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Investigation the Impact of Radiation and Physiotherapy Therapy on the Level of Cadmium in the Serum of Patients with Cancer

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Abstract:

Cancer is a devastating disease that continues to baffle doctors worldwide. While trace elements like cadmium (Cd) have been found to play various roles in the body, their involvement in cancer remains unclear. This study endeavored to analyze and compare the concentrations of specific elements in both the serum samples of cancer patients and those belonging to a control group, as well as with radiotherapy sessions.

A grand sum of 106 specimens were accumulated, comprising of 37 fit individuals and 69 cancer-afflicted patients. Following sample preparation, an atomic absorption spectrophotometer was employed to measure serum cadmium levels. The results showed that cadmium levels were significantly higher in cancer patients during sessions from 1 to 20 compared to healthy controls and the rest of the sessions.

The average concentration of cadmium in cancer patients without radiotherapy was found to be 9.033 ± 2.82, while it was 7.369 ± 1.025 for healthy individuals. The average cadmium concentrations varied in the patients group during the sessions. During sessions 1 to 10 days, the average cadmium concentration was 11.13 ± 1.57 (ppb). In sessions from 11 to 20 days, it increased to 11.83 ± 3.14 (ppb). Surprisingly, in the 21- to 30-day sessions, the average cadmium concentration decreased to 6.168 ± 0.79 (ppb). Finally, at sessions from 31 to 40 days, it decreased further to 5.955 ± 0.88 (ppb).

These findings suggest that exposure to radiotherapy in cancer patients may increase the level of cadmium concentration during sessions from 1 to 20 days. While the exact role of cadmium in cancer remains unclear, this study provides valuable insights into the potential impact of radiotherapy on cadmium levels in cancer patients. A complete comprehension of the connection between cadmium and cancer, as well as developing efficient treatment methods, requires additional investigation.

Keywords: Cancer patients, radiotherapy sessions, heavy elements, cadmium (Cd), SPSS Program, Atomic absorption Spectrophotometer.

Introduction:

Cadmium is a highly toxic heavy metal present naturally in the environment and certain industrial activities [1]. It has been linked to various health problems such as kidney damage [2], osteoporosis [3], and cancer [4]. In cancer treatments, radiotherapy is a commonly used method that can potentially affect the cadmium serum levels of patients [5]. We will explore the effect of radiotherapy on the cadmium serum of cancer patients in detail.

High-energy radiation is employed in radiotherapy for the purpose of diminishing or destroying cancer cells [6]. It can be delivered externally or internally depending on the location and type of cancer [7]. The DNA of cancer cells is damaged through radiation therapy, thus halting their advancement and separation [8]. While it

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is highly effective in killing cancer cells, it also affects healthy cells in the vicinity of the tumor [9]. As a result, patients may experience side effects such as fatigue, nausea, and skin irritation [10].

Cadmium is a heavy metal that can accumulate in the body over time. It can be absorbed through inhalation, ingestion, or skin contact [11]. In cancer patients, the cadmium serum levels may be affected by the type of cancer, stage, and treatment method. Research has revealed that cancer patients possess elevated cadmium serum levels, as compared to individuals in good health. This could be due to the release of cadmium from the tumors or the impaired excretion of cadmium in cancer patients[12].

Radiotherapy can potentially affect the cadmium serum levels of cancer patients in several ways. Firstly, radiation therapy can cause the release of cadmium from the tumors. As cancer cells are damaged by radiation, they release various cellular components, including cadmium. This can result in an increase in the cadmium serum levels of patients undergoing radiotherapy [13].

Secondly, radiation therapy can affect the excretion of cadmium from the body. Kidneys are the primary excretory organs for cadmium, and radiation therapy can damage these organs. This can lead to impaired excretion of cadmium from the body, resulting in an increase in the cadmium serum levels of cancer patients [14].

Finally, radiation therapy can affect the absorption of cadmium from the environment. The gastrointestinal tract is another route of cadmium uptake, and radiation therapy can cause damage to the intestinal lining, affecting the absorption of cadmium [15].

In conclusion, radiotherapy can potentially affect the cadmium serum levels of cancer patients through various mechanisms. It is essential to monitor the cadmium serum levels of patients undergoing radiotherapy to ensure their safety and wellbeing. Additional research work is required to identify the extent of the effect of radiotherapy on the cadmium serum levels and its long-term implications. Ultimately, the reduction of cadmium exposure in the environment and industrial processes remains the most effective method to prevent cadmium toxicities [16].

This research aims to explore the connection between the concentrations of Cadmium and radiotherapy treatments. The purpose is to gain a better understanding of how exposure to radiation impacts the accumulation of Cadmium in the body. By examining this relationship, we hope to shed light on the potential health risks associated with radiation exposure and Cadmium accumulation. Our findings could have significant implications for the medical community and public health policies.

