Efficacy and safety of nanoparticle albumin-bound paclitaxel compared with solvent-based paclitaxel in adjuvant therapy for breast cancer: A retrospective study

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Abstract. The current evidence for the use of nanoparticle albumin-bound paclitaxel (nab-PTX) for adjuvant breast cancer chemotherapy is insufficient. The present study aimed to assess the efficacy and toxicity of nab-PTX in comparison with solvent-based paclitaxel (sb-PTX) in postoperative adjuvant breast cancer treatment. A total of 345 patients were included in the study and separated into nab-PTX (n=289) and sb-PTX (n=56) groups based on the type of taxane used in the adjuvant chemotherapy regimen. The study evaluated the baseline characteristics in both groups and the risk factors for postoperative recurrence of mammary cancer. Furthermore, data concerning disease-free survival (DFS) and adverse effects were obtained and analyzed, and group confounding variables were addressed using 1:2 propensity score matching (PSM). Comparisons before PSM revealed significant differences in baseline characteristics including age, underlying disease, lymph node involvement, vascular invasion, human epidermal growth factor receptor 2 and axillary surgery (P<0.05). Following PSM, there were 90 patients in the nab-PTX group and 56 in the sb-PTX group, with no significant differences in the baseline differences (P>0.05). Before PSM, the 73-month DFS rate was 97.9% in the nab-PTX group compared with 91.1% in the sb-PTX group. However, there were no significant differences between the groups before or after PSM (P=0.15 and P=0.49, respectively). Additionally, Cox regression analysis demonstrated a significantly lower chance of recurrence in patients aged >45 years [hazard ratio (HR), 0.197; 95% confidence interval (CI), 0.052-0.753; P=0.018], whereas underlying disease (HR, 5.352; 95% CI, 1.310-21.854; P=0.019) and lymph node infiltration (HR, 8.930; 95% CI, 1.121-71.161; P=0.039) significantly increased the risk of recurrence. Regarding safety, the sb-PTX group had a significantly greater incidence of anaphylaxis, whereas the nab-PTX group had significantly increased rates of anemia and peripheral neuropathy (P<0.05). In summary, the 73-month DFS rate of the nab-PTX cohort exceeded that of the sb-PTX cohort, but no significant difference was detected between them. Underlying disease, lymph node metastasis and an age of ≤45 years are significant predictors of postoperative recurrence of breast cancer.

Introduction

Breast cancer is recognized for its considerable heterogeneity and is influenced by genetic, environmental, age-related, lifestyle and dietary factors. As reported by global cancer data analysis in 2022, cancer of the breast ranks fourth globally in terms of cancer-related deaths. Furthermore, it has the highest incidence and fatality rates (23.8 and 15.4%, respectively) among women (1). American cancer statistics for 2024 identified breast carcinoma as the most prevalent malignant tumor among American females and the second leading cause of cancer mortality, trailing only lung cancer (2). For patients eligible for adjuvant chemotherapy, regimens based on taxane drugs are considered among the optimal treatments (3).

Paclitaxel (PTX), a plant alkaloid chemotherapeutic agent, is widely used to treat several cancers, including breast cancer. It inhibits tumor growth primarily by disrupting the mitotic activity of cancer cells. This action is mediated by its binding to tubulin, which impedes the dynamic stability of microtubules, leading to abnormal aggregation and disassembly during mitosis and ultimately causing the apoptosis of tumor cells (4). Owing to its limited solubility in water, solvent-based (sb)-PTX requires the use of solvents for administration. In contrast, nanoparticle albumin-bound (nab)-PTX represents an innovative formulation that encapsulates the drug in albumin, increasing its solubility and stability. This formulation permits shorter infusion times (20 min compared with 120 min for

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the sb-PTX form), does not require premedication or specialized infusion equipment, and reduces the risk of toxicity and allergic reactions (5).

Previous evidence indicates that nab-PTX is markedly more effective than its sb-PTX counterpart (6). A major international phase III trial reported that ABI-007, a novel nab-PTX nanoparticle, had notable effectiveness compared with traditional Taxol in managing advanced breast cancers, offering reduced toxicity (7). Moreover, a meta-analysis further corroborated that nab-PTX markedly extends OS compared with sb-PTX taxanes in patients with metastatic breast carcinoma and improves overall response and disease control rates, with toxicity and discontinuation rates similar to those of traditional formulations (8). For elderly patients with advanced mammary breast cancer, weekly administration of nab-PTX has been reported to be safer and more productive than the triweekly sb-PTX regimen (9). With promising efficacy and excellent tolerability, nab-PTX is now approved in the USA for the management of breast cancer in individuals for whom combination treatment for advanced cancer has failed or for those who have relapsed within 6 months of adjuvant therapy (10). Furthermore, the GeparSepto-GBG69 phase III trial reported that, compared with sb-PTX, nab-PTX notably increased the number of patients who achieved a pathological complete response following anthracycline therapy in neoadjuvant treatments for initial-stage breast carcinoma (11). In addition, the 2024 Chinese Society of Clinical Oncology Breast Cancer Treatment Guidelines supported nab-PTX as an initial-line neoadjuvant chemotherapy treatment and highlighted its potential benefits for certain patients with metastatic mammary cancer after progression following first-line taxane treatments (12).

