Study of the effect of inhalation of secondhand smoke on certain tissues, chemical tests, and complete blood picture in male white rats

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Abstract

Inhalation of secondhand smoke causes significant damage to the body, which may harm the occurrence of lung infections and poisoning of some organs of the body. This study aimed to assess histological and hematological morphological changes and the effect of smoking cigarettes on red and white blood cells in white rats inhaled for acute doses for 3, 12, and 20 hours. Rats were exposed to cigarette smoke for periods from 3 to 24 hours. Most cigarette smoke was inhaled through the respiratory tract in the courtroom containing air openings for breathing and preventing choking of rats. Chemical techniques were employed to analyze liver and kidney enzymes in blood and tissue samples to study tissue changes. The findings revealed that acute exposure to smoked cigarettes led to immobility and impaired movement in rats. The analysis results indicated notable alterations in the liver and kidney tissues, particularly in the lungs. The study demonstrated elevated levels of liver and kidney enzymes in the various rat blood groups, suggesting dysfunction in the liver and kidneys. These heightened enzyme levels were statistically significant ($p < 0.05$). Moreover, the study revealed the breakdown of red blood cells and reduced hemoglobin levels upon acute inhalation of cigarette smoke. The toxic effects of smoke inhalation were observed in the blood cell count, indicating the occurrence of inflammation, along with a substantial increase in platelet count, implying an increased risk of blood clot formation. Ultimately, exposure to secondhand smoke results in poisoning, suffocation, damage to vital organs, loss of functionality, and heightened contamination of living organisms. Therefore, it is crucial to avoid exposure to secondhand smoke.

1. Introduction

Secondhand smoke is a problem that affects society, especially in public places, especially those that are confined or closed. [3]-[1] Smoking affects public health and human health [4] and secondhand smoke from other tobacco causes respiratory health problems for men, women, and children.[5],[4] With the increasing number of large-scale smokers in our daily lives, pollution is producing negative smoke for the environment. Secondhand smoke inhalation results in damage to body tissues and respiratory sensitivity, indoor tobacco smoke cannot be determined and the level of chemicals

emitted by smoke cigarettes cannot be measured.[6]

Secondhand smoke causes cancerous tumors such as lung cancer for non-smokers[8]-[6]. Studies report that secondhand smoke increases the chance of lung cancer by 20–30%[7],[6] and secondhand smoke may cause some cancers, such as oral, pharyngeal, and breast cancers,[10][9]. Some studies report that secondhand smoke causes cardiovascular and heart disease as a result of smoke inhaled from smoke, and may result in inhalation of secondhand smoke to develop strokes. [13]-[11] Studies have also shown that secondhand smoke and its harms during pregnancy increase the risk of stillbirth by 23% and the risk of having a baby with physical abnormalities by 13%. [18]-[14] Several studies have confirmed that secondhand smoke causes respiratory health damage due to smoke inhalation that affects anaphylaxis of the people and bronchi and can cause secondhand smoke exposure to tissue injury in children.[22]-[19] A study of the health damage of passive smoke to the body affects women and harms the miscarriage of pregnancy or fetal deformation. [23]

This study aimed to determine the effect of smoke cigarettes on the whole blood, liver, lung and brain tissues of rats, and to assess the level of liver and kidney enzymes and blood glucose in rats exposed to time periods of 3, 12 and 20 hours of acute cigarette doses in special boxes.

2. Materials and methods

1. 2 animals used in the experiment

In this study, 18 male rats weighing 250 to 300 grams were used, and these rats underwent a group presence under trial conditions before the start of any action or application of any nutritional effect, as they were fed a normal diet.

2.2 experiment Design

The rats were divided into four groups living in equal conditions in terms of temperature and type of food and these groups are as follows:

The first group, which is the control group and includes six rats, was given food without exposure to smoke inhalation.

The acute dose group consisted of six rats, who were fed a normal diet, with direct smoke inhalation for 3 hours.

