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A STUDY ON ROLE OF VITAMIN D LEVELS IN BREAST CANCER PATIENTS WITH CHEMOTHERAPY-INDUCED BONE LOSS

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Abstract:

Background: *Breast cancer is one of the most prevalent malignancies in women across the globe, and Chemotherapy-Induced Bone Loss (CIBL), being one of the significant complications, further debilitates the quality of life of patients. Vitamin D is skeletal in mineralization and calcium homeostasis, but the relationship between Vitamin D levels in chemotherapy-related skeletal effect is still underexplored.*

Methods: *A cross-sectional study was conducted on 60 breast cancer patients undergoing chemotherapy at a tertiary care hospital. Serum Vitamin D levels were assessed and compared with BMD of lumbar spine and femoral neck measured by utilizing DEXA scan. Statistical analysis was done to analyze Vitamin D level and BMD correlation.*

Results: *It was found in the study that 65% of the patients had Vitamin D deficiency, while 25% were deemed insufficient. Medium strength positive correlation existed between Vitamin D and BMD in lumbar spine ($r = +0.46$, $p < 0.01$) and femoral neck ($r = +0.42$, $p < 0.05$). Those classified as sufficient for Vitamin D had significantly higher mean BMD values than those who were deficient.*

Conclusion: *Breast cancer patients receiving chemotherapy have a very high rate of Vitamin D deficiency that is significantly associated with reduced bone density. Therefore, regular monitoring of Vitamin D levels and the dispensing of Vitamin D will need to be considered, so as to prevent chemotherapy-induced bone loss and to improve the outcome on bone health in the long term in this group.*

Keywords: *Breast cancer, Vitamin D, Chemotherapy-induced bone loss, Bone mineral density, Osteoporosis*

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INTRODUCTION:

Being one of the most common malignancies worldwide, breast cancer is a prominent source of morbidity and mortality among women. Worldwide cancer statistics put breast cancer at almost 25% of new cancer cases in women, thus making a matter of concern in public health (1,2). The availability of chemotherapy and hormonal therapy has improved survival; however, long-term treatment usually brings side effects that impair the quality of life of the patient (3). Chemotherapy-induced bone loss is one of them and probably one of the major ones, especially in postmenopausal women, who end up being predisposed toward osteoporosis and fractures (4).

Chemotherapy-induced bone loss occurs by multiple mechanisms. These include direct cytotoxic insult to osteoblast cells, premature induction of menopause, and missile alteration of calcium and vitamin D metabolism (5,6). Estrogen loss following chemotherapy favors bone resorption, resulting in rapid drops in bone mineral density (BMD) (7). Such a situation increases the risk of fractures and significantly impacts functional independence and survival outcomes in breast cancer patients (8). Thus, recognition and prevention should be preferably early in this group.
Vitamin D, a fat-soluble vitamin precursor, is considered the chief regulator of calcium homeostasis and thus crucial for skeletal integrity (9). A deficiency of Vitamin D is common among cancer patients, attributed partly to inadequate sun exposure, poor diet, and alterations in Vitamin D metabolism due to chemotherapeutic agents (10,11). Low Vitamin D levels have been associated impaired bone mineralization, osteoporosis, and increased risk of fractures consistently in breast cancer survivors (12). Moreover, Vitamin D deficiency has been linked onto worse oncological outcomes including higher risk of recurrence, and lowered survival (13).

Several clinical studies suggest that Vitamin D, together with calcium, acts to reduce bone loss rate and stimulate BMD in patients undergoing chemotherapy and endocrine therapies (14). Ironically, control of Vitamin D levels is never considered in cancer practice, more so in low- and middle-income countries where nutritional deficiencies are widespread (15). Bridging this gap will alleviate skeletal complications and enhance long-term quality of life in breast cancer patients.

The present study was carried out to study Vitamin D levels in breast cancer patients with chemotherapy-induced bone loss. Keeping into consideration the importance of bone mineral density measurements at lumbar spine and femoral neck as key skeletal sites, this study aimed to understand whether Vitamin D status correlates with any changes in bone mineral density and hence whether Vitamin D monitoring and supplementation could be considered to prevent the loss of bone health in this vulnerable population.

MATERIALS AND METHODS:

Study Design

This was a hospital-based cross-sectional observational study conducted to investigate the association of serum Vitamin D level with bone mineral density (BMD) in breast cancer patients going through chemotherapy.

Study Setting and Duration

The study was conducted in the Medical Oncology Department of a tertiary care teaching hospital in India, over 6 months.

Sample Size Determination

With Vitamin D deficiency assumed to be prevalent in 50% of breast cancer patients, a minimum sample size of 60 patients was calculated at 95% confidence interval and with 10% allowable error; all eligible patients who consented to participate were included during the study period until the target number was met.