Although the advantages of nab-PTX over sb-PTX for the neoadjuvant treatment of breast cancer and the treatment of patients with advanced breast cancer have been confirmed, the evidence for the use of nab-PTX in postoperative adjunctive chemotherapy remains limited due to the long-term nature of the clinical results, such as disease-free survival (DFS) and overall survival (OS) rates. Considering the convenience and manageable adverse effects of nab-PTX, there are questions as to whether nab-PTX could be more widely used. Consequently, the present study aimed to analyze the efficacy and adverse reactions of nab-PTX compared with sb-PTX in postoperative adjuvant chemotherapy for patients with mammary cancer, and to identify predictors of risk for postoperative recurrence and metastasis.

Materials and methods

Ethical approval and study flow chart. The present single-center retrospective study followed the guidelines of the Declaration of Helsinki, and the Ethics Committee of the Second Affiliated Hospital of Anhui Medical University (Hefei, China) approved the study [approval no. YX2023-203(F1)]. Fig. 1 presents a flow chart of the study design.

Inclusion and exclusion criteria. The inclusion criteria for the present study were as follows: i) Pathologically-confirmed breast cancer; ii) surgical treatment for breast carcinoma; and iii) postoperative adjuvant chemical treatment with either nab-PTX or sb-PTX. The exclusion criteria were as follows: i) Previous instances of psychiatric or cognitive issues; ii) neoadjuvant chemotherapy prior to surgery or other adjuvant chemotherapy regimens without nab-PTX or sb-PTX; and iii) incomplete adjuvant chemotherapy regimens.

Patient selection and grouping. The patient hospital records were first accessed in February 2024 for the present study. The retrospective analysis of cohorts included individuals who completed surgical treatment for breast cancer and were administered taxane-based adjuvant chemotherapy between January 2018 and June 2023 at the Second Affiliated Hospital of Anhui Medical University. The collected clinical and pathological data of patients included age, underlying disease, expression levels of immunohistochemical markers [hormone receptor, human epidermal growth factor receptor (HER)-2 and Ki-67], breast and axillary operative treatment, tumor volume, lymph gland condition, blood vessel invasion, World Health Organization (WHO) tumor grade (13) and postoperative pathology. Information was also collected on patient outcomes, specifically recurrence or metastasis, alongside adverse reactions to chemotherapy, including hematologic toxicity, allergic reactions, musculoskeletal pain and neuropathy, until February 2024. The participants were divided into two groups according to the type of PTX used: Nab-PTX and sb-PTX.

Treatment regimen and follow-up. Under the National Comprehensive Cancer Network guidelines, patients with postoperative mammary cancer should receive a PTX-based adjuvant regimen, including the following regiments: docetaxel and cyclophosphamide; doxorubicin and cyclophosphamide followed by docetaxel; epirubicin and cyclophosphamide (EC); and PTX with carboplatin. When medically indicated, nab-PTX should be substituted for docetaxel or standard PTX, with a weekly dose not exceeding 125 mg/m^2. Postoperative radiation should be applied to high-risk breast tissues. Furthermore, hormone receptor-positive and HER-2-positive individuals should receive corresponding endocrine and targeted treatments (14). Hormone receptor positivity is defined as ≥1% expression according to the American Society of Clinical Oncology/College of American Pathologists guidelines (15). Initial assessment of tumor HER-2 status is assigned as HER2-positive when scored as 3+ using immunohistochemistry or amplified by fluorescence *in situ* hybridization (16). Post-treatment follow-up should consist of a periodic history/physical examination every 4-6 months for the initial 5 years after the first treatment and annually thereafter. Mammography should be performed yearly (14). DFS is the primary endpoint. Laboratory and imaging tests are used to screen for the recurrence or metastasis of breast cancer. The Common Terminology Criteria for Adverse Events, version 5.0 from the National Cancer Institute (17), was used to evaluate and classify adverse reactions.

Statistical analysis. R V4.3.3 (The R Foundation) and SPSS V26.0 (IBM Corp.) were used for data analysis. The Mann-Whitney U test was used for the analysis of ordinal data, and the Pearson χ^2 test or Fisher's exact test were