Group III: Acute dose group of six rats fed on a regular diet, with direct smoke inhalation for 12 hours.

Group IV: Acute dose group of six rats fed on a regular diet, with direct smoke inhalation for 20 hours at a time.

Smoke cigarettes were lit in private, tightly controlled rooms with simple ventilation holes, rats were placed in these rooms, these smoke cars were lit, and rats were exposed to direct inhalation during different periods.

3.2 Collection of samples

After subjecting the rats to direct inhalation for durations of 3, 12, and 20 hours, they were anesthetized and dissected. Tissue samples were extracted from specific organs, including the liver,

lungs, kidneys, and brain. Blood samples were collected via a cardiac puncture, with one tube containing an anticoagulant substance, EDTA, and another tube devoid of any anticoagulant. The latter tube was allowed to clot before both tubes were centrifuged at 1000 rotations per minute for five minutes. Following this process, the serum was separated and preserved for subsequent chemical tests and a complete blood picture analysis.

4.2 Biochemistry tests

Blood sugar, urea and creatinine in serum were measured using a color measurement method using a commercial tool kit. The study included measuring the level of aspartate aminotransferase (ALT) and aspartate aminotransferase (AST) through a kinetic method using a commercial group using enzymatic chromatography methods using commercial instruments.

5.2 histological examination

Following the autopsy, tissue samples from the liver, kidney, lung, and brain were collected. These samples were then immersed in a 10% formalin solution for 24 hours to facilitate fixation. Subsequently, the samples were rinsed with water to eliminate the effects of formalin on the tissues. Dehydration was carried out by immersing the samples in a series of progressively concentrated alcohol solutions (50%, 70%, 90%, 100%, and 100%). To aid in the removal of alcohol and ensure transparency, the samples were placed in xylene. The next steps involved saturation, where the tissues were infiltrated, followed by embedding in paraffin wax. Microtome slicing was performed to obtain thin sections of approximately 5 microns in thickness. The sections were then stained with hematoxylin and eosin for microscopic examination, and several images were captured using a digital camera.

6.2 Statistical analysis

The statistical analysis of the biochemistry results was performed using the Graph Pad prism 6.01 program. The data were expressed on standard errors and a T-test was used to compare study groups. The P values showed significant differences between the study groups ($P < 0.05$).

3. Results

1.3 relative and absolute weights of male white rats

The absolute and relative weight of the liver, kidney, heart, brain, and lungs in Table (**1**) showed no significant weight differences for the groups treated with smoking cigarettes, absolute and relative liver weight gradually decreased. but these weight decreases are not significant (*P>0.05*), the absolute and relative weight of the heart did not change significantly

until the time of 12 hours when the weight increased compared to the control group.

Table (1) liver, kidney, heart and lung weights relative and absolute bodies of rats exposed to acute smoke doses in 3, 12 and 20 hours

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Organs	weight	Control	3h	12 hours	20 hours
Liver	Absolute	5.76 ± 0.52	5.56 ±1.20	5.17 ±0.78	5.26 ±0.82
	relative	2.99 ± 0.21	3.28 ± 0.58	2.74 ±0.33	2.78 ± 0.2
Kidney	Absolute	0.68 ± 0.05	0.79 ± 0.13	0.77 ±0.01	0.68 ± 0.06
	relative	0.36 ± 0.04	0.46 ± 0.04	0.41 ±0.02	0.36 ±0.04
Lung	Absolute	1.51 ± 0.06	1.40 ± 0.08	2.20 ±0.14	0.93 ±0.08
	Relative	0.27 ± 0.3	0.25 ± 0.04	0.38 ±0.04	0.16 ±0.02
Brain	Absolute	1.07 ± 0.07	1.32 ±0.18	1.17 ±0.21	1.04 ±0.20
	relative	0.19 ± 0.08	0.24 ± 0.17	0.20 ±0.08	0.18 ±0.08

3.2 sugar level in male rats

The values of the blood glucose level as in Figure (1) were a significant increase in the blood glucose level of the passive smoke group for acute doses (*P=0.0048*) in 12 hours, and the sugar values for the acute dose group ranged in 24 hours, compared to control cases. A significant difference (*P<0.0007*) was found between acute doses of secondhand smoke and blood glucose control.