Materials and Methods

A total of 69 cancer patients from the Middle Euphrates Tumor Center and Al-Najaf Teaching Hospital in Najaf, as well as 37 healthy individuals from the Najaf Governorate's Main Blood Bank, were selected for this study. Three milliliters of blood were drawn from each participant using a syringe. After being separated through centrifugation from the plasma, the dye was stored in a refrigerator inside an Eppendorf tube, primed for measurement, and frozen at a temperature of -20°C.

The study samples were digested depending on the reported procedures [17]. Utilizing the flame atomic absorption spectrophotometer (F-AAS) , the serum was additionally digested to find out the concentrations of Cd [18]. After that, they were sent to the laboratory for the purpose of measuring Cd using F-AAS (7000A Shimadzu, Japan) The resulted data were expressed in parts per billion (ppb) [19]. Before the measuring process, the F-AAS was calibrated for the element (Cd) as shown in the figure below.

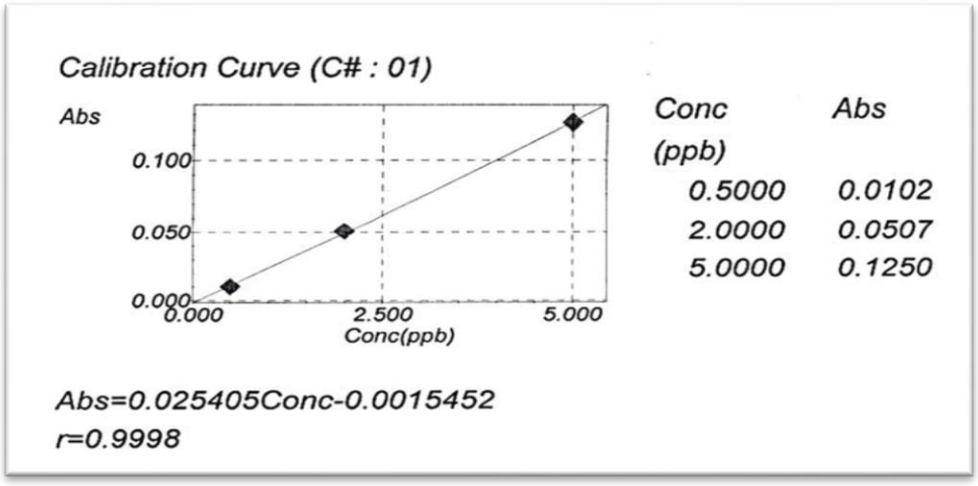

Figure (1) Calibration of the device for cadmium element.

Statistical Process

The resulted data was treated using SPSS version 23.0 statistical software. The samples were tested independently, and a P-value of less than 0.05 was used to indicate for the statistical significance between the concentrations of the groups, while a P-value which is higher than 0.05 indicates for the non-significance difference. The results were expressed using mean ± SD [20].

Results and Discussion

The mean concentrations of elements in serum samples (cadmium) were calculated in the serum of (healthy and patient without treatment) subjects in the figure (2). Were the mean the mean Cd concentrations were for the control group was (7.369 ± 1.025) (ppb)and in the patient without treatment was (9.033 ± 2.82) (ppb).

The P-value indicated a lack of statistical significance in the levels of Cd between the two groups of patients and healthy individuals.

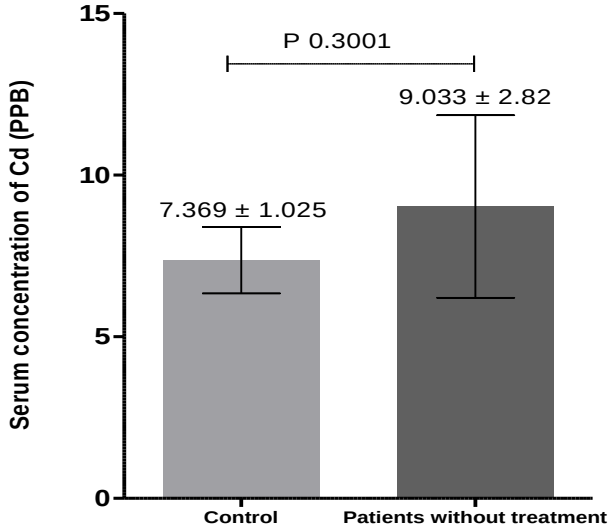

Figure (2) Serum Cd concentrations in the patient without treatment and control groups.

These results suggest that there may be a slight increase in cadmium concentrations in patients without treatment compared to healthy individuals. Nevertheless, additional research is required to substantiate these findings and determine if they have any clinical significance.

In Figure (3), clearly illustrates the mean Cd concentrations for both the healthy and patient groups. The healthy group had a consistent mean Cd concentration of (7.369 $\pm$ 1.02) (ppb). However, the patient group's mean Cd concentrations varied throughout the sessions. During sessions 1-10 days, the mean Cd concentration was (11.13 $\pm$ 1.57) (ppb). In sessions 11-20 days, it increased to (11.83 $\pm$ 3.14) (ppb). Surprisingly, in sessions 21-30 days, the mean Cd concentration decreased to (6.168 $\pm$ 0.79) (ppb). Finally, in sessions 31-40 days, it decreased even further to (5.955 $\pm$ 0.88) (ppb).