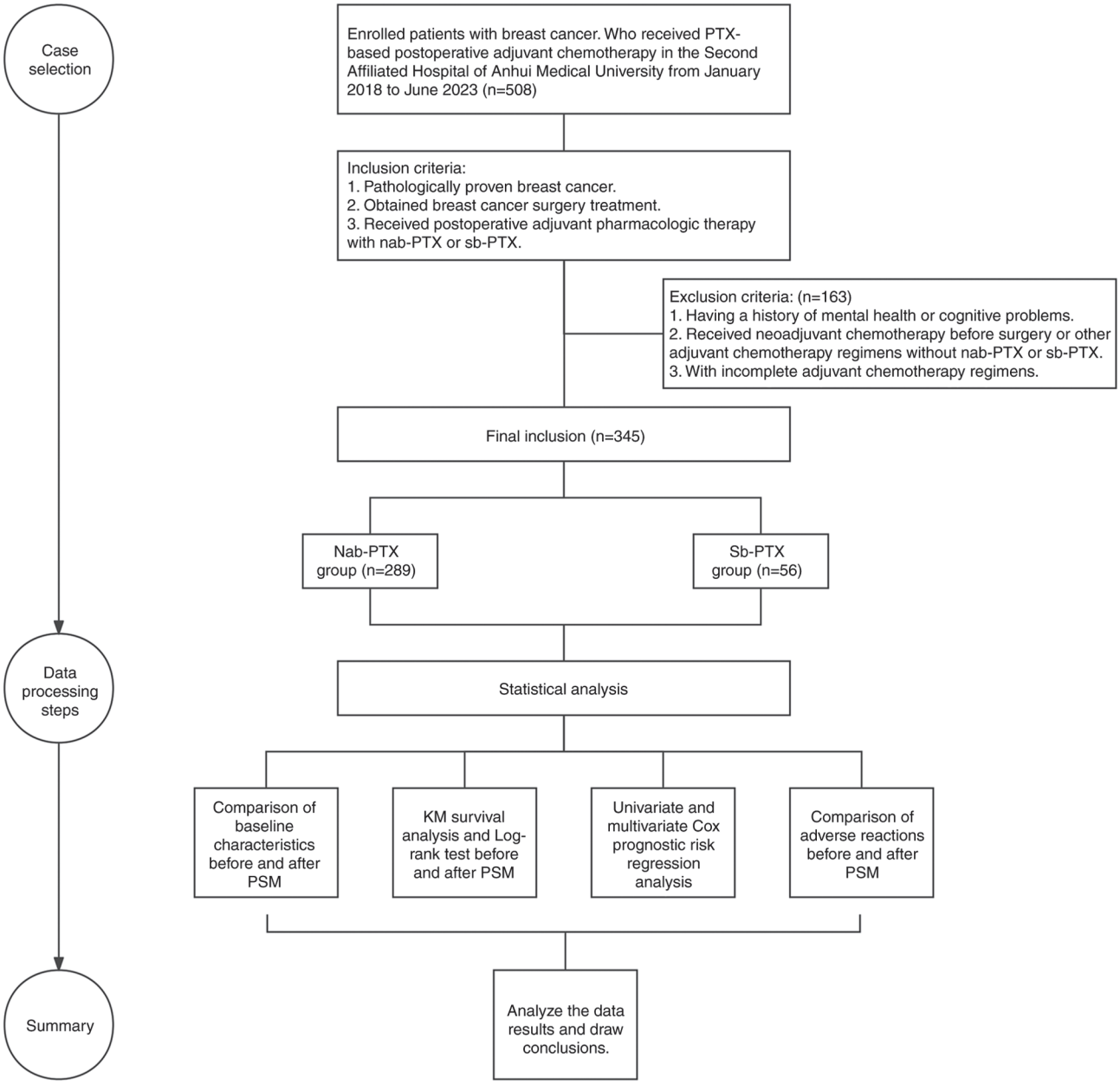

Figure 1. Flow chart of the study design. PTX, paclitaxel; nab-PTX, nanoparticle albumin-bound PTX; sb-PTX, solvent-based PTX; PSM, propensity score matching; KM, Kaplan-Meier.

used for the assessment of other categorical variables. A propensity score matching (PSM) method based on logistic regression was used to adjust for confounding factors. A minimum sample size estimation after PSM was performed using Pass 2021 (v.21.0.3; NCSS, LLC) based on the non-inferiority study Cox risk regression analysis module. The non-inferiority margin was set at 1.55 as assessed by professional clinicians. A non-inferiority test with an overall sample size of 108 subjects [of which 54 were in the control group (sb-PTX) and 54 were in the treatment group (nab-PTX)] achieved 80% power at a 0.05 significance level when the N1/N2 ratio was set to 1:1. Kaplan-Meier curves were used to analyze survival, and the log-rank test was used to compare survival rates. Cox regression analyses revealed the predictors. $P<0.05$ was considered to indicate a statistically significant difference.

Results

Baseline characteristics before and after PSM. The present retrospective study included 345 individuals (all female) with breast cancer at the Second Affiliated Hospital of Anhui Medical University who received postoperative taxane-based adjuvant chemotherapy between January 2018 and June 2023. In the nab-PTX group, 23.2% (67/289) were ≤45 years of age, and 76.8% (222/289) were >45 years of age. In the sb-PTX group, 37.5% (21/56) were aged ≤45 years, whereas 62.5% (35/56) were aged >45 years, with a statistically significant age disparity (P=0.024). The presence of underlying disease was noted in 20.1% (58/289) of the nab-PTX group compared with 8.9% (5/56) of the sb-PTX group, with a significant difference between the two groups (P=0.048). Lymph node involvement was demonstrated in 41.2% (119/289) of the nab-PTX group

Table I. Baseline information of the participants before and after propensity score matching.