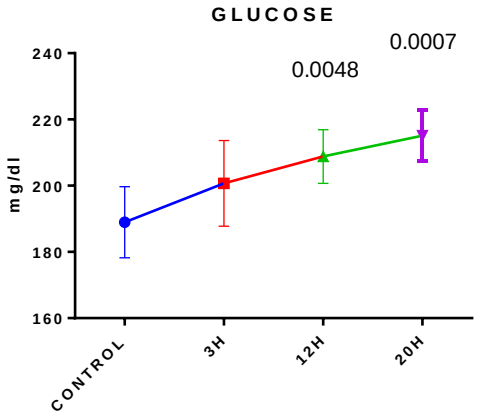

Figure (1) values blood sugar levels in male rats inhaling smoke cigarette doses over the time of 3, 12 and 20 hours.

4.2 whole blood in male rats

The blood hemoglobin levels in the rat population exhibited a significant decrease compared to the control group. The reduction in hemoglobin values was observed to increase with longer durations of cigarette smoke inhalation, as indicated by the values in the form of (2-B). Additionally, this study revealed a decrease in red blood cell count, represented by the values in the form of (2-B), along with an increase in cell stacking, demonstrated by the values in the form of (2-D). The mean corpuscular volume (MCV) showed a spherical size alteration, denoted as (2-C), while the mean corpuscular hemoglobin (MCH) displayed changes, denoted as (2-F). Furthermore, the average hemoglobin mass, represented as (2-E), demonstrated significant differences ($P<0.005$) between the rat groups exposed to acute doses of smoke for 3, 12, and 20 hours, in comparison to the control group.

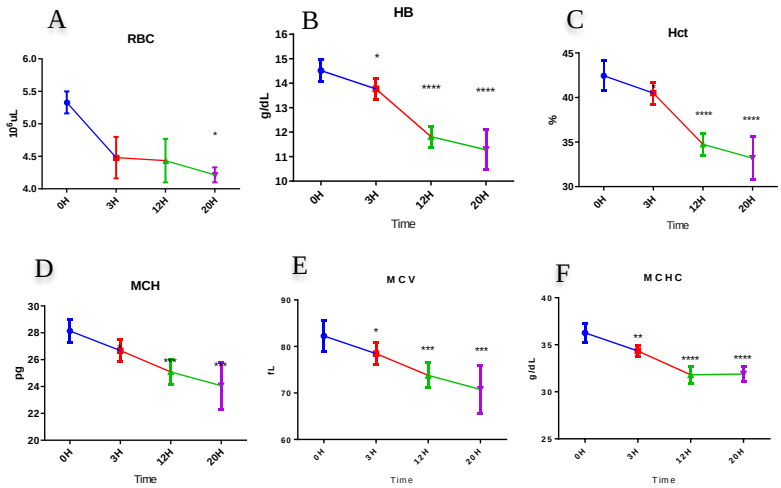

Figure (2) values the levels of hemoglobin (a), red blood cells (B), stacked cell size (C), middle spherical size (D), mean hemoglobin (E) and average hemoglobin (F) mass in male rats inhaled smoke cigarette doses over the time period 3, 12 and 20 hours.

The number of white blood cells in male rats also varied significantly as a result of inhaling smoke cigarettes as shown in Figure (3), and there was a significant

increase (*P>0.05*) in the number of white blood cells for acute doses in 12 and 20 hours compared to the control group.

