GAS Journal of Clinical Medicine and Medical Research (GASJCMMR)

Volume 2, Issue 9, 2025 Journal Homepage: https://gaspublishers.com/gasjcmmr/ ISSN: 3049-1568
Email: gaspublishers@gmail.com

Assessment and comparison of radiation dose on the liver function tests for Breast and Lung cancer patients during radiotherapy

Wael Sahib Alnweny & Mohammed Q. Almayali

Department of Chemistry, Faculty of Science, University of Kufa, Najaf, 54001, Iraq

Received: *20.08.2025* | ***Accepted:*** *18.09.2025* | ***Published:*** *20.09.2025*

***Corresponding Author:** *Wael Sahib Alnweny*

DOI: *10.5281/zenodo.17166900*

Abstract **Original Research Article**

The purpose of this study was to examine how radiation therapy affects biochemical changes in breast and lung cancer patients in Al-Najaf Governorate. Thirty cancer patients participated in the study: fifteen who received between one and seven doses of radiation therapy, and fifteen who received more than five doses. Radiation therapy was administered as the treatment. In addition, twenty-five healthy individuals (thirteen men and twelve women) were included as a control group. The investigation was conducted from February to November 2023 at the National Oncology Teaching Hospital in Najaf City. Based on the blood parameters, both male and female patients who underwent radiation therapy showed lower levels of hemoglobin, red blood cells, white blood cells, and platelets. With regard to liver enzymes, both male and female patients with cancer showed elevated levels of AST and ALT. For the ALP enzyme, no significant sex-based differences were observed, but an overall increase was noted. In terms of bilirubin, noticeable changes were detected, including increases in both direct and total bilirubin levels.

Keywords: Radiation dose, cancer patients, radiotherapy, LFT level, Breast cancer.

INTRODUCTION

Cancer is a collective term for a group of neoplastic disorders that originate in a single somatic cell and share comparable characteristics and behavioral patterns. When such a cell becomes abnormal, it grows and multiplies uncontrollably, deviating from the normal path of development and reproduction. Instead of dying at the end of its life cycle, these abnormal cells continue to proliferate rapidly and irregularly, forming new abnormal cells that eventually accumulate into a cancerous tumor. The transition from a normal cell to a cancer cell is a gradual process [1]. This transformation is triggered by numerous variables, classified as carcinogens [2]. In addition to their abnormal development and structure, malignant tumors are dangerous because their cells have the ability to invade and damage nearby or distant vital tissues and organs, potentially leading to their destruction.

Chemotherapy is a commonly used treatment for systemic cancer [1]. This anticancer approach employs drugs designed to disrupt cell function, thereby either killing cancer cells or slowing their growth [3]. However, the adverse effects of chemotherapy vary depending on several factors, including the type of treatment, duration, dosage, and the patient's medical history.

Radiotherapy is often administered in cycles, with rest periods in between to allow patients to regain strength [4]. Two of the most common side effects of radiotherapy are fatigue and hair loss. Other potential complications include bleeding and bruising, infections, anemia (low red blood cell count), nausea, dizziness, and changes in appetite. Digestive discomfort may also occur, such as ulcers, stomach pain, or difficulties in swallowing, as well as disorders of the mouth, throat, or tongue.

Additional side effects may involve changes in the skin, nails, urinary and bladder functions, and nerve-related complications such as peripheral neuropathy, which can cause tingling, numbness, or pain. Nail discoloration and dry skin are also common. Furthermore, patients may experience mood changes, reduced libido, sexual dysfunction, alterations in body composition, and fertility issues [5].

MATERIALS AND METHODS

Subjects

The study participants were divided into two groups: patients and healthy controls. The patient group consisted of 30 men and women diagnosed with cancer, aged between 25 and 68 years. Their samples were collected from the National Oncology Teaching Hospital in Najaf City. The healthy control group consisted of 25 men and women without cancer, also aged between 25 and 68 years.

