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Relationship of Radon and Uranium Concentration Index with Laryngeal Cancer Patients: A Comparative Study

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Abstract
Your larynx helps you speak, breathe and swallow. It contains your vocal cords. Cancer affecting your larynx or vocal cords happens when cells grow uncontrollably in your larynx. As these cancerous (malignant) cells multiply, they invade tissues and damage your body .In this study, 30 samples of Throat Cancer (Th .C) patients were collected from Middle Euphrates Oncology Center in Najaf, Iraq. A plastic track CR-39 Reagent technique, strippable was used to measure radium and uranium concentrations. Normality was a washing solution NaOH was 6.2 to clarify chemical drilling to read under the electron microscope to calculate alpha particles paths.

The average radon concentration in the air space of the container was lower(6.3868) Bq/m3 in healthy people compared to laryngeal cancer(38.7547) Bq/m3, The average concentration of radon in the blood sample was lower(0.00014) (Bq/m3 in healthy people compared to laryngeal cancer (2.3529) Bq/m3, also the same behavior for the radioactivity of radon Most importantly, uranium concentrations in patients' samples(1.9E-07) ppm were much higher compared to healthy people(5.22E-37)ppm .A positive relationship was observed between Radium concentration and uranium concentrations in blood samples. Measurements of Radium and uranium concentrations in (Th.C) patients, this research important in terms of health protection, simple and reliable analysis methods which available.

Keywords: Radon, Uranium, CR-39 detectors ,SPSS statistics 20.

Introduction:

Laryngeal cancer represents one-third of head and neck cancers and is a significant source of morbidity and mortality[1]. A significant health concern worldwide, laryngeal cancer affects individuals of all ages and backgrounds, most often patients with a significant smoking history. Different sites of the larynx are involved, and the site involved influences the presentation, patterns of spread, and treatment options. Early-stage disease is usually highly curable with either surgical or radiation monotherapy, often larynx-preserving. Late-stage disease is associated with worse outcomes, warrants multimodal therapy, and is less likely to allow for the preservation of the larynx[2]. Studies on radiation levels and the distribution of radionuclides in the environment provide basic information on radiation. This information is necessary to understand human exposure to natural and man-made sources of radiation and is necessary in establishing rules and regulations on radiation protection [3].

Uranium and radium belong to the primitive radionuclide group, because they were always present in the earth. Radioactive nuclides such as 238U, 235U and 232TH, are through three distinct strands of radionuclides, are of great importance in the nuclear fuel cycle [4].

Gas radionuclides can also be inhaled for example 226Ra (half-life of 1600 years), 224Ra and 228Ra (half-life of 3.6 days, 625years, respectively, both usually mix with uranium ore) are of radioactive importance because radium behaves chemically like calcium, where it is deposited on bone surfaces and metabolic areas[5].

226Ra in the environment widely distributed, its presence in different concentrations in water, soil, waste and rock[6] . When taking radium, the majority of substances are rapidly excreted. However, since the chemical behavior of radium is similar to that of calcium, the blood absorbed radium from the gastrointestinal tract or Throat s follows the behavior of calcium and is deposited mainly in bones[7]. Radium is the radionuclide common in the environment and is the origin of radon. Its shape is the most lethal of radionuclides because it produces alpha rays and has a very long lifespan[8]. Immediate radon precursors are radium (226Ra) which is widely spread, especially in materials made of metal products. The pioneer of radium is uranium (238U); which has a half-life of 4.47×10^9 years[9]. Over the past decade, there has been a growing interest in studying radium activity in blood samples for Throat Cancer patients. Since radium is a highly radioactive chemical, it is the most important source of radioactivity in a variety of blood samples. Radium is a solid radioactive element under normal temperature and pressure conditions[10].

