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Potential Effect of the Ultraviolet a Radiations in the Heart Tissue Under Different Doses on Rats Body Exposed

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ABSTRACT

Background: *Ultraviolet (UV) radiation is part of the electromagnetic spectrum longer than x-rays but shorter than that of visible light wavelength between 100 and 400 nm. Objective: This work aimed to investigate the biological effect of UVA on rat heart tissue as blood cell count, heart enzyme, trace elements content and histopathological changes. Materials and Methods: The heart samples were selected from 40 Wister male rats. They were divided into equal four groups (ten for each) as; the control group, which is not exposed to any radiation, while the other three groups were exposed to different UVA-radiation doses for continuous doses (group II (500.00 J/cm2), group III(793.15 J/cm2) and group IV (1733.18 J/cm2)). The study was examined some trace elements by Inductively Coupled Plasma Atomic Emission Spectroscopy (ICP-OES). Heart enzyme of the blood serum was used spectrophotometer, and CBCs were used mindary hematology analyzer Bc 2800, the histopathological changes of heart tissue examined by Light Microscope (LM) and Transmission Electron Microscope (TEM) examined myocardial cells. Results: The present work revealed increase of trace elements concentrations of (Ca, Cr, Cu, Fe, K, Mg, Na, Zn), mild changes of the complete blood picture (RBC, WBC, PLT and Hb) and heart enzyme, A mild to marked histopathological changes on the heart tissue. The fine ultra-structure revealed destructive myofibrile and increased of microsomes structure and lysosome vesicles. There are statistical significant decrease of mitochondria surface area and thickness of z-band of myocytes. It could be concluded that the continuously exposed to the UVA at long time caused a harmful in the heart tissues with a potential unbeneficial role of the UVA radiation exposed, so it must be used protection agent to avoid the harmful ionize radiation affected from the UVA radiation from the long-time exposed to sunlight.*

Keywords: UVA radiation, Heart tissue, Heart enzyme, Trace element, Blood picture, Myocardial cell ultrastructure

INTRODUCTION

Ultraviolet radiation occupies a significant portion of the electromagnetic spectrum. The ultraviolet is subdivided into three main types according to the long wave length for each as; UVA: (400-320 nm), UVB: (320-290 nm), UVC: (290-200 nm) [1]. The harmful effects of UV exposure depend on exposure rates, duration time of exposure, distance between radiation source and exposed object. The sensitivity of individuals to UV radiation has both positive and negative effects. The positive effects of UV radiation include warmth, plant photosynthesis and human body vitamin D synthesis. The negative effect was caused skin cancer, eye damage, suppression of the immune system, and premature aging [2].

Trace elements or trace metals are present in small quantities as constituents of all living organisms and are important for the growth and development of organisms. The biomedical research revealed that the trace elements play a dual role in the biological system through their interaction with bimolecular activity. They are incorporated in the proteins, enzymes and complex carbohydrates [3]. The trace elements are necessary for the function and maintenance of the immune system [4]. Few elements have roles in redox reactions for generation and utilization of metabolic energy, they have roles on donate or accept electrons for the structural stability to retrieval biological molecules [5]. A higher concentrations of these elements can cause toxic reactions and its deficient in tissue lead to diseases [6]. The determination of the trace elements concentration and distribution pattern is extremely important to provide some information of patho-physiological processes in examination of tissues [7].

Trace elements are involved in both humeral and cellular immunity as copper (Cu) and zinc (Zn) [8]. Elements such as iron, zinc, and selenium are essential components of enzymes and facilitate their conversion to specific need products. Some of the trace elements control important biological processes by facilitating the binding of molecules to their receptor sites and alternating the structures or ionic nature of cell membrane for allowing and preventing specific molecules to enter or leave a cell and resulting in the formation of protein involved in life processes [5]. Calcium is essential mineral for many aspects of health, as bones, teeth, and heart rhythm. It is required for muscle contractions and relaxation, nerve, hormone function, and blood pressure regulation Also, adequate amount of calcium intake to reduce the risk of osteoporosis [9].