Samples Collection and Analysis

Each patient had a venous blood sample collected, which was promptly transferred into a plain, dry tube. After allowing the blood to clot for 10–15 minutes at room temperature, it was centrifuged at 3500 rpm for 10 minutes. The serum was then separated and analyzed at the Al-Nohba and Al-Sadr Teaching Hospital laboratories to measure selected biochemical markers.

Methods: Liver enzymes were measured spectrophotometer.

Aspartate Aminotransferase AST - GOT Principle

To determine serum activity, a colorimetric method originally developed by Tonhazy, White, and Umbreit, and later adapted by Reitman and Frankel [6], was used. In this procedure, 1 mL of Reagent R2 was incubated at 37 °C for 5 minutes. Then, 200 µL of serum was added, mixed, and incubated for exactly 1 hour at 37 °C. Next, 1 mL of Reagent R3 was added and left at room temperature for 20 minutes. Afterward, 10 mL of 0.4 N NaOH was added, and the mixture was left for 5 minutes. The absorbance was then measured at 505 nm against water as a blank. The results were determined using the enclosed batch-specific standard curves.

Alanine Aminotransferase ALT - GPT Principle.

Reitman and Frankel modified the colorimetric method of Tonhazy, White, and Umbreit for determining serum enzyme activity [6]. In this procedure, 1 mL of Reagent R2 was incubated at 37 °C for 5 minutes. Then, 200 µL of serum was added, mixed, and incubated for exactly 1 hour at 37 °C. Afterward, 1 mL of Reagent R3 was added and left at room temperature for 20 minutes. Subsequently, 10 mL of 0.4 N NaOH was added, and after 5 minutes the absorbance was measured at 505 nm against water as a blank. The results were determined using the enclosed batch-specific standard curves.

Alkaline Phosphatase (ALP) Principle

Colorimetric analysis is used to determine ALP activity [7]. Kind and the King unit results: An enzyme's size that, at the reaction's conditions, releases 1 mg of phenol in 15 minutes at 37°C.

ALP activity (Kind and King unit/100mL)= $\frac{Abs\ of\ assay - Abs\ of\ Blank}{Abs\ of\ Standard} \times 20$

Or a result (IU/L) = 7, 09 x Result (Kind and King Unit/100 mL).

Statistical Analysis

The results were statistically analyzed using LFT at a probability level of $p \leq 0.05$ to compare the patient group with the control group. Biochemical parameter values were expressed as the mean ± standard error.

RESULTS

After completing their course of therapy, fifty-five patients (30 in the study group and 25 in the control group) were included in the analysis of the study. No loss needed to be followed up on. The patients in the case and control groups had mean ages of 24.14±10.19 and 26.59±17.55, respectively. Table 1 provides their general characteristics. The groups did not differ significantly from one another. For the liver to operate properly, the levels of bilirubin and the enzymes AST, ALT, and ALP were measured. Liver function tests were used to screen for liver infections, track the course of the disease, and look for potential adverse drug reactions after radiation therapy. Prior to beginning radiation therapy, the mean level of aspartate aminotransferase (AST or SGOT) was 8.40±4.66U/L. From the first to the third session of radiation therapy, the average AST level value was found to be within the typical reference range of 5 to 40 U/L. However, when the radiation treatment continues, the AST level rises (Figure 1). Over the course of the five radiation treatment regimens, the mean alanine aminotransferase (ALT or SGPT) level was found to be within the normal reference range (7-56 U/L). The mean value prior to treatment initiation was 9.13±5.72U/L.