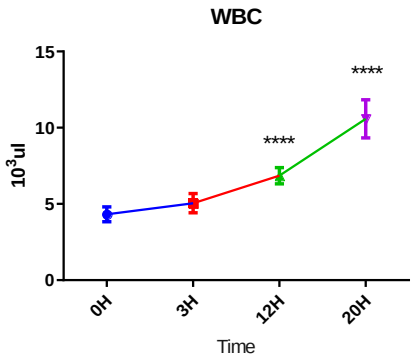

Figure (3) number of white blood cells in male rats inhaled doses of smoke cigarettes during the time period of 3, 12 and 20 hours.

The number of platelets also varied significantly as a result of inhalation of smoke cigarettes as in Figure (4), and there was a significant increase (*P>0.05*) of platelet cells for acute doses in 12 and 20 hours compared to the control group.

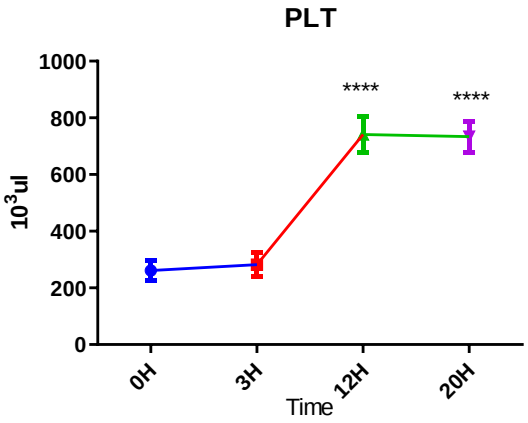

Figure (4) number of platelets in male rats inhaled smoke cigarette doses over the 3, 12 and 20 hour time.

5.2 liver enzyme level in male rats

The GPT enzyme values were increased in form (5-a) and GOTK values in form (5-B) in male white rats inhaling smoke cigarettes for periods of time from 3 hours to 20 hours and the increase in enzymes was a significant upward increase (*P>0.05*) compared to the control group.

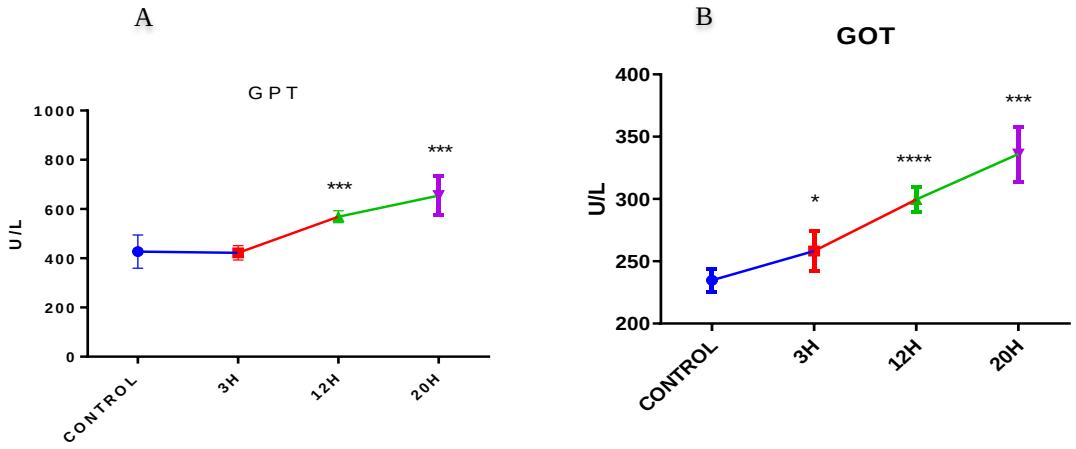

Figure (5) values the levels of the GPT enzyme values as in Figure (a) and GOT enzyme values as in form (B) in male rats inhaling smoke cigarette doses over the 3, 12 and 20-hour time period.

