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Histological study for effect Radon gas on ovary of female rats

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ABSTRACT
In this work, the effect of radon gas on histological change in ovary of female' rats were studied. there are four dose exposure of radon gas (3063.05 Bq, 4546.86 Bq, 5265.65 Bq, and 613.85 Bq) were used at four groups of females' rats which it is 4-day, 8-day, 12 day, and 16 days, respectively. The results show that, the body weight is no significant ($P>0.05$) for rates in all groups exposed by radon gas in compare with control group. Also, this result of diameter of ovary, primary follicles, secondary follicles number of Graafian follicles of ovary show significant decrease ($P<0.05$) in groups exposed by radon gas in compare with control group, while the number corpus luteum is increased. Therefore, it may be concluded that the dose exposure of radon gas was highly effect on histological change in ovary and may be cause infertility in female rats.

Keyword: histological parameters, ovary, female rats, and radon gas.

1. INTRODUCTION

Radon gas is odorless, colorless, radioactive, tasteless, and a noble gas. In fact, it is the heaviest noble gas in nature. Due to the relatively long half-life of radon and gaseous nature, radon can be regarded as a significant contributor to radioactivity in the atmosphere. Gaseous radon can be produced by rocks, soil, and construction material which contain amounts of naturally occurring thorium and uranium. Radon occurs naturally as a product of the Uranium decay. Radon contributes by over 50% of the total natural radiation that human received (Gaisberger et al.,2021). Radon greatly contributes to the exposure from naturally occurring sources of ionizing radiation. It is also widely used in the treatment of benign inflammatory and non-inflammatory diseases, in many countries. Today, it is widely accepted that the emitting alpha-particles from radon in these springs are responsible for the main dose and thus for several beneficial (Rühle et al., 2017, Gaisberger et al.,2021; Maier et al ., 2021).When radon and its short-lived decay produces are exhaled, the dose of radiation to tissue of the lung is dominated by the alpha particles emitted by the deposited decay products, which, especially those attached to small aerosols or are in unattached form, cause damage to sensitive lung cells, thereby increasing the probability of cancer developing. Therefore, radon acts mainly as the source of its decay outcome, which actually delivers the dosage to the lungs; however, as a convenient abbreviation, the health effects of radon decay products are often referred to as the health effects of radon (Abojassim et al., 2021). There are several causes of infertility in female and according to the Center for Disease Control, female infertility can be caused by defective ovulation, transport (ovum and sperm), and implantation (zygote). Defective ovulation occurs due to the dysfunction of the hypothalamus and pituitary gland, which may prevent ovulation through the excessive production of prolactin (CDC. Infertility FAQs. 2013). several known causes for female infertility are premature ovarian insufficiency, polycystic ovarian syndrome (PCOS), and endometriosis (a condition, in which endometrial tissue

grows on ovaries. Numerous types of non-ionizing and ionizing radiations and both have recognized causative influences on infertility. Other health effects have been studied but there is no conclusive evidence at present concerning radon-induced health effects other than lung cancer (Abojassim et al., 2021). The aim of this research is to study the effect of four proid time exposure (4, 8, 12, and 16 day) of radon gas on the histological sections of ovary for female Albino rats.

2. MATERIALS AND METHODS

The study included (25) female albino Swiss Rat belonging to the (Bulb/C) breed, whose ages ranged between (8-12) weeks, and their average weight was between (132-208) grams. Animals were used after confirming their fertility for the purpose of conducting fertility testing and the animals were obtained from the animal house in the Faculty of Science / University of Kufa. The animals were placed in plastic cages with their own mesh covers and the floor of the cages were furnished with sawdust and were changed weekly and the animals were placed under appropriate laboratory conditions where the temperature ranged between (21 - 30) C and at a fixed lighting system at the rate of (13) hours of light and (11) hours of darkness. Radium-226 has been used for samples irradiation of the female rates samples. Radium-226 source was produced in 2009 and has activity 6600 Bq. This source consists of a container containing a rod, where the radioactive nucleus releases the radon gases. The rats kept in animal house for acclimation to laboratory condition for two weeks before they were used for the experiment. Then, animals were placed in plastic cages that it is contans of irradiation source (by radon gas) as seen in Figure (1). Each group was formed 5 ats and the Rats exposed by radon gas (^{222}Rn) at different doses which depend on the variable period time. The values of dose exposure of radon gas in control groups, group 1(4 day), group 2(8day), group 3(12 day), and group 4(16 day) were 0 Bq/m^3, 588.51 Bq/m^3, 714.62 Bq/m^3, 756.66 Bq/m^3, and 840.73 Bq/m^3, respectively.

