Measuring of Alpha particles in Blood samples of Leukemia patients in Babylon governorate, Iraq

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Abstract. After the 1991 and 2003 Gulf war increased incidence of cancer especially (leukemia) in Babylon city which is a major motivation to measure the concentration of alpha particles in human blood. CR-39 using to measure the alpha particles emitted from radon concentration in thirty human blood samples for patients and healthy was collected from Morgan Hospital, Babylon, Iraq. The result is showed the highest concentrations in the blood sample for leukemia patient collected from centre city is 13.98 ± 0.94 Bq/m³. Whilst, the lowest concentration is collected from Al-Mudhatia 5.24 ± 0.54 Bq/m³ with an average value is 7.79 ± 0.51 Bq/m³. On the other hand, the concentration of alpha particles emitted from radon concentration in male blood samples higher than concentration in female blood samples. A negative correlation between the disease age and alpha particles concentration in human blood was found. The comparison shows that the concentration of alpha particles in the human blood samples in the present study is lower than the concentration of alpha particles reported by UNSCEAR (2000).

1. Introduction

The main sources of radiation exposure include natural radiation of terrestrial, cosmogenic origins and internal radioisotopes as well as the artificial sources. The radionuclides may emit either alpha or beta particles, may be taken into the body through ingestion or inhalation. Alpha particles are harmful particles that work on damage the cells encounter it, produced from the decay of Uranium, Thorium and its daughters [1]. When inhaled, enter to the lungs and effect on the cells of lungs and therefore induce lung cancer or pass to human blood stream causing damage of blood cells then leukemia [2]. Radon is a natural radioactive gas produced by decay of uranium series and thorium series and its daughters. Radon is a colourless, odourless poisonous gas; it has three isotopes in natural, 222Rn, 219Rn and 220Rn emitted from 238U, 235U and 232Th, respectively. 222Rn is the most significant natural isotope of the radioactive element due to the a half-life is longer compared to another isotopes that is 3.82 days [3]. On the other hand, radon gas escapes easily from the ground into the air and decay to short-lived decay products called radon daughters. When radon gas itself is inhaled, either it stays in the lung caused lung cancer or may be transferred it or its progeny to the blood causes leukemia [4]. The radioactive gas radon was classified as dangerous carcinogen by the International Agency for Research on Cancer (IARC) [5]. Many researchers started looking to study the effect on human health
through extensive studies for examples [6, 7] have shown a significant relationship between exposure to the alpha particles and the risk of lung cancer. In 1998, about 4,800 deaths from malignant cancer while 5,417 deaths from cardiovascular diseases had occurred [8]. Radon with some cancers were associated such as Myeloid leukemia (ML), but there was no apparent association of radon with either non-Hodgkin lymphoma (NHL) or multiple myeloma (MM) where exposure of radon was associated with an increased risk of developing leukemia in underground uranium miners because they are chronically exposed to alpha particles emitted by radon and its progeny in addition to some other types of radiation which can cause cellular damage and, in some conditions, exacerbated due to malignant tumours. Leukemia disease is a malignant condition that affects the immature forming of the blood cells in bone marrow, leukemia is a result from the somatic mutations of the DNA that activate or deactivate the tumour suppressor genes, these may occur as a result of exposed to radiation or the other carcinogenic substances [9]. The aim of this study is measured alpha particles emitted from radon concentration in human blood for leukemia patients and healthy human collected from Morgan Hospital, Babylon, Iraq using CR-39 detectors.

2. Materials and methods

Thirty human blood samples of patients and healthy, males and females collected from Morgan Hospital, Babylon, Iraq as shown in table 1. On the other hand, the information of the sample (location, code, gender, age and number of illness years) was reported in table 2. The human blood sample was taken from body and put in tubes Ethylene Diamine Tetraacetic Acid (EDTA) due to not clotting. The tubes labelled with special codes, after then, the blood was emptied in Petri dishes and heated at 37°C for 24 h to dry and to oxidize organic material using an electric heating incubator [10]. The samples were then ground and sieved through a fine mesh 0.5 mm to become a powder with a homogenous grain size distribution as shown in figure 1. After then the samples was keeping in small laboratory tubes it is known as eppendorf tubes for one week to get homogenous mixed and to get equilibrium. The samples weighed for 0.5 g and saved in PVC tubes. PVC tube (Poly Vinyl Chloride) (2mm, 2.1cm, 10.5cm) thick, diameter and long respectively, and used to store samples for 70 days, after placing the sample at the bottom of the tube is well closed by a stopper to prevent gas leakage as shown in figure 2. The stopper was containing small pieces called CR-39 nuclear track detectors, CR-39 is plastic polymer detectors are the abbreviation for (Columbia Resin-39), with 500 μm thickness (Tasl Company, UK). It was cut into an area of (1×1.5) cm² with carefully by a very sharp cutter and fixed at the bottom of tube cover by adhesive tape to record the tracks of α-particles from radon during exposure [11]. After that, each CR-39 detectors were etched chemically in NaOH solution in normality 6.25 N at a temperature 70°C for 6 h [12]. The tracks were recorded using Olympus optical microscope with magnification of 400X as shown in figure 3.