It has been reported that the average per capita of uranium in food is 1.3 μg/day[11], 2-33 μg/day[12], in the USA and 1.5 3 μg/day in Japan[13]. After ingestion, uranium appears rapidly in the bloodstream[14], where it is mainly associated with red cells [15], uranium subsequently accumulates in the kidneys and the skeleton, whereas little is found in the liver[16]. The skeleton is the major site of uranium accumulation[17]. It has been estimated that the total body burden of uranium in humans is 40 μg, with approximately 40% of this being present in the muscles, 20% in the skeleton and 10%, 4%, 1% and 0.3% in the blood, Throat , liver and kidneys, respectively[16].

High intake of uranium and its decay products may lead to harmful effects in human beings. According to an estimate food contributes about 15% of ingested uranium, while drinking water contributes about 85%. An exposure of about 0.1 $mg \cdot kg^{-1}$ of body weight of soluble natural uranium results in transient chemical damage to the kidneys[18]. Throat cancer, also known as Throat carcinoma, is a malignant Throat tumor characterized by uncontrolled cell growth in tissues of the Throat This growth can spread beyond the Throat by the process of metastasis into nearby tissue or other parts of the body[19].

The aim of this study was to determine the concentrations of Radon ,Uranium and activity in 30 samples of blood from Throat Cancer patients. Comparing its concentrations with the control group, this will be the first study of its kind to obtain radiation risk indicators for the year between 2020 and 2021 for the oncology center in Al-najaf, Iraq.

Materials and Method

In this study, 30 different samples of serum Throat Cancer patients were examined. Samples were collected from Middle Euphrates Center. CR-39 detectors were washed with distilled water, and dried in the air. Thereafter, the detectors was dried at 80 ° C in oven for approximately 16 hours. 60 days in a cylindrical plastic container of 3.5 cm diameters and 6.5 cm depth which was a piece of 500-micron detector (American Technical Plastic, Inc.) with an area of (1 × 1) mm in the middle of the samples (α- autoradiography closed connection) is included in mm^2 each container. The detector records the paths of alpha particles emitted by radon from alpha decay of radium contents in the samples. After the radiation period, the bombed detector were collected and chemically etched into NaOH 6.25 M solution at 70 ° C within 8 hours, the detectors were washed in distilled water and then dipped for a few minutes in a 3% acetic acid solution and washed again with distilled water and dried in the air[20].

A technique using CR-39 detectors can be used in measurements of uranium and radium as shown in Figure 1. The background of the CR-39 track detectors was calculated by optical microscopy and subtracted from the readings of all detectors. The path density was calculated in the nuclear path detector using a light microscope, the can which put sample as in figure 1 .

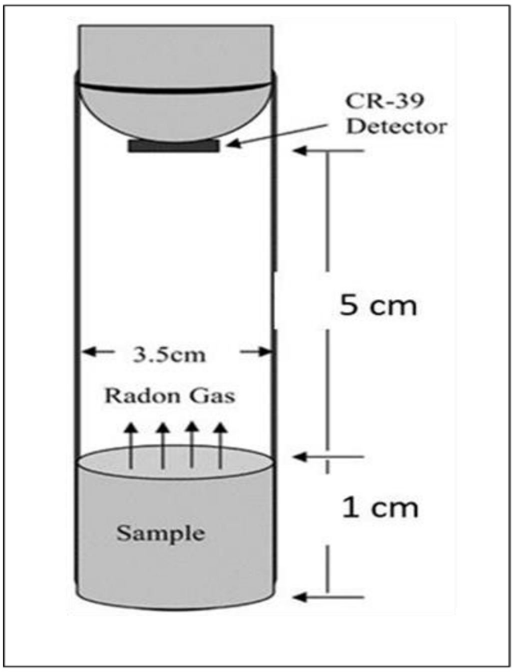

Figure 1: Shows a test tube technique used in the study.

