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Impact of Carboplatin on Long-Term Survival After Neoadjuvant Chemotherapy in Non-Metastatic Triple-Negative Breast Cancer: An Algerian Cohort Study

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ABSTRACT

Background: Triple-negative breast cancer (TNBC) is an aggressive subtype lacking estrogen receptor, progesterone receptor, and human epidermal growth factor receptor 2 (HER2) expression. Platinum agents such as carboplatin have been incorporated into neoadjuvant regimens to improve pathological complete response (pCR), but their long-term survival benefit remains unclear, particularly in North African populations.

Methods: We conducted a retrospective cohort study with prospective longitudinal follow-up of 183 Algerian women with nonmetastatic TNBC who received neoadjuvant chemotherapy between February 2015 and February 2017 at the Pierre and Marie Curie Cancer Center, Algiers. Patients received six cycles of docetaxel plus anthracycline–cyclophosphamide (FAC60), with or without the addition of carboplatin (AUC 5). After surgery, patients were followed for overall survival (OS) and event-free survival (EFS) until November 2024. Statistical analyses were performed using R version 4.3.2.

Results: The median age was 43 years; 74% were premenopausal. The pCR rate was significantly higher with the carboplatin-containing regimen than without carboplatin (58% vs 36%, $P = .004$). After a median follow-up of 103 months (range, 9-118 months), 3-, 5-, and 8-year OS rates in the carboplatin group were 89%, 83.5%, and 75.2%, respectively. However, the carboplatin-containing regimen did not improve OS ($P = .34$) or EFS ($P = .49$). Achieving pCR was independently associated with better survival outcomes (EFS $P < .001$ and OS $P < .001$, respectively) in multivariable Cox regression models.

Conclusion: Among Algerian women with nonmetastatic TNBC, the carboplatin-containing regimen increased pCR rates but did not improve long-term survival. Pathologic complete response was an independent predictor of favorable prognosis.

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INTRODUCTION

Triple-negative breast cancer (TNBC) is defined by the absence of estrogen receptor (ER), progesterone receptor (PR),[1] and human epidermal growth factor receptor 2 (HER2) expression.[2,3] Representing approximately 15% to 20% of all breast cancers, TNBC is characterized by aggressive biological behavior and a poor prognosis.[4] This subtype is associated with rapid tumor proliferation, a high risk of distant metastasis, and an increased risk of early recurrence, particularly within the first 3 years after diagnosis.[5,6]

Unlike hormone receptor-positive or HER2-positive breast cancer, TNBC lacks established targeted

therapeutic options and, therefore, relies mainly on systemic chemotherapy for disease management.[7] Neoadjuvant chemotherapy (NAC), typically based on anthracycline- and taxane-containing regimens, plays a central role in the treatment of stage II to III TNBC and provides an opportunity to assess tumor sensitivity to systemic therapy through pathologic complete response (pCR).[8-10]

The addition of platinum compounds such as carboplatin to NAC has shown promising improvements in pCR rates, although this benefit is often accompanied by increased hematologic toxicity.[11-13] While several clinical trials and meta-analyses have reported improvements in event-free survival (EFS) and overall survival (OS) with the addition of carboplatin to NAC, the long-term benefit of this strategy in nonmetastatic TNBC remains debated. Existing studies have yielded conflicting results.[14-17]

Importantly, most of the available evidence originates from randomized clinical trials conducted in Western or high-income countries, with highly selected patient populations that may not reflect the clinical and biological characteristics of patients from other regions, whereas data from underrepresented regions, such as North Africa, are particularly scarce. Evaluating the reproducibility of these findings and the survival outcomes of carboplatin-based neoadjuvant strategies in an Algerian population may, therefore, help refine the clinical relevance of these approaches in underrepresented populations.

Therefore, the present study aimed to evaluate long-term survival outcomes following NAC with or without carboplatin in Algerian patients with nonmetastatic TNBC. Secondary objectives were to identify prognostic factors associated with survival and to describe the baseline demographic and clinicopathological characteristics of the study population.

METHODS

Study design and patients

This investigation is a single-center cohort study with prospective longitudinal follow-up. After initial enrollment, 10 patients were found not to meet the biological inclusion criteria due to receptor misclassification (6 hormone receptor-positive and 4 HER2-positive tumors). These patients were excluded prior to efficacy and survival analyses.

Overall, 183 Algerian women were enrolled between February 2015 and February 2017 to receive one of the two neoadjuvant treatment strategies at the Pierre and Marie Curie Cancer Center, Algiers, Algeria.

Eligible patients were aged between 18 and 70 years with histologically confirmed TNBC presenting with operable stage II or locally advanced stage III disease. An Eastern Cooperative Oncology Group performance status (ECOG PS) ≤ 1 was required. Eligibility for anthracycline- and taxane-based chemotherapy was assessed by a cardiologist, with a threshold of left ventricular ejection fraction (LVEF) > 55% with no other abnormalities in clinical examination, echocardiography, or electrocardiogram (ECG).

Eligibility for the cohort excluded individuals who were pregnant or nursing, had severe coexisting conditions that precluded surgical procedures or systemic medications, had undergone any prior breast cancer therapy, exhibited initial laboratory readings (hematologic, renal, or hepatic indices) greater than three times the standard upper limit, or refused the planned operation or enrollment. The initial workup comprised a physical examination with nodal assessment, bilateral mammography, breast ultrasonography, and baseline magnetic resonance imaging (MRI) to determine the full locoregional spread of the malignancy. To rule out distant lesions, all participants underwent computed tomography of the chest, abdomen, and pelvis, alongside a radionuclide bone scan. Patients received one of the two neoadjuvant treatment strategies recorded for this cohort.

Treatment-group information was retained for the subsequent prospective follow-up and survival analyses.

The Ethics Committee (EC003KB08052022) approved the extended prospective follow-up and survival analysis, and all participants provided written informed consent. All procedures were conducted in accordance with the Declaration of Helsinki.

Data collection

Clinical and pathological variables were obtained from medical and pathology records and included age, menopausal status, family history of breast or ovarian cancer, body mass index (BMI), clinical T and N stages in accordance with the American Joint Committee on Cancer/Union for International Cancer Control (AJCC/UICC) tumor, node, and metastasis (TNM) classification system,[18] tumor size in millimeters, histological subtype,[19] Scarff-Bloom-Richardson grade (SBR),[20] lymphovascular invasion, and immunohistochemical markers assessed at diagnosis (ER, PR, HER2, Ki-67, CK5/6, CK14, and EGFR).

The American Society of Clinical Oncology/-College of American Pathologists (ASCO/CAP) framework guided the evaluation of hormone receptor status, setting the positivity benchmark at 1% or greater staining of tumor cells for both ER and PR. HER2 categorization likewise followed ASCO/CAP criteria, where an immunohistochemistry (IHC) score of 3+ was interpreted as positive, while 2+ readings required reflex testing via in situ hybridization (ISH) for confirmation. For basal-like tumors, a surrogate immunohistochemical signature was applied, defined by positive expression—scored at 2+ or 3+—for at least one of these markers: cytokeratin 5/6 (CK5/6), cytokeratin 14 (CK14), or epidermal growth factor receptor (EGFR).[21,22] Ki-67 immunostaining was assessed by calculating the proportion of positively stained tumor cell nuclei across selected hot spots, counting a minimum of 1000 cells.[23] Tumors were categorized as high Ki-67 using a cutoff of 40% or greater.[24] All immunohistochemical analyses were

performed on the BenchMark ULTRA automated platform using the Ultra View Universal DAB Detection Kit (Ventana Medical System, Tucson, AZ, USA) for all patients.

Follow-up and outcomes

Patients were prospectively followed for OS and EFS, with data collected annually from hospital records and via telephone calls when follow-up visits were missed. The data cutoff for survival analyses was November 2024. When the exact date of death or recurrence was unavailable, the date of last contact was used for censoring. All eligible patients were included in the cohort analyses according to their recorded treatment strategy.

