Evaluation of Uranium Concentration in the Blood of Cancer Patients in Salah Al-Din Governorate

Asmaa A. Aziz[1], Fareed M.Majed[2], Nada F. Tawfiq[3]

[1]*Department of Physics, College of Education for Pure Sciences, Tikrit University, Tikrit, Iraq*
[2]*Department of Physics, College of Science, Tikrit University, Tikrit, Iraq*
[3]*Department of Physics, College of Science,Al- Nahrain University, Baghdad, Iraq*
https://doi.org/10.25130/tjps.v26i2.124

ABSTRACT

In this study, the nuclear fission shrapnel technique was used to find the level of uranium at blood of cancer patients in Salah Al-Din Governorate. Average level of uranium at the patient samples ranged between 1.738 ppb to 7.003 ppb (female, 60 years old, from Baije), while results for the healthy group ranged between 0.302 ppb and 2.332ppb. The results showed a significant increase in the level of uranium in blood of cancer patients, compared with level of healthy people.

Introduction

Uranium is naturally radioactive. White, silvery, shiny, dense and weakly radioactive [1].Its density is about 19 g cm^{-3}. Its concentration from the outer layer from earth at a rate of 2000 ppb [2]. And each unstable isotope is different half-lives. Uranium comes in three forms (^{234}U, ^{235}U, ^{238}U), these isotopes are decomposed by emission (alpha and gamma) [3]. There are various ways can reach the human body directly by inhaling, contaminated particles and entry into uranium-contaminated water [4].

Environmental factors, including nuclear radiation, can increase mutations in cell transmission from generation to generation. Radiation can cause genetic mutations that lead to different types of cancer [5]. Uranium is retained in the bones and various organs, in this way it is discharged back into the circulatory system, causing some dangerous medical problems such like cancer [7]. Epidemiological studies revealed an association between uranium exposure and cancer. Thus, uranium has a carcinogenic potential [8]. The neutron activation technique can be used with nuclear trace detectors to find uranium levels in the blood [9]. In Iraq, the annual cancer incidence rate recorded by the Iraqi Ministry of Health increased dramatically after the Gulf War (1991-2003) and ISIS events (2014-2016).

The purpose of this research is to find out the levels of uranium in the blood of cancer patients in Salah Al-din governorate using nuclear track detector CR-39 as well to find the correlation between uranium levels and cancer in this governorate.

Materials and Methods

1. Sample collection:

49 samples of cancer patients were collected in the Oncology Center of Tikret Military Hospital. Samples were collected from cancer patients from the Oncology Center of Tikret Military Hospital. And 20 samples of healthy people from the same governorate, all sample were collected in (January, February and March) 2020. Fig. 1 and fig. 2 shows the location of cities in Salah al-din governorate and the number of patients with cancer in this governorate, respectively.

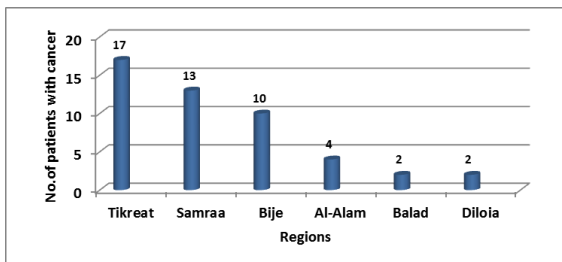**Fig.1: Location of cities in Slah Al-din governorate**

Fig.2: Number of patient's cancer in Salah al-din regions.

2. Experimental work

Uranium concentration in the blood was measured using the neutron activation technique. In this technique, a drop of blood (70 μl) is drawn using a pipette, and dried on a square CR-39(1.5×1.5) cm^2[8,9]. Samples were irradiated in (Physics branch, College of Education, Ibn Al-Haytham - University of Baghdad). Samples were irradiated with the neutron source ((Am-Be)) for (7) days with total thermal neutron flounce ($3.024x10^9$ n.cm^{-2}) to produce fission tracks in (CR-39). After irradiation of detectors were etched in (6.25 N) NaOH solutions at 60^0C for (5) hours. Detectors were cleaned in distilled water. And were microscopically examination with microscope at (40x) magnification. The fission track density (ρ) calculation by using the following equation:

Density of the nuclear track

$$(\rho) = \frac{average\ of\ total\ track}{area\ of\ field\ view} \ ..... \ (1)$$

$$C_x = \rho_x \times (C_s/\rho_s)... \ (2)$$

C_x: Represents uranium concentration of unknown samples and C_s: standard samples.