6.2 kidney level function in male rats

The levels of kidney function in male rats were evaluated in this study. The blood creatinine values, depicted in Figure (6-a), showed a non-significant increase (P>0.05) in the groups exposed to cigarette smoke inhalation compared to the control group. On the other hand, the blood urea values, illustrated in Figure (6-B), exhibited a significant increase (P=0.0011) in the acute group, indicating a notable difference between the acute dose and the control group in terms of blood urea levels.

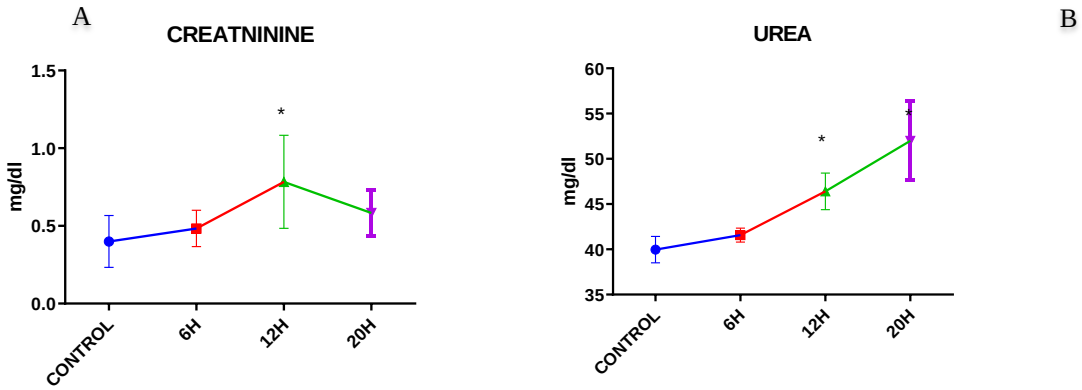

Figure (6) levels of creatinine (a) and urea values (B) in male rats inhaled for smoke cigarette doses over the 3, 12, and 20-hour time period.

7.2 effect of secondhand smoke cigarettes on kidney tissue

During the microscopic examination of kidney sections from male white rats exposed to cigarette smoke for durations ranging from 3 to 20 hours, notable findings were observed. The results revealed a combination of structural changes in the glomeruli, along with abnormalities in certain regions of the inner membrane of renal tubules. The renal tubules appeared dilated, and the renal tissue exhibited deformations, as depicted in Figure (7). In the histological sections of the kidneys from the 12-hour group, illustrated as Figure (B-7), a significant contraction in the glomerular parts was observed, accompanied by evident expansion of the renal tubules. In addition, signs of cell death were noted in the 20-hour group, along with evident degradation in the lining of the tubules. Furthermore, the presence of a collection of red blood cells and damage to the overall rounded structure of the kidneys were also observed, as shown in Figure (C-7).