Treatment protocol

All participants were treated with 6 cycles administered every 3 weeks of neoadjuvant chemotherapy. For those assigned to the carboplatin group, therapy began with 3 cycles of docetaxel (75 mg/m²) combined with carboplatin (AUC 5)—with the lower docetaxel dose used for combination-regimen tolerability—and concluded with 3 cycles of FAC60. Each FAC cycle was administered every 21 days and included 5-fluorouracil (600 mg/m²), doxorubicin (60 mg/m²), and cyclophosphamide (600 mg/m²). By contrast, patients in the control arm received 3 initial cycles of docetaxel (100 mg/m²) under standard single-agent dosing, followed by the same 3-cycle FAC60 course. Because docetaxel dosing differed between groups, outcome differences reflect the net effect of the distinct treatment regimens rather than the isolated effect of carboplatin. Following the completion of neoadjuvant treatment, curative-intent surgery (either mastectomy or breast-conserving surgery) was performed, and postoperative radiotherapy was delivered according to established clinical criteria.

Study endpoints

For the present long-term follow-up, the primary clinical endpoints were overall survival (OS) and event-free survival (EFS). In the original study, the primary short-term endpoint was pathologic complete response (pCR), which was also assessed in the present analysis. OS was defined as the time from diagnosis to death from any cause.[25]

EFS was defined as the time from diagnosis to disease progression, recurrence, second primary cancer, failure to undergo surgery due to progression, or death from any cause in accordance with the NeoSTEEP guidelines.[25]

pCR was defined as the absence of residual invasive disease in the breast and axillary lymph nodes (ypT0/Tis ypN0) following neoadjuvant therapy.[8,25] Patients who did not undergo surgery due to disease progression or death during neoadjuvant treatment were strictly evaluated as non-pCR.

Statistical analysis

Using MedCalc, version 12.5, we calculated that 74 participants per arm would be sufficient to identify a 20% absolute rise in the pCR rate for the investigational regimen, assuming a one-sided type I error of 5% and 80% power—this was later rounded to 80 per group. Based on a directed superiority hypothesis between the two treatment regimens, the original study design prespecified the one-sided 5% alpha. No sample-size estimation was performed for the long-term clinical endpoints of OS or EFS. Statistical processing relied on R, version 4.3.2. In our analytical framework, age and tumor size were modeled as continuous measures, while BMI was divided into normal, overweight, and obese categories. To compare treatment arms, we applied chi-square or Fisher exact tests for categorical data and the Wilcoxon rank-sum test for continuous data, with all comparisons 2-sided and $P < .05$ indicative of significance. Missing data were present for tumor size (7 observations, 3.8%), molecular classification (26 observations, 14.2%), and lymphovascular invasion (4 observations, 2.18%). Multiple imputation by chained equations was performed using the mice package. The imputation model included age, tumor size, clinical stage, nodal status, histologic grade, Ki-67, molecular classification, lymphovascular invasion, treatment assignment, pCR status, EFS and OS event status, and cumulative follow-up time. For univariable Cox models and adjusted logistic regression, 20 imputed datasets (m = 20) were generated; for the multivariable Cox models, 5 imputed datasets (m = 5) were used, with tumor size the primary missing covariate retained. Complete-case analyses were compared with imputed datasets for the univariable Cox model and adjusted logistic regression. Results were highly consistent; for adjusted logistic regression, the carboplatin-containing regimen was associated with higher pCR rates in both the imputed analysis (n = 183; adjusted OR = 2.58, 95% CI, 1.33-5.09; $P = .006$) and the complete-case analysis (n = 157; adjusted OR = 2.08, 95% CI, 1.02-4.23; $P = .043$).

Survival curves for OS and EFS were estimated using the Kaplan–Meier method and compared via the log-rank test. Treatment-effect Cox models adjusted for baseline imbalances included age, menopausal status, SBR tumor grade, and basal-like subtype. Separate multivariable Cox prognostic models for EFS and OS included tumor size, Ki-67, nodal status, treatment strategy, and pathologic response; prognostic factors with $P < .20$ in univariable analyses as well as clinically relevant baseline variables were considered for inclusion. Multivariable logistic regression determined the independent effect of treatment on pCR while adjusting for imbalanced baseline variables. The proportional hazards assumption was verified using Schoenfeld residuals.

RESULTS

Patient characteristics

Patient selection and study flow are illustrated in Figure 1. Between February 2015 and February 2017, 183 women with nonmetastatic TNBC were enrolled and classified into two treatment groups. The baseline characteristics of the study cohort are

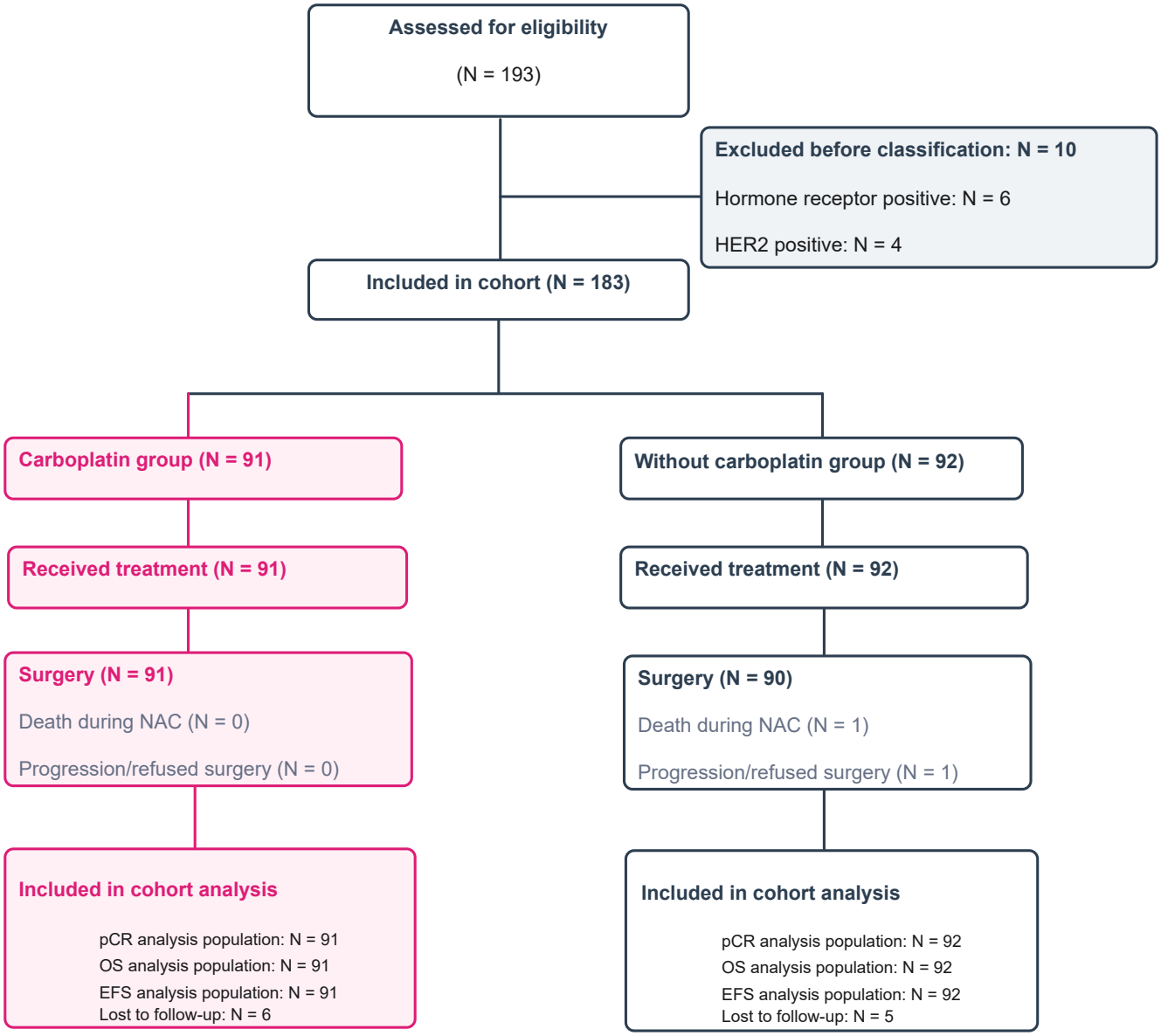


Figure 1. Study participant flow from eligibility assessment through treatment groups, surgery, and follow-up The diagram summarizes 193 patients assessed for eligibility, 10 excluded before treatment classification, and 183 included in the carboplatin (n = 91) or no-carboplatin (n = 92) treatment groups. The final boxes report the pCR, OS, and EFS analysis populations and loss to follow-up by treatment group. NAC indicates neoadjuvant chemotherapy; OS, overall survival; EFS, event-free survival; pCR, pathologic complete response.

summarized in Table 1. The median age at diagnosis was 43 years (36-51), and the carboplatin group was significantly younger (39 (34-46) vs 48 (40-53); $P <$ .001). Postmenopausal status was less frequent in the carboplatin group (18% vs 34%; $P = .02$), whereas a family history of breast or ovarian cancer was more frequent in this group (40% vs 25%; $P = .04$). BMI distribution did not differ significantly between groups ($P = .30$).