Study Population

- **Inclusion Criteria**
  - Female patients aged **35–65 years**
  - Histologically confirmed **Stage I–III breast cancer**
  - Receiving **chemotherapy for ≥6 months**
  - Completed at least **4 cycles** of chemotherapy
- **Exclusion Criteria**
  - Patients with **bone metastases**
  - Those with known **metabolic bone disorders** (osteogenesis imperfecta, hyperparathyroidism, Paget's disease)
  - Patients on **Vitamin D or bisphosphonate supplementation** in the last 6 months
  - Chronic kidney or liver disease
  - Patients unwilling to provide consent

Ethical Approval and Consent

Ethical clearance was obtained from the Institutional Ethics Committee, and written informed consent was obtained from each participant after clarifying the purpose and procedure of the study.

Complete study Procedure

Breast cancer patients eligible for the study were recruited after informed consent. The demographic and clinico-pathological data were collected, including age, menopausal status, BMI, stage, and chemotherapy regimen. Venous fasting blood samples (5 mL) were collected for serum 25-hydroxy Vitamin D estimation using a chemiluminescent immunoassay. Based on vitamin D levels, the patients were labeled as vitamin D deficient (<20 ng/mL), insufficient (20–30 ng/mL), and sufficient (>30 ng/mL). Bone mineral density at lumbar spine (L1–L4) and femoral neck site was carried out on a DEXA scan and reported as T-scores. The data were analyzed using the SPSS program version 26, employing ANOVA and Pearson's correlation to analyze the association between Vitamin D and BMD.

Outcome Measures

- **Primary Outcome:** Correlations between serum Vitamin D and BMD of lumbar spine and femoral neck.
- **Secondary Outcomes:** Prevalence of Vitamin D deficiency, insufficiency, and sufficiency among breast cancer patients on chemotherapy.

Statistical Analysis

SPSS (version 26.0) was employed for analysis. Continuous variables were presented as mean ± standard deviation, while categorical variables were given in frequencies and percentages. One-way ANOVA followed by post-hoc Tukey's test was conducted to compare bone mineral density values across Vitamin D categories. Pearson correlation coefficients assessed the relationship between Vitamin D levels and bone mineral density. A level of <0.05 was set as statistically significant.

RESULTS:

Table 1: Demographic and Clinical Characteristics of Patients (n = 60)

Variable	Category	Frequency (n)	Percentage (%)
Age (years)	<40	10	16.7
	40–50	24	40.0
	>50	26	43.3
Menopausal status	Premenopausal	18	30.0
	Postmenopausal	42	70.0
BMI category	Normal (18.5–24.9)	20	33.3
	Overweight (25–29.9)	25	41.7
	Obese (≥30)	15	25.0
Stage of breast cancer	Early stage (I–II)	28	46.7
	Advanced (III–IV)	32	53.3
Chemotherapy regimen	Anthracycline-based	34	56.7
	Taxane-based	26	43.3

Almost all patients were above 50 years (43.3%), predominantly postmenopausal (70%), with most being overweight or obese (66.7%). More than half (53.3%) were diagnosed with advanced-stage breast cancer. Slightly more patients had anthracycline-based chemotherapy than taxane-based chemotherapy.

Table 2: Distribution of Vitamin D Levels in Patients

Vitamin D Status	Serum 25(OH)D (ng/mL)	Patients (n)	Percentage (%)
Deficient	<20	28	46.7
Insufficient	20–30	20	33.3
Sufficient	>30	12	20.0

Almost half of the patients (46.7%) were deficient in Vitamin D, whereas only 20% had sufficient levels, indicating widespread hypovitaminosis D in breast cancer patients undergoing chemotherapy.

Table 3: Bone Mineral Density (BMD) Status by DEXA Scan

Site of BMD Measurement	Mean T-score ± SD	Normal (n, %)	Osteopenia (n, %)	Osteoporosis (n, %)
Lumbar Spine (L1–L4)	-1.9 ± 0.6	12 (20.0%)	30 (50.0%)	18 (30.0%)
Femoral Neck	-2.1 ± 0.7	10 (16.7%)	28 (46.7%)	22 (36.7%)

The mean T-score of lumbar spine was -1.9 ± 0.6 and -2.1 ± 0.7 for femoral neck, indicative of significant bone loss. Osteopenia and osteoporosis were very common at both sites from where only about 20% of the patients had normal bone density.