	Before PSM			After PSM		
Baseline characteristic	Nab-PTX (n=289)	Sb-PTX (n=56)	P-value	Nab-PTX (n=90)	Sb-PTX (n=56)	P-value
Age						
≤45 years	67 (23.2)	21 (37.5)	0.024	30 (33.3)	21 (37.5)	0.608
>45 years	222 (76.8)	35 (62.5)		60 (66.7)	35 (62.5)	
Underlying disease						
No	231 (79.9)	51 (91.1)	0.048	79 (87.8)	51 (91.1)	0.536
Yes	58 (20.1)	5 (8.9)		11 (12.2)	5 (8.9)	
Tumor size						
≤2 cm	112 (38.8)	14 (25.0)	0.050	25 (27.8)	14 (25.0)	0.712
>2 cm	177 (61.2)	42 (75.0)		65 (72.2)	42 (75.0)	
Lymph node involvement						
Negative	170 (58.8)	5 (8.9)	<0.001	11 (12.2)	5 (8.9)	0.536
Positive	119 (41.2)	51 (91.1)		79 (87.8)	51 (91.1)	
Vascular invasion						
No	158 (54.7)	22 (39.3)	0.035	34 (37.8)	22 (39.3)	0.855
Yes	131 (45.3)	34 (60.7)		56 (62.2)	34 (60.7)	
WHO grade						
I	6 (2.1)	2 (3.6)	0.770	1 (1.1)	2 (3.6)	0.703
II	205 (70.9)	40 (71.4)		66 (73.3)	40 (71.4)	
III	78 (27.0)	14 (25.0)		23 (25.6)	14 (25.0)	
Hormone receptor						
Negative	69 (23.9)	11 (19.6)	0.492	16 (17.8)	11 (19.6)	0.778
Positive	220 (76.1)	45 (80.4)		74 (82.2)	45 (80.4)	
HER-2						
Negative	200 (69.2)	48 (85.7)	0.012	71 (78.9)	48 (85.7)	0.302
Positive	89 (30.8)	8 (14.3)		19 (21.1)	8 (14.3)	
Ki-67						
<14%	22 (7.6)	3 (5.4)	0.779	4 (4.4)	3 (5.4)	1.000
≥14%	267 (92.4)	53 (94.6)		86 (95.6)	53 (94.6)	
Breast surgery						
Mastectomy	254 (87.9)	47 (83.9)	0.416	78 (86.7)	47 (83.9)	0.647
Lumpectomy	35 (12.1)	9 (16.1)		12 (13.3)	9 (16.1)	
Axillary surgery						
SLNB only	132 (45.7)	4 (7.1)	<0.001	10 (11.1)	4 (7.1)	0.428
ALND	157 (54.3)	52 (92.9)		80 (88.9)	52 (92.9)	
Pathology						
Infiltrating	278 (96.2)	56 (100.0)	0.223	89 (98.9)	56 (100.0)	1.000
Non-infiltrating	11 (3.8)	0 (0.0)		1 (1.1)	0 (0.0)	

Data are presented as n (%). PSM, propensity score matching; PTX, paclitaxel Nab-PTX, nanoparticle albumin-bound PTX; Sb-PTX, solvent-based PTX; WHO, World Health Organization; HER-2, human epidermal growth factor receptor 2; SLNB, sentinel lymph node biopsy; ALND, axillary lymph node dissection.

and 91.1% (51/56) of the sb-PTX group, and the difference was significant (P<0.001). For axillary surgery, 45.7% (132/289) of patients in the nab-PTX group underwent a sentinel lymph node biopsy only, whereas 7.1% (4/56) of patients in the sb-PTX group underwent a sentinel lymph node biopsy only. Furthermore, an axillary lymph node dissection occurred in 54.3% (157/289) of patients in the nab-PTX group, compared with 92.9% (52/56) of patients in the sb-PTX group. These

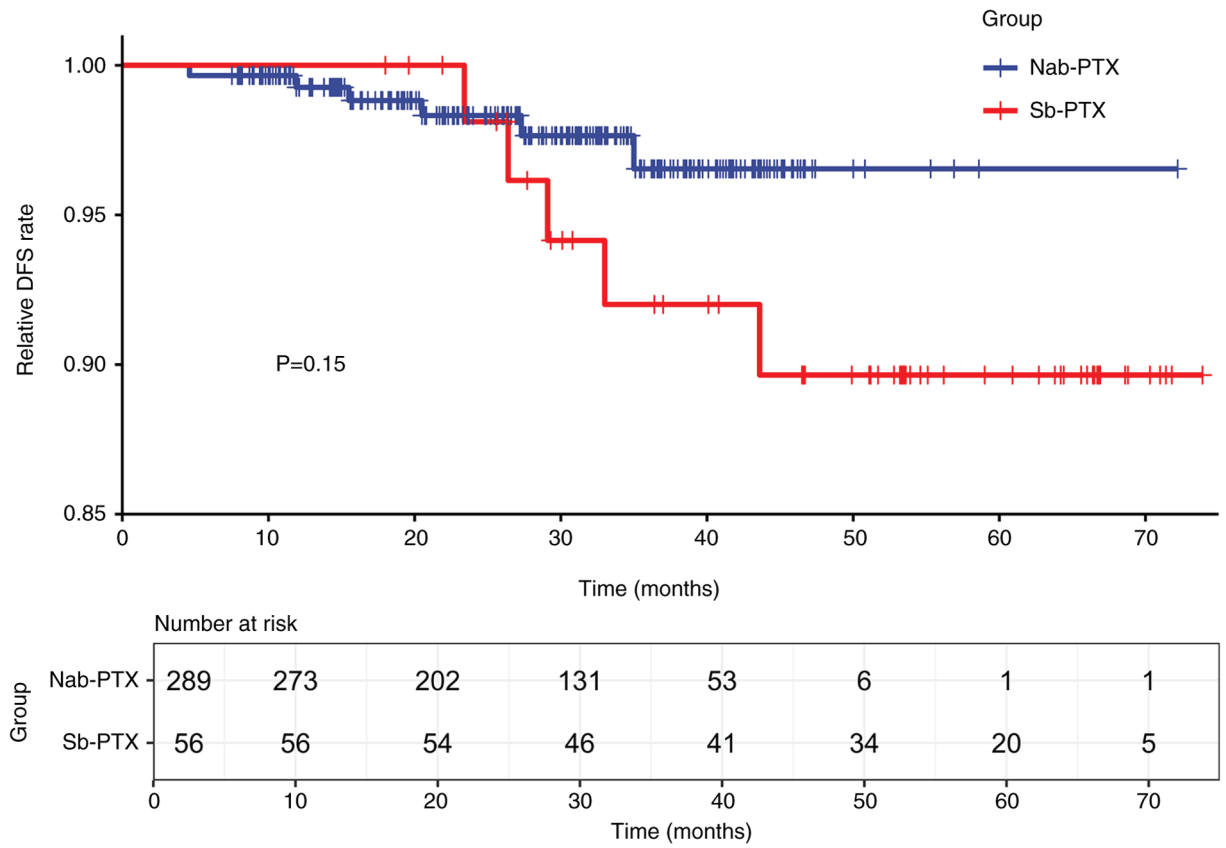

Figure 2. Kaplan-Meier curves for DFS before propensity score matching. DFS, disease-free survival; PTX, paclitaxel; nab-PTX, nanoparticle albumin-bound PTX; sb-PTX, solvent-based PTX.

