

## The effects of Towers Electromagnetic on White Mice Thyroid Gland: an Histological Study

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### Abstract:

The study designed to investigated the effects of towers electromagnetic radiation on the white mice thyroid gland histological structures and some physiological function after exposed to radiation. Twenty male, white mice were used as experimental model and divided into 2 groups. Group A and group B, each comprised of 10 mice and acted as control and treated group respectively. The histological features of the control group revealed normal structures. While, cellular proliferation accumulated between the high aggregations of small follicles, a lot of blood congestion in deferent locations of thyroid parenchyma, acute degenerations and aggregations of inflammatory cells, necrosis, and blood congestion were the prominent histopathological changes in treated group. Additionally, to the absence of lined epithelial layer of the internal surface of thyroid follicles in many locations revealing prominent vacuoles. The biochemical investigation revealed significant increase in the levels of T3 and T4 in the treated group in compare to control group that revealed normal levels, In conclusion, the results of this study approved that tower radiation treated mice group revealed both biochemical and histopathological changes of the thyroid gland. The authors recommend to do more future studies to investigate the other side effects of tower electromagnetic radiation on body organs,

### Introduction:

The electromagnetic radiation has the cause of electric currents in conductive media that able to create sparks (electrical arcs), the exceeds voltage lead to destruction the voltage, which surrounding medium (e.g., air at 3.0 MV/m), [1] These can deliver an electric shock to persons or animals. For example, the radio emissions from transmission lines have occasionally caused shocks to construction workers from nearby equipment, causing OSHA to establish standards for proper handling [2].

The thyroid gland situation on the frontal aspect of the trachea under the larynx, exactly on the

lateral surface of the six rings of the trachea[3]. The thyroid gland considers as an endocrine gland responsible for hormonal secretion, which includes thyroglobulin, triiodothyronine. The thyroxin has played a role in metabolic activity in the animal. The gland is composed of many different follicles, including (small, medium, and large) the follicles are lining by tall cells [4].

The follicles consider the functional and structural unit of the thyroid gland; the follicle was composed of a prominent wall compose of follicular cells that responsible for the secretion of thyroxin and clear materials called intrafollicular colloid [4]. Different sizes and shapes of follicles lined by height follicular epithelia, which have deferent in height that depending on functional role, the thyroid gland was surrounded by connective tissue capsule [1]. The thyroid can store and secret hormones, which include thyroxin and triiodothyronine. Thyroxin hormone is a dominant quantity hormone produced from the thyroid gland, while the triiodothyronine, which has more activity and produces from peripheral deiodination of thyroxin [5] .

Many previous studies on the radiation effects on the body's health noted many histological changes when exposed to radiation for a long period and recurrent exposure. The radiation leads to a prominent effect on the tissue structures of the organs in the body and cells [6]

The use of radiation in the treatment of pathological conditions in child and adult patients that have many side effects after the treated time of ionizing radiation, The ionized Radiation noted effects which lead to an effect on the blood vessels and causes injuries in the wall of the vessel because of increase in the contrast overloaded[7]. In the environment, when exposed to scattered natural radiation that has main effects on the metabolism rate in the body during daily work. The accumulated dose of ionizing radiation is a harmful effect. It plays as an act as a carcinogenic effects on the cells and tissues of the organs in the human body [8].

#### **Aim of study:**

The present study conducted to investigate the gross and microscopic structures of thyroid gland of white mice after exposure to the deferent level of electromagnetic waves.

#### **Material and methods:**

Twenty animals were collected from the center. The animals were placed in the animal house under appropriate environmental conditions, after ensuring that they were free from clinical signs of disease, the animals were distributed into two groups in plastic cages, group A and group B, each group composed of ten healthy make white mice. Group A was considered as control while group B was exposed to radiation of electromagnetic towers.

Group B was placed near the electromagnetic transmission tower for three hours a day for two consecutive months. After the end of the specified period of time, blood samples were

collected from the heart directly by heart prick and blood drawing to find out the levels of T3 and T4 hormones, after which the animals were euthanized for the purpose of taking samples from the thyroid gland for histological study. The thyroid glands tissues collected from experimental animals were processed routinely for histological preparation according to method described previously by:

- 1- **Washing:** The tissue samples washing in normal saline.
- 2- **Fixation:** the tissue samples put in 10 % of formalin for 48 hours.
- 3- **Washing:** after fixation the samples wash with tap water for one hour
- 4- **Dehydration:** the tissue samples passed on an ascending chain of ethanol alcohol solution that beginning with **50%, 70%, 80%, 90%<sub>1,2</sub>, 100%<sub>1,2</sub>**. The sample remained two hours for each concentration.
- 5- **Clearing:** the tissue samples put in xylene for ½ hour
- 6- **Infiltration:** by using paraffin wax
- 7- **Blocking and embedding:** the tissue samples poured in molds filled with paraffin wax.
- 8- **Cutting:** tissue sections made by rotary microtome
- 9- **Staining:** by used heamatoxilin and eosin stain H&E.[10].

