapy played an important role in facilitating surgical de-escalation among patients with breast carcinoma by increasing the feasibility of breast-conserving surgery in appropriately selected cases. A favorable response to treatment, particularly complete response, emerged as the most important factor supporting breast conservation, while earlier clinical stage, younger age, shorter symptom duration, and lower histological grade also contributed to more conservative surgical management. These findings emphasize the value of individualized treatment planning, careful response assessment, and multidisciplinary decision-making in modern breast cancer care. When applied safely and according to oncological principles, neoadjuvant chemotherapy can reduce the need for mastectomy, preserve the breast where feasible, and improve functional, cosmetic, and psychosocial outcomes for patients.

AUTHOR CONTRIBUTION

Author	Contribution
Dr. Zufishan Ahmad	Conceptualization, Methodology, Formal Analysis, Writing - Original Draft, Validation, Supervision
Dr. Irum Sabir Ali	Methodology, Investigation, Data Curation, Writing - Review & Editing
Dr. Mah Muneer Khan	Investigation, Data Curation, Formal Analysis, Software

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