Tumor characteristics

Invasive ductal carcinoma (IDC) was the most common histological subtype (97%). SBR grade III tumors were more frequent in the carboplatin group (63% vs 47%; $P = .03$). Most patients had lymph node involvement (67%) and T2 to T3 disease (76%). Tumors of the basal-like phenotype occurred more frequently among patients receiving carboplatin (56% vs 36%; $P = .003$). For 14% of the cohort (n = 26), however, molecular subtyping could not be completed—primarily because of technical constraints or inadequate tissue sampling. Across the two treatment groups, lymphovascular invasion status and TNM staging parameters remained comparable, with no significant differences detected.

Treatment

Following NAC, 181 patients (99%) had surgery, including 126 (69%) mastectomy and 55 (30%) breast-conserving surgery. Adjuvant radiotherapy was given to 176 patients (96%). No significant differences in surgical or radiotherapy treatment were observed between the groups (Table 2).

Pathological response and recurrence

Pathological response and recurrence outcomes are summarized in Table 2. In our series, pCR was

Table 1. Baseline characteristics of patients with nonmetastatic triple-negative breast cancer by neoadjuvant carboplatin treatment

Variable	Total (n = 183)	With carboplatin (n = 91)	Without carboplatin (n = 92)	*P*
Age at diagnosis, years	43 (36-51)	39 (34-46)	48 (40-53)	< .001
Menopausal status				.02
Menopause	47 (26%)	16 (18%)	31 (34%)	
Pre/perimenopausal	136 (74%)	75 (82%)	61 (66%)	
Familial breast-ovarian cancer				.04
Yes	59 (32%)	36 (40%)	23 (25%)	
No	124 (68%)	55 (60%)	69 (75%)	
Body mass index				.30
Normal	47 (26%)	25 (27%)	22 (24%)	
Overweight	74 (40%)	32 (35%)	42 (46%)	
Obese	62 (34%)	34 (37%)	28 (30%)	
Tumor size, mm	55 (45-70)	60 (45-75)	50 (45-70)	.13
NA	7	3	4	
Pre-NAC node stage				.40
N0	61 (33%)	33 (36%)	28 (30%)	
N1	103 (56%)	46 (51%)	57 (62%)	
N2	15 (8.2%)	10 (11%)	5 (5.4%)	
N3	4 (2.2%)	2 (2.2%)	2 (2.2%)	
Pre-NAC tumor stage				.30
T1	3 (1.6%)	1 (1.1%)	2 (2.2%)	
T2	72 (39%)	30 (33%)	42 (46%)	
T3	67 (37%)	36 (40%)	31 (34%)	
T4	41 (22%)	24 (26%)	17 (18%)	
TNM stage				.50
I-II	98 (54%)	46 (51%)	52 (57%)	
III	85 (46%)	45 (49%)	40 (43%)	
Histologic type				> .90
IDC	178 (97%)	89 (98%)	89 (97%)	
ILC	3 (1.6%)	1 (1.1%)	2 (2.2%)	
Other	2 (1.1%)	1 (1.1%)	1 (1.1%)	
Pre-NAC SBR grade				.03
II	83 (45%)	34 (37%)	49 (53%)	
III	100 (55%)	57 (63%)	43 (47%)	
Ki-67				.20
>40%	141 (77%)	74 (81%)	67 (73%)	
≤40%	42 (23%)	17 (19%)	25 (27%)	
Pre-NAC molecular classification				.003
NA	26 (14%)	6 (6.6%)	20 (22%)	
TNBL	84 (46%)	51 (56%)	33 (36%)	
TNNBL	73 (40%)	34 (37%)	39 (42%)	
LVI				.11
No	167 (91%)	84 (92%)	83 (90%)	
Yes	12 (6.6%)	7 (7.7%)	5 (5.4%)	
NA	4 (2.2%)	0 (0%)	4 (4.3%)	

Abbreviations: NAC, neoadjuvant chemotherapy; SBR, Scarff-Bloom-Richardson; IDC, invasive ductal carcinoma; ILC, invasive lobular carcinoma; TNBL, triple-negative basal-like; TNNBL, triple-negative non-basal-like; LVI, lymphovascular invasion; IQR, interquartile range; NA, not available or not applicable.

Continuous variables are presented as median (IQR), and categorical variables as n (%). *P* values were obtained using the Mann-Whitney test for continuous variables and Fisher exact or chi-square tests for categorical variables.

achieved in 86 patients (47%), with a significantly higher rate in the carboplatin-containing regimen (58% vs 36%; $P = .004$) (Figure 2), corresponding to an absolute risk difference of 22 percentage points (95% CI, 8-37), which remained significant after adjusting for baseline imbalances (OR = 2.58, 95% CI, 1.33-5.09; $P = .006$). Disease recurrence occurred in 58 patients (32%); among them 21 (11.5%) had local/locoregional relapse and 37 (20%) developed distant metastases. Visceral metastases were the most prevalent distant site (51%), with bone metastases occurring only in the group without carboplatin (22.7%). The median time to recurrence was 17 months (IQR, 10-42 months).

Table 2. Treatment, pathologic response, and recurrence outcomes by neoadjuvant carboplatin treatment

Characteristic	Total (n = 183)	With carboplatin (n = 91)	Without carboplatin (n = 92)	*P*
Surgery type				.20
Surgery not done	2 (1.1%)	0 (0%)	2 (2.2%)	
Mastectomy	126 (68.9%)	60 (66%)	66 (72%)	
Breast-conserving surgery	55 (30%)	31 (34%)	24 (26%)	
Radiotherapy				> .99
No	7 (3.8%)	3 (3.3%)	4 (4.3%)	
Yes	176 (96%)	88 (97%)	88 (96%)	
Pathological response				.004
Non-pCR	97 (53%)	38 (42%)	59 (64%)	
pCR	86 (47%)	53 (58%)	33 (36%)	
Recurrence				.20
No recurrence	124 (67.8%)	64 (70%)	60 (65%)	
Death without documented recurrence	1 (0.5%)	0 (0%)	1 (1.1%)	
Distant	37 (20.2%)	15 (16%)	22 (24%)	
Local	15 (8.2%)	6 (6.6%)	9 (9.8%)	
Locoregional	6 (3.3%)	6 (6.6%)	0 (0%)	
Distant relapse site				.13
Nodal	13 (35%)	6 (40%)	7 (31.8%)	
Bone	5 (13.5%)	0 (0%)	5 (22.7%)	
Visceral	19 (51%)	9 (60%)	10 (45%)	

pCR, pathologic complete response. Categorical variables are presented as n (%). *P* values were calculated using the Fisher exact or Pearson chi-square test. Distant relapse site was calculated among patients with distant recurrence (n = 37).

Survival outcomes

Among the 183 patients, 11 (6.0%) had incomplete follow-up. After a median follow-up of 103 months (95% CI, 101-106; range, 9-118), 50 patients (27.3%) died. For the entire cohort, Kaplan–Meier analysis showed event-free survival (EFS) rates of 78.1%, 74.2%, and 67.9% at 3, 5, and 8 years, respectively, while overall survival (OS) rates were 86.9%, 79.7%, and 73.5% at the same time points.