It can also calculate the density of the track (track per cm^2 in detector surface)of the relationship[21]:

$\rho(Track/cm^2) = \frac{Numbers\ of\ tracks}{Area\ of\ the\ field\ of\ view} = \frac{N_{avg}}{A_{fov}}$ 2

is the average of total tracks and A_{fov} is the N_{avg} area of the field of view (cm^2) where the calibration factor k = 0.27 + 0.01 tracks cm-2 per kBq h m 3 was determined[22].

$\rho = K.Ca.T$ 3

Where ρ = alpha track density due to radon (Track. cm^{-2})

Ca = radon gas concentration in space. (Bq.m^{-3})

The measured ^{222}Rn concentrations in the air above the sample inside the can are represented by $C(Bq/m3)$ according to the equation[23] :

$C_{Rn}^{a}(Bq/m3)= \rho/k$t 4

C_{Rn}^{a}: is the radon gas concentration in space (Bq.m^{-3}).

t: represents the exposure time of the detectors or sample (i.e., the period of storage of samples with detectors -90 days).

The concentration of radon $^{222}_{86}Rn$ in the studied female blood samples C_{Rn}^{S}can be calculated as in the equation[23]:

C_{Rn}^{S} (Bq/m^3)= C_{Rn}^{a} λ h t/L 5

Where: λ is the decay constant for $^{222}_{86}Rn$ (0.1814 day^{-1}), h is the height above the blood surface up to the detector (4.5cm), L: the sample's thickness, equal to 0.5cm.

The radium concentration$^{226}_{88}Ra$ in the blood samples can be estimated in terms of

Also, radon activity in the blood samples can be calculated in terms of radon concentration C_{Rn}^{S} (Bq/m^3) in the sample, from the following equation[24]:

A_{Rn}^{S} (Bq)= C_{Rn}^{S} ×V 7

Where: V is the sample volume (m^3)=$\pi\ L\ r^2$

The number of uranium atoms$^{238}_{92}U$ in the sample at secular equilibrium can be obtained by Podgorsak formula according to equation[25]:

N_U=A_{Rn}^{S} $(Bq)/\lambda_U$ 8

Where: λ_U is uranium decay constant ($4.9\times10^{-18}/s$). Therefore, uranium weight (g) in the sample is given by equation:

$M_U(g)$=N_U A_U/N_A 9

Where: A_U is the mass number of $^{238}_{92}U$, N_A is Avogadro's number. Therefore, the uranium concentration can be calculated from Equation[25] :

$C_U(ppm)$=$M_U(g)/m$ 10

Results and Discussion

The results of radon, activity and uranium concentrations from the blood samples of Throat Cancer patients are shown in Table 1, Figure 2 , uranium concentrations C_U in units of part per million (ppm) of blood samples

From Table (1) we observed that there were differences in Radon concentration in sample and in cup air , activity and Uranium concentration values among health samples of sera. This difference may arise due to the difference in the nature of the human body, age, gender, and environmental conditions in which the individual lives.

Also From Table (2) we observed that there were differences in Radon concentration in sample and in cup air , activity and Uranium concentration values among Throat Cancer samples. After the radiological variables were calculated for the blood samples for the two groups, laryngeal cancer and the control, their averages were calculated and compared in the figure 2 below.

In Table 1, the number of tracks generated from alpha particles on the surface of the detector attached to the nozzle of the container from the inside, as in Figure 1, For 30 blood samples taken from the blood of a group of healthy people from Al-Sadr Teaching Hospital in Najaf, at an average age of (84 ± 20 year) which was calculated according to the equations mentioned in the theoretical side of the manuscript. The number of tracks generated by alpha particles was calculated. Calculating the radon concentration in the air space, the radon concentration in samples ,activity of radon, and also the uranium concentration in terms of the average, maximum and minimum value.

As for Table 2, the same values were calculated for radiological variables for 30 blood samples taken from a group of laryngeal cancer patients with an average age of (85± 23 year) from the Oncology and Hematology Center in Najaf.