During the course of treatment, an increase in the ALT enzyme level was noted. (Figure 2). An elevated ALT level is a sign of dysfunctional liver function. Prior to radiation therapy, the average ALP value was 56.87±13.99U/L. ALP levels were found to be within a normal range (44–147 IU/L) from irradiation courses 1–5, with a modest increase at the fifth cycle of radiation. (Figure 3). An elevated number indicates damage to the liver and bones. During the various radiation treatments, the Two types of bilirubin were evaluated to help identify conditions such as hemolytic anemia, liver disease, and bile duct obstruction. As the course of radiotherapy progressed from the first to the fifth session, the total bilirubin (T. Bilirubin) level was observed to increase (Figure 4). The mean total bilirubin level prior to treatment was 0.64 ± 0.17 mg/dl. Elevated bilirubin levels may result from hemolytic or pernicious anemia, transfusion reactions, viral hepatitis, or drug-induced reactions. Before treatment, the mean direct bilirubin (D. Bilirubin) level was 0.14 ± 0.12 mg/dl. Following five radiation cycles, an increase in direct bilirubin levels was observed (Figure 5).

Table (1): The comparison of serum biochemical parameters between Patients and Control group (p≤0.05)

*Values expressed as Mean±SD, P value <0.05 was considered as significant

Parameters	Patients (n=)Mean±SD	Control(n=)Mean±SD	P-value
Age (Yrs)	40.83± 9.47	36.67± 11.71	N.S
BMI(kg/m2	28.56± 6.45	24.30± 2.74	0.000**
AST	24.14±10.19	8.40±4.66	<0.05
ALT	26.59±17.55	9.13±5.72	<0.05
ALP	127.33±78.34	56.87±13.99	<0.05
TSB	0.45±0.29	0.64±0.17	0.000**
DSB	0.15±0.10	0.14±0.12	<0.05

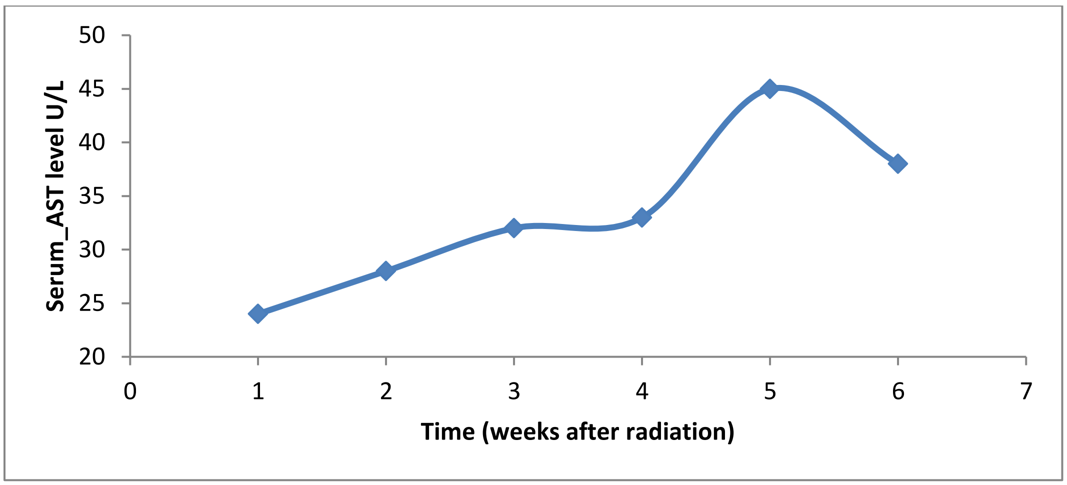

Figure 1. Comparison serum AST level after seven weeks radiotherapy.