In the carboplatin group, 3-, 5-, and 8-year OS rates were 89% (95% CI, 82.8%-95.6%), 83.5% (95% CI, 76.2%-91.5%), and 75.2% (95% CI, 66.7%-84.8%), compared with 84.7% (95% CI, 77.7%-92.4%), 76% (95% CI, 67.8%-85.3%), and 71.6% (95% CI, 63%-81.5%) in the group without carboplatin. Corresponding EFS rates were 81% (95% CI, 73.6%-89.7%), 80.2% (95% CI, 72.4%-88.8%), and 69.6% (95% CI, 60.6%-79.7%) versus 74.8% (95% CI, 66.4%-84.2%), 68.2% (95% CI, 59.2%-78.4%), and 65.9% (95% CI, 56.9%-76.4%). Median survival was not reached in either group. Log-rank analysis revealed no significant differences between the groups for OS ($P = .34$) or EFS ($P = .49$) (Figure 3), consistent with baseline-imbalance-adjusted Cox regression models (OS: HR = 0.83, 95% CI, 0.44-1.54; $P = .56$; EFS: HR = 0.66, 95% CI, 0.38-1.17; $P = .16$). These treatment-effect models were adjusted for age, menopausal status, SBR tumor grade, and basal-like subtype. Patients achieving pCR had significantly better OS ($P < .001$) and EFS ($P < .001$) than those without pCR (Figure 4).

Survival rates are provided for patients grouped by carboplatin use and pathological response (pCR versus non-pCR). Colors represent the four groups. Log-rank *P* values are displayed on the plots.

Prognostic factors

Univariable and multivariable Cox regression analyses were performed to identify factors associated with EFS (Table 3) and OS (Table 4).

In univariable analysis, pCR was strongly associated with improved OS (HR = 0.16, 95% CI, 0.07-0.37; $P < .001$) and EFS (HR = 0.30, 95% CI, 0.17-0.56; $P < .001$). Larger tumor size was associated with worse OS (HR = 1.01, 95% CI, 1.01-1.02; $P < .001$) and EFS (HR = 1.01, 95% CI, 1.00-1.02; $P = .02$). Stage III disease was associated with worse OS (HR = 1.95, 95% CI, 1.09-3.49; $P = .03$), and Ki-67 was associated with improved EFS (HR = 0.99, 95% CI, 0.98-1.00; $P = .03$).

In multivariable analysis, pCR remained the strongest predictor for both OS (HR = 0.18, 95% CI, 0.08-0.41; $P < .001$) and EFS (HR = 0.34, 95% CI, 0.16-0.56; $P < .001$). Tumor size retained independent prognostic significance for OS (HR = 1.02, 95% CI, 1.01-1.03; $P = .006$) and EFS (HR = 1.01, 95% CI, 1.00-1.02; $P = .004$). Ki-67 was independently associated with improved EFS (HR = 0.98, 95% CI, 0.97-0.99; $P = .010$) but not with OS (HR = 0.98, 95% CI, 0.98-1.00; $P = .08$). Nodal involvement did not reach statistical significance in adjusted analysis for OS (HR = 1.93, 95% CI, 0.94-3.94; $P = .07$) or EFS (HR = 1.61, 95% CI, 0.86-2.59; $P = .13$). Carboplatin use was not independently associated with either endpoint (OS: HR = 0.97, 95% CI, 0.49-1.91; $P = .94$; EFS: HR = 0.88, 95% CI, 0.48-1.61; $P = .67$).

The proportional hazards assumption held for both

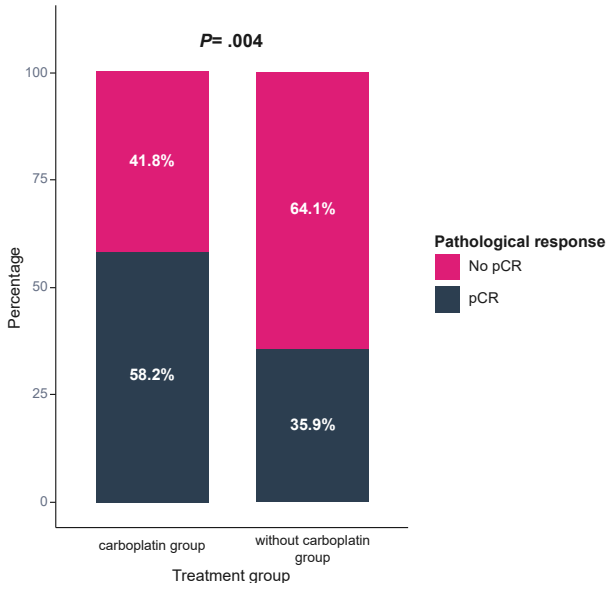


Figure 2. Pathologic complete response by neoadjuvant carboplatin treatment
The bars show the percentage of patients with and without pathologic complete response in the carboplatin and no-carboplatin groups. The between-group comparison was *P* = .004. pCR indicates pathologic complete response.

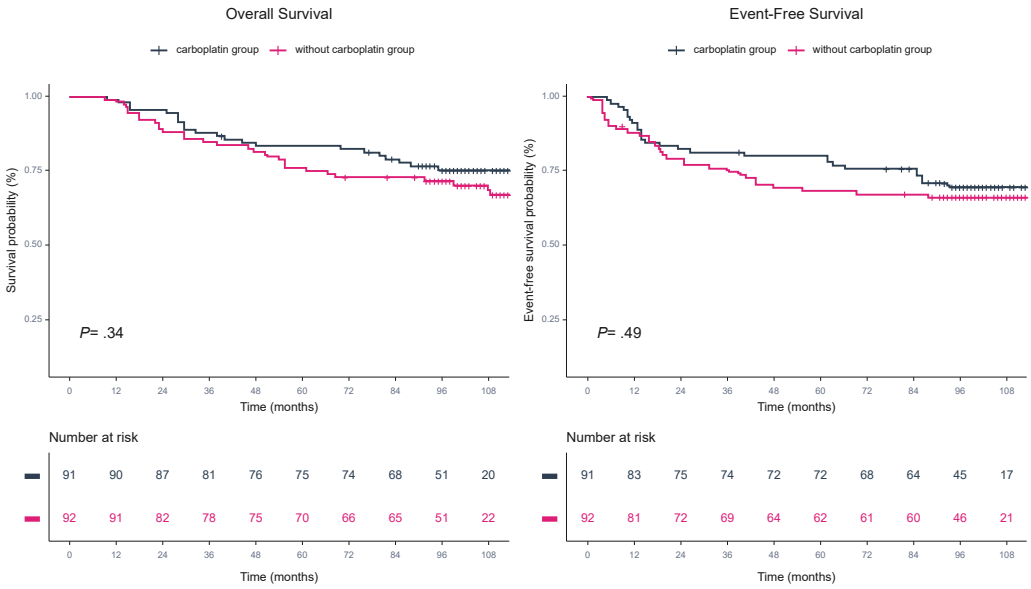


Figure 3. Kaplan–Meier estimates of overall and event-free survival by neoadjuvant carboplatin treatment
Panels A and B show overall survival and event-free survival, respectively, for patients treated with or without carboplatin. Numbers at risk are shown below each panel, and *P* values are from log-rank tests.

survival endpoints, with Schoenfeld residual tests giving global *P* values of .12 (EFS) and .10 (OS). Discriminative capacity was strong across the two models, reflected in Harrell's C-indices of 0.714 ± 0.002 for EFS and 0.770 ± 0.003 for OS. Formal collinearity diagnostic confirmed the absence of multicollinearity (VIF < 1.3). Additionally, baseline Ki-67 levels did not differ significantly between patients who achieved pCR and those with residual disease (Wilcoxon rank-sum test, *P* = .754).

Taken together, pCR and tumor size were the only consistent independent prognostic factors identified in this cohort across both endpoints, while Ki-67 showed an independent association with EFS only. Carboplatin use did not independently influence long-term outcomes in either analysis.