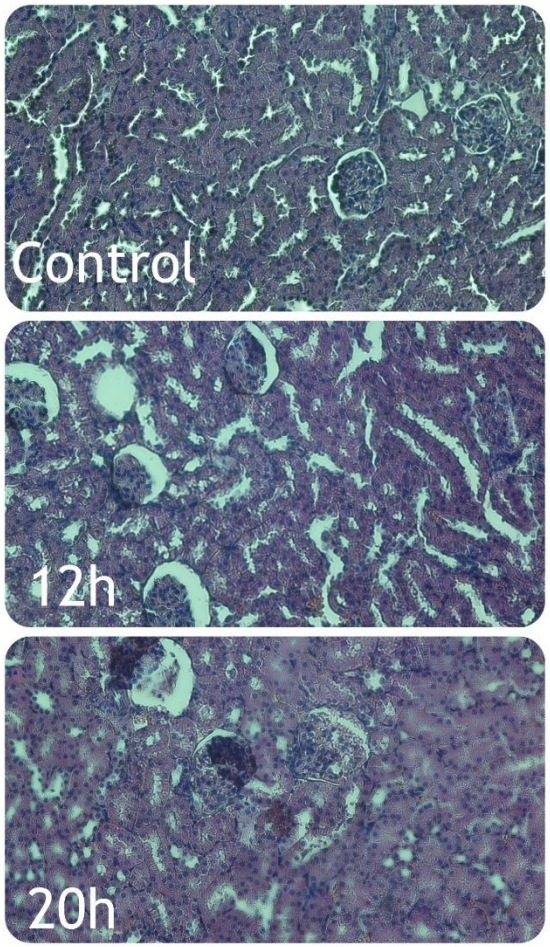

Figure (7) renal histogram for male control rats (a), renal histogram for male rats taking doses of acute smoke cigarettes at 12 hours (B), renal histogram for male rats taking doses of acute smoke cigarettes at 20 hours (C) time.

8.2 effect of secondhand smoke cigarettes on liver tissue

Liver tissue in the 3- to 20-hour group has shown little expansion of the central vein with some endothelial decomposition and death of some liver cells with the observed conservative radial structure in this group (B-8). while the increase in exposure time of rats to smoke inhalation showed complete damage to the radial structure of the liver sections, with the appearance of clear blood clusters in the central vein due to bleeding of red blood cells, in addition to the presence of cell death of liver cells spread around the central vein (C-8).

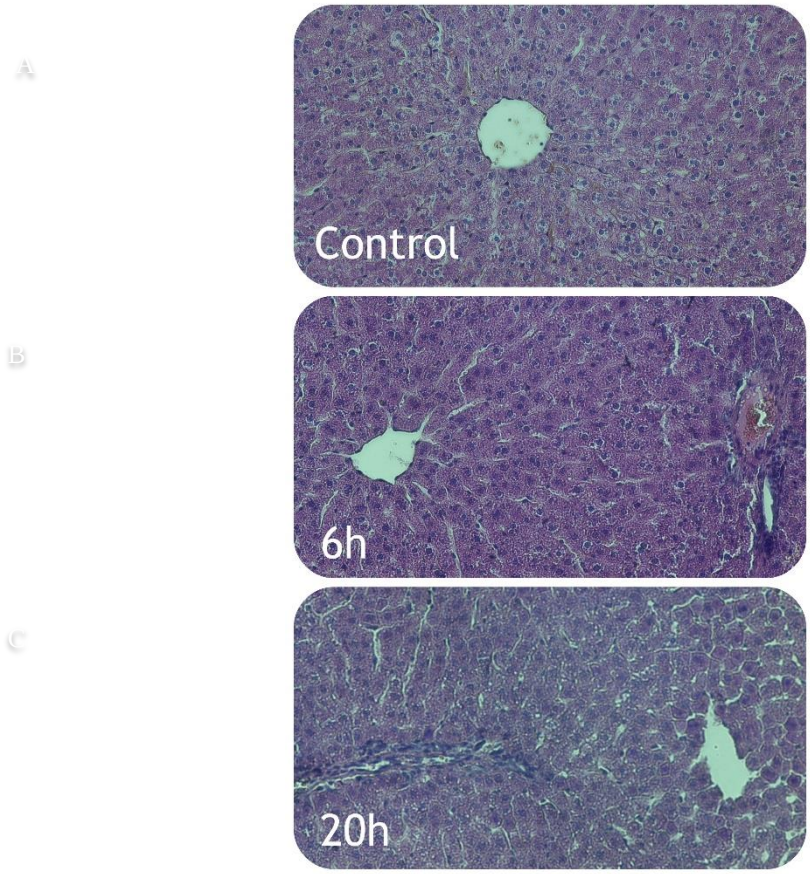

Figure (8) liver tissue for male control rats (A), liver histogram for male rats administered for doses of acute smoke cigarettes at 12 hours (B) time, liver histogram for male rats administered for doses of acute smoke cigarettes at 20 hours (C) time.