#### **Statistical analysis:**

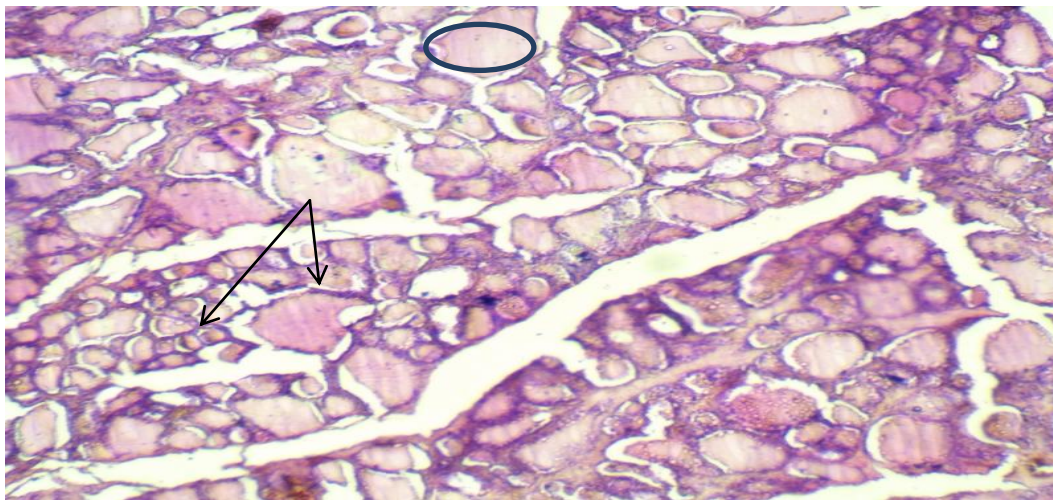
One-way analysis of variance (ANOVA) test was used to compare 2 independent groups, with post hoc Tukey test used for pairwise comparison. t-test used for comparative between studied groups. Repeated measures ANOVA test was used to compare of 2 studied groups with post hoc Tukey test.  $p < 0.05$  was considered statistically significant.

#### **Results and discussion:**

##### **Histological result**

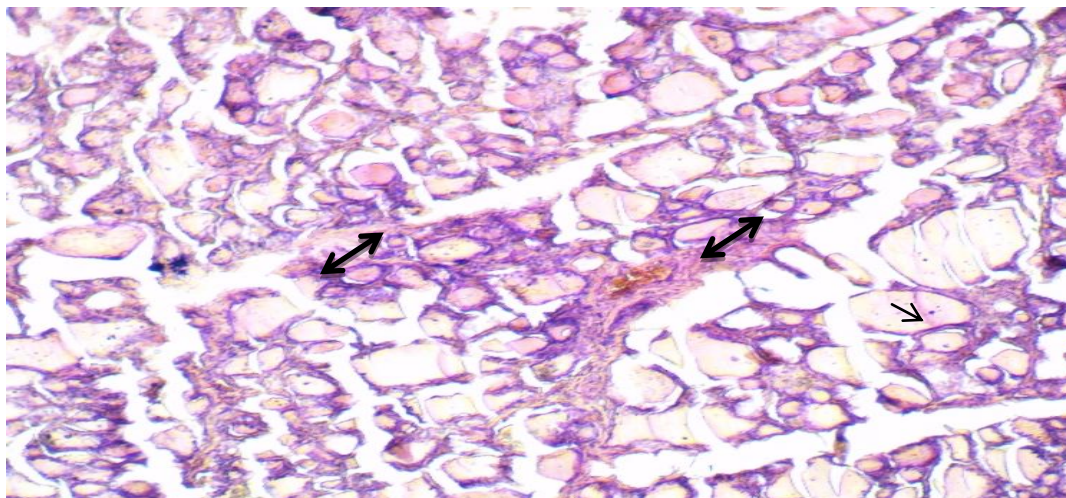
##### **Control Group:**

The thyroid gland composed of different types of follicles that distributed through the gland parenchyma (Fig.1 ). The field showed small follicles have high population in the gland, These results were confirmed with [1] that noted the thyroid gland is the follicles, which composed of prominent wall composed of follicular cells that responsible to secretion of thyroxin and clear materials called intrafollicular colloid, so this result agreement with [2] which said that there are different sizes and shapes of follicles which lined by height follicular epithelia which have different in height that depending on functional role.



