Original Article

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Pathology Section

Impact of Neoadjuvant Chemotherapy on Hormone Receptor Status and Systemic Inflammatory Markers in Breast Cancer Patients: A Retrospective Cohort Study

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ABSTRACT

Introduction: Breast Cancer (BC) remains the leading cause of cancer-related morbidity and mortality among women worldwide. Neoadjuvant Chemotherapy (NACT) is important in treating both locally advanced and early-stage BCs, as it helps make breast-conserving surgery possible and improves patient outcomes. However, not all patients respond to NACT equally. Finding reliable prognostic markers after NACT is essential for selecting optimal follow-up treatments and improving patient outcomes. Systemic inflammatory markers derived from peripheral blood, including abnormal blood counts, the Neutrophil-To-Lymphocyte Ratio (NLR), and the Platelets-to-Lymphocyte Ratio (PLR), have been widely investigated as surrogate indicators of host-tumour interaction in BCs. These should be contextualised with pre-treatment hormonal receptor status and tumour biology, when evaluating response to NACT.

Aim: To determine whether changes in systemic inflammatory markers (NLR and PLR) and Hormone Receptor (HR) status during NACT are associated with pathological response by Miller-Payne scoring (MPS).

Materials and Methods: This retrospective cohort study was conducted in the Department of Pathology, RL Jalappa Hospital, Kolar, Karnataka, India, from January 2023 to December 2024. It included data of 25 patients, collected retrospectively from the registers maintained in the department, who had pre-treatment biopsy and post-NACT resection specimens, along with hormonal receptor status. Pathological response was assessed using the MPS scoring. Peripheral blood parameters like WBC, absolute neutrophils, lymphocytes count and platelets count were obtained, and NLR, and PLR were calculated using standard formulae. Paired t-test and Spearman's correlation coefficient were used for statistical analysis.

Results: A total of 25 BC patients treated with NACT were analysed. The median age at diagnosis was 51 years, with 12 patients (48%) aged ≤50 years and 13 patients (52%) aged >50 years. Pathological response assessed by MPS showed grade 3 as the most common response (40%), while major pathological response (grades 4-5) was observed in 20% of cases. Neutrophil proportion increased significantly after chemotherapy (p-value=0.024), whereas changes in total White Blood Cell (WBC) count, lymphocyte proportion and platelet count were not significant. A significant reduction in NLR category was observed after treatment (p-value=0.003), whereas PLR did not change significantly (p-value=0.06). Spearman correlation showed no significant correlation between NLR (ρ=0.25, p-value=0.23) or PLR (ρ=0.06, p-value=0.76) and pathological response. Although Receiver Operating Characteristic (ROC) yielded a high Area Under the Curve (AUC) values for NLR (AUC=1.00) and PLR (AUC=0.94) these results should be interpreted as exploratory due to small sample size and lack of external validation rather than definitive. HR status, Human Epidermal Growth Factor Receptor 2 (HER2) and Ki-67 did not show significant association with pathological response.

Conclusion: Systemic inflammatory markers demonstrated post-treatment changes following NACT; nevertheless, NLR and PLR did not show a significant correlation or association with pathological response. Although ROC analysis indicated potential discriminatory value, inflammatory markers cannot be considered independent predictors of response.

Keywords: Abnormal blood count, Pathological complete response , Residual cancer burden

INTRODUCTION

The BC represents the leading cause of cancer-related morbidity and mortality among women worldwide. The GLOBOCAN 2022 report from the International Agency for Research on Cancer (IARC) indicates that BC constitutes approximately 11.5% of all newly diagnosed cancer cases [1]. In India, BC constitutes 13.6% of all cancer diagnoses. The incidence rate in Bangalore is higher, at 34.4%, with Kolar and surrounding areas accounting for 6.4% of all female cancers [2].

The NACT plays a pivotal role in managing locally advanced and early-stage BCs by facilitating breast-conserving surgery and improving outcomes. NACT improves operability and provides an in-vivo test of chemosensitivity, achieving pathological Complete Response (pCR) is associated with favourable long-term outcomes, and Residual Cancer Burden (RCB) refines prognosis beyond pCR [3,4]. Pathological response to NACT was assessed using the Miller-Payne grading system, which evaluates the reduction in tumour cellularity between pre-treatment core biopsy and post-treatment surgical specimens. Originally described by Miller and Payne, this scoring method grades response from grade 1 (no/minimal reduction) to grade 5 (no residual invasive tumour), and serves as a standardised tool to assess chemotherapy effectiveness [5].