9.2 effect of secondhand smoke cigarettes on brain tissue

Histological changes of neuromodulators in male white rats inhaling smoke cigarettes for periods from 3 hours to 20 hours as shown (9), and the male white rat group with acute doses in 12 hours showed some changes in the tissue cell forms of the nervous system. The histological sections showed some shrinkage in the cells and few clusters in the form of masses of neurons (B-9). Tissue sections of white rats ingested smoke cigarettes in 20 hours showed changes in the forms of neurons, as well as a decrease in cell size, and this decrease may be the beginning of atrophy of neurons as the form (C-9).

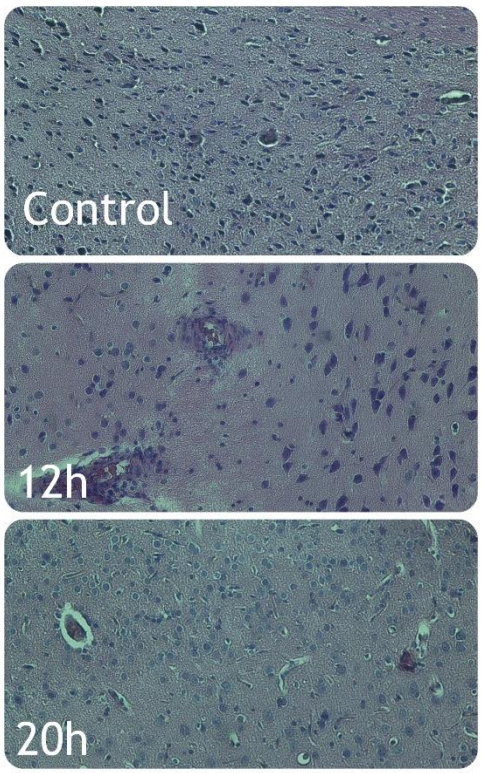

Figure (9) Brain tissue section for male control rats (a), brain tissue section for male rats taking doses of acute smoke cigarettes in 12 hours (B), brain tissue section for male rats taking doses of acute smoke cigarettes in 20 hours (C).

10.2 effect of secondhand smoke cigarettes on lung tissue

Tissue sections in the lung of male rats exposed to acute inhalation showed clear changes in the histological shape of the lung due to the density of smoke cigarettes as well as expansion of the trachea tissue, which explains the presence of bleeding as in the figure (B-10), the expansion of the air ducts and the increase in the volume of the air sacs, which indicates emphysema or destruction of the air sacs in the acute doses of smoke cigarettes, as in the form (C-10).

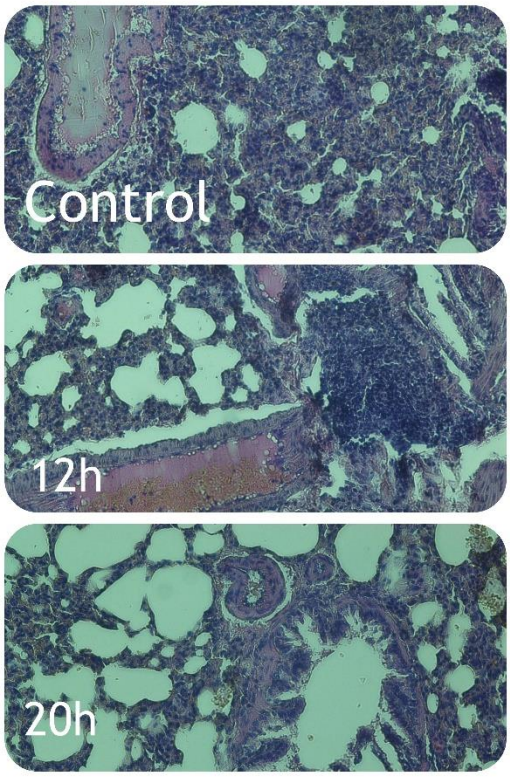

Figure (9) Lung tissue section of male control rats (a), lung tissue section of male rats administered for doses of acute smoke cigarettes in 12 hours (B), lung tissue section of male rats administered for doses of acute smoke cigarettes in 20 hours (C).