By comparing Tables 1 and 2 with Table 3 and drawing the relationship between the variables as in the figure (2) it was found that the average concentration of radon in the blood of laryngeal cancer was the highest (38.75472) compared to the concentration of radon in the blood of healthy people (6.386814) The concentration of radon in the sample was also in the blood of laryngeal cancer (2.352987) The highest compared to healthy people (0.000148). Certainly, the effectiveness of radon will be highest in laryngeal cancer. As for the uranium concentration, it was the highest in the blood of laryngeal cancer (1.9E-07) compared to the blood of healthy people (5.22E-37) and as shown in the figure(2).

So, it is possible to say, based on the results, that the values of radiological variables are much higher in laryngeal cancer compared to the levels of values in healthy people, but what must be pointed out is that the levels of values calculated for all radiological variables in patients were very small compared to the percentages of these values in international health reports such as UNSCEAR 2000 organizations.

Consultation of main research articles or reviews in scientific publications pertaining to occupational safety, radiation protection, or environmental health would be required for specific and detailed values. Additionally, information and guidelines about radon exposure and its quantification in biological samples may be available from agencies like the World Health Organization (WHO) and the Environmental Protection Agency (EPA).

People who live in areas with average radon levels often have blood radon concentrations between 0.1 and 0.2 Bq/L. As a point of reference, a 1992 study by Harley et al. titled "Radon and radon progeny concentrations in human blood" discovered that people who lived in homes with average radon concentrations of roughly 150 Bq/m³ had 0.1 to 0.2 Bq/L of radon in their blood. This amount can change depending on the amount of radon in the air as well as other elements like ventilation and exposure time[26].

Table 1. Radon concentration in sample and in air cap, activity and Uranium concentration in blood samples for Health group.

Code	Age(year)	Track Density (Tr.cm^{-2})	C^a_{Rn}	C^S_{Rn}	A(Bq)	Cu(ppm)
H.1	84	38	8.786572	0.000203	2.51E-18	7.18E-37
H.2	80	87	20.11663	0.000465	5.75E-18	1.64E-36
H.3	70	29	6.705542	0.000155	1.92E-18	5.48E-37
H.4	65	107	24.74114	0.000572	7.07E-18	2.02E-36
H.5	60	120	27.74707	0.000642	7.93E-18	2.27E-36
H.6	52	21	4.855737	0.000112	1.39E-18	3.97E-37
H.7	50	20	4.624512	0.000107	1.32E-18	3.78E-37
H.8	48	125	28.9032	0.000668	8.26E-18	2.36E-36
H.9	40	28	6.474316	0.00015	1.85E-18	5.29E-37
H.10	45	39	9.017798	0.000209	2.58E-18	7.37E-37
H.11	37	50	11.56128	0.000267	3.3E-18	9.45E-37
H.12	35	218	50.40718	0.001166	1.44E-17	4.12E-36

H.13	31	21	4.855737	0.000112	1.39E-18	3.97E-37
H.14	30	166	38.38345	0.000888	1.1E-17	3.14E-36
H.15	28	168	38.8459	0.000898	1.11E-17	3.17E-36
H.16	25	29	6.705542	0.000155	1.92E-18	5.48E-37
H.17	24	37	8.555346	0.000198	2.45E-18	6.99E-37
H.18	23	39	9.017798	0.000209	2.58E-18	7.37E-37
H.19	22	175	40.46448	0.000936	1.16E-17	3.31E-36
H.20	20	33	7.630444	0.000176	2.18E-18	6.24E-37
H.21	46	84	19.42295	0.000449	5.55E-18	1.59E-36
H.22	43	83	19.19172	0.000444	5.49E-18	1.57E-36
H.23	41	66	15.26089	0.000353	4.36E-18	1.25E-36
H.24	39	114	26.35972	0.00061	7.54E-18	2.15E-36
H.25	34	221	51.10085	0.001182	1.46E-17	4.18E-36
H.26	32	121	27.97829	0.000647	8E-18	2.29E-36
H.27	29	53	12.25496	0.000283	3.5E-18	1E-36
H.28	27	42	9.711474	0.000225	2.78E-18	7.94E-37
H.29	26	38	8.786572	0.000203	2.51E-18	1E-36
H.30	21	87	20.11663	0.000465	5.75E-18	7.94E-37
Average	40	27	6.386814	0.000148	1.83E-18	5.22E-37
Max.	84	38	9.004116	0.000208	2.57E-18	7.36E-37
Min.	20	11	2.635151	6.09E-05	7.53E-19	2.15E-37