ρ_x: fission track densities of the unknown samples ,

ρ_s: standard samples (tracks/mm^2) ,

The slope of the linear relationship between the density and the uranium concentration of the standard sampl .In fig.3 which represents the relationship between path density and uranium concentration (ppb) for standard samples, the equation becomes:

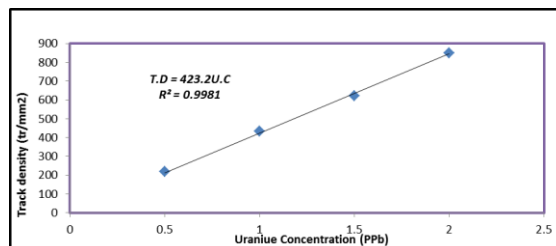$$C_x = \rho_x / slope ...... \ (3)$$

Fig .3: Pathway density and uranium concentration (ppb) for standard blood samples

Analyze the results statistically

All results obtained were statistically processed using the Statistical Package for Social Sciences (SPSS) software.

Result and discussion

Table 1 shows the minimum, maximum and average levels of uranium in blood for cancer patients and healthy groups.

Table 1: Descriptive Statistics of Uranium Concentrations (ppb) of patients with cancer

Statistical values	Patients group	Healthy group
No. of subjects	49	20
Minimum	1.728	0.303
Maximum	7.003	2.332
Mean±Std.Error	3.52±o.814	1.089±0.150
Std.Deviation	0.942	0.128
P-Value*	0.004	0.004

*Independent Sample One-way ANOVA

Figure (4) shows that uranium concentration in blood of cancer patients is higher than in healthy group. We note that the average concentration of uranium values in blood samples in the patient group is more than 3.2 times the value of the average uranium concentration in healthy group. This result agrees with a large number of researchers [8-11].
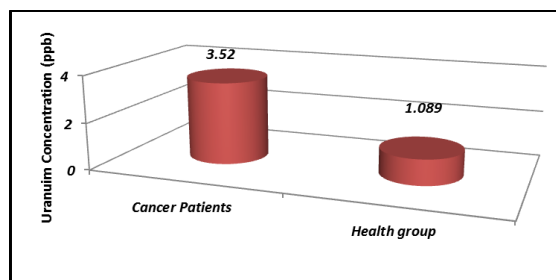

Fig. 4: Relation between average values of uranium concentrations (ppb) for cancer patients with healthy group

Table 2 shows the mean values recorded for the uranium contents in blood for male and female cancer patients and healthy groups, as plotted in Fig. 5. The table shows that average concentration of uranium in blood samples of male and female cancer groups is 3.585±0.830 ppb and 3.482±1.055 ppb, respectively. And mean values of uranium concentrations in blood samples of male and female healthy group are 1.101±0.814 and 1.077±0.635 ppb, respectively.

Table 2: Descriptive Statistics of Uranium Concentrations (ppb) of patients with cancer

Classification	Sex	Number of Sample	Mean±Std. Error	P-Value*
Cancer group	Male	13	3.585±0.830	P=0.004
	Female	36	3.482±1.055	
Healthy group	Male	7	1.101±0.814	P=0.004
	Female	13	1.077±0.635	

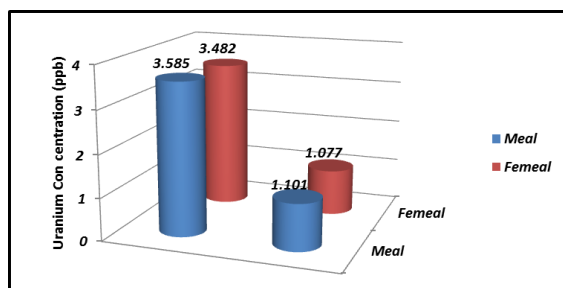* Independent Sample One-way ANOVA

Fig.5: Uranium concentration of blood samples from Patients with cancer and health group as function of gender.

We note from the results that the average values of uranium concentration among male cancer groups and healthy groups were higher than those of female cancer patients and healthy groups. Because of the blood volume of males is greater than that of females, where the total blood volume of males is 5-6 liters while females are 4-5 liters. [10].

Table 3 and figure 6 shows rate of uranium concentration in the blood healthy and cancer patients are shown as a function of age. Where we note that the highest concentration of uranium in patients with cancer in the age group 61-80 years. The reason for this may be that the level of uranium depends type cancer, degree of its incidence, and the type and number of treatment doses [11]. As well in the healthy group, the uranium concentration increased with increasing age. These results are in agreement with the researchers [8, 9].

