Physiology study for effecting of radon gas on some hormones of female rats

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Abstract. Background: Radium-226 and its daughters, such as radon-222 gas, are harmful elements to the human body it is considered a known carcinogen. The present study aimed to determine the physiological effect of radon gas (radium-226 source) on female rats and included the study of some hormone changes. Methods: The study was done on 25 animals aged (8-12) weeks and the weight of (132-208) g. Results: The first group of rats were not exposed to radon gas, which is as control group. While other groups of rats, (four groups) were exposed to radon gas at doses 3063.05 Bq, 4546.86 Bq, 5265.65 Bq, and 613.85 Bq, respectively. Conclusion: The result of body weight shows no significance ($P>0.05$) in the body weight of rats in groups exposed to radon gas in comparison with the control group. In addition, the result of FSH and LH hormones shows a significant decrease ($P<0.05$) in groups exposed to radon gas in comparison with the control group, while the estrogen is not significant ($P>0.05$) in groups exposed to radon gas in comparison with the control group. The study showed a significant increase ($p \leq 0.05$) in the body weight of rats groups exposed to radon gas (RAD) groups. Furthermore, the study showed a significant decrease ($p \leq 0.05$) in hormones (FSH, LH) and a significant increase ($p \leq 0.05$) in hormones (Estrogen) of rats groups exposed to radon gas (RAD) groups in comparison with control groups. Keyword: FSH, LH, E2, female rats, and radon gas.

1 Introduction

The hypothalamic-pituitary-ovarian (HPO) axis serves as the main controller of the reproductive system. The basophilic cells of the anterior pituitary gland release follicle-stimulating hormone (FSH) and luteinizing hormone (LH) in response to activation by neurons situated in the arcuate nucleus of the hypothalamus. The granulosa and theca cells of an ovarian follicle are subsequently attached to these hormones, which promote the follicle's growth and development. Any disruption to this process may lead to the formation of polycystic ovaries, which can evolve into PCOS, a major cause of infertility if left untreated. A novel therapy strategy has been proposed to evaluate the effect of this frequency on cystic development employing 150 kHz Intermediate Frequency (IF) Electromagnetic

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Radiation (EMR). Radon, a noble gas, is a naturally occurring radioactive element. It significantly enhances the level of exposure to ionizing radiation that comes from natural sources. It is extensively used in several nations for the treatment of both benign inflammatory and non-inflammatory illnesses. Currently, there is a widespread consensus that the emission of alpha-particles from radon in these springs is the primary source of radiation exposure, which in turn has various positive effects [1-21].

The production of alpha particles by the deposited decay products of radon is the main way in which lung tissue is exposed to radiation from these sources. These alpha particles have the potential to harm sensitive lung cells, which raises the risk of cancer formation. This is especially true of particles that are unattached or connected to tiny aerosols. As a result, the main source of the decay byproduct that exposes the lungs to radiation is radon. However, for convenience's sake, the term "health impacts of radon" is sometimes used to refer to the effects of radon decay products on health. There are several forms of non-ionizing and ionizing radiations, both of which are known to have a direct impact on infertility. Additional health impacts have been examined, however, there is currently no definitive information about health problems caused by radon, other than lung cancer (Abojassim et al., 2021). Neuroendocrine changes generated by the influence of electromagnetic fields (EMFs) are a significant contributing factor to alterations in hormone function and the development of infertility symptoms in females (Nelson et al., 1995). The objective of this study is to investigate the impact of different durations of exposure to radon gas (4, 8, 12, and 16 days) on the physiological parameters of FSH, LH, and E2 in female Albino rats.

2 Materials and methods

2.1 Preparing laboratory animals

In the study, there were 25 female albino Swiss Rats of the breed (Bulb/C), weighing an average of 132 to 208 g and growing between 8 and 12 weeks of age. The animals whose fertility was verified were chosen for the fertility tests. The University of Kufa's Faculty of Science's animal house provided these animals. The animals were brought into the University of Kufa's Faculty of Science animal house. Their living quarters consisted of plastic cages with mesh coverings filled with sawdust that was replaced every week. The animals were housed in carefully regulated laboratory settings, with a temperature range of (21–30)°C and a set lighting schedule of (11 hr) of darkness and (13 hr) of light. Water and food (blackberries, depending on the animals' needs) were regularly given to the animals and were purchased from specialized agricultural shops in Baghdad.

