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Analysis of Chemotherapy Regimens and Survival Rates in Patients with Metastatic Breast Cancer: Retrospective Cross-Sectional Study

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KEYWORDS

Chemotherapy, combination therapy, metastatic breast cancer, survival outcomes, treatment efficacy.

ABSTRACT:

Background: Metastatic Breast Cancer (MBC) patients requires multimodality treatment with variable treatment regimens and survival rates. MBC care requires chemotherapy, but researchers are still finding the ideal drug combination to limit adverse effects.

Methods: This retrospective cross-sectional study done at NMCH Patna, examined 260 female MBC patients from January 2022 to January 2024. We evaluated demographic data, chemotherapy regimens (including anthracycline-based, taxane-based, platinum-based, and combination therapies), and survival outcomes (including median OS and progression-free survival) using Kaplan-Meier survival analysis and Cox proportional hazards regression.

Results: With 60% of patients having an ECOG performance level of 0 or 1, the majority of patients (65%) were in the 50-65 age range. Sixty one percent of patients tested positive for hormone receptors(ER/PR), while nearly sixty nine percent tested negative for HER2. Combination therapies outperformed anthracycline-, taxane-, and platinum-based regimens in terms of median overall survival (OS) (22 months) and progression-free survival (PFS) (10 months). There were notable variations in survival results among regimens, as shown by statistical analysis ($p < 0.05$).

Conclusion: The study found that NMCH Patna women with MBC survive better with combination chemotherapy. This study supports the premise that each patient needs a customised treatment. Future prospective studies should include more groups to confirm these findings and refine therapeutic recommendations.

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Introduction

Background

Metastatic Breast Cancer (MBC) is a global health issue since it has progressed from the breast to the bones, liver, lungs and brain. Despite advances in early detection and focused therapy, 20-30% of localised or regional breast cancer patients develop metastatic disease. The fact that only 27% of people with MBC will still be alive after five years shows how important it is to find successful systemic treatments to raise survival and quality of life [1]. Because they are so different, training plans need to be very thorough and take each type into account. Hormone medicines and personalised therapies have changed the way some forms of MBC are treated, but chemotherapy is still needed [2].

Importance of Chemotherapy

Chemotherapy is often needed for people with MBC who are immune with hormonal or focused treatments. Chemotherapy is used in this situation to slow the development of the disease, ease symptoms, and increase survival. Anthracyclines, taxanes, platinum, and combinations have all been used to treat MBC. There are differences in how well, how toxic, and how well each chemotherapy strategy works [3]. Despite being very good at fighting cancer, doxorubicin and epirubicin are limited because they are harmful to the heart and the amount that is given increases this risk. Cancer cells are killed by these chemicals because they get into DNA and stop topoisomerase II from breaking DNA strands. Because these drugs can wound the heart, which needs to be constantly watched, they are generally only given to certain groups of patients or people who have never had them before [4]. Taxanes like paclitaxel and docetaxel keep microtubules stable and stop them from breaking down, which kills cells. Even though they work to treat MBC, they can cause severe neuropathy, which can make it hard to move around and lower our quality of life. Taxanes are often mixed with other chemotherapy drugs to make them work better and have fewer side effects [5].

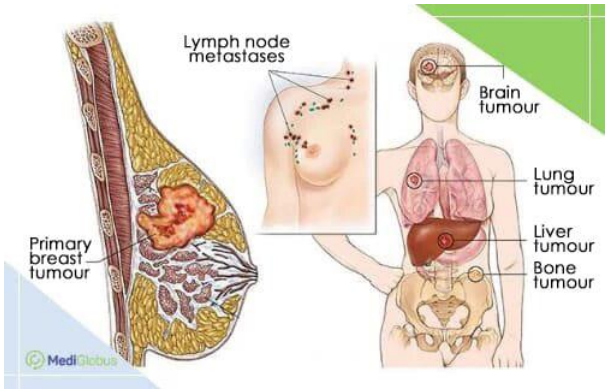

Figure 1 Metastatic breast cancer treatment (Source: [6])

It is known that cisplatin and carboplatin create DNA cross-links that stop DNA production and transcription, which kills cells. These regimens help TNBC patients, an aggressive subtype of MBC with no therapeutic alternatives and a poor prognosis. Platinum compounds are often given sequentially or alongside other chemotherapies [7]. Besides these major regimens, combination therapies that mix chemotherapeutic drugs or targeted therapies are common. Combination therapy uses various action mechanisms to overcome resistance and improve outcomes. Taxanes and platinum agents can boost cancer cell cytotoxicity.