Chronic inflammation substantially contributes to cancer formation and progression. Peripheral blood indices which includes systemic inflammatory markers such as NLR, PLR ,reflects host-tumour inflammation and has been investigated for potential surrogate biomarkers of tumour-host interaction. These systemic inflammatory markers may variably associate with NACT response in BC, and receptor conversion after NACT may influence outcomes and can be investigated as low-cost predictors of response. The meta-

analyses suggest lower baseline NLR relates to higher odds of pCR, while PLR findings are relatively mixed [5-7].

Importantly, systemic inflammatory markers should be interpreted as surrogate markers for stromal tumour infiltrating lymphocytes, as they reflect generalised host inflammatory responses that may be influenced by chemotherapy-related cytopenia, infections or nutritional status. Hence, their interpretation must be contextualised with pre-hormonal receptor status and cannot be interpreted as direct substitutes. Hence, the present study aimed to evaluate changes in the systemic inflammatory markers and hormonal receptor status before and after NACT and explored their association with pathological response using the MPS scoring system and the objective were to evaluate changes in systemic inflammatory markers (NLR and PLR) and HRs status before and after NACT and their association with pathological response using MPS.

MATERIALS AND METHODS

This retrospective cohort study was conducted in the Department of Pathology at RL Jalappa Hospital, Kolar, Karnataka, India, from January 2023 to December 2024. The Institutional Ethics Review Board approved the study under document number: SDUAHER/KLR/R&D/CES/S/PG/142/2025. Informed consent was obtained from all participants prior surgery. Subsequently, patient data were retrospectively collected from Electronic Health Record

(EHR), registers and anonymised.

Inclusion and Exclusion criteria: Patients with available pre-treatment Tru-Cut biopsy specimens and post-NACT resection specimens were included. Cases with metastatic disease or unavailable histological material were excluded.

Study Procedure

Twenty-five BC patients who underwent NACT followed by surgical resection were included where six months of follow-up were monitored. Systemic inflammatory markers, including total White Blood Cell (WBC) count, and derived ratios such as the NLR and PLR, were calculated using haematological parameters obtained before initiation of NACT and after completion of treatment. The NACT protocol was administered over a duration of approximately three to six months, following which patients underwent definitive surgical management, and a post-treatment blood sample was collected just before the surgery. HR status, Oestrogen Receptor

(ER) and Progesterone Receptor (PR), HER2 status and Ki-67 proliferation index were assessed on paired pre-treatment and post-treatment samples using immunohistochemistry in accordance with American Society of Clinical Oncology (ASCO) / College of American Pathologists (CAP) guidelines [8,9]. Pathological response was evaluated on Haematoxylin and Eosin (H&E) stained sections using the MPS [5] by comparing tumour cellularity between the pre-treatment biopsy and the post-treatment surgical specimen, with MPS Grades 4 and 5 considered as major pathological response, and patients were followed up for a total duration of six months.

Histopathological evaluation was independently performed by two pathologists blinded to clinical data. Interobserver agreement was assessed using Cohen's kappa statistic and interpreted according to the Landis and Koch scale (kappa was 0.78), demonstrating substantial agreement.

STATISTICAL ANALYSIS

All data were entered in Microsoft Excel and analysed using IBM Statistical Package for the Social Sciences (SPSS) statistical software version 26.0. Continuous variables such as age, haematological parameters (WBC count, NLR and PLR) measured before and after NACT were assessed for normality. Normally distributed continuous data were expressed as mean±Standard Deviation (SD), whereas non normally distributed data were presented as median with Interquartile Range (IQR).

Categorical variables including HR status (ER and PR: positive/negative), HER2 status (0/1+/2+/3+), Ki-67 category (≥14% and <14%, Miller–Payne score (MPS grade 1-5) and grouped pathological response (major response=MPS grade 4-5; moderate response=grade 3; minimal response=grade 1-2) were summarised as frequencies and percentages.

For comparing paired continuous parameters before and after NACT (WBC, neutrophils, lymphocytes, platelets, NLR and PLR), paired t-test was applied for normally distributed variables, and the Wilcoxon signed-rank test was used for non parametric paired variables. Comparisons between categorical variables and pathological response groups were performed using the Chi-square test or Fisher's-exact test was applied when expected cell counts were <5.

Changes in paired biomarker status between pre- and post-treatment samples were analysed using the McNemar test for binary outcomes (ER/PR positive vs negative) across Miller–Payne response categories. For paired multi-category outcomes such as HER2 (0/1+/2+/3+), the Stuart-Maxwell test for marginal homogeneity was used to evaluate category shift following NACT. Correlation between systemic inflammatory indices (NLR and PLR) and pathological response (MPS grade) was assessed using Spearman's rank correlation coefficient.