2.2. Irradiation Source and Radon detector

Female rats have been exposed to Radium-226 radiation for scientific purposes. In 2009, a Radium-226 source was created with an activity of 6600 Bq. This source comprises a receptacle that contains a rod, inside which the radioactive nucleus emits radon gas.

CR-39 nuclear track detector sheets are sensitive polymeric plastic. These sheets are often employed to test radionuclides that release α-particles, including radon gas. They are tiny, simple, and durable (Hamzah et al., 2022). "CR-39" refers to the Columbia Resin No. 39 detector. Formula for CR-39: (C_{12} H_{18} O_7). Each detector has a code to differentiate it. UK-based TASTRAK Analysis System sold the CR-39 detector. The CR-39 detector sheet was 2.5cmx2.5cm and had a thickness of 1mm. The TASL image system supported each sheet's coding. Sheet density is 1.32 g/m^3.

2.3. Experimental Design

The rats were housed in an animal facility for two weeks to adapt to the laboratory environment prior to being used for the experiment. Each group consisted of five rats that were exposed to varying amounts of radon gas (^{222}Rn) over varied periods.

- Group 1: Rats exposed to radon gas at a concentration of 588.51 Bq/m3 for 4 days for three groups (radon gas).

- Group 2: Rats exposed to radon gas at a concentration of 714.62 Bq/m3 for 8 days for three groups (radon gas).

- Group 3: Rats exposed to radon gas at a concentration of 756.66 Bq/m3 for 12 days for three groups (radon gas).

- Group 4: Rats exposed to radon gas at a concentration of 840.73 Bq/m3 for 16 days for three groups (radon gas).

-Group 5: Rats administered normal saline only as a control for three groups (radon gas).

The female Rat was explained after being anesthetized with chloroform at the end of each group. The abdominal cavity was opened, and the various organs of the female reproductive system, including the Uterus, were removed and placed in a solution of formalin (10%) after removing the fatty substances attached to it. It was dried with filter paper and then weighed using a sensitive scale type (Sartorius, Germany), after which the textile and physiological manifestations were studied according to the experiments designed in this study.

3 Result

The findings from Table (1) suggest that there is no statistically significant difference (p>0.05) between the radiation groups and control groups (before and after weights) at different weights (186.67±32.32, 186.33±19.0, 208±35.76, 174.33±10.07, 163±13.11, 180.67±42.15, 177±28.05, 198.33±20.21, 178.33±15.89, 172.33±15.01) respectively.

Table 1: Demographic of treated periods and weights (before and after) radiation.

Treated groups	Treated Periods	Weight before (g)	Weight after (g)	Weight gain (g)	Weight gain %
Control	D.W	163±13.11	172.33±15.01	9.33±2.31	5.7±1.08
RAD	4 days	186.67±32.32	180.67±42.15	-6±9.85	-3.97±6.46
	8 days	186.33±19.01	177±28.05	-9.33±26.5	-4.73±14.52
	12 days	208±35.76	198.33±20.21	-9.67±17.1	-3.77±8.37
	16 days	174.33±10.07	178.33±15.89	4±10.15	2.27±5.94
Univariate	LSD	44.250	47.784	28.184	15.418
	p-value	0.296	0.782	0.492	0.501

The findings presented in Table (2) demonstrate a statistically significant (p>0.05) reduction in FSH in both the radiation and control groups (145.59±2.28, 148.31±1.11, 134.87±8.71, 123.17±4.68, 172.33±2.03, 171±1.53, 170±2.89 and169±0.58) respectively.

Table 2: Effect of RAD for (4, 8, 12, and 16) day on FSH in female Rats in compared with control group

FSH (mIU/ mg/kg)		
	Control	**RAD**
4 days	172.33±2.03	145.59±2.28
8 days	171±1.53	148.31±1.11

12 days	170±2.89	134.87±8.71
16 days	169±0.58	123.17±4.68
LSD	6.339	**9.608**
p-value	0.67	**0.001***

Table (3) findings show a substantial (p>0.05) reduction in LH in both the radiation and control groups (85.62±5.55, 74.2±6.27, 61.63±5.71, 55.15±9.82, 77.17±1.48, 76±1.61, 76.43±1.15 and 75.77±0.83) respectively.