**Fig.(1):** Histological section of control thyroid gland showed, a-thyroid parenchyma, deferent follicles c- glandular trabecular, d- colloid fluid in the follicles. H&E. Stain (10x).

The histological section in control group showed the thyroid gland follicles were filled with thick secretion called (colloid. The internal surface of capsule was send some of trabecular septa that divided the gland parenchyma into many lobules (Fig. 1 ). This finding was similar to. [1] that refer to the thyroid gland surround by connective tissue capsule.



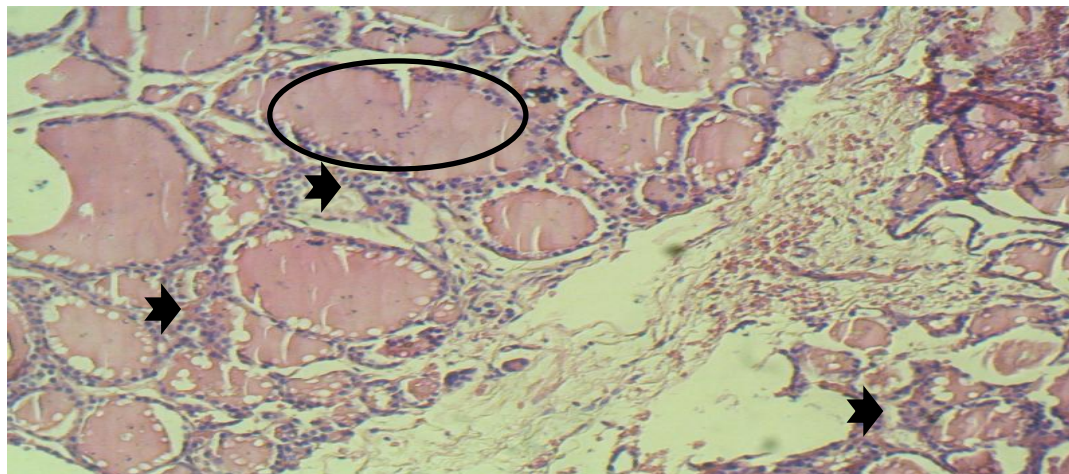
**Fig.(2):** Tissue section of thyroid gland in control group noted, trabecular septa, connective tissue septa between follicles c- colloid fluid. D- Internal surface of follicles.H&E. Stain (10x). The tissue section noted the parenchyma of thyroid gland have many follicles in deferent size that distributed in deferent level of parenchyma.The internal surface of lobule was lined by simple columnar epithelia or high pyramidal epithelia. The histological result appeared the small clusters of cells which have dark oval nuclei in deferent locations between the follicles called C cells,(Fig.2 )

#### **Treated Groups:**

The histological results after exposure to radiation noted prominent tissue changes which included high cellular proliferation in deferent location of thyroid parenchyma, exactly