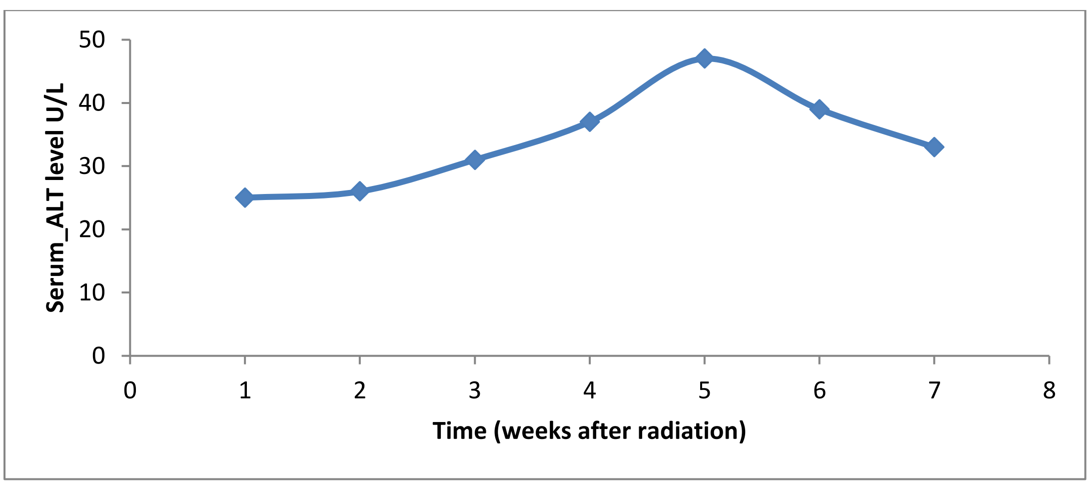

Figure 2. Comparison serum ALT level after seven weeks radiotherapy.

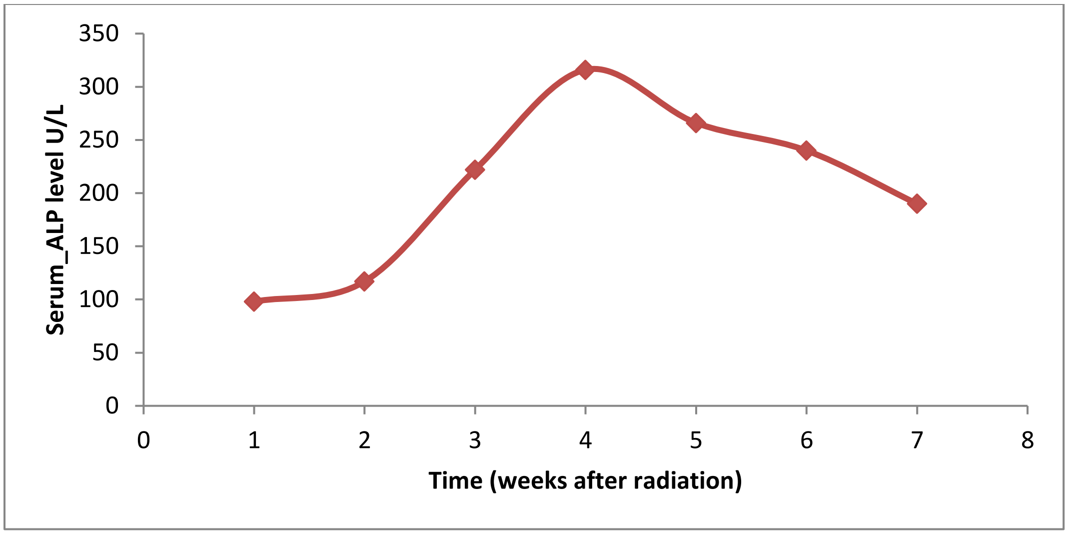

Figure 3. Comparison serum ALP level after seven weeks radiotherapy.