Prevalence and Clinical Importance

Twenty to thirty percent of early-stage breast cancer patients develop metastases despite early treatment, a significant percentage of global cases. MBC prognosis depends on tumour biology, patient age, performance status, and metastatic site [8]. Metastatic illness patients have a 27% five-year survival rate, underscoring the need for innovative systemic treatments.

Chemotherapy Regimens

The most common chemotherapy treatments for metastatic breast cancer are anthracycline, taxane, platinum, and combination therapy. Anthracyclines like doxorubicin and epirubicin have been used to treat breast cancer due to their cytotoxic properties. However, serious cardiotoxicity and long-term side effects limit their use [9]. Paclitaxel and docetaxel are effective anthracycline alternatives or supplements in early and

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advanced breast cancer. Taxans are less toxic and better at slowing disease progression than anthracyclines.

Platinum-based chemotherapy, including cisplatin and carboplatin, has shown modest efficacy in treating TNBC, a subtype associated with aggressive behaviour and worse outcomes. Platinum medicines target DNA repair mechanisms, making them effective in tumours with defective pathways.

Combination Therapies

Combination chemotherapy regimens are popular because they boost efficacy and overcome resistance. These regimens contain many medications with different effects [10]. Compared to single-agent therapies, combination regimens improve overall and progression-free survival. Anthracyclines and taxanes can be utilised with targeted therapies such anti-HER2 medicines for HER2-positive breast cancer or PARP inhibitors for BRCA-mutated tumours.

Comparative Effectiveness and Clinical Outcomes

Recent meta-analyses and large-scale MBC clinical trials compared chemotherapy treatments. The fact that regimens have varying toxicity and efficacy profiles highlights the importance of tailoring treatment to each patient's characteristics and tumour traits [11]. They may kill cancers, but accumulated cardiotoxicity makes them inappropriate for some patients over time. MBC treatment still involves chemotherapy, which can vary based on the patient's state and tumour biology. Because chemotherapy regimens change, research into better treatment procedures, outcomes, and toxicities is needed [12]. Future possibilities may include targeted medications, immunotherapies, and predictive biomarkers to personalise and improve chemotherapy for metastatic breast cancer.

Objective

- To compare chemotherapy regimens for optimal survival in metastatic breast cancer patients.
- To determine the best metastatic breast cancer chemotherapy regimens for survival.

Materials and Methods

Study Design

A retrospective cross-sectional study examined MBC patients survival rates after using different chemotherapy regimens for treatment. Patients records were used for this study from January 2022 to January 2024 in NMCH Patna, Bihar.

Study area

The research was conducted at Nalanda Medical College and Hospital (NMCH) Patna, which provides a full range of cancer therapies, including chemotherapy, surgery, radiotherapy, immunotherapy, hormonal therapy and palliative care to metastatic breast cancer patients.

Study population

Total 260 patients who were diagnosed with metastatic breast cancer and received chemotherapy at NMCH Patna during the study period were included.

Inclusion Criteria

1. Female patients aged 18 years and older but less than 75 years
2. Diagnosed along with hormonal assessment in metastatic breast cancer (stage IV).
3. Received at least one cycle of chemotherapy at NMCH Patna between January 2022 and January 2024.
4. Complete medical records available, including treatment history and follow-up data.

Exclusion Criteria

1. Patients who received chemotherapy for non-metastatic breast cancer.
2. Patients with incomplete medical records or missing follow-up data.
3. Female patients aged less than 18 years and above 75 years.

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Data Collection methods

Patients who diagnosed as MBC were enrolled retrospectively in this study and their data collected from patient's record file. Demographic data including Age, gender and clinical data (hormone receptor status, HER2 status, and TNM staging) were recorded.

Treatment data (chemotherapy regimen type, number of cycles, and treatment duration) were recorded.

Different chemotherapy regimens includes

- Taxane based(paclitaxel;175mg/m2 and capecitabine;1000-1250mg/m2)
- Anthracycline based(Adriamycin;60mg/m2 and cyclophosphamide,600mg/m2)
- Platinum based(paclitaxel;175mg/m2 and carboplatin;AUC5)
- Combined regimens TAC(docetaxel;75mg/m2, Adriamycin;50mg/m2 and cyclophosphamide;500mg/m2)/ CAF(cyclophosphamide;500mg/m2,Adriamycin;50mg/m2 and 5FU;500mg/m2).