Receiver Operating Characteristic (ROC) curve analysis was performed to assess the ability of systemic inflammatory markers to discriminate pathological response, however ROC-derived cut-off values were used for exploratory analysis only and should not be interpreted as clinically validated thresholds. Predictive performance was evaluated using the Area Under the Curve (AUC) with 95% confidence intervals, and statistical significance was assessed against a null hypothesis of AUC=0.5. Optimal cut-off values were determined using the Youden Index. In the present study, the ROC-derived cut-off values were 2.37 for NLR and 103.04 for PLR, with corresponding AUC values of 1.00 and 0.94, respectively. A p-value <0.05 was considered statistically significant.

RESULTS

A total of 25 BC patients who received NACT and had both pre-treatment biopsy and post-treatment resection specimens available were included in this retrospective cohort study. The median age at diagnosis was 51 years, with 12 patients (48%) aged ≤50 years and 13 patients (52%) aged >50 years. The majority of patients received four cycles of NACT (18/25; 72%), while five patients (20%) received six cycles, and two patients (8%) received ≥8 cycles.

Paired comparison of haematological and systemic inflammatory parameters before and after NACT showed that the mean WBC count decreased from 7.91 $\times 10^3$/µL pre-NACT to 7.42 $\times 10^3$/µL post-NACT, this change was not statistically significant (paired t-test, p-value=0.465). Neutrophil proportion showed a significant increase after chemotherapy, rising from 56.4 (pre-NACT) to 63.8 (post-NACT) (paired t-test, p-value=0.024). Lymphocyte proportion decreased numerically after treatment (31.1 to 27.3), but the change was not statistically significant (paired t-test, p-value=0.146). Platelet count showed a slight increase from 260.76$\times 10^3$/µL to 265.84$\times 10^3$/µL, without statistical significance (Wilcoxon signed-rank test, p-value=0.161).

Pathological response was assessed using the MPS grading system on H&E-stained sections. The most frequent response was grade 3, observed in 10 patients (40%), indicating a moderate reduction in tumour cellularity. pCR (pCR; grade 5 only) was achieved in three patients (12%), while major pathological response (grades 4-5) was observed in five patients (20%) [Table/Fig-1].

A statistically significant reduction in the NLR was observed following NACT (p-value=0.003) reflecting treatment related modulation of systemic inflammatory status. The proportion of patients with low

Variables	Category	n (%)
Age (years)	≤50	12 (48%)
	>50	13 (52%)
NACT (Number of cycles)	4	18 (72%)
	6	5 (20%)
	≥8	2 (8%)
Miller-Payne Score (MPS)	1	5 (20%)
	2	5 (20%)
	3	10 (40%)
	4	2 (8%)
	5	3 (12%)

[Table/Fig-1]: Demographic data.

NLR (<2.37) increased from 36%, 9/25 (36%) before NACT to 15/25 (60%) after NACT (p-value=0.003). Correspondingly, patients with high NLR decreased from 16/25 (64%) to 10/25 (40%). In contrast, PLR did not show a statistically significant change after treatment. Low PLR was observed in 11/25 (44%) before NACT and 10/25 (40%) after NACT (p-value=0.061) [Table/Fig-2].

Variables	Pre-NACT	Post-NACT	p-value
NLR (cut-off 2.37)			
Low	9 (36.0%)	15 (60.0%)	0.003*
High	16 (64.0%)	10 (40.0%)	
PLR (cut-off 103.04)			
Low	11 (44.0%)	10 (40.0%)	0.061*
High	14 (56.0%)	15 (60.0%)	
ER			
Positive	15(60.0%)	5 (20.0%)	0.21#
Negative	10 (40.0%)	20 (80.0%)	
PR			
Positive	13 (52.0%)	6 (24.0%)	0.53#
Negative	12 (48.0%)	19 (76.0%)	
HER2			
1+	13 (52.0%)	14 (56.0%)	0.48$
2+	2 (8.0%)	2 (8.0%)	
3+	10 (40.0%)	9 (36.0%)	
Ki-67			
≤14%	4 (16.0%)	11 (44.0%)	0.26#
>14%	21 (84.0%)	14 (56.0%)	

[Table/Fig-2]: NLR, PLR and hormonal receptors data.
*Using paired t test, #Using McNemar test and $Using Stuart–Maxwell test for marginal homogeneity

Pre-NACT, ER positivity was observed in 15 patients (60%), which declined to five patients (20%) post-NACT; however, this change was not statistically significant (p-value=0.21). Similarly, PR positivity decreased from 13/25 (52%) before treatment to 6/25 (24%) after treatment (p-value=0.53). HER2 immunohistochemistry categories (0, 1+, 2+, 3+) did not demonstrate a statistically significant shift following NACT (p-value=0.48). HER2-equivocal (2+) cases showed no category shift following NACT, and In-situ Hybridisation (ISH) was not available for further classification. The Ki-67 proliferation index showed a numerical reduction following NACT, with cases having Ki-67 ≤14% increasing from 4/25 (16%) to 11/25 (44%), though this change did not reach statistical significance (p-value=0.26) [Table/Fig-2]. Overall, receptor status changes were not statistically significant, indicating that NACT did not consistently alter hormonal or HER2 receptor expression in this cohort.