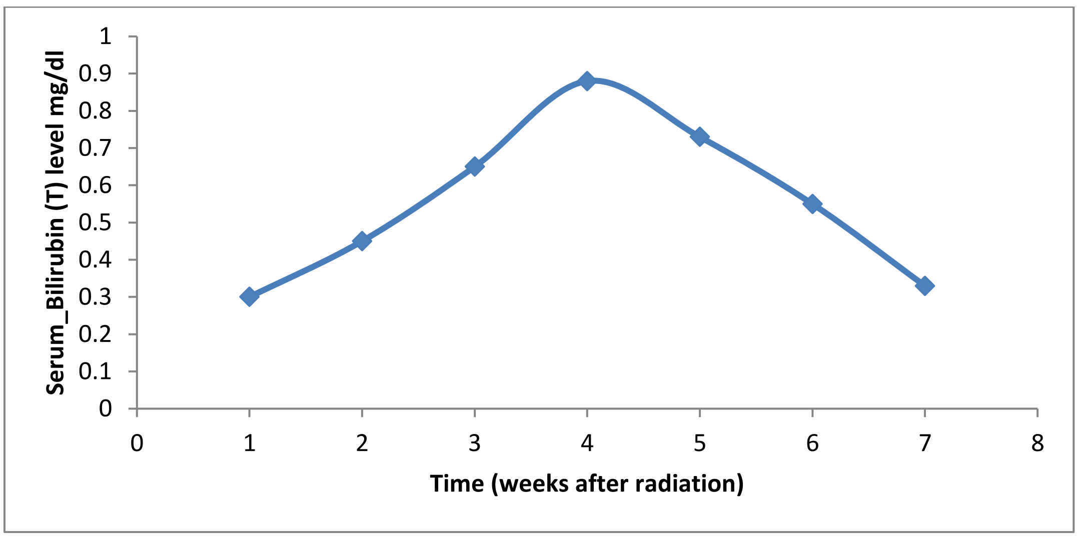

Figure 4. Comparison serum T. Bilirubin level after seven weeks radiotherapy.

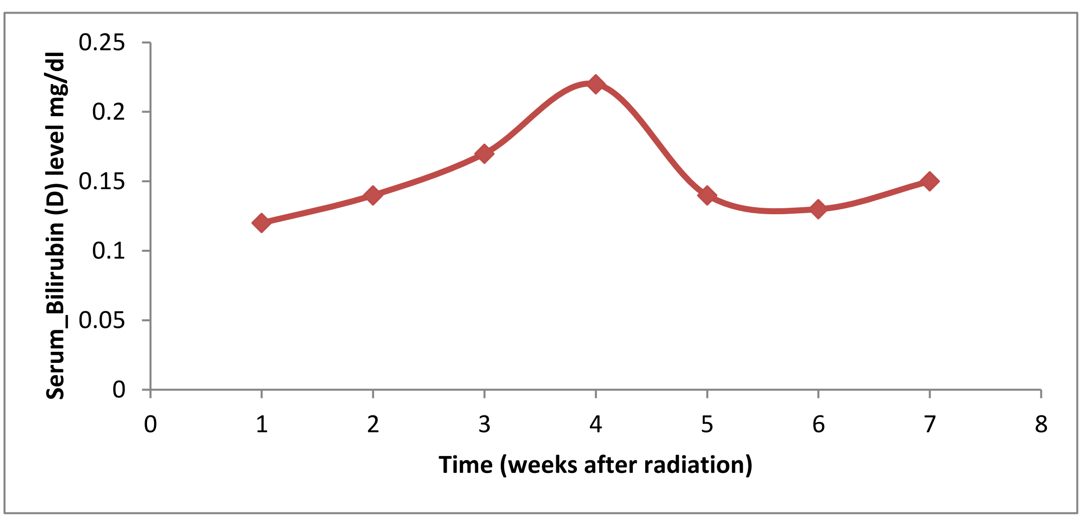

Figure 5. Comparison serum D. Bilirubin level after seven weeks radiotherapy.

Eight patients had pretreatment AST readings above the normal range, while twelve patients had elevated pretreatment ALT values. During radiation therapy, transaminase levels progressively increased. By the end of treatment, AST levels had risen by more than 1.77-fold, while ALT levels increased by 1.62-fold. After completion of radiation therapy, transaminase levels began to decline.Before treatment, 28 patients (88%) had abnormal ALP levels. ALP values increased further after the initiation of radiation therapy, reaching 1.21-fold above the normal level by the end of treatment.Pretreatment total bilirubin (T. Bilirubin) levels were elevated in 12 patients. Following therapy, both direct and total bilirubin levels increased to approximately 1.2 times the normal range.