DISCUSSION

Taxanes, anthracyclines, and cyclophosphamide are the standard systemic neoadjuvant chemotherapy drugs, used to treat triple-negative breast cancer (TNBC).[9,10] Recently, incorporating platinum-based agents, particularly carboplatin, into these regimens has resulted in significant improvements in pCR rates,[26-28] making it an appropriate addition to standard treatment.[14,29]

This study represents one of the first long-term follow-up analyses of nonmetastatic TNBC treated with neoadjuvant chemotherapy in an Algerian population. The results demonstrate that the carboplatin-containing regimen significantly increased pCR rates, while no significant benefit in OS or EFS was observed. Because docetaxel dosing differed between groups,

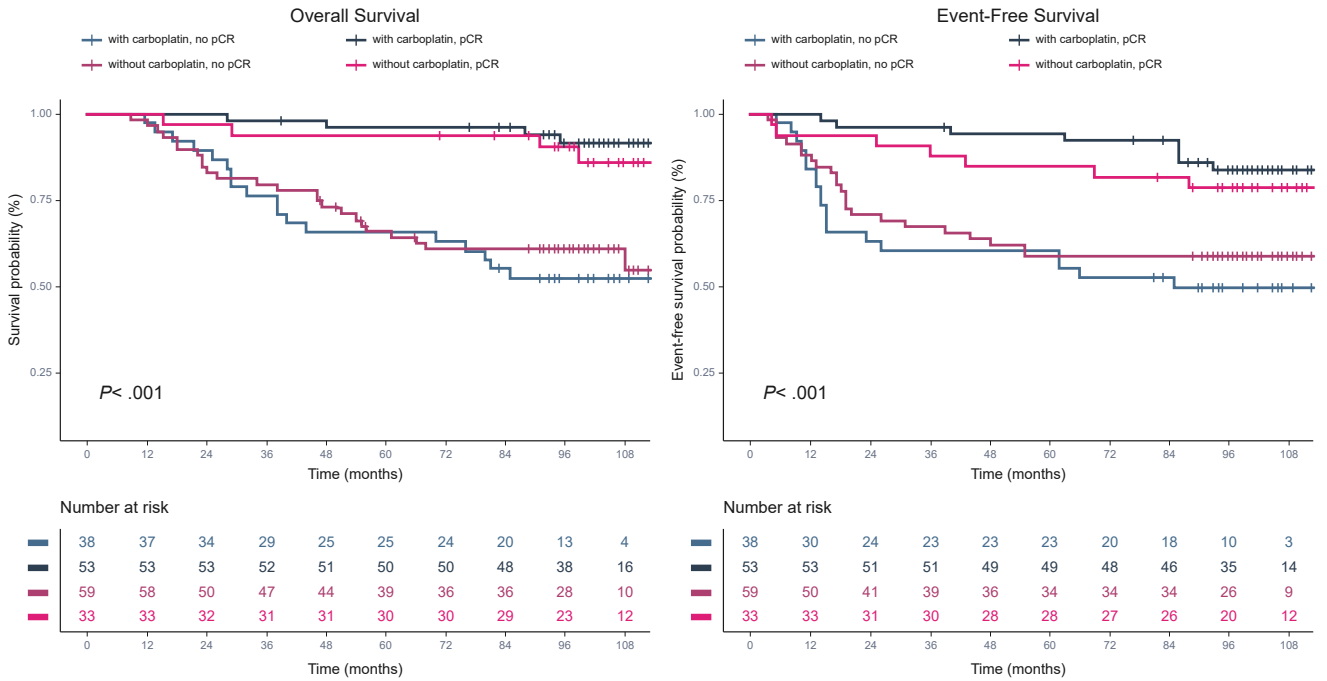


Figure 4. Kaplan–Meier estimates of overall and event-free survival by pathologic response and carboplatin treatment

Panels A and B show overall survival and event-free survival, respectively. Curves are stratified by carboplatin treatment and pCR status; numbers at risk are shown below each panel. *P* values are from log-rank tests. pCR indicates pathologic complete response.

Table 3. Univariable and multivariable Cox regression analyses of event-free survival

	Univariable EFS			Multivariable EFS		
Variable	**HR**	**95% CI**	***P***	**HR**	**95% CI**	***P***
Pathologic response: pCR vs non-pCR (reference)	0.30	0.17-0.56	< .001	0.34	0.16-0.56	< .001
Tumor size (mm)	1.01	1.00-1.02	.02	1.01	1.00-1.02	.004
Ki-67 (%)	0.99	0.97-0.99	.03	0.98	0.97-0.99	.010
Surgery type: BCS vs MC (reference)	0.81	0.45-1.47	.48	-	-	-
Molecular subtype: TNNBL vs TNBL (reference)	0.83	0.47-1.47	.51	-	-	-
Nodal status: N+ vs N– (reference)	1.39	0.77-2.51	.26	1.61	0.86-2.59	.13
Carboplatin: no vs yes (reference)	1.20	0.71-2.04	.49	0.88	0.48-1.61	.67
TNM stage: III vs I-II (reference)	1.35	0.79-2.29	.26	-	-	-
LVI: yes vs no (reference)	1.41	0.53-3.73	.48	-	-	-
Age, years	1.01	0.98-1.03	.55	-	-	-

Abbreviations: EFS, event-free survival; HR, hazard ratio; CI, confidence interval; pCR, pathologic complete response; BCS, breast-conserving surgery; MC, mastectomy; TNBL, triple-negative basal-like; TNNBL, triple-negative non-basal-like; N+, node-positive; N–, node-negative; LVI, lymphovascular invasion. Variables not selected for the multivariable analysis are indicated by a dash (–). *P* < .05 was considered statistically significant.

these findings reflect the net effect of the distinct treatment regimens rather than the isolated effect of carboplatin. pCR emerged as the most powerful independent predictor of long-term outcomes.

The median age at diagnosis in this cohort was 43 years, consistent with data from previous North African studies, which report median ages in the forties.[30,31] The predominance of premenopausal women (74%) further supports the observation that TNBC in North African populations tends to occur at a younger age compared with Western populations, where the median age often exceeds 50 years.[32,33]

The carboplatin group had a higher proportion of younger and premenopausal patients, indicating

Table 4. Univariable and multivariable Cox regression analyses of overall survival

Variable	Univariable OS			Multivariable OS		
	HR	95% CI	*P*	HR	95% CI	*P*
Age, years	1.01	0.98-1.04	.26	-	-	-
Tumor size (mm)	1.01	1.01-1.02	< .001	1.02	1.01-1.03	.006
Surgery type: BCS vs MC (reference)	0.60	0.30-1.19	.15	-	-	-
LVI: yes vs no (reference)	1.69	0.63-4.51	.28	-	-	-
Molecular subtype: TNNBL vs TNBL (reference)	0.89	0.46-1.69	.70	-	-	-
Ki-67 (%)	0.99	0.98-1.00	.19	0.98	0.98-1.00	.08
Nodal status: N+ vs N– (reference)	1.67	0.86-3.27	.12	1.93	0.94-3.94	.07
Carboplatin: no vs yes (reference)	1.31	0.74-2.32	.35	0.97	0.49-1.91	.94
Pathologic response: pCR vs non-pCR (reference)	0.16	0.07-0.37	< .001	0.18	0.08-0.41	< .001
TNM stage: III vs I-II (reference)	1.95	1.09-3.49	.03	-	-	-

Abbreviations: OS, overall survival; HR, hazard ratio; CI, confidence interval; BCS, breast-conserving surgery; MC, mastectomy; LVI, lymphovascular invasion; TNBL, triple-negative basal-like; TNNBL, triple-negative non-basal-like; N+, node-positive; N–, node-negative; pCR, pathologic complete response. Variables not selected for the multivariable analysis are denoted by a dash (–). $P < .05$ was considered statistically significant.

possible biological or demographic factors that could affect treatment results. These differences could influence the interpretation of results.[32] For instance, younger and premenopausal women may exhibit distinct tumor biology and treatment sensitivity, which could impact treatment outcomes.[34,35]

The majority of tumors were high grade (55%), with nearly half of the cases (46%) diagnosed at stage III, reflecting the typically aggressive nature of TNBC[4,5] and the delay in diagnosis frequently observed in resource-limited settings.[36] The high proportion of overweight or obese patients (74%) may also contribute to disease aggressiveness, as obesity is associated with metabolic and inflammatory factors that promote tumor progression.[37]

Lymph node involvement was identified in 66% of cases, aligning with regional reports[30] but higher than rates observed in studies from Oman and New Zealand.[33,38] These differences may reflect disparities in screening programs and healthcare accessibility across populations.

A family history of breast or ovarian cancer was reported in 32% of our TNBC patients, consistent with previous Algerian data showing a higher prevalence of familial breast cancer among TNBC than non-TNBC (37.15% vs 17.10%).[31] Familial aggregation is strongly associated with BRCA1/2 mutations, particularly in early-onset disease.[34,39] Although systematic genetic testing was not routinely performed in our patient cohort, the elevated prevalence of familial cancer history does suggest an underlying inherited predisposition.[39] Further molecular characterization is warranted to more fully elucidate the genomic profile of TNBC within this specific demographic.