Table 3: Uranium concentration (ppb) from Patients with cancer and health group with age

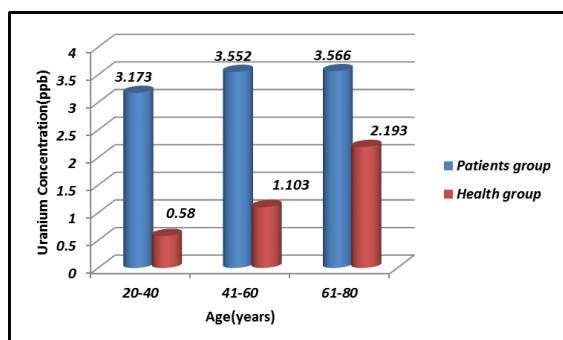| Classification	Age groups years	Number of Sample			Mean± Std. Error
		Male	Female	total	
Patients Group n=49	20-40	2	4	6	3.173±0.724
	41-60	10	21	31	3.552±1.057
	61-80	1	11	12	3.566±0.971
Health Group n=20	20-40	3	6	9	0.580±0.041
	41-60	2	5	7	1.103±0.1738
	61-80	2	2	4	2.193±0.1716

Fig.6: Average uranium concentration in patients and healthy as a function of age

Conclusion

• Average uranium level of blood samples for cancer patients is much higher than healthy group.

• This study represents a database of uranium levels for residents of Salah al-Din governorate

• This study represents a database of uranium levels for residents of Salah al-Din governorate

• This study represents a database of uranium levels for residents of Salah al-Din governorate

References

[1] Al-Rubaii, N.(2004) ., Radiation Study of Selected Biological Samples (Doctoral dissertation, Ph. D. Thesis, College of Science, University of Al-Mustansiriyah).

[2] Morss, L.R.; Edelstein, N.M.; Fuger, J.; eds. (2006). The Chemistry of the Actinide and Transactinide Elements (3rd ed.). Netherlands: Springer.

[3] Al-Jobouri, A. F. S. (2012). Determination of Uranium Concentration in Human Urine for Selected Regions in Iraq Using Laser-Induced Kinetic Phosphorimetry and CR-39 Nuclear Track Detector. MSc. Thesis, College of Science, Al-Nahrain University.

[4] Favre-Réguillona A.; Lebuzitb G.; Muratb D.; Foosb J.; Mansourc C. and Drayed M. (2008).

Selective removal of dissolved uranium in drinking water by nanofiltrationm, Water Res. 42, 1160-1166.

[5] Coursey, J. S.; Schwab, D. J.; Tsai, J. J. and Dragoset, R. A. (2015). Atomic weights and isotopic compositions with relative atomic masses. NIST Physical Measurement Laboratory.

[6] Banks, D.; Royest, O.; Strand, T. and Skarphagen, H. (1995). Radioelement (U, Th, Rn) concentration in Norwegian bedrock waters, J. Environ Geol. **(25)**, 165-180.

[7] Bersina, I.G.; Brandut, R.; Vater, P. K. and Hinke, M. (1995). Fission tracks autoradiography as ameans to investigate for their contamination with natural and technogenic uranium, J. Radiation Measurements. **(24)** 277-285.

[8] Tawfiq, N.F.; Ali, L.T.; Al-jobbery H.A. (2012). Uranium concentration in human blood for some governorates in Iraq using CR-39 track detector, J. Radioanal Nuc Chem. (295), 671-674.

[9] Abed, M.M., (2019). Calculation of Uranium Concentrations in Blood and Urine Samples of Renal Failure Patients in Al-Muthanna Governorate, Ph.D, College of Education for pure Sciences Ibn Al-Haitham, University of Baghdad.

[10] Fox SI, (2003).Human physiology. McGraw-Hill Science, New York.

[11] HASSAN, A.A. (2015). STUDY OF URANIUM CONCENTRATION AND TOXIC ELEMENTS IN BIOLOGICAL SAMPLES OF CANCEROUS PATIENTS IN SOUTHERN IRAQ, Ph.D, UNIVERSITI SAINS MALAYSIA,

تقييم تركيز اليورانيوم في الدم لمرضى السرطان في محافظة صلاح الدين

اسماء احمد عزيز[1]، فريد محمد مجيد[2]، ندى فاضل توفيق [3]

[1]قسم الفيزياء، كلية التربية للعلوم الصرفة، جامعة تكريت، تكريت، العراق

[2]قسم الفيزياء، كلية العلوم، جامعة تكريت، تكريت، العراق

[3]قسم الفيزياء، كلية العلوم ، جامعة النهرين، بغداد، العراق

الملخص

في هذه الدراسة تم استخدام تقنية مسار الانشطار لتحديد نسبة اليورانيوم في دم مرضى السرطان في محافظة صلاح الدين. تراوح تركيز اليورانيوم في عينات مرضى سرطان الدم بين 1.738 ppb جزء في البليون و ppb 7.003 جزء في البليون (أنثى، 60 سنة ، من بيجي)، بينما تراوحت نتائج المجموعة الصحية بين ppb 0.302 جزء في البليون و ppb 2.332 جزء في البليون. وأظهرت النتائج ارتفاع تركيز اليورانيوم في دماء مرضى السرطان.