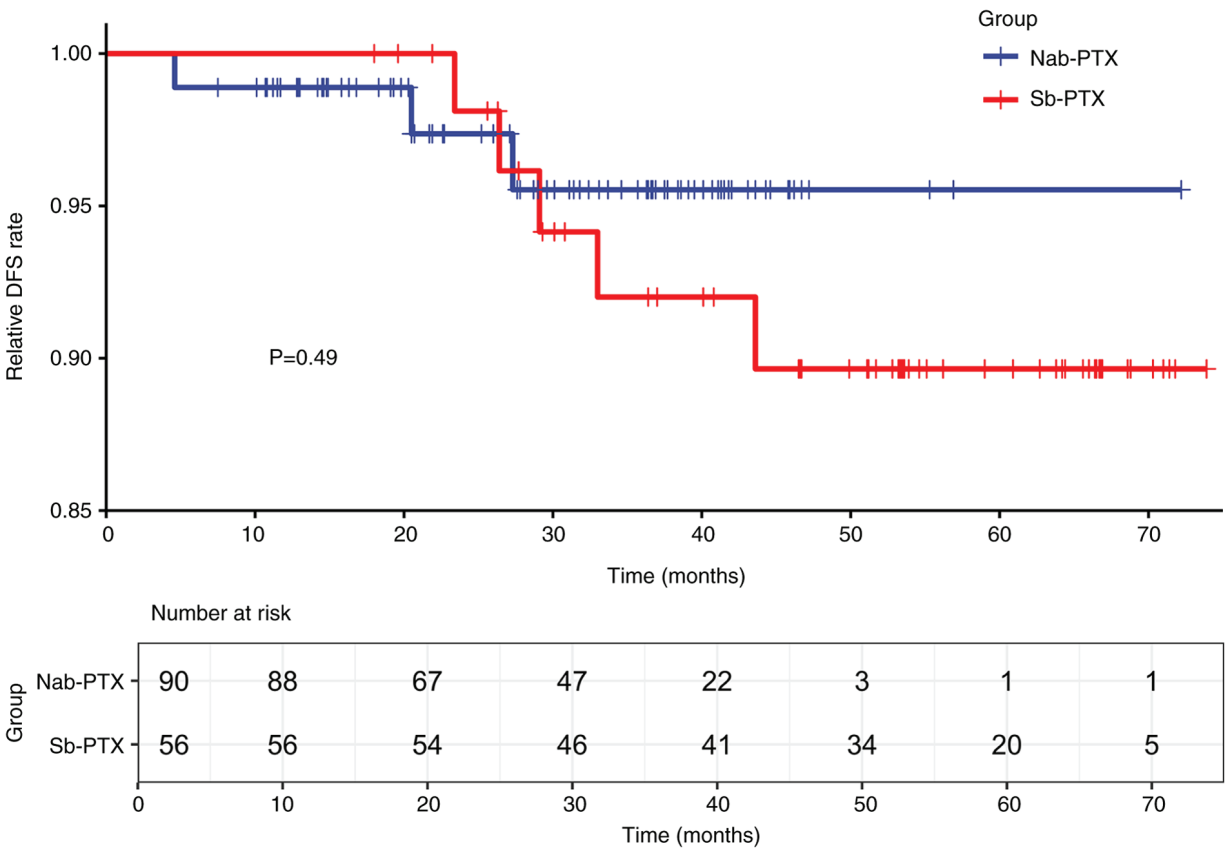

Figure 3. Kaplan-Meier curves for DFS after propensity score matching. DFS, disease-free survival; PTX, paclitaxel; nab-PTX, nanoparticle albumin-bound PTX; sb-PTX, solvent-based PTX.

Table II. Cox analysis of postsurgical recurrence in all patients.

	Univariate analysis		Multivariate analysis	
Variable	HR (95% CI)	P-value	HR (95% CI)	P-value
Group				
Sb-PTX[a]				
Nab-PTX	0.419 (0.124-1.418)	0.162		
Age				
≤45 years[a]				
>45 years	0.314 (0.096-1.028)	0.056	0.197 (0.052-0.753)	0.018
Underlying disease				
No[a]				
Yes	2.462 (0.717-8.450)	0.152	5.352 (1.310-21.854)	0.019
Tumor size				
≤2 cm[a]				
>2 cm	2.213 (0.477-10.260)	0.310		
Lymph node involvement				
Negative[a]				
Positive	7.682 (0.979-60.287)	0.052	8.930 (1.121-71.161)	0.039
Vascular invasion				
No[a]				
Yes	2.954 (0.783-11.141)	0.110		
WHO grade				
I[a]				
II	8300.010 (0.000->1000.000)	0.959		
III	8816.518 (0.000->1000.000)	0.959		
Hormone receptor				
Negative[a]				
Positive	2.663(0.341-20.814)	0.350		
HER-2				
Negative[a]				
Positive	0.992 (0.263-3.741)	0.991		
Ki-67				
<14%[a]				
≥14%	22.599 (0.001->1000.000)	0.542		
Breast surgery				
Mastectomy[a]				
Lumpectomy	1.688 (0.364-7.824)	0.503		
Axillary surgery				
SLNB only[a]				
ALND	4.718 (0.601-37.054)	0.140		
Pathology				
Infiltrating[a]				
Non-infiltrating	0.048 (0.000->1000.000)	0.759		