Table 4: Association of Vitamin D Levels with Bone Mineral Density

Vitamin D Status	Lumbar Spine Mean T-score ± SD	Femoral Neck Mean T-score ± SD
Deficient (<20)	-2.4 ± 0.5	-2.6 ± 0.6
Insufficient	-1.8 ± 0.4	-2.0 ± 0.5
Sufficient	-1.2 ± 0.3	-1.4 ± 0.4
p-value	**0.001**	**0.002**

Vitamin D-deficient patients had the lowest BMD at both lumbar spine (-2.4 ± 0.5) and femoral neck (-2.6 ± 0.6) compared with sufficient Vitamin D level, which was positively associated with higher BMD. The difference was significant ($p < 0.05$).

Table 5: Correlation Between Serum Vitamin D and BMD

Variable	Correlation Coefficient (r)	p-value
Vitamin D vs. Lumbar Spine BMD	+0.46	0.001
Vitamin D vs. Femoral Neck BMD	+0.42	0.002

Vitamin D levels moderately positively correlated with BMD at lumbar spine ($r = +0.46$) and femoral neck ($r = +0.42$), supporting that high Vitamin D correlates with better bone mineral density.

DISCUSSION:

The presented study was conducted in order to assess Vitamin D levels in patients undergoing chemotherapy for breast cancer and their correlation with BMD. Our findings imply that, in this population, Vitamin D deficiency was very common with almost half of the patients with suboptimal levels. This is in line with other earlier studies which suggested that chemotherapy may accelerate bone loss mainly through ovarian suppression and altered bone remodeling but may also worsen Vitamin D deficiency.(16,17)

The study showed a moderate positive correlation between Vitamin D level and BMD at both the lumbar spine and femoral neck. This indicated that patients with high Vitamin D levels had good bone strength, whereas those with lowered Vitamin D levels were prone to chemotherapy-induced bone loss. The results are also corroborated by the studies in postmenopausal women, the association of Vitamin D sufficiency with better bone quality and less fracture risk was very strong (18,19). Here, the role of Vitamin D in calcium absorption, osteoblast differentiation, and bone turnover regulation is well recognized. A lack of it may increase osteoclastic activity and reduce bone mass and strength(20).

Bone loss is more common in Vitamin D deficient and insufficient groups, as observed in our study, further stressing the need for regular monitoring and timely intervention for correcting Vitamin D status. Interventional studies indicate that adjunct supplementation of Vitamin D with bisphosphonates or denosumab can greatly improve BMD and reduce fracture risk in breast cancer patients receiving chemotherapy or endocrine therapy (21). This points to the clinical utility of Vitamin D as a factor that can be modified to sustain skeletal health and improve the quality of life of cancer patients.

Nevertheless, some limitations of this study must be considered. The sample size was relatively small ($n = 60$), and its cross-sectional design limits causal inference. Longitudinal studies with larger cohorts are warranted to establish whether Vitamin D supplementation directly improves BMD outcomes in this patient population. Overall, our results reinforce the importance of Vitamin D screening in breast cancer patients receiving chemotherapy and support the integration of bone health management into oncology care.

CONCLUSION:

This study highlights the key role of Vitamin D in the maintenance of bone health among breast carcinoma patients who are on chemotherapy. Our findings results have demonstrated that an association exists between low Vitamin D levels and the decrease in bone mineral density at the levels of lumbar spine and femoral neck, thereby pointing towards an increased risk of chemotherapy-induced bone loss. Considering the moderately positive association between Vitamin D status and bone strength, the routine screening of Vitamin D levels combined with supplementation when required could be a simple and effective way of reducing skeletal complications amongst this vulnerable group. Incorporation of Vitamin D optimization into the supportive care plan could potentially have a positive impact on patient outcomes with an enhanced quality of life.

REFERENCES:

1. Łukasiewicz S, Czeczelewski M, Forma A, Baj J, Sitarz R, Stanisławek A. Breast Cancer-Epidemiology, Risk Factors, Classification, Prognostic Markers, and Current Treatment Strategies-An Updated Review. Cancers (Basel). 2021 Aug 25;13(17):4287
2. Kashyap D, Pal D, Sharma R, Garg VK, Goel N, Koundal D, Zaguia A, Koundal S, Belay A. Global Increase in Breast Cancer Incidence:

Risk Factors and Preventive Measures. Biomed Res Int. 2022 Apr 18;2022:9605439.
3. Anand U, Dey A, Chandel AKS, Sanyal R, Mishra A, Pandey DK, De Falco V, Upadhyay A, Kandimalla R, Chaudhary A, Dhanjal JK, Dewanjee S, Vallamkondu J, Pérez de la Lastra JM. Cancer chemotherapy and beyond: Current status, drug candidates, associated risks and progress in targeted therapeutics. Genes Dis. 2022 Mar 18;10(4):1367-1401. doi: 10.1016/j.gendis.2022.02.007. Erratum in: Genes Dis. 2024 Jan 20;11(4):101211.
4. Kalder M, Hadji P. Breast cancer and osteoporosis - management of cancer treatment-induced bone loss in postmenopausal women with breast cancer. Breast Care (Basel). 2014 Oct;9(5):312-7.
5. Wissing MD. Chemotherapy- and irradiation-induced bone loss in adults with solid tumors. Curr Osteoporos Rep. 2015 Jun;13(3):140-5.
6. Alba A, Martínez-Díaz-Guerra G, Nogués X, Ojeda Thies C, Torregrosa Suau Ó, Rodríguez-Lescure Á. Bone loss induced by cancer treatments in breast and prostate cancer patients. Clin Transl Oncol. 2022 Nov;24(11):2090-2106. doi: 10.1007/s12094-022-02872-1
7. Ottanelli S. Prevention and treatment of bone fragility in cancer patient. Clin Cases Miner Bone Metab. 2015 May-Aug;12(2):116-29.
8. Melton LJ 3rd, Hartmann LC, Achenbach SJ, Atkinson EJ, Therneau TM, Khosla S. Fracture risk in women with breast cancer: a population-based study. J Bone Miner Res. 2012 May;27(5):1196-205.
9. Fleet JC. The role of vitamin D in the endocrinology controlling calcium homeostasis. Mol Cell Endocrinol. 2017 Sep 15;453:36-45.
10. Dev R, Del Fabbro E, Schwartz GG, Hui D, Palla SL, Gutierrez N, Bruera E. Preliminary report: vitamin D deficiency in advanced cancer patients with symptoms of fatigue or anorexia. Oncologist. 2011;16(11):1637-41
11. Wimalawansa SJ. Vitamin D's Impact on Cancer Incidence and Mortality: A Systematic Review. *Nutrients*. 2025; 17(14):2333.
12. de Sire A, Gallelli L, Marotta N, Lippi L, Fusco N, Calafiore D, Cione E, Muraca L, Maconi A, De Sarro G, Ammendolia A, Invernizzi M. Vitamin D Deficiency in Women with Breast Cancer: A Correlation with Osteoporosis? A Machine Learning Approach with Multiple Factor Analysis. Nutrients. 2022 Apr 11;14(8):1586.
13. Timerman D, McEnery-Stonelake M, Joyce CJ, Nambudiri VE, Hodi FS, Claus EB, Ibrahim N, Lin JY. Vitamin D deficiency is associated with a worse prognosis in metastatic melanoma. Oncotarget. 2017 Jan 24;8(4):6873-6882.
14. Datta M, Schwartz GG. Calcium and vitamin D supplementation and loss of bone mineral density in women undergoing breast cancer therapy. Crit Rev Oncol Hematol. 2013 Dec;88(3):613-24.
15. Gupta D, Vashi PG, Trukova K, Lis CG, Lammersfeld CA. Prevalence of serum vitamin D deficiency and insufficiency in cancer: Review of the epidemiological literature. Exp Ther Med. 2011 Mar;2(2):181-193.
16. Puspitaningtyas H, Sulistyoningrum DC, D status in breast cancer cases following chemotherapy: A pre and post observational study in a tertiary hospital in Yogyakarta, Indonesia. PLoS One. 2022 Jun 24;17(6):e0270507
17. Shaukat N, Jaleel F, Moosa FA, Qureshi NA. Association between Vitamin D deficiency and Breast Cancer. Pak J Med Sci. 2017 May-Jun;33(3):645-649.
18. Sadat-Ali M, Al Elq AH, Al-Turki HA, Al-Mulhim FA, Al-Ali AK. Influence of vitamin D levels on bone mineral density and osteoporosis. Ann Saudi Med. 2011 Nov-Dec;31(6):602-8
19. Albrahim TI, Binobead MA. Vitamin D status in relation to age, bone mineral density of the spine and femur in obese Saudi females - A hospital-based study. Saudi Pharm J. 2019 Feb;27(2):200-207
20. Voulgaridou G, Papadopoulou SK, Detopoulou P, Tsoumana D, Giaginis C, Kondyli FS, Lymperaki E, Pritsa A. Vitamin D and Calcium in Osteoporosis, and the Role of Bone Turnover Markers: A Narrative Review of Recent Data from RCTs. Diseases. 2023 Feb 8;11(1):29.
21. Laird E, Ward M, McSorley E, Strain JJ, Wallace J. Vitamin D and bone health: potential mechanisms. Nutrients. 2010 Jul;2(7):693-724.