calculated and compared in the figure 2 below.

Table 2. Radon concentration in sample and in air cap, activity and Uranium concentration in blood samples for Throat Cancer patients.

Code	Age (year)	Track Density (Tr.cm^2)	C^a_{Rn}	C^S_{Rn}	A(Bq)	Cu(ppm)
Th.1	85	104	24.97236	1.516193	0.001516	1.23E-07
Th.2	82	74	18.0356	1.095028	0.001095	8.86E-08
Th.3	81	134	31.90913	1.937358	0.001937	1.57E-07
Th.4	80	18	5.086963	0.308854	0.000309	2.5E-08
Th.5	78	26	6.936767	0.421165	0.000421	3.41E-08
Th.6	76	27	7.167993	0.435204	0.000435	3.52E-08
Th.7	75	122	29.13442	1.768892	0.001769	1.43E-07
Th.8	73	124	29.59687	1.79697	0.001797	1.45E-07
Th.9	72	51	12.71741	0.772135	0.000772	6.25E-08
Th.10	70	67	16.41702	0.996757	0.000997	8.07E-08
Th.11	68	123	29.36565	1.782931	0.001783	1.44E-07
Th.12	67	109	26.12849	1.586387	0.001586	1.28E-07
Th.13	66	144	34.22139	2.077746	0.002078	1.68E-07
Th.14	65	133	31.6779	1.923319	0.001923	1.56E-07
Th.15	64	134	31.90913	1.937358	0.001937	1.57E-07
Th.16	63	115	27.51584	1.67062	0.001671	1.35E-07
Th.17	62	117	27.97829	1.698698	0.001699	1.37E-07
Th.18	61	46	11.56128	0.701941	0.000702	5.68E-08
Th.19	60	57	14.10476	0.856368	0.000856	6.93E-08
Th.20	59	70	17.11069	1.038873	0.001039	8.41E-08
Th.21	58	51	12.71741	0.772135	0.000772	6.25E-08
Th.22	52	38	9.711474	0.589631	0.00059	4.77E-08
Th.23	51	37	9.480249	0.575592	0.000576	4.66E-08
Th.24	50	59	14.56721	0.884446	0.000884	7.16E-08

Th.25	44	53	13.17986	0.800213	0.0008	6.48E-08
Th.26	42	80	19.42295	1.179261	0.001179	9.54E-08
Th.27	41	82	19.8854	1.207339	0.001207	9.77E-08
Th.28	39	161	38.15222	2.316406	0.002316	1.87E-07
Th.29	24	227	53.41311	3.242969	0.003243	2.62E-07
Th30	23	147	34.91506	2.119863	0.00212	1.72E-07
Average	61	167	38.75472	2.352987	0.002353	1.9E-07
Max.	85	301	69.76445	4.235738	0.004236	3.43E-07
Min.	23	100	23.1294	1.404298	0.001404	1.14E-07