[a]Control group. PSM, propensity score matching; PTX, paclitaxel; Nab-PTX, nanoparticle albumin-bound PTX; Sb-PTX, solvent-based PTX; WHO, World Health Organization; HER-2, human epidermal growth factor receptor 2; SLNB, sentinel lymph node biopsy; ALND, axillary lymph node dissection; HR, hazard ratio; CI, confidence interval.

differences were significant (P<0.001). Immunohistochemical analysis revealed that 30.8% (89/289) of the nab-PTX patients were HER-2 positive, whereas 14.3% (8/56) of the sb-PTX patients were HER-2 positive, with significant differences between the two groups (P=0.012). No notable differences were demonstrated for hormone receptor or Ki-67 expression,

Table III. Adverse events associated with nanoparticle albumin-bound paclitaxel and solvent-based paclitaxel before and after propensity score matching.

	Before PSM			After PSM		
Adverse event	Nab-PTX (n=289)	Sb-PTX (n=56)	P-value	Nab-PTX (n=90)	Sb-PTX (n=56)	P-value
Leukopenia						
No	186 (64.4)	35 (62.5)	0.851	62 (68.9)	35 (62.5)	0.483
I-II	94 (32.5)	20 (35.7)		25 (27.8)	20 (35.7)	
III-IV	9 (3.1)	1 (1.8)		3 (3.3)	1 (1.8)	
Neutropenia						
No	191 (66.1)	42 (75.0)	0.193	64 (71.1)	42 (75.0)	0.556
I-II	83 (28.7)	12 (21.4)		20 (22.2)	12 (21.4)	
III-IV	15 (5.2)	2 (3.6)		6 (6.7)	2 (3.6)	
Anemia						
No	51 (17.6)	18 (32.1)	0.011	16 (17.8)	18 (32.1)	0.030
I-II	225 (77.9)	37 (66.1)		69 (76.7)	37 (66.1)	
III-IV	13 (4.5)	1 (1.8)		5 (5.6)	1 (1.8)	
Thrombocytopenia						
No	222 (76.8)	38 (67.9)	0.183	73 (81.1)	38 (67.9)	0.077
I-II	62 (21.5)	18 (32.1)		16 (17.8)	18 (32.1)	
III-IV	5 (1.7)	0 (0.0)		1 (1.1)	0 (0.0)	
Anaphylaxis						
No	289 (100.0)	54 (96.4)	0.026	90 (100.0)	54 (96.4)	0.145
Yes	0 (0.0)	2 (3.6)		0 (0.0)	2 (3.6)	
Musculoskeletal pain						
No	165 (57.1)	28 (50.0)	0.328	42 (46.7)	28 (50.0)	0.695
Yes	124 (42.9)	28 (50.0)		48 (53.3)	28 (50.0)	
Peripheral neuropathy						
No	65 (22.5)	24 (42.9)	0.001	23 (25.6)	24 (42.9)	0.030
Yes	224 (77.5)	32 (57.1)		67 (74.4)	32 (57.1)	

Data are presented as n (%). PSM, propensity score matching; PTX, paclitaxel; Nab-PTX, nanoparticle albumin-bound PTX; Sb-PTX, solvent-based PTX.

postoperative pathology, tumor size or WHO tumor grade (all P>0.05). Moreover, PSM at a 1:2 ratio was performed to adjust for age, underlying disease, tumor size, lymph node status, vascular invasion, WHO tumor grading, surgical methods, hormone receptor, HER-2 and Ki-67 levels, axillary surgery and postoperative pathology. Following matching, all the baseline characteristics revealed no significant differences between the two groups (all P>0.05). Table I presents information about the baseline characteristics.

DFS before and after PSM. As of January 2024, after a median follow-up of 30.4 months, 6/289 patients in the nab-PTX group experienced recurrence or metastasis, compared with 5/56 in the sb-PTX group. Therefore, the recurrence rates of breast cancer in the sb-PTX and nab-PTX groups before PSM were 9 and 2%, respectively. Kaplan-Meier survival analysis revealed that the 73-month DFS rate was 91.1% for the sb-PTX cohort and 97.9% for the nab-PTX cohort, demonstrating no statistically significant differences in DFS rates between the two groups (log-rank test, P=0.15; Fig. 2). After PSM, 3/90 patients in the nab-PTX group experienced recurrence, compared with 5/56 patients in the sb-PTX group. Kaplan-Meier survival analysis revealed no significant differences in DFS between the two cohorts (log-rank test, P=0.49; Fig. 3).