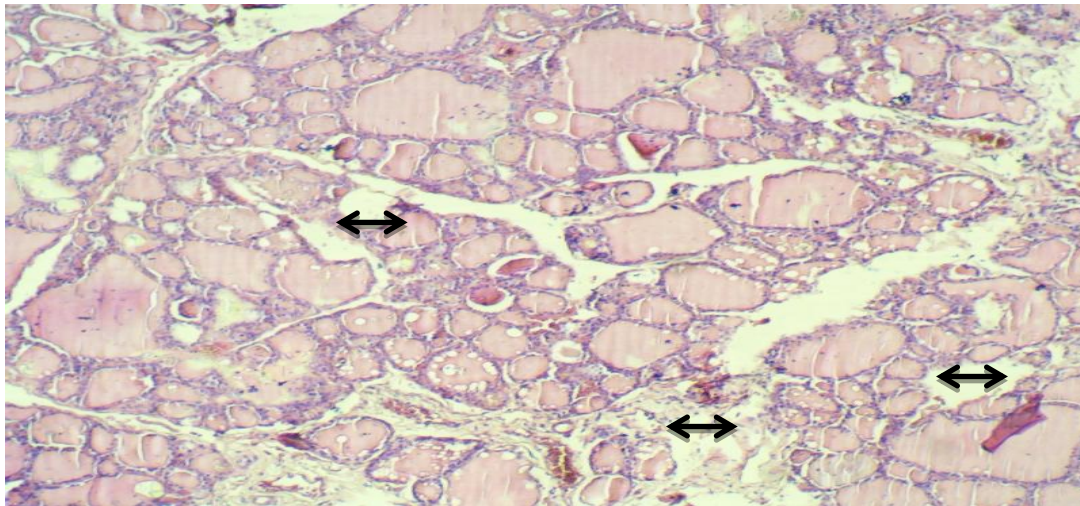


between the follicles of thyroid gland (Fig. 3), these findings that agreement with [11], that said the direct exposure to the radiation source that lead to prominent cellular damage, the ionizing radiation have effect through the radiolysis of water in the cells, that lead to rating the free radicals, occurrence interact between the free radicals and molecules in cells, partially DNA to forming the chemical alterations which causes harmful effects.



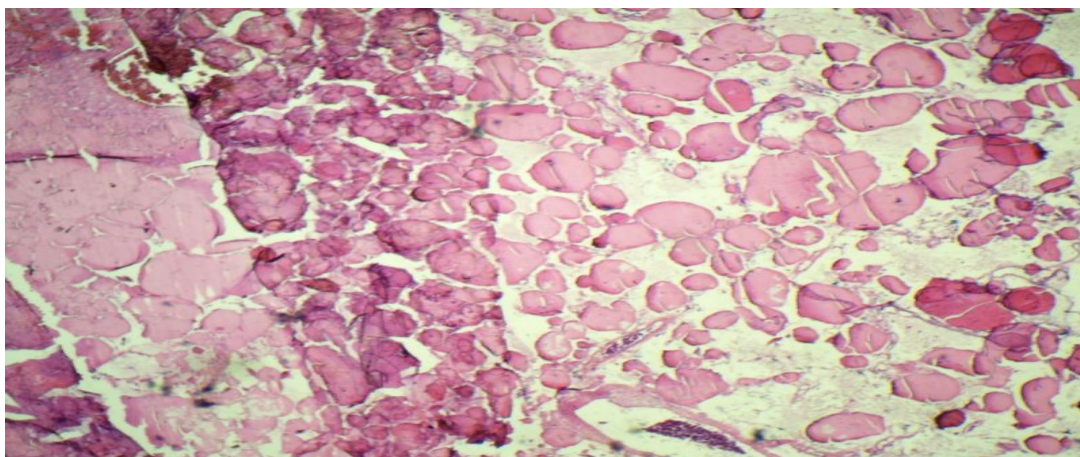
**Fig.(3):** Tissue section of infected thyroid gland after exposure to radiation showed the main tissue changes which included, Prominent cellular proliferation, cytoplasmic vacuoles, abnormal epithelium and high amount H&E. Stain (20x).

The tissue section showed wide inflammatory lesions in many locations of thyroid parenchyma, abnormal epithelial cells that lining the inner surface of follicles which have wide cytoplasmic vacuoles, no clear basement membrane under epithelial layer in many follicles of thyroid gland (Fig. 4), this finding were abnormal when comparative with control group, this result was confirmed with [12] that claimed the radiation have ability on the penetration into deep layers of the body and destroyed the tissue in the organs, these results were similar to [13]. which noted in rat exposure to 60 dose of radiation causes alteration in the structures of blood-brain barrier that lead to acute vasculature leakage, and acute destruction in capillary network, atrophy in the cortex and necrosis.



**Fig.(4):** Histological section of radiated thyroid gland showed, prominent epithelial cells proliferation and basement membrane in the follicles, the section noted blood congestions, cystic dilation H&E. Stain (10x). ↔

The micrograph of thyroid gland after radiation noted the wall of the follicles was very thin and have prominent destruction compared with control group, so the epithelial layer exfoliated from the internal surface of the thyroid follicles (Fig. 4). Some of thyroid follicles were filled with thick colloid secretion, dark in color compared with control group, so showed prominent blood congestions. The enlargement of thyroid follicles was confirmed with increased the colloid accumulation inside of thyroid follicles that well lead to increased the hormonal activity of thyroid gland in group after exposure to radiation(Fig. 4), these result may be due to increase the cellular proliferation in epithelial cells that lining the internal surface of the follicles.