Breast cancer subtypes exhibit variability in their pathologic complete response rates, ranging from 35% to 48% for triple-negative breast cancer (TNBC) treated with subsequent taxane/anthracycline regimens.[40,41] The estimated rate of pathological complete response (pCR) in our cohort was 47%, which aligns with published data.[8,29,42]

These findings are consistent with randomized trials such as GeparSixto, BrighTNess, and NACATRINE.[27,43,44] The carboplatin-containing regimen significantly improved pCR rates in our cohort (58% vs 36%, $P = .004$). Because docetaxel dosing differed between groups, this comparison reflects the overall treatment strategies rather than the isolated effect of carboplatin. These findings align with the well-documented chemosensitizing effect of platinum salts in TNBC. Similarly, Elnaggar *et al.* reported a significant improvement in pCR rate with the use of platinum derivatives (42.5% vs 22.5%, $P = .05$), whether carboplatin or cisplatin.[45] Furthermore, this substantial rise in pCR associated with the incorporation of carboplatin in treatment strategies for TNBC is demonstrated by many meta-analyses.[14,29,46]

Importantly, after adjustment for baseline clinicopathological factors, multivariable regression confirmed that carboplatin-containing therapy was independently tied to higher pCR rates, with a nearly 2.6-fold increase in odds versus the control group (adjusted OR = 2.58, 95% CI, 1.33-5.09; $P = .006$). Nonetheless, this pCR advantage did not correspond to meaningful gains in either OS or EFS between the treatment groups in our patient cohort. In Cox regression adjusted for baseline imbalances, the difference in EFS was not statistically significant in the carboplatin group compared with the group without carboplatin (HR = 0.66, 95% CI, 0.38-1.17; *P*

= .16), while no meaningful difference was observed for OS (HR = 0.83, 95% CI, 0.44-1.54; P = .56). These comparisons reflect the net effect of the distinct treatment regimens because docetaxel dosing differed between groups. The consistency of these results before and after adjustment confirms that baseline imbalances did not account for the absence of survival benefit. Given our sample size and the limited number of events (EFS: n = 59, OS: n = 50), the lack of statistical significance may be attributed to limited statistical power to detect moderate treatment effects. Similar findings were reported in the CALGB 40603 trial, where the addition of carboplatin increased the pCR rate without demonstrating a significant survival benefit.[17] It should be noted that survival data from the NACATRINE trial remain immature.[44]

In contrast, the neoadjuvant GeparSixto trial demonstrated a significant improvement in 3-year disease-free survival (HR = 0.56, 95% CI, 0.34-0.93; P = .04), particularly among patients with homologous recombination deficiency (HRD).[16] Similarly, the BrighTNess trial reported a significant 4.5-year EFS benefit (HR = 0.57, 95% CI, 0.36-0.91; P = .02) in patients receiving carboplatin-taxane vs taxane therapy, with a difference in OS that was not statistically significant.[15]

The apparent discordance between pCR improvement and survival outcome in our cohort may reflect the biological heterogeneity of TNBC.

The benefit from platinum-based therapy appears to be driven by the likelihood of achieving pCR, a surrogate endpoint[8] whose predictive value is particularly enhanced in molecularly defined subgroups harboring BRCA mutations or homologous recombination deficiency (HRD).[15,16] Future studies integrating molecular stratification, including BRCA and HRD testing, are, therefore, essential to refine patients' risk stratification. Future trials should prioritize stratification by HRD/BRCA status and incorporate mature survival data to validate whether improved pCR indeed translates into a meaningful long-term survival advantage in this highly responsive subgroup. The median time to recurrence was 17 months, confirming the tendency of TNBC to relapse early, typically within three years after diagnosis.[5] The observed distribution, predominantly distant metastases involving lymph nodes, lungs, and brain, mirrors known metastatic patterns for this subtype. The coexistence of both early and late relapses suggests biological heterogeneity, with possible differences in clonal evolution and treatment resistance.

Pathologic complete response emerged as the strongest prognostic factor in this study. Patients achieving pCR had markedly reduced risks of recurrence and death, reinforcing the central role of treatment response in determining long-term outcomes in TNBC, as demonstrated in large meta-analyses.[8,40]

Tumor size at diagnosis emerged as a significant and independent adverse prognostic factor. Larger tumors were associated with worse EFS (univariable P = .02; multivariable P = .004) and OS (univariable P < .001; multivariable P = .006), highlighting their role as a robust indicator of tumor burden and the importance of early detection.[32,33,38]

Although stage III disease was significantly associated with poorer OS in univariable analysis (HR = 1.95, 95% CI, 1.09-3.49; P = .03), it did not show a significant impact on EFS (HR = 1.35, 95% CI, 0.79-2.29; P = .26) and was excluded from the multivariable model to avoid collinearity with nodal status and tumor size.

The current investigation revealed that a high Ki-67 index is associated with improved EFS (univariable P = .03; multivariable P = .010). This result suggests that, despite its traditional classification as a marker of tumor proliferation and aggressiveness, Ki-67 may reflect increased chemosensitivity to NAC in TNBC. Formal collinearity diagnostic confirmed the absence of multicollinearity (VIF < 1.3). Additionally, baseline Ki-67 levels did not differ significantly between patients who achieved pCR and those with residual disease (Wilcoxon rank-sum test, P = .754). In contrast, Ki-67 was not associated with OS (univariable P = .19; multivariable P = .08), consistent with da Silva *et al.* (2021), who reported no independent prognostic value for survival outcomes.[47]

In this cohort, age, nodal status, surgery type, and treatment regimen lacked significant prognostic value. Despite their established role in general breast cancer prognosis, these factors seem more variable in TNBC and are likely overshadowed by measures of response to neoadjuvant therapy.

Clinical implications and future perspectives

The present findings underscore the complexity of TNBC management and support the need for individualized therapeutic approaches. Although the carboplatin-containing regimen significantly improved pCR rates, no survival benefit was observed, indicating that its long-term impact may depend on underlying tumor biology.

In this context, evidence from the literature indicates that molecular biomarkers such as BRCA mutation status, homologous recombination deficiency (HRD), and intrinsic subtypes may help identify patients most likely to benefit from platinum-based therapies.

Future studies incorporating systematic molecular testing are warranted to refine treatment selection. Additionally, optimization of post-neoadjuvant strategies in patients with residual disease may further improve long-term outcomes.

Limitations

Several constraints should be noted. The single-institution design, limited enrollment, and low event frequency likely reduced our capacity to identify a subtle but clinically significant survival difference between the treatment arms. These factors also limit how broadly our results can be generalized. Nevertheless, the alignment of our cohort's demographic and tumor characteristics with those typical of North African TNBC populations suggests that our data are most applicable to comparable, understudied communities. Treatment heterogeneity,

particularly variation in docetaxel dosing, may have introduced residual confounding despite multivariable adjustment. Molecular stratification was not feasible, as BRCA1/2 and HRD testing were not routinely accessible, and basal-like classification relied on immunohistochemistry surrogates rather than transcriptomic profiling, precluding definitive subtype assignment. Family history data were limited to first-degree relatives without formal pedigree assessment. Treatment-related toxicities were not systematically recorded, precluding a formal benefit-risk assessment of carboplatin-containing regimens; tolerability should therefore be interpreted in light of data from prospective trials such as GeparSixto and BrighTNess. Finally, comparisons with randomized trials should be interpreted cautiously given differences in study design, patient selection, and molecular characterization.

CONCLUSION

In this long-term follow-up of Algerian women with nonmetastatic triple-negative breast cancer treated with neoadjuvant chemotherapy, the carboplatin-containing strategy significantly increased pathological complete response rates but was not associated with improved long-term survival after a median follow-up of 8.6 years. Because docetaxel dosing differed between groups, this finding reflects the net effect of the distinct treatment regimens rather than the isolated effect of carboplatin. Pathologic complete response independently predicted overall and event-free survival, whereas larger tumor size remained an adverse prognostic factor. These findings underscore the prognostic value of treatment response and support the need for biomarker-driven strategies to refine patient selection for platinum-based therapy.

ETHICAL CONSIDERATIONS

The Ethics Committee (EC003KB08052022) approved the study protocol, and all participants provided written informed consent. All procedures were conducted in accordance with the Declaration of Helsinki.