Table 3: Effect of RAD for (4, 8, 12, and 16) day on LH in female Rats in compered with control group

LH (mIU/ mg/kg)		
	Control	**RAD**
4 days	77.17±1.48	85.62±5.55
8 days	76±1.61	74.2±6.27
12 days	76.43±1.15	61.63±5.71
16 days	75.77±0.83	55.15±9.82
LSD	4.244	**13.290**
p-value	0.877	**0.003***

The findings from Table (4) suggest that there is no statistically significant difference (p>0.05) in Estrogen between the radiation groups and the control groups (1.05±0.06, 0.97±0.19, 0.99±0.19, 0.98±0.17, 0.77±0.01, 0.87±0.04, 0.84±0.02 and 0.83±0.03) respectively.

Table 4: Effect of RAD for (4, 8, 12, and 16) day on E2 in female Rats in compered with control group

Estrogen (Pg/mg/kg)		
	Control	**RAD**
4 days	**0.77±0.01**	**1.05±0.06**
8 days	**0.87±0.04**	**0.97±0.19**
12 days	**0.84±0.02**	**0.99±0.19**
16 days	**0.83±0.03**	**0.98±0.17**
LSD	**0.091**	**0.308**
p-value	**0.168**	**0.963**

4 Discussion

The study reveals no significant difference in radiation groups and control groups (before and after weights) at different weights, as presented in Table (1). When female rats were exposed to radon gas source for different periods, the outcome did not find a significant change in the body weight of female rats. Our study agrees with previous studies, such as (Xuexian Pei et al., 2015), that showed no difference was found for the change of weight in mice that were exposed to radiation.

FSH promotes the development of ovarian follicles in the follicular phase of the menstrual cycle. Follicle-stimulating hormone (FSH) reaches its highest level simultaneously with the luteinizing hormone (LH) surge, which triggers the process of ovulation. During the luteal phase, FSH levels stay low, which inhibits the growth of new follicles (Barbieri, 2014).

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The research suggests that radon gas leads to a considerable fall in FSH levels, as shown in Table (2). The concentration of radon gas reached a high level of 840.73 Bq/m3 during 16 days. Within 4 days, it was noted that there was an elevation in the level of follicle-stimulating hormone (FSH). Luteinizing hormone (LH) stimulates the production of steroid hormones in the ovaries of women. Luteinizing hormone (LH) has a role in the development of primordial germ cells. Luteinizing hormone (LH) stimulates the Leydig cells in the testes of males to produce testosterone (Ilahi and Ilahi, 2021). Luteinizing hormone (LH) has a crucial function in regulating the duration and sequence of the menstrual cycle in females. It is involved in both the release of an egg during ovulation and the attachment of the fertilized egg to the uterus during implantation (Kumar and Sait, 2011). As shown in Table (3). The delivery of RAD resulted in a decrease in blood levels of the Luteinizing hormone. The impact of radon gas was measured at a concentration of 840.73 Bq/m3 for 16 days. In 4 days observed that increase in LH level. Which alpha activity of radon gas. This study supports earlier research, including that of (Abuelhija, 2013). Demonstrated that Suppression of testosterone and gonadotropins after irradiation was observed in different strains of rats. One of the primary ovarian hormones, estrogen regulates several aspects of female reproduction, including ovulation, uterine propagation, the rise in serum gonadotropin concentrations, estrus behavior, and endometrial gland secretion (Tokunaga et al., 2014, K. J. Hamilton et al., 2014).

The most common side effect of radiation therapy on the head in patients at developmental age is anterior pituitary hormone deficiency, which affects sexual maturation and fertility. Depending on the dose, method of dose fractioning, duration of exposure, and treatment plan, radiation therapy of the scalp can also have an impact on fertility. Although the exact reason for the H-P-G axis' high radiosensitivity is unknown, it is most likely connected to IR-induced damage to the pituitary and hypothalamus cells. As the biological effective dosage of IR increases, the malfunctioning of the H-P-G axis becomes more severe (Marci et al., 2018).

As shown in Table (4). RAD exposure does not cause significant changes in estrogen levels in the blood. This simple change may be occurring for essential estrogen to the maturation of ovarian follicles; In addition, estrogen plays an important role in regulating the secretion of gonadotropins.

Several prior research, such as the one conducted by (Mahmoud et al.,2020), have examined this topic. A study shown that radiation exposure leads to a decrease in estrogen levels. The present study included studies on the impact of electromagnetic radiation (EMR) exposure on the female reproductive system in both human subjects (Nazıroğlu et al., 2013) and animals (Kismali et al., 2012).

5 Conclusion

Radon gas does not cause any effected on the weight of the body in female rats, while it causes an effect on hormone change. It was found that FSH and LH were decreased with increasing radon concentrations, while the estrogen had no significant change with the period time of radiation.

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