DISCUSSION

Liver function tests (LFTs) are commonly prescribed by physicians to aid in the diagnosis of various diseases. They also serve other important purposes, including screening, monitoring patient progress, and detecting adverse drug effects. Hepatotoxicity leads to liver damage, impairing its functions and resulting in abnormal LFT results [8,9]. In this study, fifteen of the thirty participants were healthy individuals. Most participants were between the ages of 25 and 65, with approximately 50% being female. The study group consisted of untreated cancer patients in Al-Najaf City. The LFT panel included ALT, AST, ALP, total bilirubin (T. bilirubin), and direct bilirubin (D. bilirubin). Among patients, 36% had elevated ALT levels, while 64% had values within the normal range. Increases in ALT and AST are indicative of liver dysfunction, tissue damage, or necrosis. According to a previous study, cancer patients' ALT levels were within the normal range prior to the initiation of radiotherapy but began to rise after seven weeks of treatment [8]. In the present study, all groups—except the urogenital group—showed higher mean AST and ALT levels in patients compared with healthy controls. This may be explained by the fact that patients with malignant breast cancer exhibit higher transaminase activity compared to those with benign breast disease or healthy individuals [10–12]. In a study with comparable participants, elevated AST and ALT levels were associated with patient death within ten weeks; however, that study focused on individuals with advanced cancer [13]. Few investigations have examined LFT levels in untreated cancer patients, and those that have generally did not include all cancer types as in the present study. In this cohort, the majority of patients had normal ALP levels (83.7%), while 14.3% showed elevated values and fewer than 2% showed low values. When stratified by age, patients under 29 years and those with urogenital cancer demonstrated higher ALP levels compared to other patients. Although elevated ALP has been reported in individuals with breast cancer and is considered indicative of breast cancer metastases, other studies have found ALP levels to remain within normal limits [10,14–16]. Total bilirubin (T. bilirubin) was elevated in 14.5% of patients and normal in 85.5%. Direct bilirubin (D. bilirubin) was normal in 88% of patients, while 12% showed elevated levels; patients aged ≥55 years with hematological malignancies had particularly higher D. bilirubin. Bilirubin levels were lower in head and neck cancer patients compared with healthy controls, and only a small fraction of this study population showed elevated levels. These findings are consistent with previous reports showing that chemotherapy can increase bilirubin concentrations [17, 18]. Furthermore, no cancer subtype demonstrated a D/T bilirubin ratio ≥0.7, as none of these patients had yet initiated treatment. In summary, the LFT parameters most significantly affected in this study were ALT, AST, ALP, total bilirubin, and direct bilirubin.

CONCLUSION

According to the current findings, radiation therapy—while effective in reducing and treating malignant tumors—has significant adverse effects, including alterations in liver function tests and enzyme levels (AST, ALT, ALP), as well as total and direct bilirubin. These effects occur because radiation therapy is a systemic treatment that impacts not only cancerous cells but also healthy cells.