Association analysis using Chi-square test showed no statistically significant association between NLR category (<2.37 vs ≥2.37) and pathological response groups defined by MPS (p-value=0.755). Similarly, PLR category (<103.04 vs ≥103.04) did not show a significant association with pathological response (p-value=0.878) [Table/Fig-3].

Variables	Pathological response using MPS			
	Minimal response (G1 & G2) n=10	Moderate response (G3) n=10	Major response (G4 & G5) n=5	Chi-square test*/Fisher-exact test# p-value
NLR				
Low	7 (70.0%)	5 (50.0%)	3 (60.0%)	χ^2-0.56 0.755*
High	3 (30.0%)	5 (50.0%)	2 (40.0%)	
PLR				
Low	7 (70.0%)	4 (40.0%)	2 (40.0%)	χ^2- 0.26 0.878*
High	3 (30.0%)	6 (60.0%)	3 (60.0%)	
ER				
Positive	3 (30.0%)	1 (10.0%)	1 (20.0%)	0.314#
Negative	7 (70.0%)	9 (90.0%)	4 (80.0%)	
PR				
Positive	2 (20.0%)	2 (20.0%)	2 (40.0%)	0.43#
Negative	8 (80.0%)	8 (80.0%)	3 (60.0%)	
HER2				
1+	7 (70.0%)	5 (50.0%)	2 (40.0%)	0.54#
2+(Equivocal)	1 (10.0%)	1(10.0%)	0	
3+	2 (20.0%)	4 (40.0%)	3 (60.0%)	
Ki-67				0.06#
≤14% (Low)	5 (50.0%)	4 (40.0%)	2 (40.0%)	
>14%(High)	5 (50.0%)	6 (60.0%)	3 (60.0%)	

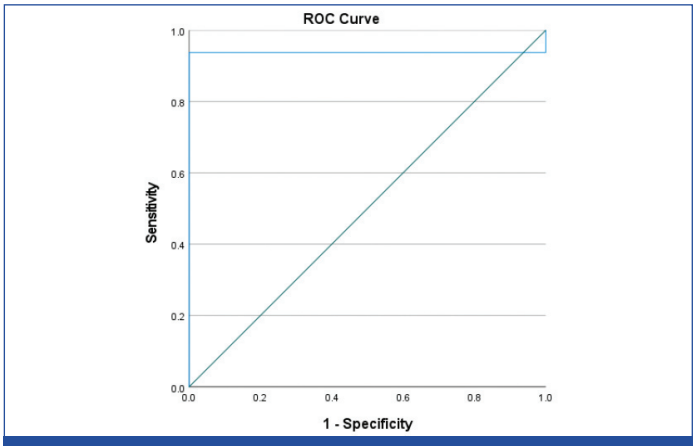
[Table/Fig-3]: Association of NLR, PLR and HR characteristics with pCR (MPS grades) in univariate analysis.
*Chi-square test,#Fisher's-Exact test

Spearman's rank correlation analysis demonstrated a weak positive correlation between NLR and MPS (ρ=0.25, p-value=0.23), which did not reach statistical significance. PLR showed a very weak and non significant correlation with pathological response (ρ=0.06, p-value=0.76) [Table/Fig-4].

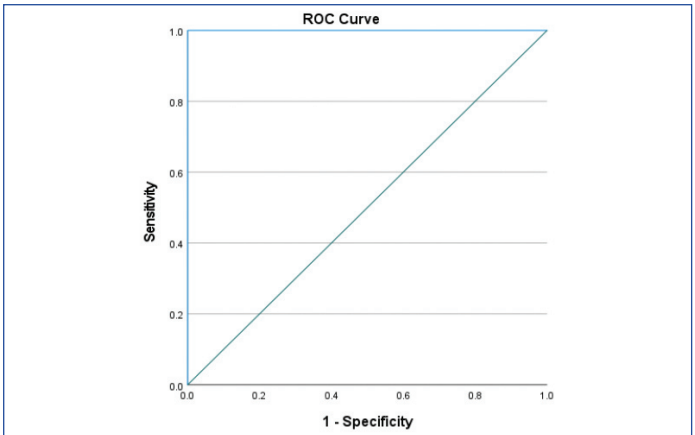
Marker	Spearman's ρ	p-value	Interpretation
NLR vs MPS	0.25	0.228	Weak, non significant
PLR vs MPS	0.064	0.763	Weak to negligible correlation, Non significant

[Table/Fig-4]: Correlation of NLR and PLR with pCR (MPS grades) in univariate analysis.