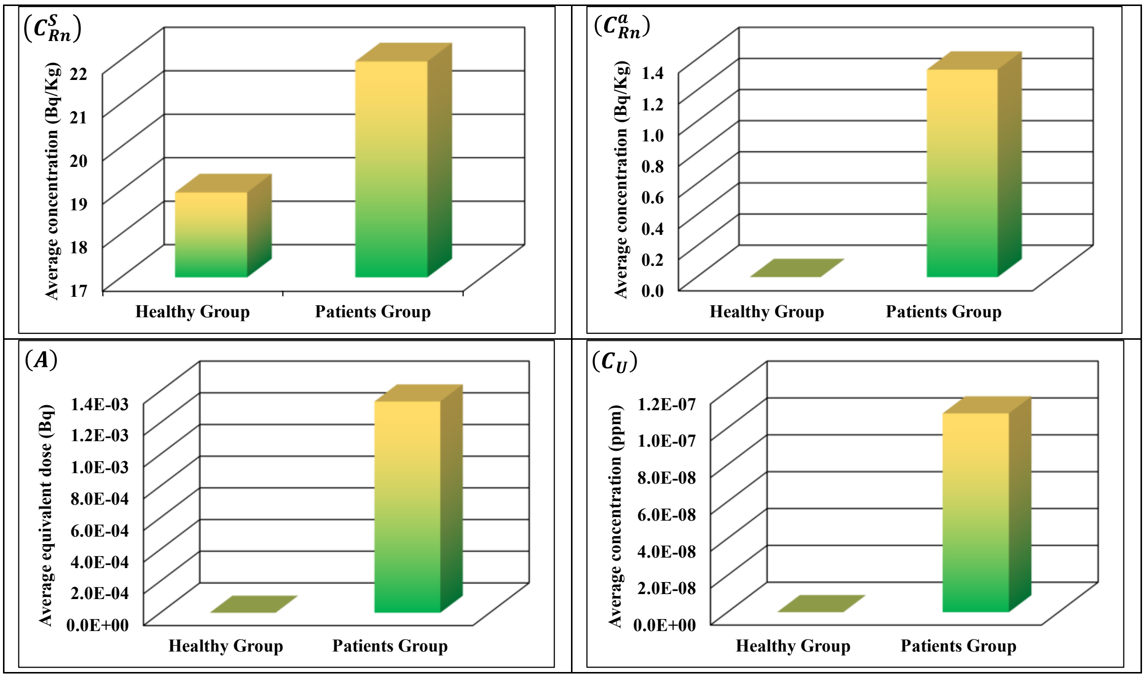

Figure 2: Comparison of radiological parameters between blood of laryngeal cancer and healthy controls

Table 3: Comparison of radiological parameters between blood of laryngeal cancer and healthy

Group	C^s_{Rn}	C^a_{Rn}	A(Bq)	C_U(ppm)
Healthy Group	1.895E+01	4.383E-04	5.511E-18	1.575E-36
Patients Group	2.197E+01	1.334E+00	1.334E-03	1.079E-07

Determination of radon and uranium concentrations in blood samples is very important We found that the uranium content in blood samples was high and important from a health risk perspective. Figure 2 illustrate the distribution of activity and uranium concentrations, respectively, for different blood samples.

The result of uranium concentration of blood samples is low compared to the limit (11.7 ppm) UNSCEAR 2000 .

We note that the average values of radiological variables in general were higher in laryngeal cancer compared to the control group, and as shown in the figures above, the difference is large in concentrations in the blood samples of healthy people.

Conclusions

The results we obtained showed that the average values of radon concentrations in blood samples, laryngeal cancer, whether in the sample or in the air space chamber of the container, and as well as uranium concentrations, are the highest compared to the average concentrations in blood samples of the control group, and this may indicate the conditions to which it was exposed. The disease is unhealthy, but nevertheless it falls within the permissible limits of World Health Organizations and UNSCEAR 2000.

Although radon is a known risk factor for lung cancer, there is less conclusive evidence linking it to laryngeal cancer. The evidence that is now available points to a possible connection, especially in groups with high occupational exposures. To elucidate the association and comprehend the mechanisms by which uranium and radon may contribute to laryngeal cancer, more research is required. Reducing radon exposure in residences and places of employment is still a wise public health precaution to reduce the risk of lung cancer and maybe other malignancies.

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