This data highlights the significant differences in Cd concentrations between healthy individuals and patients. The healthy group's consistent mean Cd concentration suggests that they were not exposed to any significant sources of Cd. In contrast, the patient group's mean Cd concentrations varied significantly, Evident from the results was their exposure to differing amounts of Cd over the course of the sessions.

In addition, Figure (3) presents a thorough analysis of the P-values that compare the mean Cd concentrations between the healthy group and the group of patients who underwent radiotherapy. Our study has produced the following outcomes:

The statistical analysis has revealed a noteworthy difference in the levels of cadmium between the groups of patients and healthy subjects during the 1-10 day and 21-30 day sessions (p-value < 0.05). However, no significant difference was seen in the other groups (p-value > 0.05).

The statistical analysis reveals a notable discrepancy in cadmium levels among the patient groups and healthy subjects during the 1-10 day and 21-30 day sessions. This finding is of great importance as it highlights the potential health risks associated with cadmium exposure in these groups.

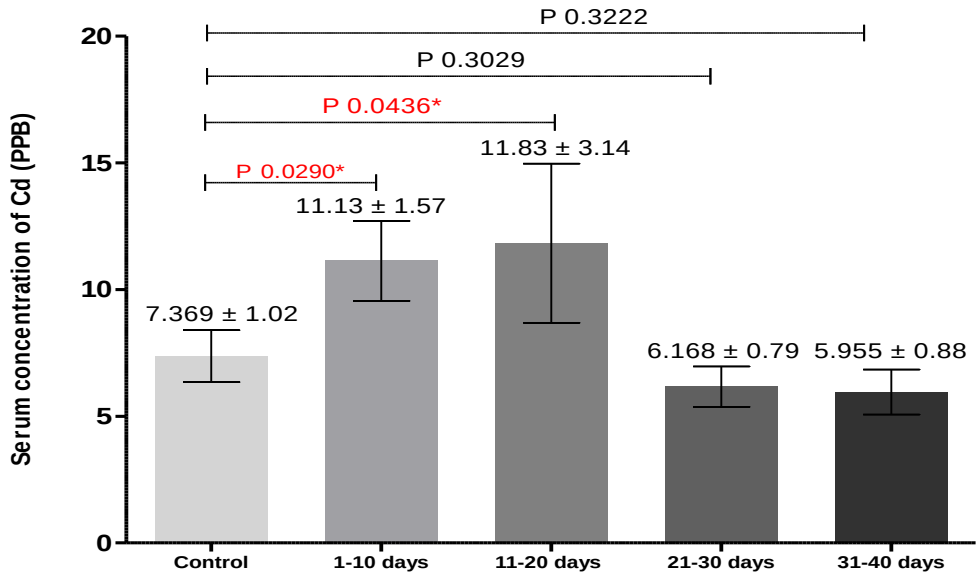

Figure (3) Comparing serum Cd concentrations between those receiving radiation therapy versus those in a control group.

Table (1) Comparison of the Mean Concentration of Cd between Radiotherapy Session Groups

Group	Radiation	Mean ± SE	P-Value	
			C.G.	value
A	1-10 Days	11.13 ± 1.575	AB	0.4153
B	11-20 Days	11.83 ± 3.141	AC	0.0008*
C	21-30 Days	6.168 ± 0.798	AD	0.0153*
D	31-40 Days	5.955 ± 0.8844	BC	0.0004*
			BD	0.0097*
			CD	0.4345

SD: Standard Deviation, G.C.: Group Correlation, * significant

The information provided in Table (1) is quite revealing. It is evident that the mean cadmium concentrations of the patient groups varied significantly across different sessions. Interestingly, the highest average concentration of cadmium was noticed during the sessions that lasted from 11 to 20 days, with a value of (11.83 ± 3.141) (ppb), Furthermore, we noticed a rise in the average concentration of cadmium during the sessions that extended from 1 to 10 days, with a value of (11.13 ± 1.575) (ppb), after which it decreased in sessions from 21 to 30 days and from 31 to 40 days to take the values (6.168 ± 0.798) (ppb) (5.955 ± 0.8844) (ppb), respectively.

The statistical analysis conducted on patients who underwent radiotherapy sessions revealed a significant difference in Cd levels between groups during the comparison of sessions (AC), (AD), (BC), and (BD) (p-value < 0.05). Nevertheless, there was no notable discrepancy found in (AB) and (CD) (p-value > 0.05).

Conclusions

These study conclusions imply that the Cd levels in patients who underwent radiotherapy sessions varied significantly depending on the specific session. This information can be useful in developing personalized treatment plans for patients undergoing radiotherapy. It is worth mentioning that there was no significant variation in Cd levels among certain sessions. Overall, this study provides valuable insights into the effects of radiotherapy on Cd levels and highlights the importance of careful monitoring and analysis of patient data.

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