Although ROC analysis suggested high AUC values for NLR and PLR, these findings are not supported by association or correlation analysis as these results should be interpreted as exploratory due to small sample size and lack of adequate validation rather than confirmatory [Table/Fig-5,6].



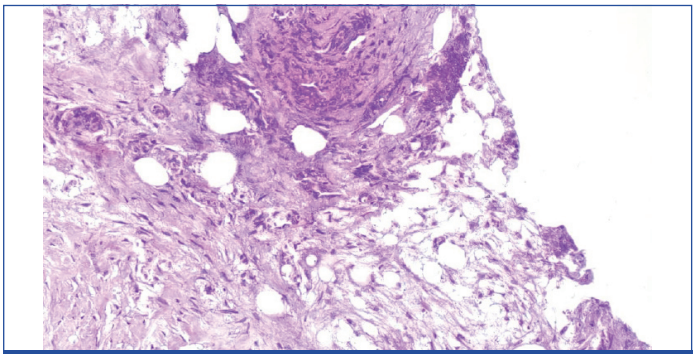
[Table/Fig-5]: ROC curve for NLR.



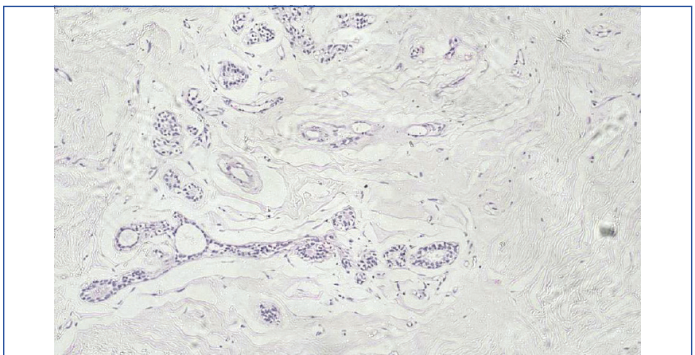
[Table/Fig-6]: ROC curve for PLR.

In ER, PR, HER2, and Ki-67 status did not show significant associations with pathological response in univariate analysis [Table/Fig-3].

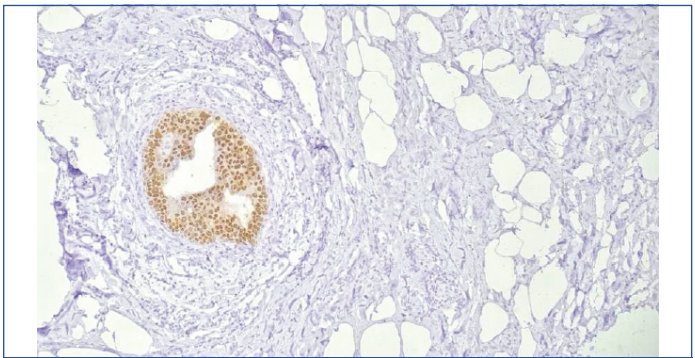
The pre-NACT Tru-Cut biopsy shows tumour cells arranged in sheets and nests infiltrating the surrounding stroma. The post-NACT excision biopsy demonstrates treatment-induced tumour regression, characterised by stromal fibrosis and hyalinisation. Residual scattered tumour cells are embedded within the desmoplastic stroma. Immunohistochemistry shows variable modulation of ER, PR, HER2, and Ki-67 expression following NACT [Table/Fig-4,7-9].



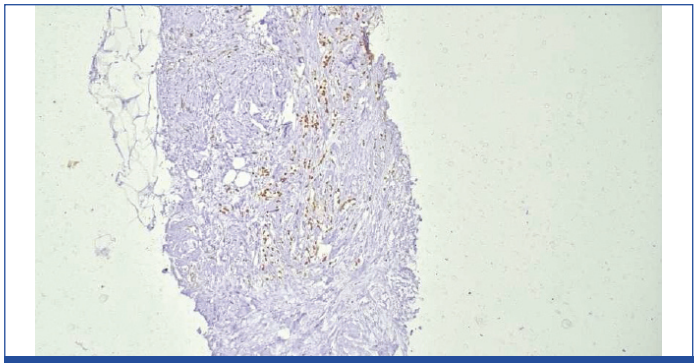
[Table/Fig-7a]: Tru-Cut biopsy pre-NACT (H&E, 200X).