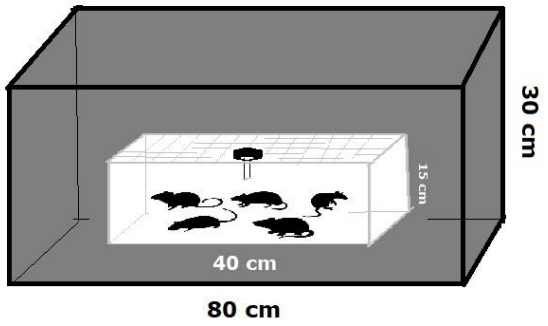

Figure (1): Diagram of house of Irradiation for animals in the present study using radon source.

3. RESULT

The results of Table (1) indicate that there is no significant difference ($p>0.05$) in 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 results of Table (2) indicate that there is significant decrease ($p>0.05$) in radiation groups and control groups for diameters of ovary (241.67±85.09, 107.5±15.21, 117.5±8.0, 98.33±10.1, 944.67±5.03) respectively. The results also show that there is significant decrease ($p>0.05$) in radiation groups (4 days) that treatment with (100 and 200 ml) and radiation groups (4 days) for diameters of ovary (220.83±47.32, 216.67±62.92, 241.67±85.09) respectively. When comparing in means of ovary diameters within each period, notice a significant ($p<0.05$) decrease in all treated groups as compared with the control group. But there was significant decrease when compared between them (RAD periods), with the highest effect at period of 16 days. Table (4-1): Demographic of diameter of ovary in control groups, radiation groups and treatment radiation groups.

Table (2) Comparison between Diameter of ovaries for control groups and (radiation groups

Diameter of ovary (μm)			
Treated groups Periods	Control	RAD	Multivariate p-value, LSD
4 days	944.67±5.03	241.67±85.09	0.0001 * 66.819
8 days	944.67±5.03	107.5±15.21	
12 days	944.67±5.03	117.5±8.0	
16 days	944.67±5.03	98.33±10.1	
p-value	1.000	0.012 *	
LSD	9.477	82.270	

The results of Table (3) indicate that there is significant decrease ($p>0.05$) in radiation groups and control groups for ovarian follicles of ovary (2.67±0.88, 1.33±0.33, 5.0±2.08, 6±2.52) respectively.

Table (3): Demographic of Ovarian follicles of ovary in control groups and radiation groups

Ovarian follicles	Treated periods	4 days	8 days	12 days	16 days

Mean of No. Corpus luteum	RAD	2.67±0.88	1.33±0.33	5.0±2.08	6±2.52
	Control	1.0±0.0.0	1.0±0.0	1.0±0.0	1.0±0.0
	p-value	0.114	0.539	0.148	0.224
Mean of No. Primary follicles	RAD	2.67±0.33	1.33±0.33	1±0.58	0.33±0.33
	Control	12.27±0.78	12.27±0.78	12.27±0.78	12.27±0.78
	p-value	0.001*	0.001*	0.0001*	0.0001*
Mean of No. Secondary follicles	RAD	2.67±0.88	0.67±0.33	1.33±0.33	2.0±1.0
	Control	6.67±0.27	6.67±0.27	6.67±0.27	6.67±0.27
	p-value	0.005*	0.089	0.0001*	0.023*
Mean of No. Graafian follicles	RAD	2.67±0.33	1.67±0.33	1.33±0.33	4.67±1.2
	Control	4.53±0.19	4.53±0.19	4.53±0.19	4.53±0.19
		0.140	0.026*	0.005*	0.069