Heart tissue is one of the late tissues that react to ionizing radiation. Cardiovascular diseases are common non-cancer disorders in people who have been exposed to ionizing radiation. A long period of time exposure to radiation affected the heart damage (for example radiotherapy or radiation accidents). This caused ischemia, vascular occlusion, fibrosis, and pericarditis [10]. The changes in the heart induced the blood supply to heart muscles, thereby posing the risk of heart attacks to irradiated persons [11]. There is relationship of the heart tissues and trace element which is necessary for muscle contraction. The hearts withdraw more Mg and Cu to overcome the heart failure problems caused by continuous exposure to high doses of UV radiation [12]. Calcium is very important to muscle contraction, and chromium is involved in the metabolism of the proteins, carbohydrates and minerals and balanced the body glucose and lipid [13]. Magnesium is implicated in the pleomorphic activity of fundamental cellular activities and metabolic pathways. In athletes, magnesium depletion is associated with structural damage to muscle cells [14]. Also, the body requires iron for the synthesis of its oxygen transport proteins, the formation of heme enzymes and other enzymes involved in electron transfer and oxidation-reductions [15,16]. Therefore, the present study aimed to investigate the affected role of UVA radiation exposed to rats of the some trace elements concentration, histopathological changes of heart tissues, and fine structure of cardiac muscle cell.

MATERIALS AND METHODS

Processing of UVA radiation

Irradiation of rats was carried out by two UVA- lamp 40 watt, and 45 cm length model F40W/2FT/T12/6L368-made in Germany, The used UVA- lamp has been calibrated in the National Institute for Standards NIS Radiometry Lab. –Reference Radiometry S480/268-UVC Report No.5A/52/2017, At Cairo, Egypt. Table 1 distributed the average doses measuring (J/cm^2) for each groups exposed related to the continuously exposure (24 hrs/day) and interval days exposure [17].

Table 1: The average doses of the UVA-radiation in interval exposure groups (24 hrs /day).

Groups	Gp I	Gp II (17 days)	Gp III (27 days)	Gp IV (59 days)
Energy doses	0	500.00J/cm^2	793.15 J/cm^2	1733.18 J/cm^2

Experimental design

The forty male rats weight (180-200 g) were divided into four equal groups (ten rats for each) as; control (Gp I) which not exposed to radiation and three experimental groups which exposed into three interval exposure to UVA radiation at (24 hrs/day) for 17 days (Gp II), 27 days (Gp III), 59 days (Gp IV). They were held in the laboratory for 24 days at a constant temperature (20 ± 2°C). The rats were individually housed in special cages, shaved the dorsal hair and exposed to UVA- lamps. At the end of the each radiation cycles the weight of every rat in all groups were checked. The rats were euthanized and anesthetized. Then the blood sample was collected from the abdominal aorta. The heart organ were selected and divided into three parts and prepared to evaluate the three parameters later. The animals were care according to The Institutional Animal Care and Use Committee (IACUC), Alexandria University, Egypt.

Complete blood count

The blood sample was collected from the abdominal aorta to study the hematological parameter of the complete blood picture (RBC, WBC and Hb and PLT) using mindary hematology analyzer BC-2800 (specific lab animal software, Germany) In Physiology & Integrative Medicine Department-Pharmaceutical and Fermentation Industries Development, Center-City of Scientific Research and Technological Applications. The sample volume was 120 uL as

a minimum using clean EDTAK2 anticoagulant collection tubes. They were should be stored at the room temperature and run them within 8 hours after collection. After the sample is prepared, be sure to wait for at least 5 minutes before running analyzer. It well known that all the samples, controls, calibrators, reagents, wastes and areas contacted them are potentially biohazard. Wear proper personal protective equipment (e.g. gloves, lab coat, etc.) and follow safe laboratory procedures.

Blood serum heart enzymes

Other blood sample was put in the lab tubes and kept on room temperature for 15 minutes and centrifuged at 3000 r.p.m. for 10 minutes. The serum obtained was kept at -20ºC until analyzed biochemical enzyme of CK-MB. A specific antibody inhibits the M subunits of CK-MM and CK-MB and thus allows determination of the B subunit of CK- MB (assuring the absence of CK-BB or CK-1) CK.B catalytic concentration, which corresponds to half of CK-MB concentration is determined from the rate of NADPH formation: by means of the Hexokinase (HK) and glucose -6- phosphate (G6PDH) coupled reactions and measured by Spectrophotometer at 340 nm [18].