| Location         | Patient and Healthy | Number of samples |
|------------------|---------------------|-------------------|
| Centre City      | Patients            | 4                 |
|                  | Healthy             | 1                 |
| Al-Kifl          | Patients            | 4                 |
|                  | Healthy             | 1                 |
| Al-Iskandaria    | Patients            | 4                 |
|                  | Healthy             | 1                 |
| Al-Mhawyl        | Patients            | 4                 |
|                  | Healthy             | 1                 |
**Table 2. Information of patients and healthy**

| Location       | Code | Gender | Age (year) | Disease age (year) |
|----------------|------|--------|------------|--------------------|
| Al-Qasim       |      |        |            |                    |
| Patients       | 4    |        |            |                    |
| Healthy        | 1    |        |            |                    |
| Al-Mudhatia    |      |        |            |                    |
| Patients       | 4    |        |            |                    |
| Healthy        | 1    |        |            |                    |
| Total          |      |        |            |                    |
| Patients       | 24   |        |            |                    |
| Healthy        | 6    |        |            |                    |

- **Al-Qasim**
  - S1: Male, 63, 4
  - S2: Male, 62, 2
  - S3: Female, 70, 2
  - S4: Male, 37, 1
  - H5: Male, 35, Healthy
  - S6: Female, 16, 5
  - S7: Male, 45, 3

- **Al-Kifl**
  - S8: Female, 42, 3
  - S9: Male, 24, 2
  - H10: Female, 13, Healthy
  - S11: Male, 19, 4
  - S12: Male, 41, 2

- **Al-Iskandaria**
  - S13: Female, 59, 1
  - S14: Male, 36, 3.5
  - H15: Female, 25, Healthy
  - S16: Male, 65, 3
  - S17: Male, 57, 3

- **Al-Mhawyl**
  - S18: Female, 29, 2
  - S19: Male, 51, 2
  - H20: Female, 35, Healthy
S21  Male  18  7
S22  Male  34  6
Al-Qasim  S23  Male  60  2
S24  Male  70  2
H25  Female  39  Healthy
S26  Female  36  11
S27  Female  41  7
Al-Mudhatia  S28  Male  40  3
S29  Female  57  1.5
H30  Male  16  Healthy

Figure 1. Preparation the blood samples

Figure 2. PVC tube to storage the blood samples
3. Calculations

Alpha particles emitted of radon concentrations in human blood were measured using track detector technique CR-39 by record the tracks of that particle appear on the surface of the detector according to the following relation [13]. The density of track $\rho$ (track / cm$^2$) was calculated using the equation.

$$\rho = \frac{N_t}{A}$$

where $N_t$ average number of tracks and $A$ is area of field view. The density represented tracks of $\alpha$-particles emitted from radon during exposure in blood samples. To calculate the concentration of alpha particles $C_{Rn}$ in human blood (Bq/m$^3$) was used equation [14].

$$C_{Rn} = \frac{\rho}{k \times T}$$

where: $k$ is the calibration factor of detector (0.212 tr. cm$^{-2}$ per Bq. m$^{-3}$.d) [15] and $T$ is exposure time (70 d).