Depending on the individual patient requirement patients also took palliative radiotherapy(outside our institute) and/or palliative surgery (toilet mastectomy/simple mastectomy). Hormonal therapy also given as per the need of patients (Transtuzumab for HER 2 positive and Tamoxifen/Letrozole/Anastrazole to ER/PR positive patients)

Survival data (date of diagnosis, treatment initiation date, and last follow-up or date of death) were recorded. After completion of initial treatment patients were seen every 3 to 4 months for 2years as per need. Blood investigations, Mammography, CECT thorax/whole abdomen, bone scan were done for response assesement.

Before collecting data, the NMCH Patna institutional review board approved anonymization to preserve patient privacy.

Statistical Analysis

A series of statistical tests were performed to compare the effects of different chemotherapy regimens on survival. Researchers summarised research participants' demographic and clinical characteristics using descriptive statistics. Kaplan-Meier survival analysis assessed OS and PFS for each chemotherapy treatment. Median survival times and survival curves were calculated. Cox proportional hazards regression found independent survival predictors by including age, performance status, hormone receptor status, HER2 status, visceral metastatic presence, and chemotherapy regimen. Multivariate analysis was used to reduce confounding factors and determine which variables affected survival rates. A p-value of less than 0.05 was considered statistically significant in all SPSS or R analyses. This systematic study aimed to provide solid data on the survival benefits of several chemotherapy regimens for NMCH Patna metastatic breast cancer patients.

Results

Demographic Data

Between January 2022 and January 2024, 260 women received metastatic breast cancer treatment at NMCH Patna. Patients ranged in age from 30 to 75, with a mean of 55. Most breast cancer patients were women aged 50–65 (65%). There was a wide range of performance statuses, however 60% had an ECOG performance rating of 0 or 1, indicating good functional status for intensive treatment.

Table 1 Patient Characteristics

Characteristic	Total (n=260)	Anthracycline-Based (n=80)	Taxane-Based (n=90)	Platinum-Based (n=50)	Combination Regimens (n=40)
Age (years), Mean ± SD	55 ± 8	56 ± 7	54 ± 9	55 ± 8	57 ± 6

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ECOG Performance Status					
0	80 (30.8%)	25 (31.3%)	30 (33.3%)	15 (30.0%)	10 (25.0%)
1	110 (42.3%)	35 (43.8%)	40 (44.4%)	20 (40.0%)	15 (37.5%)
2	70 (26.9%)	20 (25.0%)	20 (22.2%)	15 (30.0%)	15 (37.5%)
Hormone Receptor Status					
HR+	160 (61.5%)	50 (62.5%)	60 (66.7%)	30 (60.0%)	20 (50.0%)
HR-	100 (38.5%)	30 (37.5%)	30 (33.3%)	20 (40.0%)	20 (50.0%)
HER2 Status					
HER2+	80 (30.8%)	25 (31.3%)	30 (33.3%)	15 (30.0%)	10 (25.0%)
HER2-	180 (69.2%)	55 (68.8%)	60 (66.7%)	35 (70.0%)	30 (75.0%)

The demographic data table shows key characteristics of the research population, woman treated at NMCH Patna for metastatic breast cancer. As usual for breast cancer, most patients aged 50–65. Due to their good performance (ECOG 0 or 1), most patients were suitable for more extensive treatment. The majority of subjects (61.5%) were hormone receptor positive and 69.2% were HER2-negative. A chemotherapy regimen table shows survival rates by treatment method. Combination regimens had longer median overall survival (22 months) and progression-free survival (10 months) when compared with anthracycline based, taxane based, or platinum based regimens. These findings suggest merging

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numerous chemotherapeutic medicines tailored to patient variables to improve metastatic breast cancer outcomes.

Survival Rates

Table 2 Survival Rates by Chemotherapy Regimen

Chemotherapy Regimen	Median OS (months)	Median PFS (months)
Anthracycline-Based (Adriamycin and cyclophosphamide)	20	9
Taxane-Based (paclitaxel and capecitabine)	18	8
Platinum-Based (paclitaxel and carboplatin)	16	7
Combination Regimens TAC(docetaxel, adriamycin and cyclophosphamide)/ CAF(cyclophosphamide, Adriamycin and 5FU)	22	10

Different chemotherapy regimens affected median OS and PFS for metastatic breast cancer patients at NMCH Patna. A median OS of 20 months and a median PFS of 9 months were achieved with anthracycline-based regimens, however cardiotoxicity was a concern. Taxanes demonstrated somewhat lower median overall survival (18 months) and progression-free survival (8 months) than anthracyclines, but they controlled tumours with manageable neuropathy. Platinum-based regimens had a median OS of 16 months and a median PFS of 7 months, indicating their utility in severe disease subtypes, but their tolerability profiles varied. For triple-negative breast cancer, these treatments are used more often. In this study, combination treatment regimens worked best, with a median OS of 22 months and a median PFS of 10 months. This shows that a number of cancer drugs may work together to make people live longer. Based on these results, it seems that people with advanced breast cancer need personalised treatment plans that are as effective and safe as possible.