Trace element analysis

A part of heart organs was immediately kept in the freezer (- 80.00°C) for examining concentrations of some trace elements (Ca, Cr, Cu, Fe, K, Mg, Na, Zn). They were measured by Inductively Coupled Plasma Atomic Emission Spectroscopy (ICP-OES) in Institute of Graduate Studies and Research, Alexandria University: In briefly, the frozen part of heart sample was placed in electric oven at 75°C for about 7 hours The samples are dried again in electric desiccators (with vacuum) for 24 h. Using an accurate electric balance to get the weight of each sample. Adding 25 ml of nitric acid HNO3 (Merck 70%) gradually until the reaction solution was clear and let to cool at room temperature. Then add 5-10 ml of hydrogen peroxide H2O2 and heated again. The solution was transferred into volumetric flask and diluted into 50 ml with distilled water. The tissue sample was ready to be analyzed in the Inductively Coupled Plasma Atomic Emission Spectroscopy ICP-OES to carry out a quantitative analysis for the trace elements present in the tissue sample [5].

Light microscopy technique

The second part was of heart organ fixed at 10% neutral formalin for proceeding paraffin sections. The sections were proceed for staining with hematoxlyen and eosin [19] and examined by the light microscope associated with digital camera (OLYMPUS COMPANY) and connected with software of image J (Math work USA, MAT-lab, version 5.5), in Histochemistry and Cell Biology Dept., Medical research Institute- Alexandria University.

Electron microscopy technique

The third part of the heart organ is divided into very small pieces and fixed by immersing immediately in 4% F1G in phosphate buffer solution. (PH=7.2) at 4◦C for 3 hours. They were proceed for araldite ultra-thin sections were stained by uranyl acetate and lead citrate for examining by the Transmission Electron Microscope, (TEM) JEOL– JSM-1400 PLUS in Center lab of Faculty of Science-Alexandria University [20].

Morphometry (image analysis)

The ten TEM photomicrographs for each group were stored in the computer include software program image J for measuring the surface area of mitochondria. The thickness of Z-band and T-Tubular were recorded. The collecting data were evaluated by minimum and maximum digit of pixel and tabulated to proceed for statistical analysis [21].

The Statistical Analysis was expressed in all data as mean ± standard deviation for every group. They were performed using statistical program (SPSS). Statistical studies performed include one-way ANOVA with statistically significant P values <0.05.

RESULTS

Complete blood count

A comparative study between the control and continuous exposed (24 hrs/day) of three group were get doses of [500

J/cm^2 (Gp II), 793.15J/cm^2 (Gp III), and 1733.18J/cm2 (Gp IV),], the results showed a significant differences of hematological blood count parameters. The Figure 1 illustrated no significance effect of Hemoglobin (Hb) and Red Blood Cell (RBC) of (GpII&III). While a significant increase was noticed in group IV and the decrease of PLT and WBC in the Gp IV was noticed (Figure 1).

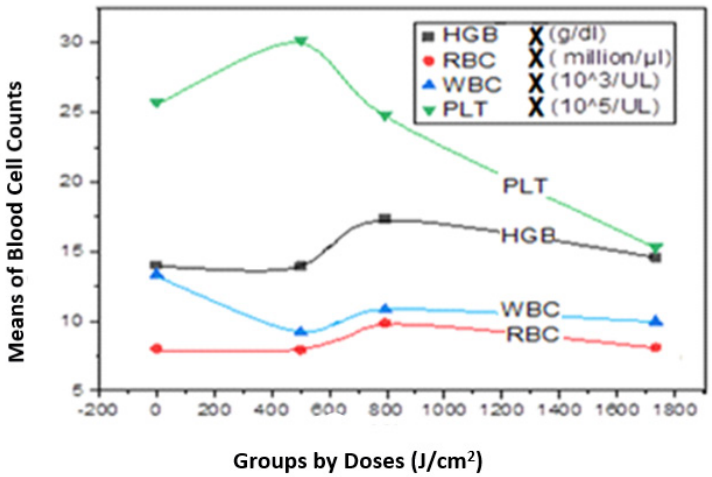

Figure 1: Line Chart illustrate the mean values of the blood cell counts.

Blood serum heart enzymes

(Figure 2): Distributed the blood serum enzymes of Creatine Kinase (CK) and Creatine Kinase (Myocardium) (CK-MB) for both control group and the exposed groups to UVA radiation in the heart homogenates tissue sample. There was a significant decrease of Gp II exposed to UVA radiation (500 J/cm^2) and a significant increase in Gps III &IV exposed to UVA radiation at doses of (793.15 and 1733.18 J/cm^2) compare to the control one (GpI). Whereas, an insignificance value was noticed of CK-MB enzymes in the experimental groups exposed to UVA radiation compare to the control one.