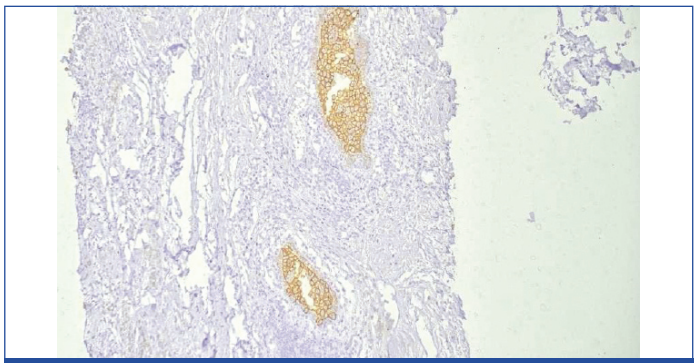
[Table/Fig-7b]: Excision biopsy post-NACT showing areas of fibrosis, hyalinisation of stroma along with few tumour cells and desmoplastic reaction (H&E, 200X).



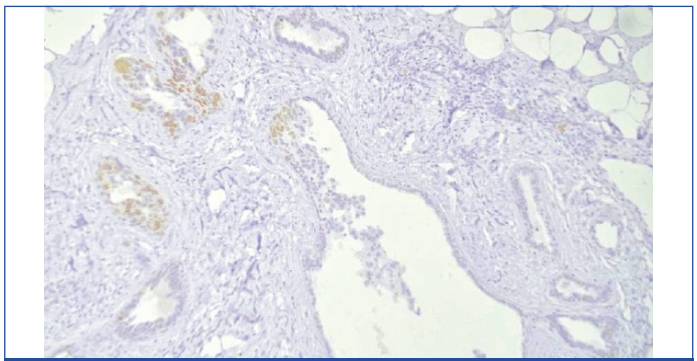
[Table/Fig-8a]: Immunohistochemistry stain for ER in pre-NACT (IHC, 200X).



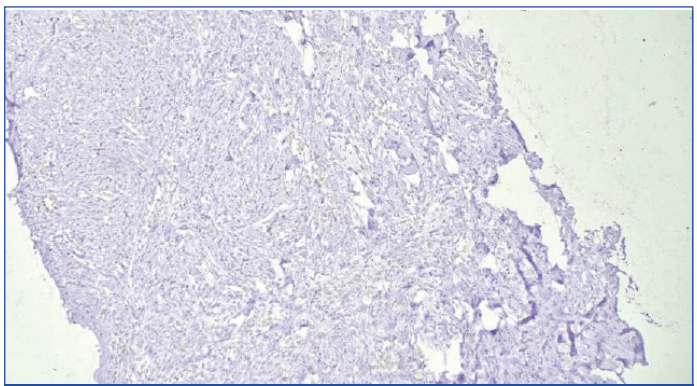
[Table/Fig-8b]: Immunohistochemistry stain for PR in pre-NACT (IHC, 200X).



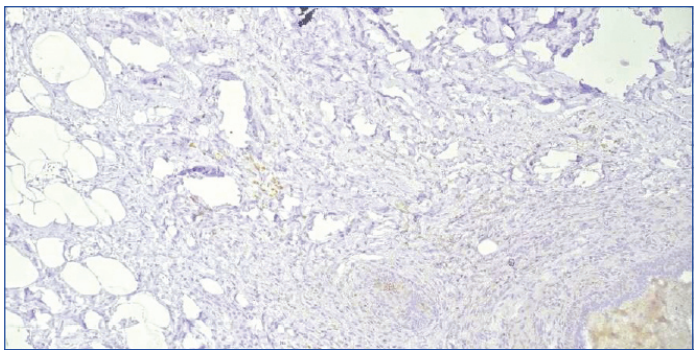
[Table/Fig-8c]: Immunohistochemistry stain for HER2 in pre-NACT (IHC, 200X).



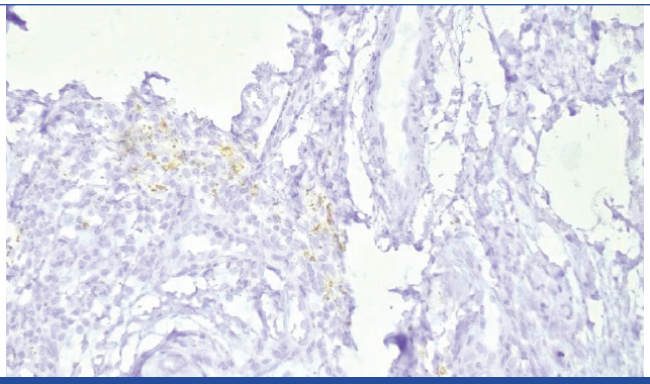
[Table/Fig-8d]: Immunohistochemistry stain for Ki-67 in pre-NACT (IHC, 200X).