REFERENCES

1. Wong, M. C., Huang, J., Lok, V., Wang, J., Fung, F., Ding, H., & Zheng, Z. J. Differences in incidence and mortality trends of colorectal cancer worldwide based on sex, age, and anatomic location. *Clinical Gastroenterology and Hepatology*, 2021, 19.5: 955-966. e61.
2. Cursons, J., Souza-Fonseca-Guimaraes, F., Foroutan, M., Anderson, A., Hollande, F., Hediyeh-Zadeh, S. ... & Davis, M. J. A gene signature predicting natural killer cell infiltration and improved survival in melanoma patients. *Cancer immunology research*, 2019, *7*(7), 1162-1174.
3. Tashima, T.: Possibilities of Cancer Chemotherapy Based on Transporter-Conscious Drug Design, Journals of Carcinogenesis & Mutagenesis, 2016, Vol (6), No(4), pp.: 2157- 2518.
4. Generaal, J.D., Lansdorp, C.A., Boonstra, O., van Leeuwen, B.L.,Vanhauten, H.A.M., Stevenson, M.G., Been, L.B.Hyperbaric oxygen therapy for radiation-induced tissue injury following sarcoma treatment: A retrospective analysis of a Dutch cohort (2020) PLoS ONE, 15 (6), art. no. e0234419.
5. Szok D, Tajti J, Nyári A, Vécsei L. Therapeutic approaches for peripheral and central neuropathic pain. Behav Neurol. 2019; 2019:8685954.
6. A colorimetric method for the determination of serum GOT and GPT, REITMAN S. and FRANKEL S., Amer. J. Clin. Path., 1957; 28, p.56-63.
7. Kind P. R. N., King E. J, Estimation of plasma Phosphatase by determination of hydrolysed phenol with amino-anti-antipyrine, J. Clin. Path, 7,(1954), p.322-326.
8. Sudhakar V, Javerappa D, Department B. Study of Liver Function Tests in Breast Carcinoma Patients before and

After Chemotherapy. International Journal of Biotechnology and Biochemistry. 2018. 14: 177–184.

9. Navarro VJ, Senior JR. Drug-related hepatotoxicity. New England Journal of Medicine. N Engl J Med. 2006. 354: 731–739.

10. Chauhan P, Yadav R. Evaluation of serum biochemical profile of breast cancer patients. Int J Med Res Heal Sci. 2016. 5: 1–7.

11. Thangaraju M, Rameshbabu J, Vasavi H, Ilanchezhian S, Vinitha R, Sachdanandam P. The salubrious effect of tamaxifen on serum marker enzymes, glycoproteins, and lysosomal enzymes level in breast cancer women. Mol Cell Biochem. 1998. 185: 85–94.

12. Devi LI, Ralte L, Ayub Ali M. Serum biochemical profile of breast cancer patients. Eur J Pharm Med Res. 2015. 2: 210–214.

13. Tsai HJ, Hsieh MY, Tsai YC, Liu ZY, Hsieh HY, Lee CM, Chien CH, Chiu YW, Chuang HY, and Huang CT. Liver function tests may be useful tools for advanced cancer patient care: A prelimi- nary single-center result. Kaohsiung J Med Sci. 2014. 30: 146–152.

14. Ramaswamy G, Rao VR, Krishnamoorthy L, Ramesh G, Gomathy R, Reriukadevi D. Serum levels of bone alkaline phosphatase in breast and prostate cancers with bone metastasis. Indian J Clin Biochem. 2000. 15: 110–113.

15. Mishra S, Sharma DC, Sharma P. Studies of biochemical param- eters in breast cancer with and without metastasis. Indian J Clin Biochem. 2004. 19: 71–75.

16. Damodar G, Smitha T, Gopinath S, Vijayakumar S, Rao Y. An evaluation of hepatotoxicity in breast cancer patients receiving in- jection doxorubicin. Ann Med Health Sci Res. 2014. 4: 74–79.

17. Liu Z, Ning H, Que S, Wang L, Qin X, Peng T. Complex associa- tion between alanine aminotransferase activity and mortality in general population: A systematic review and meta-analysis of pro- spective studies. PLoS ONE. 2014. 9: 1–19.

Alexandre J, Bleuzen P, Bonneterre J, Sutherland W, Misset JL, Guastalla JP, Spielman, M. Bensmaïne, A. Marty, M. Mahjoubi, M. Cvitkovic, E. Factors predicting for efficacy and safety of docetaxel in a compassionate-use cohort of 825 heavily pretreated advanced breast cancer patients. J Clin Oncol. 2000. 18: 562–562.