DATA AVAILABILITY

The data sets utilized and/or analyzed in this study are available from the corresponding author upon a reasonable request.

CONFLICT OF INTERESTS

The authors declare that they have no conflicts of interest.

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AI DISCLOSURE

The authors declare that generative artificial intelligence tools were used solely for language editing, grammatical improvement, and stylistic refinement. AI tools were not used to generate data, perform statistical analyses, interpret findings, or formulate study conclusions. The authors have reviewed and validated all final content and take full responsibility for its accuracy and scientific integrity.

AUTHOR CONTRIBUTIONS

Conceptualization, SM and AL; methodology, SM, AK, and AL; software, Abdellah Berber; validation, AL; formal analysis, AL and AK; investigation, SM and Amira Bouguedra; writing, original draft preparation, SM; writing, review and editing, SH, Abdellah Berber, and RN; visualization, SM; supervision, KB and MO; project administration, KB and MO. All authors have read and agreed to the published version of the manuscript.

REFERENCES

1. Hammond MEH, Hayes DF, Dowsett M, Allred DC, Hagerty KL, Badve S, et al. American Society of Clinical Oncology/College of American Pathologists guideline recommendations for immunohistochemical testing of estrogen and progesterone receptors in breast cancer. *Arch Pathol Lab Med*. 2010;134(6):907-22. doi: 10.5858/134.6.907

2. Wolff AC, Hammond MEH, Allison KH, Harvey BE, Mangu PB, Bartlett JMS, et al. Human Epidermal Growth Factor Receptor 2 Testing in Breast Cancer: American Society of Clinical Oncology/College of American Pathologists Clinical Practice Guideline Focused Update. *Arch Pathol Lab Med*. 2018;142(11):1364-82. doi: 10.5858/arpa.2018-0902-sa

3. Wolff AC, Hammond MEH, Hicks DG, Dowsett M, McShane LM, Allison KH, et al. Recommendations for human epidermal growth factor receptor 2 testing in breast cancer: American Society of Clinical Oncology/College of American Pathologists clinical practice guideline update. *J Clin Oncol*. 2013;31(31):3997-4013. doi: 10.1200/jco.2013.50.9984

4. Zagami P, Carey LA. Triple negative breast cancer: Pitfalls and progress. *NPJ Breast Cancer*. 2022;8(1):95. doi: 10.1038/s41523-022-00468-0

5. Dent R, Trudeau M, Pritchard KI, Hanna WM, Kahn HK, Sawka CA, et al. Triple-negative breast cancer: clinical features and patterns of recurrence. *Clin Cancer Res*. 2007;13(15 Pt 1):4429-34. doi: 10.1158/1078-0432.ccr-06-3045

6. Memon AI, Ujjan ID, Bhatti AM. *Breast Cancer Updates*. London: IntechOpen; 2023. doi: 10.5772/intechopen.110149

7. Bou Zerdan M, Ghorayeb T, Saliba F, Allam S, Bou Zerdan M, Yaghi M, et al. Triple Negative Breast Cancer: Updates on Classification and Treatment in 2021. *Cancers (Basel)*. 2022;14(5):1253. doi: 10.3390/cancers14051253

8. Cortazar P, Zhang L, Untch M, Mehta K, Costantino JP, Wolmark N, et al. Pathological complete response and long-term clinical benefit in breast cancer: the CTNeoBC pooled analysis. *Lancet*. 2014;384(9938):164-72. doi: 10.1016/s0140-6736(13)62422-8
9. Korde LA, Somerfield MR, Carey LA, Crews JR, Denduluri N, Hwang ES, et al. Neoadjuvant Chemotherapy, Endocrine Therapy, and Targeted Therapy for Breast Cancer: ASCO Guideline. *J Clin Oncol*. 2021;39(13):1485-505. doi: 10.1200/jco.20.03399
10. Cardoso F, Kyriakides S, Ohno S, Penault-Llorca F, Poortmans P, Rubio IT, et al. Early breast cancer: ESMO Clinical Practice Guidelines for diagnosis, treatment and follow-up. *Ann Oncol*. 2019;30(8):1194-220. doi: 10.1093/annonc/mdz173
11. Poggio F, Bruzzone M, Ceppi M, Pondé NF, La Valle G, Del Mastro L, et al. Platinum-based neoadjuvant chemotherapy in triple-negative breast cancer: a systematic review and meta-analysis. *Ann Oncol*. 2018;29(7):1497-508. doi: 10.1093/annonc/mdy127
12. Petrelli F, Coinu A, Borgonovo K, Cabiddu M, Ghilardi M, Lonati V, et al. The value of platinum agents as neoadjuvant chemotherapy in triple-negative breast cancers: a systematic review and meta-analysis. *Breast Cancer Res Treat*. 2014;144(2):223-32. doi: 10.1007/s10549-014-2876-z
13. Mason SR, Willson ML, Egger SJ, Beith J, Dear RF, Goodwin A. Platinum chemotherapy for early triple-negative breast cancer. *Breast*. 2024;75:103712. doi: 10.1016/j.breast.2024.103712
14. Pathak N, Sharma A, Elavarasi A, Sankar J, Deo SVS, Sharma DN, et al. Moment of truth-adding carboplatin to neoadjuvant/adjuvant chemotherapy in triple negative breast cancer improves overall survival: An individual participant data and trial-level Meta-analysis. *Breast*. 2022;64:7-18. doi: 10.1016/j.breast.2022.04.006
15. Geyer CE, Sikov WM, Huober J, Rugo HS, Wolmark N, O'Shaughnessy J, et al. Long-term efficacy and safety of addition of carboplatin with or without veliparib to standard neoadjuvant chemotherapy in triple-negative breast cancer: 4-year follow-up data from BrighTNess, a randomized phase III trial. *Ann Oncol*. 2022;33(4):384-94. doi: 10.1016/j.annonc.2022.01.009
16. Loibl S, Weber KE, Timms KM, Elkin EP, Hahnen E, Fasching PA, et al. Survival analysis of carboplatin added to an anthracycline/taxane-based neoadjuvant chemotherapy and HRD score as predictor of response-final results from GeparSixto. *Ann Oncol*. 2018;29(12):2341-7. doi: 10.1093/annonc/mdy460
17. Shepherd JH, Ballman K, Polley MYC, Campbell JD, Fan C, Selitsky S, et al. CALGB 40603 (Alliance): Long-Term Outcomes and Genomic Correlates of Response and Survival After Neoadjuvant Chemotherapy With or Without Carboplatin and Bevacizumab in Triple-Negative Breast Cancer. *J Clin Oncol*. 2022;40(12):1323-34. doi: 10.1200/jco.21.01506
18. Amin MB, Greene FL, Edge SB, Compton CC, Gershenwald JE, Brookland RK, et al. The Eighth Edition AJCC Cancer Staging Manual: Continuing to build a bridge from a population-based to a more "personalized" approach to cancer staging. *CA Cancer J Clin*. 2017;67(2):93-9. doi: 10.3322/caac.21388
19. Lakhani SR, Ellis IO, Schnitt SJ, Tan PH, van de Vijver MJ, editors. *WHO Classification of Tumours of the Breast*. Lyon: International Agency for Research on Cancer; 2012;4. 240 p.
20. Bloom HJ, Richardson WW. Histological grading and prognosis in breast cancer; a study of 1409 cases of which 359 have been followed for 15 years. *Br J Cancer*. 1957;11(3):359-77. doi: 10.1038/bjc.1957.43
21. Nielsen TO, Hsu FD, Jensen K, Cheang M, Karaca G, Hu Z, et al. Immunohistochemical and clinical characterization of the basal-like subtype of invasive breast carcinoma. *Clin Cancer Res*. 2004;10(16):5367-74. doi: 10.1158/1078-0432.ccr-04-0220
22. Cheang MCU, Voduc D, Bajdik C, Leung S, McKinney S, Chia SK, et al. Basal-like breast cancer defined by five biomarkers has superior prognostic value than triple-negative phenotype. *Clin Cancer Res*. 2008;14(5):1368-76. doi: 10.1158/1078-0432.ccr-07-1658
23. Dowsett M, Nielsen TO, A'Hern R, Bartlett J, Coombes RC, Cuzick J, et al. Assessment of Ki67 in breast cancer: recommendations from the International Ki67 in Breast Cancer working group. *J Natl Cancer Inst*. 2011;103(22):1656-64. doi: 10.1093/jnci/djr393
24. Wu Q, Ma G, Deng Y, Luo W, Zhao Y, Li W, et al. Prognostic Value of Ki-67 in Patients With Resected Triple-Negative Breast Cancer: A Meta-Analysis. *Front Oncol*. 2019;9:1068. doi: 10.3389/fonc.2019.01068
25. Litton JK, Regan MM, Pusztai L, Rugo HS, Tolaney SM, Garrett-Mayer E, et al. Standardized Definitions for Efficacy End Points in Neoadjuvant Breast Cancer Clinical Trials: NeoSTEEP. *J Clin Oncol*. 2023;41(27):4433-42. doi: 10.1200/jco.23.00435
26. Sikov WM, Berry DA, Perou CM, Singh B, Cirrincione CT, Tolaney SM, et al. Impact of the addition of carboplatin and/or bevacizumab to neoadjuvant once-per-week paclitaxel followed by dose-dense doxorubicin and cyclophosphamide on pathologic complete response rates in stage II to III triple-negative breast cancer: CALGB 40603 (Alliance). *J Clin Oncol*. 2015;33(1):13-21. doi: 10.1200/jco.2014.57.0572
27. Loibl S, O'Shaughnessy J, Untch M, Sikov WM, Rugo HS, McKee MD, et al. Addition of the PARP inhibitor veliparib plus carboplatin or carboplatin alone to standard neoadjuvant chemotherapy in triple-negative breast cancer (BrighTNess): a randomised, phase 3 trial. *Lancet Oncol*. 2018;19(4):497-509. doi: 10.1016/s1470-2045(18)30111-6
28. Petrelli F, Ghidini A, Rea C, Parati MC, Borgonovo K, Ghidini M, et al. Platinum dose in neoadjuvant therapy for triple-negative breast cancer: A systematic review and network meta-analysis. *Curr Probl Cancer*. 2024;50:101096. doi: 10.1016/j.currproblcancer.2024.101096
29. Mason SRE, Willson ML, Egger SJ, Beith J, Dear RF, Goodwin A. Platinum-based chemotherapy for early triple-negative breast cancer. *Cochrane Database Syst Rev*. 2023;2023(9):CD014805. doi: 10.1002/14651858.cd014805.pub2
30. Haddad S, Frimeche Z, Lakehal A, Sifi K, Satta D, Abadi N. Descriptive study of triple negative breast cancer in Eastern Algeria. *Pan Afr Med J*. 2018;29:45. doi: 10.11604/pamj.2018.29.45.12523
31. Gaceb H, Cherbal F, Bakour R, Ould-Rouis A, Mahfouf H. Clinicopathological and Molecular Study of Triple-Negative Breast Cancer in Algerian Patients. *Pathol Oncol Res*. 2018;24(2):297-308. doi: 10.1007/s12253-017-0242-2
32. Vihervuori H, Korpinen K, Autere TA, Repo H, Talvinen K, Kronqvist P. Varying outcomes of triple-negative breast cancer in different age groups-prognostic value of clinical features and proliferation. *Breast Cancer Res Treat*. 2022;196(3):471-82. doi: 10.1007/s10549-022-06767-1
33. James M, Dixit A, Robinson B, Frampton C, Davey V. Outcomes for Patients with Non-metastatic Triple-negative Breast Cancer in New Zealand. *Clin Oncol (R Coll Radiol)*. 2019;31(1):17-24. doi: 10.1016/j.clon.2018.09.006
34. Zhu JW, Charkhchi P, Adekunte S, Akbari MR. What Is Known about Breast Cancer in Young Women?. *Cancers (Basel)*. 2023;15(6):1917. doi: 10.3390/cancers15061917
35. Nishimura R, Osako T, Okumura Y, Nakano M, Otsuka H, Fujisue M, et al. Triple Negative Breast Cancer: An Analysis of the Subtypes and the Effects of Menopausal Status on Invasive Breast Cancer. *J Clin Med*. 2022;11(9):2331. doi: 10.3390/jcm11092331
36. Srinath A, van Merode F, Rao SV, Pavlova M. Barriers to cervical cancer and breast cancer screening uptake in low- and middle-income countries: a systematic review. *Health Policy Plan*. 2023;38(4):509-27. doi: 10.1093/heapol/czac104
37. Harborg S, Zachariae R, Olsen J, Johannsen M, Cronin-Fenton D, Bøggild H, et al. Overweight and prognosis in triple-negative breast cancer patients: a systematic review and meta-analysis. *NPJ Breast Cancer*. 2021;7(1):119. doi: 10.1038/s41523-021-00325-6