4. Discussion

The study reveals no significant difference in radiation groups and control groups (before and after weights) at different weights as present in table (1). Which female rats exposure to radon gas source for different periods, the outcome not found significant change in body weight of female rats. Our study agreement with previous study such as Xuexian Pei et al, (2015) that showed no difference was found for the change of weight in mice that exposed radiation.Figure (2) shows the Ovarian tissue for control group of female white rats appears: a. diameter Ovarian b. The number of ovarian follicles, and c. the corpus luteum numbers.The study reveals decrease significant in RAD groups as presented in table (2). From the obtained results, it could be observed that female rat's radiation markedly decrease in diameter of ovary Ovarian tissue is very sensitive to radiation (Gross et al., 2010).Radiation can induce systemic effects in which complex tissue responses are observed in non-irradiated regions due to signaling from irradiated cells. These systemic effects include inflammatory responses that may indirectly contribute to ovarian damage and follicle loss (Frey et al., 2015, Rödel et al., 2015, Sologuren et al., 2014).The study reveals decrease significant in RAD groups as presented in table (3). From the obtained results, it could be observed that female rats radiation markedly decrease primary and secondary follicles in all periods, this lead to infertility. The high effect radiation was in period 16 days in 840.73 Bq/m^3 this is for primary follicles while secondary follicles was high effect for radon gas at

period 8 days in 714.62 Bq/m^3. These results agreement with Briley et al., 2016. This showed that Follicle loss is a common feature of both iatrogenic reproductive aging due to radiation and physiologic reproductive aging, and advanced reproductive age is also associated with increased stromal fibrosis.Also agreement with previous studies such as Straub et al., 2015. This showed that in humans both radiation-induced vascular injury and tissue fibrosis are both long-term consequences of exposure which can take up to years to manifest clinically.These results agreement with previous studies such as Meirow et al., 2010 and Adriaens et al., 2009 When the ovary is exposed to radiation through total body or abdominal radiation, oocytes are lost through cell death pathways; granulosa cell damage results in impaired gonadal hormone production; and the ovarian vasculature and stroma are compromised. These changes may ultimately lead to premature ovarian failure, subfertility, or infertility, Kimler et al., 2018found that 1 Gy was sufficient to decrease follicle counts within the mouse ovary, virtually all eliminated at 5 weeks post-exposure. Marci et al., 2018 Radio-sensitivity of the ovaries also depends to a great degree on the age of the woman exposed to IR: the younger the patient exposed to irradiation, the greater the damage, and in the case of oncologic radiotherapy this effect may be enhanced by the use of alkylating chemotherapy, e.g. by means of cyclophosphamide. In a female at pre-pubertal age, exposure to a dose lower or equal 2 Gy will result in damaging a half of the oocytes, while in approximately 30% of young women and in nearly all women aged over 40, doses within the range 25 – 50 Gy will cause infertility. Also,our study indicates significant increase in radiation groups as present in table (3). Which these results included increase in corpus luteum of ovary this occur duo to effect of radiation on steroid hormones specifically progesterone and estrogen. This was high effect for radon gas on corpus luteum in period 16 days in 840.73 Bq/m^3. The Graafian follicles depletion because radiation, these results indicate significant decrease as present in table (3). The high effect for radiation was in period 12 days in 756.66 Bq/m^3 this to for Graafian follicles, whereas we did not notice change in Graafian number as compared with control groups (Figure 3).Also our study agreement with Camats et al., 2009 changes concerning the direct parameters of fertility, e.g. reduction in the number of oocytes, ovarian failure, and loss of the reproductive potential, were used as indicators of the genotoxic effects of IR only in several studies, including rats The results of these studies are inconsistent; however, they allow formulation of the conclusion that fertility disorders are not related with the irradiated species, but rather with the duration of exposure and the dose.