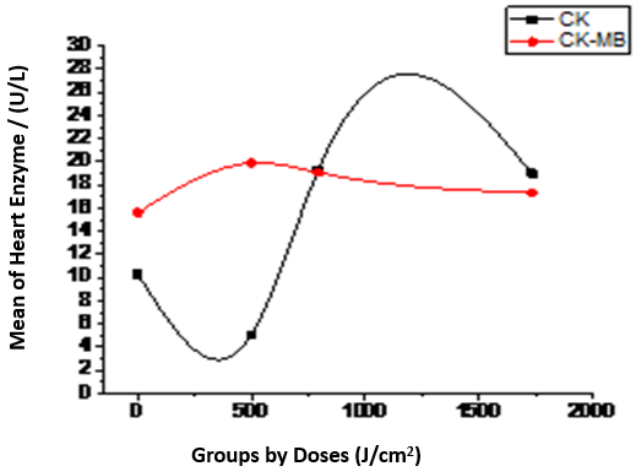

Figure 2: Line Chart distribute the mean value of CK and CK-MB in heart tissue of both control and three exposure groups.

Trace elements evaluation

(Figure 3): illustrated the mean values of the trace element's concentrations (Cr, Ca, Na, Fe, Mg, Cu, Zn, K) in the heart homogenates tissue of both control and three experimental groups exposed to UV-A radiation. The results showed increase of trace elements concentrations (Ca, Cr, Cu, Fe, K, Mg, Na, Zn) in GPIII exposed, while they decrease in GPIV exposured with exception of the magnesium, which increased with increasing the exposure time.

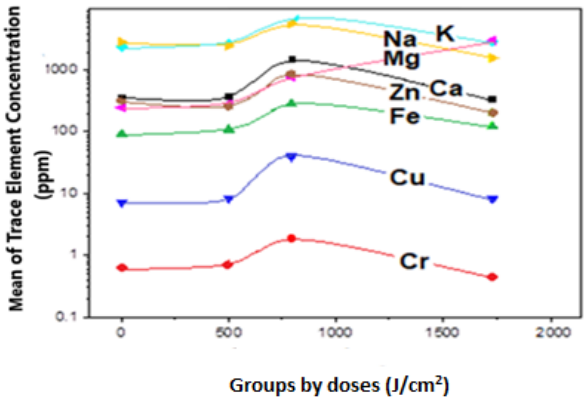

Figure 3: Line Chart illustrate the relationship of the trace element's concentrations in heart tissue.

Light microscopic finding

Paraffin sections were stained with haematoxylin and eosin for morphological changes in a part of right atrium of rat heart tissues. It was noticed the myocardium nuclei stained with deep violet color and pink cytoplasm. The white clear color may be indicted to the vacuolated cytoplasm or edema at the tissue. The rat heart tissue from normal unexposed animal (GPI) showed longitudinal bundle of myofibril cell with dark nuclei and eosinophilic cytoplasm, mild dilation of between bundles and myocardium was seen (Figure 4A). Heart tissue exposed for 17 days (GPII) showed destructive muscle bundles of the heart, beside the disarranged or degenerative myocardium bundle, an interstitial edema was observed, a mild congestive blood vessels between myocardium bundles beside hyperchromatic myofibril nuclei was present as well as necrotic one. (Figure 4B) At 27 days exposed (GPIII) showed the disorganized bundles, beside the regenerative myocardium bundles, a mild interstitial edema, congestive blood vessels between myocardium bundles, and apoptotic myofibril cells were appeared as well as increased necrotic one (Figure 4C). A marked destructive bundle, beside the regenerative myocardium bundle, mild interstitial edema was observed between myocardium bundles and myofibril cells, Myofibril has large dark nuclei with compact cytoplasm and increased necrotic one was shown after 59 days exposure (GPIV) (Figure 4D).