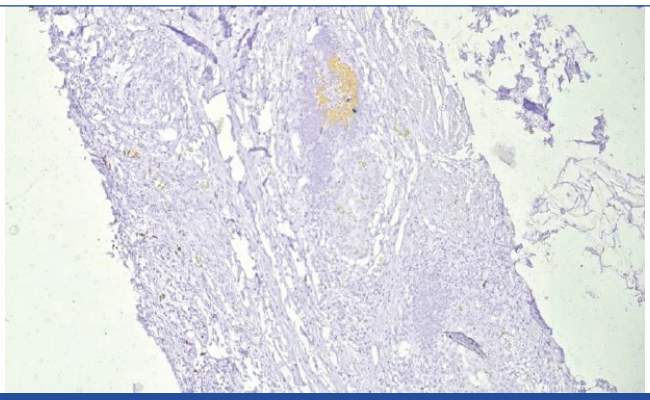
[Table/Fig-9a]: Immunohistochemistry stain for ER in post-NACT (IHC, 200X).



[Table/Fig-9b]: Immunohistochemistry stain for PR in post-NACT (IHC, 200X).



[Table/Fig-9c]: Immunohistochemistry stain for HER2 in post-NACT (IHC, 200X).



[Table/Fig-9d]: Immunohistochemistry stain for Ki-67 in post-NACT (IHC, 200X).

DISCUSSION

Multiple studies have shown that systemic inflammation in cancer patients is linked to reduced survival rates [6,10,11]. Clinicians use inflammatory markers to predict patient outcomes. Inflammation affects all stages of cancer development. Acute inflammation can help eliminate cancer cells by starting an anti-tumour immune response [10-12].

In contrast to acute inflammation, chronic inflammation from treatment can promote resistance to therapy and support tumour progression. Tumour invasion increases immunogenicity and releases tissue factors, which trigger anti-tumour responses through several mechanisms. Markers such as the NLR and PLR are often used to predict outcomes and are established risk factors for poor prognosis in various tumour types [12].

The present study included 25 patients with a median age of 51 years, evenly divided between those above and below 50 years. Notably, the majority of patients (72%) received four cycles of NACT, with minimal variation in treatment regimens. Regarding treatment response, the MPS indicated that 40% of cases exhibited modest tumour cell loss. In the present cohort, although systemic inflammatory modulation was evident post-NACT, this did not translate into a consistent gradient across Miller–Payne response categories.

Regarding HR status, ER positivity dropped from 60% to 20% after NACT. This change was not statistically significant (p-value=0.21). PR positivity declined from 52% to 24% (p-value=0.53), also without significance. These changes may result from technical or biological factors. Overall, there is no evidence that NACT altered ER or PR status. For inflammatory markers, NLR decreased after NACT (p-value=0.003), indicating reduced inflammation. The proportion of patients with low NLR rose from 36% to 60.0%. PLR remained relatively unchanged (p-value=0.061). The growth factor receptor 2 (HER2) categories and the Ki-67 proliferation index did not change significantly following treatment (p-value=0.48 and p-value=0.26, respectively). Although HER2 demonstrated a trend toward reduced signal intensity and Ki-67 indicated decreased cellular proliferation, these changes were not statistically significant.

In the present study, systemic inflammatory markers demonstrated variable relationships with pathological response depending on the analytical approach employed. Although ROC analysis suggested discriminatory ability of NLR and PLR for identifying major pathological response, neither marker showed a statistically significant association across response categories, nor a significant monotonic correlation with increasing pathological response. This discrepancy may be attributed to the small cohort size, imbalance in response groups, and the inherent methodological differences between correlation, association, and discrimination analyses, along with lack of independent validation. The extremely high AUC observed in the present study is likely influenced by the small sample size and potential overfitting, and therefore should not be interpreted as evidence of true clinical discrimination.

These findings suggest that while inflammatory markers such as NLR and PLR may have exploratory classification value at specific thresholds, they may not exhibit a consistent linear or ordinal relationship with pathological regression in this cohort. Therefore, inflammatory markers should be interpreted as supportive prognostic indicators rather than standalone predictors of chemotherapy response [Table/Fig-5,6]. In contrast to other factors, broad categories of receptor status (ER, PR, and HER2) do not show a statistically significant association with pathological response in this cohort. Ki-67 proliferation shows only minor group differences without a consistent trend.