4. Discussion

The results showed that exposure to acute doses of smoke cigarettes at 12 or 24 hours of dose may cause disturbances in rat activity, and the rats were observed to be unable to move due to the amount of smoke that affected the functioning of the nervous system of the rats .[25] [24] exposure to smoke has been found to cause damage to the active behavior of rats, and the cause of inactivity and laziness of rats is due to damage to nerve cells and some vital organs of rats or as a result of the decomposition and necrosis of the neurons of rats, and as a result of changes and damage of oxidative substances due to free radicals.

Exposure to high doses of smoke cigarettes has also been found to cause a slight decrease in body weight, a result consistent with his study[27],[26] this effect on body weight, possibly due to reduced lunch intake and loss of appetite.

Exposure to acute doses of smoke cigarettes causes many harmful to human health, especially the nervous system, as well as affects some organs

such as the liver, kidneys and others .[31]-[28] the results of histological tests have shown the presence of changes in cell forms of liver, kidney, lung and brain tissue, especially in acute doses and there is a change in cell forms, the organ most sensitive to the toxicity of acute doses of smoke cigarettes is the total, and this increase in the concentration of acute doses of smoke cigarettes can cause the accumulation of chemical particles in the kidney tissue during the salt disposal and urination process. the total tissue sections of the inhaled animals doses of smoke cigarettes sharp for the presence of large changes in the kidney tissue represented by deformation of renal tissue and clumps in the glomeruli and sclerosis in the renal tubules, and the appearance of red blood cells spread in the renal tissue that appeared damaged, using doses with a sharp concentration of smoke cigarettes for short periods, this leads to changes in the composition of the kidney tissue and abnormal changes, and can cause physiological changes in the kidneys, which leads to damage to distant and nearby renal tubules and the Bowman wallet, in addition to the fact that these changes can cause nephrotoxicities in the kidneys as a result of the effect of high concentrations of smoke cigarettes .[32] several research has stated that exposure to inhalation of secondhand smoke cigarettes leads to noticeable pathological changes in the organs of the body, especially the kidneys being one of the most exposed organs. research has also indicated severe kidney failure, kidney tissue damage and decomposition, as well as death to their cells due to high concentrations.[37]-[33]

The current study also showed elevated levels of liver enzymes and liver function enzymes in rats exposed to acute doses of cigarette smoke, which agrees with the results of many studies showing disturbances in liver and kidney functions in the blood due to inhalation of concentrated smoke at high density [38]–[40]. This increase in liver and kidney functions may be due to cell damage or inflammation caused by acute doses, and this disruption in cells can lead to loss of vital functions .

Elevated percentages of dead cells and shrinkage in the sizes of liver and kidney cells were also observed after exposure to inhalation of high doses of smoke, and this result agreed with a study in which they observed increased liver enzyme levels in

rats exposed to cigarette smoke. The reason was attributed to liver cell damage.

5. Conclusions

We can conclude from this current study that exposure to secondhand cigarette smoke causes many negative effects on the body's organs and perhaps a decrease in blood cell damage and may cause disturbances in liver and kidney enzyme production. Exposure to large amounts of cigarette smoke causes destruction of the lungs and reduces respiratory efficiency. Inhaling secondhand cigarette smoke causes harm to the central nervous system in non-smokers.

6. Recommendations

This study recommends avoiding the negative effects of secondhand cigarette smoke on health, as the chemical compounds emitted from cigarette smoke interact with toxic substances which accumulate in parts of the body like hair and skin and can be inhaled, thus causing damage to vital organs of the body. Therefore, all age groups should avoid smoking areas to prevent harm.

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