4. Result and Discussion

The alpha particles emitted from radon concentration in human blood were collected from Morgan Hospital, Babylon. The highest concentration for leukemia patient was $13.98 \pm 0.94$ Bq/m$^3$ in the blood sample in centre city and the lowest concentration was $5.24 \pm 0.54$ Bq/m$^3$ in the sample collected from Al-Mudhatia, with an average concentrations $7.79 \pm 0.51$ Bq/m$^3$, as shown in table 3 and figure 4. While the highest concentration for healthy was $5.30 \pm 0.36$ Bq/m$^3$ collected from Centre city and the lowest concentration was $3.76 \pm 0.25$ Bq/m$^3$ collected from Al-Iskandaria with an average value was $4.32 \pm 0.39$ Bq/m$^3$. The results showed the concentration of leukemia patients higher than an average concentration for healthy as shown in figure 5. On the other hand, the result showed the alpha particles concentrations emitted from radon in males was higher than the concentrations for females, because the males are more exposed to radiation than the females depending on their work at different exposure locations of the environment as shown in figure 6. Negative correlations between the age of
the disease and the concentration of alpha particles emitted from radon in human blood samples during exposure as clear in figure7. The results comparison with other studies, the results revealed that the average of alpha particles emitted from radon concentration was $7.79 \pm 0.51$ Bq/m$^3$. It was lower than the alpha particles concentration in Karbala Governorate, Iraq and Malaysia as shown in table 4. In addition to, the results of alpha particles emitted from radon concentrations in the human blood samples for leukemia patients were within the permitted limits approved by the International Atomic Energy Agency IAEA and the United Nations Scientific Committee on Radiological Protection UNSCEAR reported is 200 Bq/m$^3$ [16].

**Table3.** Concentration of alpha particles in the human blood samples collected from Babylon, Iraq.

| Location       | Code | concentration of alpha ± Std. Error |
|----------------|------|-------------------------------------|
| Centre City    | S1   | 9.60 ± 0.62                         |
|                | S2   | 13.98 ± 0.94                        |
|                | S3   | 7.81 ± 0.53                         |
|                | S4   | 8.71 ± 0.59                         |
|                | H5   | 5.30 ± 0.36                         |
|                | S6   | 8.20 ± 0.55                         |
|                | S7   | 7.30 ± 0.49                         |
| Al-Kifl        | S8   | 8.26 ± 0.55                         |
|                | S9   | 11.03 ± 0.74                        |
|                | H10  | 3.89 ± 0.26                         |
|                | S11  | 6.79 ± 0.46                         |
|                | S12  | 6.72 ± 0.45                         |
| Al-Iskandaria  | S13  | 7.68 ± 0.52                         |
|                | S14  | 7.55 ± 0.50                         |
|                | H15  | 3.76 ± 0.25                         |
|                | S16  | 6.59 ± 0.44                         |
|                | S17  | 7.42 ± 0.50                         |
| Al-Mhawyl      | S18  | 6.97 ± 0.47                         |
|                | S19  | 6.07 ± 0.40                         |
|                | H20  | 5.24 ± 0.35                         |
|                | S21  | 7.74 ± 0.52                         |
|                | S22  | 6.91 ± 0.47                         |
| Al-Qasim       | S23  | 7.94 ± 0.54                         |
|                | S24  | 6.15 ± 0.41                         |
|                | H25  | 3.82 ± 0.26                         |
|                | S26  | 7.61 ± 0.51                         |
|                | S27  | 5.24 ± 0.35                         |
| Al-Mudhatia    | S28  | 8.07 ± 0.54                         |
|                | S29  | 6.97 ± 0.47                         |
|                | H30  | 3.89 ± 0.26                         |
| Mean patient   |      | 7.79 ± 0.51                         |
| Mean Healthy   |      | 4.32 ± 0.39                         |
Figure 4. Alpha particles of radon concentration in human blood samples for leukemia patients and healthy samples.

Figure 5. Alpha particles concentration in blood samples for patients and healthy.

Figure 6. Alpha particles concentrations in blood samples for males and females.
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![Graph showing correlations between alpha particles and age of disease](image)

**Figure 7.** Correlations between the alpha particles and age of disease

**Table 4.** A comparison between alpha particles concentrations in blood samples of the present study with other studied

| Country            | Alpha particles concentration Bq/m³ | References |
|--------------------|------------------------------------|------------|
| Malaysia           | 570.25                             | [4]        |
|                    | 734.50                             |            |
| Iraq/ Karbala      | 64.3 ± 25.92                       | [15]       |
| UNSCEAR            | 200                                | [16]       |
| Iraq/ Babylon      | 7.79 ± 0.51                        | present study |

5. Conclusions

The human blood samples collected from Morgan Hospital, Babylon were measured the alpha particles emitted from radon concentration. The results showed that the alpha particles concentration in blood samples for leukemia patients was higher than the healthy samples with an average concentration 7.79 and 4.39, respectively. On the other hand, the result is found that the proportion of males is higher than females in terms of concentration of alpha particles in blood samples. A negative correlation was found between the age of the disease and the concentration of alpha particles. Although, the average concentration was lower than the concentration as reported in Karbala Iraq, Malaysia and it remains below the recommended action level by UNSCEAR, 200 Bq/m³.

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