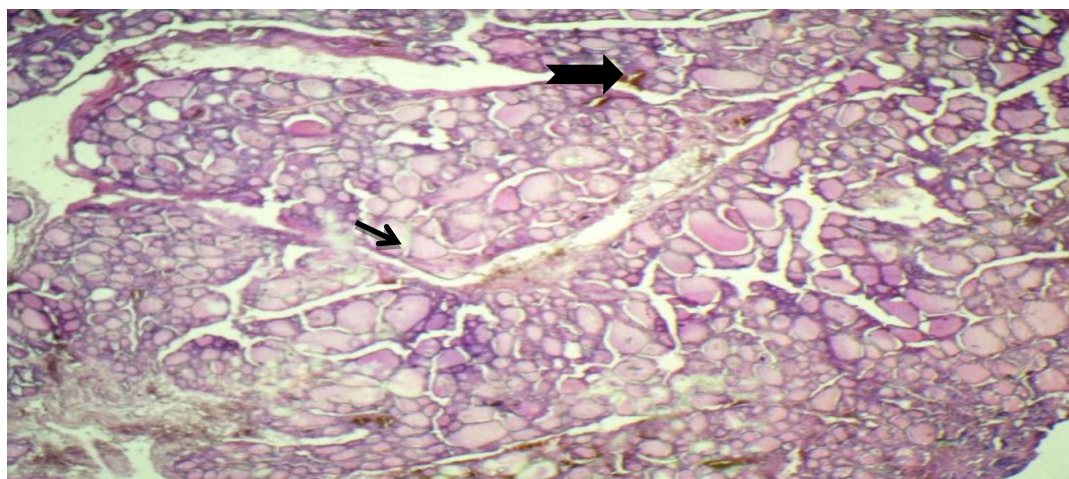


**Fig.(5):** Histological section of thyroid gland after exposure to radiation showed, a- thyroid parenchyma, b- different follicles c- glandular trabecular, d- colloid fluid in the follicles. H&E. Stain (10x)



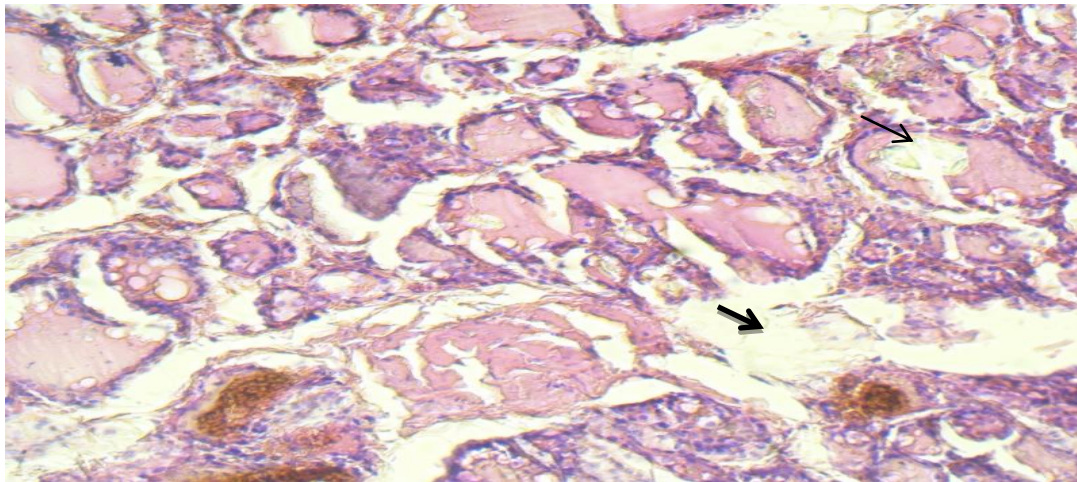
The histological result noted small aggregation of inflammatory cells between the follicles in thyroid parenchyma, the tissue section noted wide spread of small follicles, which scattered in deferent spaces between the large follicles, the large follicles appeared low distributed than small follicles (Fig.5, 6), these result similar to [11] that noted the minimum dose of radiation that lead to venous blood hemoglobin oxygen saturation and lead to histological changes.

The tissue section of thyroid gland after exposure to radiation have prominent wide aggregation of small follicles which filled with dark secretion, the follicular epithelia was very thin and disappeared in some follicles. no clear parenchymal septa between the follicle, the tissue field many blood congestions in deferent locations between the thyroid follicles, these findings were confirmed with [14], they noted the radiations lead to blood vessels expansion. In addition to, its lead to prominent changes in cellular and molecular mechanisms and causes allergic encephalomyelitis.