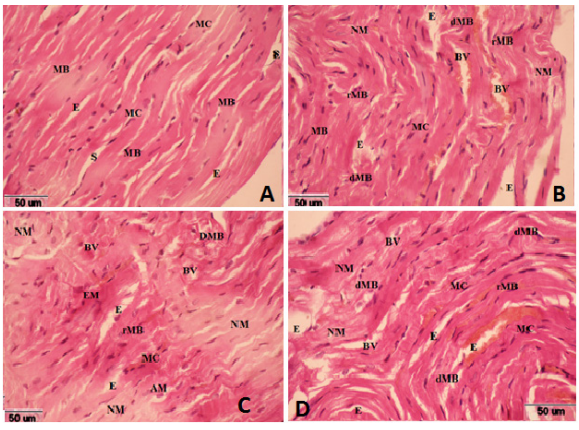

Figure 4: Paraffin sections micrographs of rat heart tissue: A) GpI, show heart muscle cells are longitudinal bundles of myofibril cells with dark nuclei and eosinophilic cytoplasm, mild dilation space between bundles and myocardium cells. B) GPII, show a destructive bundle (DB) of the heart, beside the rearranged myocardium bundle, an interstitial edema, and wild congestive blood vessels between myocardium bundle. Hyperchromatic myofibrl nuclei were appeared as necrotic one. C) GPIII, show a destructive bundle, beside the regenerative myocardium bundle, mild interstitial edema and congestive blood vessels between myocardium bundle. A pyknotic myofibril cells and many necrotic one were noticed. D) GPIV, show distractive myocardium bundle with marked interstitial edema and congestive blood vessels between myocardium bundles and myofibril cells. Myofibril has large dark nuclei with compact cytoplasm and few necrotic one was observed. (Myocardium Bundle (MB), destructive bundle (DB), Myofibril Cells (MC), blood vessels (BV), hyperchromatic myofibril nuclei (MC), Necrotic Myofibril(NM), pyknotic myofibril cells (AM), edema(E)) (H and E stains, Bar 50 µm).

Transmission electron microscopy

The electron microscopy examination visualized the fine structure of the myocardium cells stained by uranyl acetate and lead citrate and the photomicrograph were taken under different magnification to illustrate the changes of longitudinal sections myocardium cell in both control and exposure groups to Ultraviolet Radiation (UVA). There was arrangement of myofibrils associated with nucleus at area of perinuclear mitochondria with varying shape and size of mitochondrion. Intercalated disc Z-band of the cell which arranged in parallel to nucleus and microtubule T tubule lumen contains extracellular matrix material, the sarcoplasmic reticulum and intermediate filaments A-band myofibriles profile were arrangement of thick and thin filaments. (Figure 5A). At 17 days exposed showed myocardial structure appeared as arrangement of myofibrils eccentric nucleolus of irregular nucleus envelope, few changes was seen as decrease of Z bands thickness and mild differentiated myofibriles with short segmented sarcoplasmic reticulum, an enlarged size of mitochondria have dense granules. A mild width of T-tubular, few glycogens invasive to myofibril axis and upper nucleus of the degenerative myofibrils was seen (Figure 5B). The reduction of mitochondrial number and size at the perinuclear mitochondria as well as increased of the atrophied mitochondria was appeared, a shorted dilated Sarcoplasmic Reticulum (SR) along dilated myofibriles. Thin thickness Z bands at transverse regions of the intercalated and marked dilated T-tubule along the disorganized myofibriles were observed after the 27 days of UVA exposed (Figure 5C). The disorganized and atrophied myofibrils with increased a disorganized septa between myofibriles, decreased number of the mitochondria along the disorganized myofibril, atrophied of the perinuclear mitochondria at dark nucleus, presence of short segmented sarcoplasmic reticulum and large lysosomes were noticed after 59 days exposed to UVA radiation (Figure: 5D).