Analysis of the test results indicates that in the present cohort, which primarily received four cycles of chemotherapy and exhibited few strong responses, the most consistent trend was observed in markers of systemic inflammation, specifically NLR, rather than in cell receptor status or proliferation rate. The prognostic value of a reduced NLR following treatment remains uncertain due to the limited sample size and lack of detailed patient matching. Therefore, within this cohort, no individual biomarker reliably predicts response to MPS, and clinical decisions should not be based solely on these markers until further evidence is available. Although NLR demonstrated significant post-treatment reduction at the cohort level, this change did not stratify meaningfully across pathological response categories.

Two independent meta-analyses show that lower baseline NLR predicts higher pCR rates with NACT. One links low NLR with better Disease-Free Survival (DFS) and Overall Survival (OS) (17-19 studies; ~5,500 patients) [5,10,11]. Another confirms the pCR signal in eight studies (~1,586 patients) but finds no statistically significant DFS advantage in the pooled 5-year analysis [7,11]. A third review, focused on NACT, similarly concluded that a high NLR is associated with a poor pathological response but not clearly with DFS/OS [13].

The present cohort analysis using the MPS system demonstrated that although post-treatment NLR and PLR showed changes following NACT, neither marker demonstrated a statistically significant correlation or association with pathological response in the present cohort. While ROC analysis suggested potential discriminatory ability of NLR and PLR in identifying major pathological response, these findings should be interpreted with caution due to the small sample size and imbalance of response categories. Previous meta-analyses have reported that higher PLR and NLR are associated with reduced pCR rates and poorer survival outcomes in patients receiving NACT; however, such associations could not be consistently demonstrated in the current study, underscoring the need for larger prospective studies to validate the prognostic utility of peripheral blood inflammatory indices [6,10].

The ER and PR positivity rates decreased after NACT, but the changes were not statistically significant. Earlier studies have shown that receptor status can change after NACT and may affect prognosis. Taucher S et al., found that preoperative chemotherapy can change steroid receptor status and stressed the importance

of checking for differences between biopsy and surgical samples when looking at HR results [14]. Other studies, such as those by Hirata T et al., have also reported changes in HRs after NACT and examined their effects on long-term outcomes. Recent research supports testing ER, PR, and HER2 again on surgical samples [15]. Changes in receptors, especially HR loss, are fairly common and can influence decisions about further therapy. Chemotherapy-related myelosuppression and treatment timing may have contributed to the observed changes in peripheral counts.

Several studies have shown that a decrease in Ki-67 during NACT is associated with better clinical outcomes and a higher likelihood of a positive pathological response. For example, Bottini A et al., (n=157) found that lower Ki-67 levels after chemotherapy were linked to tumour shrinkage [16]. Burcombe RJ et al., reported that tumours with a Ki-67 index of 75% or higher were more likely to have a pathological response [17].

However, some studies have found different results. Pohl G et al., observed no overall change in Ki-67 but found that high baseline Ki-67 was strongly associated with pCR [18]. These results show that differences in testing methods, cut-off values, and tumour types can affect findings. The current borderline result matches the general trend in the literature, but it should be viewed with caution.

Variability in results raises concerns about the reliability of peripheral blood indices, highlighting the necessity for their independent evaluation separate from clinicopathological characteristics. In addition, inflammatory and nutritional status should be considered when interpreting peripheral blood indices. Frequent alterations in receptor status between pre-treatment and post-NACT significantly affect survival outcomes in patients with invasive ductal BC. Therefore, receptor status must be assessed both prior to and following NACT to inform treatment strategies. Larger, prospective multicenter studies are necessary to confirm these observations.

Limitation(s)

The present study's limitations include single centre study with small sample size, imbalanced response outcome groups substantially reducing statistical power. Some haematological markers were affected by timing and clinical confounders, which were not standardised. Biomarker assessments were subject to methodological variability. HER2 equivocal and ultralow was not performed as there is no availability of ISH. Further investigation into mechanisms linking systemic inflammation with tumour aggressiveness is also necessary. The study did not assess survival outcomes, limiting generalisability and long-term interpretation.

CONCLUSION(S)

The NACT significantly modified in systemic inflammatory markers, with a significant change in NLR reflecting alterations in the host inflammatory response. However, neither NLR nor PLR showed a significant correlation or association with pathological response across Miller–Payne grades. Although ROC analysis suggested potential discriminatory ability, these findings should be interpreted cautiously due to the small sample size. HR status, HER2 expression and Ki-67 index were not significantly associated with pathological response. Larger prospective studies are required to validate the prognostic role of inflammatory markers in this setting.

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