**Fig.(6):** tissue section of radiated thyroid gland noted, high aggregations of small follicles, epithelial layer of small follicles( ) and blood congestions( ) H&E. Stain (10x).

The tissue section noted different figures of mitotic divisions in the thyroid parenchyma, the tissue section have prominent apoptosis figure in the cystic dilation, the section showed necrosis lesions in the peripheral zone of cortical region of thyroid gland with aggregations of inflammatory cells around the lesions of necrosis, these results were similar to [14] that noted the main effects of low dose of radiation included, necrosis and inflammation in the skin, lungs, and blood cells, also led to severe histological damage in the wall of elementary canal, the radiation exposure that lead to effects on the chromosomes during cell division.



**Fig.(7):** Histological section of infected thyroid gland after radiation showed, inflammatory lesions between follicles, necrosis, acute degeneration in the gland parenchyma( ), prominent vacuoles in the follicles and cystic dilation. H&E. Stain (20x).

### **Biochemical test of T3 and T4 hormones:**

The biochemical results which included the level of triiodothyronine (T3) and thyroxine T4 hormones in the serum of experimental animals. The T3 and T4 value in the control group was (0.142pmol/L, 38.2 pmol/L) respectively, which consider as normal level in the control group. The hormonal tests of thyroid gland of control group noted the level of hormonal secretion of thyroid gland were normal in values compared with other study.

The current study showed the T3 values in serum was (1.76pmol/L ).The level of T3 in infected animals have significant difference's compared with control group. The present hormonal results referred to the electromagnetic waves have severe effect on the thyroid gland activity that lead to increased the thyroid gland secretion, this result was agreement with [15]that reported that the Thyroid diseases such as hypothyroidism, thyroiditis and cancer can potentially causes mental, physical and even death if not properly treated Direct or incidental thyroid glands exposure to radiation may disturb in their function.

The present hormonal result of thyroid gland noted prominent variation in the level of T4 compared with control group, the level of T4 hormone in treated group was (92.65 pmol/L ). The level of T4 have significant differences compared with control group. The terminal observations showed the electromagnetic waves have harmful effects on the thyroid gland, these effects lead to many changes in the histological structures and the hormonal secretions, this result was disagreement with [Elzaki A.,2012] that said the In one animal study, there were no significant variations in concentration of T3 and T4 in the blood of the rats that had been irradiated at doses of 0.5, 1, 2, 4 and 6 Gy when compared with non-irradiated rats [7].



The hormonal secretions of thyroid gland have significant differences in the level of T3, T4 hormones when compared between infected and control groups. The level of hormonal secretions of thyroid gland in the treated group have prominent increased compared with control group, this result was confirmed with [16; 17] which noted The current study was undertaken to explore whether exposed radiology technologists working at radiology departments at one referral university hospital are at higher risk of asymptomatic thyroid hormones and gland abnormalities.

**Table (1) showed the statistical analysis of (T3) values of control and infected groups.**

<b>The blood sample of T3 for control vs infected mice</b>			
<b>Group</b>	<b>N</b>	<b>Mean</b>	<b>SE</b>
<b>control group</b>	<b>10</b>	<b>0.142</b>	<b>0.024</b>
<b>Infected group</b>	<b>10</b>	<b>1.76</b>	<b>0.0134</b>
<b>Difference = mu (control group) – mu (infected group)</b>			
<b>Estimate for difference: 0.200</b>			
<b>95% CI for difference: (0.116; 0.385)</b>			
<b>T-Test of difference = 0.01 (vs not =): T-Value = 1.44 P-Value = 0.000</b>			
<b>DF = 38</b>			

**Table (2) showed the statistical analysis of (T4) values of control and infected groups.**

<b>The blood sample of T4 for control vs infected mice</b>			
<b>Group</b>	<b>N</b>	<b>Mean</b>	<b>SE Mean</b>
<b>Male control</b>	<b>10</b>	<b>38.2</b>	<b>0.4</b>
<b>Infected group</b>	<b>10</b>	<b>92.65</b>	<b>1.32</b>
<b>Difference = mu (control group) - mu (infected group)</b>			
<b>Estimate for difference: 43.03</b>			
<b>95% CI for difference: (34.57; 50.13)</b>			
<b>T-Test of difference = 0.01 (vs not =): T-Value = 5.48 P-Value = 0.000</b>			
<b>DF = 43</b>			

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