Predictor of postsurgical recurrence for patients with breast cancer. In all patients with breast cancer treated with sb-PTX and nab-PTX in postoperative adjuvant chemotherapy in the present study, univariate and multivariate Cox regression analyses revealed that underlying disease, lymph node metastasis and an age of ≤45 years were significantly associated with increased risks of postsurgical recurrence for patients with breast cancer. Notably, patients aged >45 years had a significantly lower recurrence risk than those aged ≤45 years [hazard ratio (HR), 0.197; 95% confidence interval (CI), 0.052-0.753;

P=0.018]. Patients with underlying disease had a significantly greater risk of recurrence than did those without underlying disease (HR, 5.352; 95% CI, 1.310-21.854; P=0.019). Moreover, lymph node involvement significantly increased the risk of recurrence (HR, 8.930; 95% CI, 1.121-71.161; P=0.039). Other subgroup analyses revealed no statistically significant differences between groups (all P>0.05). In addition, there was a notable trend toward a lower postoperative risk of breast cancer in the nab-PTX group compared with the sb-PTX group, but no statistically significant difference was observed (HR, 0.419; 95% CI, 0.124-1.418; P=0.162). Table II details the results of the Cox regression analyses.

Adverse events before and after PSM. Table III presents the adverse effects associated with both cohorts before and after PSM. The safety evaluation of hematologic toxicity revealed no significant differences in the incidence of Grade I-II leukopenia (32.5% vs. 35.7%) or Grade III-IV leukopenia (3.1% vs. 1.8%) between the nab-PTX and the sb-PTX groups (P=0.851). Similarly, there was no significant difference in the rate of neutropenia between the two groups (P=0.193). However, significant differences were demonstrated in the prevalence of anemia: 77.9% of the nab-PTX group experienced grade I-II anemia, compared with 66.1% of the sb-PTX group, and grade III-IV anemia was also more common in the nab-PTX cohort (4.5% vs. 1.8%; P=0.011). The incidence of thrombocytopenia did not differ significantly between the groups (P=0.183). Furthermore, for nonhematologic adverse events, no Grade III-IV events were present for anaphylaxis, musculoskeletal pain or peripheral neuropathy. Notably, allergic reactions occurred in 3.6% of the sb-PTX group but there were no cases in the nab-PTX group (P=0.026). Peripheral neuropathy was significantly more prevalent in the nab-PTX cohort than in the sb-PTX cohort (77.5% vs. 57.1%; P=0.001). However, musculoskeletal pain was not significantly different between the two groups (P=0.328). After PSM, analysis of hematologic toxicity revealed significant differences in the incidence of anemia between the groups (grades I-II: 76.7% in the nab-PTX group vs. 66.1% in the sb-PTX group; grades III-IV: 5.6% vs. 1.8%, respectively; P=0.030). Additionally, the proportion of patients with peripheral neuropathy was significantly greater in the nab-PTX group than the sb-PTX group (74.4% vs. 57.1%; P=0.030). However, no significant differences in the incidences of leukopenia, neutropenia, thrombocytopenia, allergic reactions or musculoskeletal pain were observed after matching (all P>0.05).

Discussion

Breast cancer is a significant oncological concern within gynecology and has consistently emerged as the most common cancer among women (5). Previous data revealed that ~36% of women initially diagnosed with breast malignancy presented with local or distant metastatic disease, yet 89.9% achieved a survival rate of ≥5 years post-diagnosis (18). For the majority of patients, adjuvant chemotherapy is advised to improve their prognosis, except for those with stage I or II hormone receptor-positive/HER-2-negative cancers (19). In the present single-center cohort study, 345 patients with postoperative breast cancer underwent taxane-based chemotherapy; 289 received nab-PTX and 56 received sb-PTX. Statistical analyses identified an age of ≤45 years, underlying disease and lymph node positivity as predictors of postoperative recurrence and revealed that a superiority or inferiority of nab-PTX efficacy to sb-PTX was not found based on the results of survival analysis. Compared with the sb-PTX group, the nab-PTX group presented an increased incidence of anemia and peripheral nerve damage; however, the nab-PTX group presented an advantage in terms of allergic reactions. These statistical results provide theoretical evidence for the use of nab-PTX in postoperative adjuvant chemotherapy for breast cancer and emphasize the importance of further research.

According to the Kaplan-Meier survival analysis, the DFS rates at 73 months were 91.1% for the sb-PTX group and 97.9% for the nab-PTX group. Although the sb-PTX cohort had lower DFS rates than the nab-PTX cohort, there were no significant differences in DFS. A study of nab-PTX and cyclophosphamide combined with trastuzumab in patients with initial-stage breast carcinoma reported that the combination of nab-PTX and cyclophosphamide, regardless of the addition of trastuzumab, was feasible and well accepted (20). Additionally, a comprehensive study comparing nab-PTX and conventional PTX across all stages of mammary cancer reported no major variations in short-term or long-term efficacy across the formulations (18,21). A study on adjuvant therapy for high-risk initial-stage breast carcinoma reported that combining nab-PTX with continuous anthracycline and cyclophosphamide chemotherapy provide marked benefits, with 2- and 6-year DFS rates of 93 and 82%, respectively (22). Furthermore, the ICE II-GBG 52 trial reported that non-frail elderly adults aged ≥65 years with early moderate-to high-risk breast cancer could benefit from comprehensive taxane-based chemotherapy. After ~23 months of follow-up, no notable difference in OS was detected between individuals receiving nab-PTX and those receiving EC or cyclophosphamide, methotrexate and fluorouracil regimens (23). However, the current research on the efficacy of nab-PTX for postoperative adjuvant therapy in breast carcinoma is restricted by a lack of robust evidence owing to the relatively limited number of clinical cases and the potential for outdated treatment regimens. These limitations highlight the necessity for further studies.