38. Kumar S, Furrukh M, Al-Baimani K, Al-Ajmi A, Burney IA, Al-Moundhri MS. Outcomes of Women with Non-Metastatic Triple-Negative Breast Cancer in Oman: A single-centre experience. *Sultan Qaboos Univ Med J*. 2019;19(3):e209-e216. doi: 10.18295/squmj.2019.19.03.006
39. Hamdi Y, Mighri N, Boujemaa M, Mejri N, Ben Nasr S, Ben Rekaya M, et al. Identification of Eleven Novel BRCA Mutations in Tunisia: Impact on the Clinical Management of BRCA Related Cancers. *Front Oncol*. 2021;11:674965. doi: 10.3389/fonc.2021.674965
40. von Minckwitz G, Untch M, Blohmer JU, Costa SD, Eidtmann H, Fasching PA, et al. Definition and impact of pathologic complete response on prognosis after neoadjuvant chemotherapy in various intrinsic breast cancer subtypes. *J Clin Oncol*. 2012;30(15):1796-804. doi: 10.1200/jco.2011.38.8595
41. Lucas MW, Kelly CM. Optimal Choice of Neoadjuvant Chemotherapy for HER2-Negative Breast Cancer: Clinical Insights. *Cancer Manag Res*. 2022;14:2493-506. doi: 10.2147/cmar.s341466
42. Gündoğdu A, Uluşahin M, Çekiç AB, Kazaz SN, Güner A. Pathological complete response and associated factors in breast cancer after neoadjuvant chemotherapy: A retrospective study. *Turk J Surg*. 2024;40(1):73-81. doi: 10.47717/turkjsurg.2024.6308
43. von Minckwitz G, Schneeweiss A, Loibl S, Salat C, Denkert C, Rezai M, et al. Neoadjuvant carboplatin in patients with triple-negative and HER2-positive early breast cancer (GeparSixto; GBG 66): a randomised phase 2 trial. *Lancet Oncol*. 2014;15(7):747-56. doi: 10.1016/s1470-2045(14)70160-3
44. de Pádua Souza C, Carneiro ASB, de Oliveira Lessa AC, Lacerda DC, Paiva CE, Zorzetto MMC, et al. Neoadjuvant carboplatin in triple-negative breast cancer: results from NACATRINE, a randomized phase II clinical trial. *Breast Cancer Res Treat*. 2023;202(1):57-65. doi: 10.1007/s10549-023-07011-0
45. Elnaggar AA, Ismail SS, Elzawawy SF, Faheim RM, Abdel-Hakim KN. Effectiveness and safety of platinum based agents neoadjuvant chemotherapy on pathological complete response in triple negative breast cancer patients (a retrospective study). *Ain Shams Med J*. 2024;75(2):337-47. doi: 10.21608/asmj.2024.280363.1262
46. Feng W, He Y, Xu J, Zhang H, Si Y, Xu J, et al. A meta-analysis of the effect and safety of platinum-based neoadjuvant chemotherapy in treatment of resectable triple-negative breast cancer. *Anticancer Drugs*. 2022;33(1):e52-e60. doi: 10.1097/cad.0000000000001196
47. da Silva JL, Rodrigues FR, de Mesquita GG, Fernandes PV, Thuler LCS, de Melo AC. Triple-Negative Breast Cancer: Assessing the Role of Immunohistochemical Biomarkers on Neoadjuvant Treatment. *Breast Cancer (Dove Med Press)*. 2021;13:31-44. doi: 10.2147/bctt.s287320

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Available from: https://www.archbreastcancer.com/index.php/abc/article/view/1325