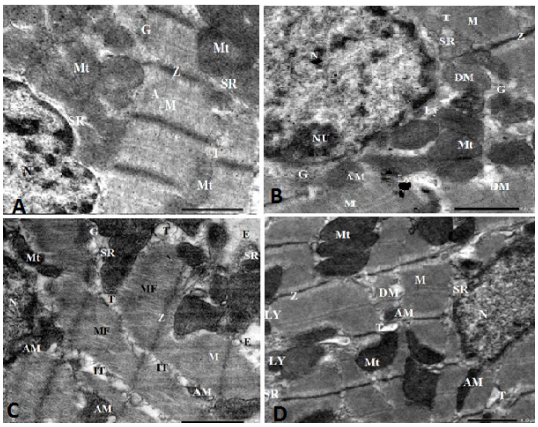

Figure 5: TEM photomicrograph of rat heart:- A) GPI, show myocardial nuclei, perinuclear mitochondria, T-tubule at longitudinal section. Note varying shape and size of mitochondia, T tubule lumen contains extracellular matrix material, A-band (A) overlying a Z band with arrangement of thick and thin filaments myofilaments. B) GPII, show an eccentric nucleolus of irregular nucleus envelope, thin Z bands, mild differentiated myofibril, short segmentated sarcoplasmic reticulum, enlarged size of mitochondria, as well as atrophied one with dense granules, mild width T-tubular with few Glycogen invasive to myofibril axis. C) GPIII, show Destructive and disorganized arrangement of intermediate filaments, thin Z bands and a marked dilated T-tubule. An increase of the atrophied mitochondria and shorted dilated sarcoplasm reticulum along dilated myofilament were seen. D) GPIV, show marked dilated of T-tubule along the disorganized and atrophied myofibrils with disorganized septa between myoflament. An atrophied perinuclear mitochondria, dark nucleus and, short segmented sarcoplasmic reticulum, and large lysosomes were noticed. (myofibril (M), intermediate filaments (MF), Z bands (Z), T-tubule (T), Nucleus (N), Mitochondria (Mt), Sarcoplasmic Reticulum (SR), lysosomes (LY), Glycogen (G), (lead citrate and uranyle acetate stains, Bar=illustrate for each image).

The morphometric finding

1- Surface area of mitochondria

Table 2 distributed the mitochondria surface area (MS) in the four studied groups. The mean level in control (GPI) was (1652.30±160), (GPII) exposed for 17 days was (1043.56±264.89), (GPIII) exposed for 27 days (1041.37±253.11), and GP IV exposed for 59 days was (292.71±247.92). There was a high significant decrease in three groups exposed to UVA radiation as compared to the control group (GPI) P≤ 0.000001. Whereas a high statistical significant decrease

in GPIV was noticed in comparison to the GPII & GPIII.

Table 2: Distribute the morphometry analysis of the myocardical cells for each groups.

Groups/ Parameters	Control (GPI)	17 days (GPII)	27 days (GPIII)	59 days (GPIV)	F	P
(MS) (Mean±S.D)	1652.30±160.60	1043.56±264.89	1041.37±253.11	292.71±247.92	55.9261	<0.001*
T -tubular (Mean±S.D)	164.59±16.63	114.45±21.49	127.87±22.33	138.84±20.34	10.9173	<0.001*
Z –bands (Mean±S.D)	69.29±8.81	63.37±11.78	40.97±7.30	40.78±27.5	27.1592	<0.001*

2. T- Tubular wide

The mean level of the T- Tubular wide in continuously three exposed groups to UVA radiation and unexposed control group was recorded in Table 2. (GP I) was (164.5 ± 16.63), (GPII) exposed for 17 days was (114.45 ± 21.49), (GPIII) exposed for 27 days (127.87 ± 22.33), and (GPIV) exposed for 59 days was (138.84 ± 20.43). There was a high significant decrease of the T- tubular wide in three exposed groups to UVA radiation as compared to the control group GPI ($p \leq 0.001$). While a significant increase tubular wide ($p>0.001$) was increased with increased the dose exposure to the UVA respectively.

3- Z- bands Thickness

Also, Table 2 distributed the mean value of the Z- bands Thickness in the studied groups. The GPI was (69.29 ± 8.81), GPII exposed for 17 days was (63.37 ± 11.78), GP III exposed for 27 days (40.97 ± 7.30), and GPIV exposed for 59 days was (40.78 ± 27.5). There was a high significant decrease in all groups exposed to UVA radiation as compared to the control group GPI ($p \leq 0.001$).

DISCUSSION

It is known that the sun was essentially source of UVR, the UVR is 5% of the solar terrestrial radiation and the major source of human exposure to UVR, but now the artificial sources the opportunity for additional exposure has increased. Ultraviolet radiation is the light radiation in the electromagnetic spectrum between wavelengths λ=100 nm and 400 nm, which is subdivided into UVC: 100-280 nm, UVB: 280-315 nm, and UVA: 315-400 nm [22]. The harmful effects of UV resulting from natural sunlight and artificial therapeutic lamps are a significant concern for human health [23]. The present work aimed to evaluate the biological effects of the artificial lamps of UVA radiation on the heart tissue under the continuously exposure of UVA radiation on the whole body of experimental animals.