The analysis in the present study revealed that among patients with breast cancer treated with sb-PTX and nab-PTX in postoperative adjuvant chemotherapy, patients aged ≤45 years with underlying disease or positive lymph nodes, are at greater risk of postoperative recurring mammary cancer, which is in agreement with the findings of previous studies. Research has indicated that patients diagnosed before the age of 40 years, those with estrogen receptor-positive tumors, those who are undergoing breast-conserving surgery, those with ≥4 positive lymphedema cases, and those with primary lesions ≥20 mm are more likely to experience late recurrence (24). Furthermore, a history of diabetes in women with breast cancer is associated with worse outcomes (25,26), potentially due to dysregulation of the mTOR/AKT signaling pathway, which fosters tumor development under diabetic conditions (27). Moreover, chronic conditions, including hypertension, diabetes and dyslipidemia, adversely affect the treatment outcomes, prognosis and survival in patients with cancer, particularly in patients with diabetes with

mammary cancer, increasing the chance of recurrence and mortality (28).

The present study performed a systematic evaluation of adverse reactions in two treatment groups, specifically hematologic toxicity, allergic reactions, musculoskeletal pain and peripheral neuropathy. The findings revealed that the nab-PTX group had considerably greater rates of anemia and peripheral neuropathy than the sb-PTX group, but it had fewer allergic reactions. These differences reached statistical significance. A systematic review of adverse events in solid organ tumors reported that nab-PTX is related to a higher frequency of grade 3/4 anemia and a lower incidence of anaphylaxis than its sb-PTX counterparts (29). In comparative studies of individuals with several stages of breast carcinoma, nab-PTX was reported to be associated with higher rates of fatigue, nausea, vomiting and peripheral sensory neuropathy than conventional PTX formulations (18,21). The most common severe hematologic and nonhematologic side effects associated with nab-PTX have been reported to be neutropenia and peripheral neuropathy (30). Furthermore, in the previous study, post-neoadjuvant therapy based on the efficacy and safety analyses of paclitaxel drugs revealed that the liposomal paclitaxel group had a lower rate of severe leukopenia than the sb-PTX group did (31). Nevertheless, no significant differences in neutropenia-related adverse reactions were demonstrated between the groups in the present study, potentially due to the widespread use of prophylactic leukocyte-boosting medications before the initiation of adjuvant chemotherapy.

The present study has several limitations. As a single-center study, its findings may not adequately represent broader demographics. Furthermore, despite spanning 73 months, the widespread use of nab-PTX, owing to its tolerability and physician prescribing preferences, resulted in a smaller sample size for the sb-PTX group. Analysis of previous studies also found that lymph node infiltration and underlying disease in patients with breast cancer increased the risk of postoperative recurrence (32,33) and the number of infiltrating lymph nodes is used as an adjuvant therapeutic reference in breast cancer treatment guidelines (14). The Cox multifactorial regression analysis in the present study revealed that the 95% CI of the HR for lymph node positivity and underlying disease factors was wide. This may be caused by an insufficient sample size. During the Cox regression analysis, a one-factor regression analysis screening was performed before a multifactor regression analysis, and the goodness of fit of the regression model fit showed that the model modeling was successful. It was therefore concluded that lymph node infiltration and underlying disease are risk factors for postoperative recurrence in patients with breast cancer. Additionally, the limited overall sample size restricted the feasibility of performing a subgroup analysis of positive lymph node counts. Finally, discrepancies were observed in the data analysis results before and after PSM, likely due to the quasi-experimental design of PSM, which is intended to minimize selection bias by controlling for known confounding factors. The matching process itself may alter the data distribution and variability. In addition, the need to incorporate many matching variables and exclude unmatched data during PSM typically results in a reduced sample number, which may reduce the statistical power of the analysis and increase the uncertainty of the results. Despite its effectiveness in mitigating selection bias, PSM cannot eliminate all confounding variables due to its nonrandomized nature. Therefore, although PSM helps reduce selection bias, the resulting statistical analysis still has inherent limitations.

In conclusion, the 73-month DFS rate was lower in the sb-PTX cohort than in the nab-PTX cohort in patients receiving adjuvant treatments for postoperative breast carcinoma. However, no significant differences were demonstrated between the two groups, and further ongoing surveillance is needed. The identified risk factors for postoperative recurrence and prognosis in patients with breast cancer include an age of ≤45 years, comorbid conditions and lymph node positivity. Moreover, compared with the sb-PTX cohort, the nab-PTX cohort had a greater incidence of postchemotherapy anemia and peripheral neuropathy but fewer allergic reactions.

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Availability of data and materials

The data generated in the present study may be requested from the corresponding author.

Authors' contributions

MZ, HL and YH contributed to the research conception and design. The data were gathered and assessed by YH and HL. HL wrote the draft of the manuscript. For the data analysis, YZ, SL and BL were major contributors. The manuscript was revised by MZ, YH and SL. MZ, HL and YH confirm the authenticity of all the raw data. All authors have read and approved the final manuscript.

Ethics approval and consent to participate

The guidelines of the Declaration of Helsinki were followed during the investigation. The present study was approved by the Ethics Committee of the Second Affiliated Hospital of Anhui Medical University [Hefei, China; approval no. YX2023-203(F1)]. Written informed consent was obtained from each patient or their guardian.

Patient consent for publication

Not applicable.

Competing interests

The authors declare that they have no competing interests.

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