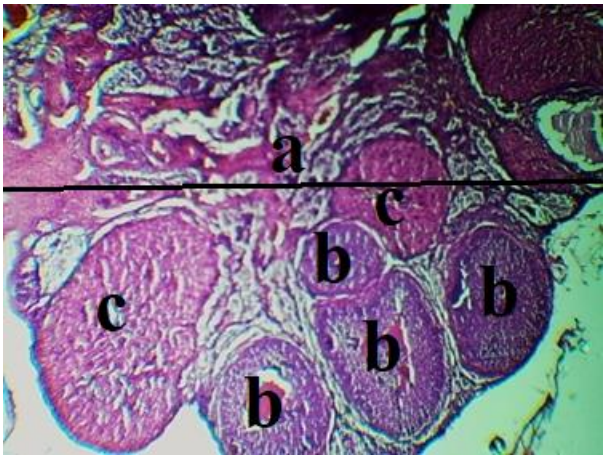

Figure (2): Ovarian tissue in the control group of female rat shows the following: a. diameter Ovarian b. the number of ovarian follicles. c. the corpus luteum numbers (Hematoxelin - Eosin × 50).

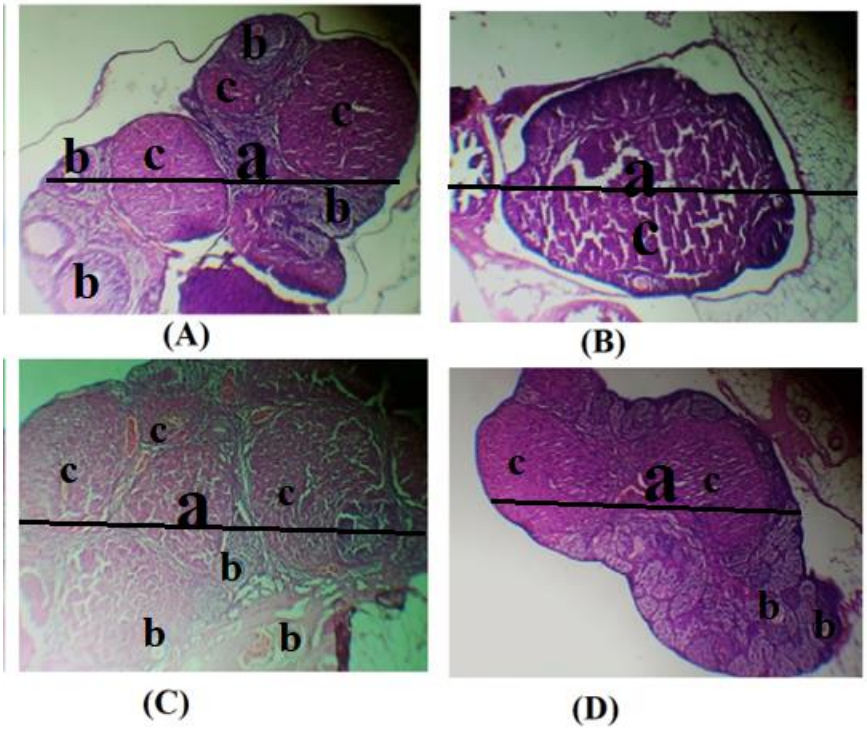

Figure (3): A, B, C & D: Ovarian tissue treated with Radon gas and for a period of irradiation (4, 8, 12 & 16) days for female white rats appears: a. Decrease in ovary diameter b. Decrease in ovarian follicles numbers c. increase the corpus luteum numbers (Hematoxelin - Eosin × 50).

5. CONCLUSION

There are many conclusions when increasing of radon gas concentrations on histological change of ovary in female' rats such as not effect of weights of body rats, decreeing of diameter of ovary, primary follicles, secondary follicles number of Graafian follicles, and increasing in the number corpus luteum. So, the dose exposure of radon gas was highly effect on histological change in ovary and may be cause infertility in female rats.

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