Trace elements are dietary minerals that are (less than 0.01 percent) of the organism's mass in very minute amounts. They are useful for proper growth, production, conservation and restoration of the organism's health [16]. The present results revealed that there were a significant increasing of trace elements concentrations (Ca, Cr, Cu, Fe, K, Na, Zn) After 27 days for dose (793.15J/cm^2) exposure to UVA radiation were compared with unexposed control group. There is an exception of the magnesium concentration which was increase after 17 days for dose (500J/cm^2). A significant increase of Mg was recorded after 27 and 59 days for doses (793.15 and 1733.18 J/cm^2) exposure on UVA-radiation. This result revealed mild heart disorder caused by continuous exposure to high dose of UVA radiation. This is confirmed that the roles of Mg and Cu in heart are the most common minerals that protect heart from stress and contribute to stabilize cardiovascular function. The increase of Mg element at the high doses of UVA (793.15 and 1733.18 J/cm^2) revealed that the Mg is increased through the body need more energy exposed and oxidation to the free radical induced by the UVA radiation. Similarly the study found a progressive increase in serum manganese levels corresponding to the severity of the disease in male patients with and without CHD [24]. The investigators reported a similar relationship for copper and an opposite relationship for magnesium. The increasing of calcium and chromium associated with the increased of the contracted heart muscle to prevent the attitude of UVA radiation at dose of (793.15 & 1733.18J/cm^2). Moreover, there are increased of iron element was observed at the high doses of UVA radiation in groups exposed to the continuously exposure for accumulative energy equal 1733.18 J/cm^2, which lead to mild heart disorder and produced disorganized. Iron has role in transport oxygen to muscular cell of heart, this finding related to

the iron have essential functions for transport oxygen from the lungs to various parts of the body [25].

As regard to the hematological parameters which are used as accurate markers of the health status of rats environmental response and physiological changes after various exposure conditions [26]. The present results of blood count revealed no changes of the Hemoglobin (Hb) and Red Blood Cell (RBC) count in continuous exposure of UVA (500, 793.15 and 1733.18 J/cm^2) doses respectively. Whereas an increased exposure time following with significant increase of White Blood Cell (WBC) and Platelets (PLT) exposure to UVA. The increase of WBCs induced due to increase immune response of animals and enhanced defense against the UVA exposed. In contrast, there were decrease of WBCs and PLT following the increase of the accumulative energy of UVA exposed 793.15 & 1733.18 J/cm^2 in group (III and IV) respectively. This result revealed the UVA radiation may be caused mild destruction of the immune response of animal associated with increased exposure to UVA radiation. The other study reported that the radiation effects are mainly exerted by cell regeneration, apoptosis, and lymph hematopoietic cell redistribution, depending on the dosage and dose rate or these occur due to the rest of the heart tissue for accumulative iron and chromium to cover the oxygen consumption for repair its muscular contractile [25]. Similarly to the our results, the fact of UVA radiation, like other forms of rats exposed to radiation is efficient on hematological parameters for increasing WBC and PLT counts [26]. Some findings reported gamma ray doses induced a significant decrease ($p \leq 0.05$) in the percentage of RBCs, Hb and Ht. Elevation in MCV and MCH and decreased of platelets and WBCs and lymphocytes count with increased exposure to rats [27].

In addition, the present results of heart enzymes analysis (CK-MB) revealed insignificant change in groups in contrast to creatine kinase of all body (CK), a significant decrease at (Gp II) exposure to (500 J/cm^2) doses of UVA. And significant increases in Gps (III and IV) exposed to (793.15 and 1733.18J/cm^2) doses these finding revealed that the heart muscle was affected by the high level of radiation. For confirming to our result, cardiac biomarkers are proteins that escape out of injured myocardial cells resulting in elevated levels in blood; elevated creatinine kinase (CK-MB) as well as troponin I was used to assess cardiac injury [28]. Also, studies on survivors of Chernobyl and Hiroshima reported a risk of heart disease elevated after radiation exposure, As well as radiotherapy of women exposed for treated the breast cancer [29].