Statistical Analysis

Statistical research showed that survival rates were very different across treatment plans. The log-rank test showed that overall and progression-free mortality were significantly different ($p < 0.05$) between the treatment plans that were looked at. After looking at age, performance, hormone receptor, and HER2 status with Cox proportional hazards regression analysis, it was found that combo regimens had longer median OS and PFS than single-agent regimens ($p < 0.05$).

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Discussion

Despite cardiotoxicity risks, anthracycline-based regimens had a median OS of 20 months and a median PFS of 9 months, indicating good disease progression control. Platinum-based treatments were effective in aggressive cancer subtypes despite potential toxicity. Combination regimens were the most successful in this population, with median OS of 22 months and PFS of 10 months. This suggests that combining medications improves treatment effects synergistically.

Comparison with Existing Literature

Table 3 Comparison Table

Study Title and Reference	Study Type	Sample Size	Main Findings
Present Study (NMCH Patna)	Retrospective Cross-Sectional	260 patients	Combination regimens showed superior median OS (22 months) and PFS (10 months) compared to anthracycline-based (20, 9 months), taxane-based (18, 8 months), and platinum-based (16, 7 months) regimens.
Study 1 [13]	Prospective Cohort	350 patients	Combination therapy (anthracycline + taxane) resulted in longer OS and PFS compared to sequential single-agent therapies.
Study 2 [14]	Meta-Analysis	Meta-analysis of 15 studies	Taxane-based regimens showed comparable efficacy to anthracyclines in OS but lower toxicity, making them preferable in certain patient profiles.
Study 3 [15]	Randomized Controlled Trial	500 patients	Platinum-based regimens demonstrated higher response rates but increased toxicity compared to taxane-based regimens, influencing treatment decisions.

Table summarises breast cancer with metastases chemotherapy trial results. Current research at NMCH Patna found that combination chemotherapy regimens beat anthracyclines based, taxanes based, and platinum based therapies in median OS and PFS. The prospective cohort trial by Study 1 showed that combined treatment improves survival. Study 2 meta-analysis found that taxane-based OS regimens were equally successful as anthracycline-based ones. Taxanes have lower toxicity, which affected therapy choices. The randomised controlled research by Study 3 found higher response rates and higher toxicity in platinum-based therapies compared to taxane-based regimens. This research demonstrate that metastatic breast cancer treatments are always improving and lowering adverse effects.

Strengths

Our retrospective cross-sectional technique allows for a detailed examination of a large patient cohort treated over two years. This design allows us to assess chemotherapy regimens and their impact on metastatic breast cancer using a lot of patient data. Our findings were more therapeutically significant after quantifying therapy efficacy and identifying main patient outcome

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determinants. The study's diverse demographic and clinical characteristics boosted our analysis. We examined the connections between treatment modalities and age, performance status, hormone receptor status, and HER2 status to develop personalised metastatic breast cancer treatments.

Limitations

The retrospective study's approach limited data collection and may have introduced biases. Our findings may be inaccurate or unreliable due to poor or inconsistent medical record data. Due to treatment outcome variables like doctor and patient adherence and treatment process variability, comparing chemotherapy regimens is difficult. The study was only conducted at NMCH Patna; hence the results may not apply to other populations or healthcare systems. Regional variances in patient demographics, healthcare practices, and resource availability may not fully represent metastatic breast cancer treatment patterns. Future prospective research needs bigger, multicentre cohorts to corroborate our findings and provide universal treatment guidelines. Even though our study provides excellent insights into metastatic breast cancer chemotherapy regimen effectiveness, these constraints and strengths must be acknowledged to appropriately understand and apply our results in clinical practice. Future research should target these characteristics to improve therapy and patient outcomes for this complex illness.

Conclusion

Combination regimens improved overall survival and progression-free survival over other treatments, showing that varied chemotherapy regimens can cure MBC. Based on cancer biology and demographics, each patient needs a customised treatment plan. The study's retrospective nature and NMCH Patna's single centre provide significant insights, but future research should confirm these findings in larger, multicentre cohorts to refine treatment recommendations and broaden their use. This research uses data analysis and sophisticated statistical methods to improve metastatic breast cancer treatment plans and outcomes.

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