Moreover, the histopathological changes in the heart tissue by light microscopic examination revealed mild to marked histological changes induced due to high doses accumulative in the animal body through long time exposure to UVA radiation. A mild destructive bundle and wild congestive blood vessels was noticed between myocardium after exposure to accumulative doses (500 J/cm^2) of (GpII). The hyperchromatic myocyte nuclei and pyknotic myocytes were observed after exposed to 27 days (GpIII) beside few regenerative myocardium bundles. A mild interstitial edema and congestive blood vessels were seen. These changes were followed by increased necrotic and destructive myocardial bundles with dark nuclei myocytes and compact cytoplasm due to increase of accumulative doses (1733.18J/cm^2) (GPIV) of UVA radiation. This histopathological changes including congestion of myocardial blood vessels confirm the biochemical results of the mild elevated of CK_MB) in blood and heart tissue. In agreement to this result, Heart tissue from rat animals exposed to γ radiation (6 Gy) revealed congestion of myocardial blood vessels and intramuscular hemorrhage. Also, focal myocarditis, inflammatory cell infiltration between cardiac myocytes and intramuscular edema was observed. The cardiovascular effects of low-dose ionizing radiation lead to determine and rekind debate over the magnitude of the threshold dose [30]. It has been suggested that doses of 1 Gy or lower could result in increased incidence of heart disease [31].

Continuously, the results of fine ultra-structure of heart cell exposed to continuously UVA exposure revealed the fine myocardial structure was appeared as myofibrils arrangement with eccentric nucleolus and irregular nucleus envelope. Few glycogens invasive to myofibril axis and upper nucleus of the degenerative myofibrile were seen. This mild change was observed after low doses (500 J/cm^2).of UVA radiation. A confirmation to this result, the incidence of cardiovascular disease was increased in populations that have been exposed to low doses of ionizing radiation [32]. A mild disorganized of the myofibrile, shorted segmentation of sarcoplasmic reticulum, and enlarged size of mitochondria as well as few atrophied one was noticed. These results confirmed the elevated increased of the magnesium in heart tissue. And similarity of Magnesium is necessary for basic mitochondrial functions, including ATP synthesis, Magnesium in the mitochondria present as a complex with ATP and as a component of membranes and nucleic acids [16]. A Study of magnesium showed mitochondrial swelling and altered ultrastructure in muscle taken from magnesium-deficient animals [33]. Hence, that the magnesium has a fundamental role of oxidative stress and

function of muscle mitochondria [34]. However, a mild thin of Z-band and width T-tubular followed by marked edema and dilation of interstitial tissues between myofibrils was appeared after exposure to UVA following accumulative doses equal (793.15 J/cm^2) through 27 days animal exposed. The present work revealed the atrophy and disorganizes arrangement of intermediate filaments, as a significant decrease of Z-bands at transverse regions of the intercalated disks compared to the other groups (I and II). A dilated T-tubule width along the disorganized myofilament with a significant decreased (p=0.001) compared to the control group, with the decreased number and atrophied mitochondria along the disorganized myofibril, this indexed a significantly decreased of mitochondria surface (P=0.001), as well as the atrophy of the perinuclear mitochondria with dark nucleus was noticed. A short segmented sarcoplasmic reticulum and large lysosomes was observed after exposure to UVA high doses (1733.18 J/cm^2) for 59 days. These results evaluated the effect of the high doses exposure to the UVA radiation. So the present work was confirmed the radiation induced cardiovascular injury has not been completely defined. Some reports show that infiltration of inflammatory cells as reduction of mitochondria size play a key in chronic oxidative stress, collagen deposition, and changes in the normal structure of the heart tissue to fibrosis and hypertrophy, and concluded that damage seems to be related to effects of radiation dose and volume of irradiated detected to heart exposure [35,36]. The cardiac pathology including coronary artery disease, myocardial fibrosis, pericardial disease, arrhythmias, and valvar abnormalities were induced under the radiation therapy [37].

CONCLUSION

Finally: it could be concluded that the continuously exposed to the UVA at long time caused injury in the heart tissue. The study revealed many foci of increase the trace element level in the heart tissue as Mg and Ca and cardiac enzyme (CK-MB). The histopathological injury of the heart tissue was noticed wild congestive blood vessels between myocardium, hyperchromatic and pyknotic myofibril nuclei. Also, the fine structure of the myocytes revealed disorganized of the mitochondria and myofibril bands, that the high doses of UVA radiation induce long-lasting changes in heart tissues through the oxidative metabolism of mitochondria. In other hand, the beneficial effects of sunlight exposure regulate the body activities through the UVR-induced cells and mediators, including vitamin D3, under this role of the sunlight UVR rates; it might be contributed many study to understand the better time effect of UVA radiation.

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