Research Article

Effect of Low Level Laser Therapy on Diabetic Experimental Animals

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Abstract | Introduction: Diabetes mellitus is a metabolic disorder affecting the B-cells of the pancreas, that results in hyperglycemia. Streptozotocin (STZ) is a medical agent that could be used in experimental animals to induce diabetes. Nowadays, efforts have been directed and focused on complementary medicine. Aim: Our study was designed to assess the hypoglycemic activity of the laser on diabetic experimental animals. Methods: The present work was carried out on 40 albino rats, and equally divided into 4 groups, (10 rats/group) as following: Group 1, animals served as control. Group 2, animals received STZ. Group3, animals received laser. Group 4, animals received STZ+ laser. After the experiment, blood samples were collected for biochemical analysis. Also, the pancreas was dissected for histopathology. Results: biochemically, there was a significant increase in hepato-renal enzymes, cholesterol, glucose, and insulin in the STZ group, while, the other treated groups showed an improvement in such enzymes. Histopathology, STZ induced necrosis, and degenerative changes with vacuolation. Treated groups displayed moderate to mild vacuolation and congestion of the blood vessels. Conclusion: The experience showed the effectiveness of the laser and its few side effects in treating diabetic rats.

Keywords | Diabetes mellitus, Laser, Biochemical parameters, Histopathology.

Received | October 02, 2021; **Accepted** | November 08, 2021; **Published** | March 25, 2022
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Citation | Ali RA, A. Elshater AE, Mohammed HA, Elshazly M (2022). Effect of low level laser therapy on diabetic experimental animals. Adv. Anim. Vet. Sci. 10(5): 1007-1016.
DOI | http://dx.doi.org/10.17582/journal.aavs/2022/10.5.1007.1016
ISSN (Online) | 2307-8316

INTRODUCTION

Diabetes mellitus is a group of metabolic disorders characterised by hyperglycemia. Changes in carbohydrate, fat, and protein metabolism are associated with absolute or relative deficiencies in insulin secretion and/or insulin action (Nakamura et al., 2014).

Current International Diabetes Federation and WHO reports say that approximately 451 million people worldwide are living with diabetes and this is predicted to increase to 693 million by 2045 (Otieno et al., 2021).

Insulin is a hormone produced in the pancreas that enables cells to absorb glucose and convert it into energy. There are several forms of diabetes, three of the most well-known are: type 1 diabetes, type 2 diabetes, and gestational diabetes (Shanks et al., 2011).

Typical symptoms of diabetes include frequent urination, sleeplessness, eating too much, and unexpected weight loss. Besides hyperglycemia, many other factors, including lipids or hyperlipidemia, are involved in the development of micro and microvascular complications of diabetes, which are the main causes of illness and death (Arul et al., 2006). Oral hypoglycemic agents such as Glimepiride, glibenclamide, etc., have some adverse effects, and these are unavailable in rural areas also (Sumon et al., 2008).

Despite important progress in the management of diabetes using synthetic drugs, many traditional treatments are still being used throughout the world. One example of complementary medicine is acupuncture. Laser acupuncture is now commonly used because it is painless, more convenient to test on small experimental animals, and more comfortable to use on children compared to acupuncture (Abdurachman et al., 2019).

There are two types of lasers: low power and high power. The high-power lasers cut the tissue and release heat. However, the low-power lasers do not release heat and do not damage the tissue; they have the potential to produce photochemical reactions and improve the metabolism of cells. They are named low power lasers because they have a density of less than 5.0 W/cm2; they are also referred to as cold lasers or soft lasers. These lasers react in tissue without generating heat or stimulating or inhibiting cells (Rayegani et al., 2017).

For the past 40 years, low-level laser therapy (LLLT) has been widely used in the medical fields. Recently, there has been an increase in clinical applications of low-level laser radiation in various therapeutic fields. One of the most important functional aspects of laser therapy is the photocatalytic effects of a low-level laser on different biological systems based on the effects of a low-intensity laser, often described as a laser with an average power of less than 500 mW (Ansari et al., 2015).

This is a safe and effective method of laser therapy, especially for systemic disorders, that has been used in Russia, China, and Iran for more than 20 years (KazemiKhoo and Ansari, 2015).

Needling at CV-12 (Zhongwan) has been widely used to relieve symptoms of diabetes. In a previous study, CV-12 in combination with other acupuncture points such as CV-4 (Guanguan), CV-6 (Qihai), CV-10 (Xiawan), ST-24 (Huaroumen), ST-25 (Tianshu), TE-5 (Wailing), SP-15 (Daheng), and KI-13 (Qixue) decreased blood glucose levels and improved insulin resistance with no adverse effects in obese T2DM (Kumar et al., 2017).

Electro acupuncture at Shenshu (BL23) is reported to reduce the level of high fasting insulin and protect islet B cell morphology by enhancing mRNA expression of glucose transporter 2 and glucokinase (Feng et al., 2018).

Our study aims are to study the effects of laser acupuncture points on healthy rats, and rats with STZ-induced diabetes, by measuring some biochemical parameters and histopathologic examination.

MATERIALS AND METHODS

40 adult male albino rats at the age between (2-3 months) weighing 150 ± 20 gm at 2-3 months old. Animals were divided into 4 groups as follows: **Group(1):** Rats were administered only saline solution (NaCl 0.9%). This group served as a normal group, **(Normal). Group (2):** rats were intraperitoneal (i.p.) Injected with Streptozotocin - STZ (45 mg/kg body weight)**, (Diabetic control). Group (3):** rats were radiated every two days for 15 laser sessions during 30 days, BL20 acupuncture point, **(Normal+laser). Group (4):** rats were intraperitoneal (i.p.) Injected with Streptozotocin - STZ (45 mg/kg body weight), and radiated every two days for 15 laser sessions during 30 days, BL20 acupuncture point, **(Diabetic+laser).**

The animals were housed in cages (10 rats/cage), in an air-conditioned room. They fed on an adequate, stable, commercially balanced diet.

All animal experiments were carried out in accordance with the guidelines of the Institutional Animals Ethics Committee (Published by the Department of Primary Industries Biosecurity Victoria, April 2011). All animals were clinically examined before being used in the study. Also, before they were injected with STZ, blood glucose was measured to ensure that all animals were free of diabetes before the experiment. After 18 hours of starvation, the blood glucose level of each rat was measured, and rats of different groups were rendered diabetic by an intraperitoneal injection of STZ, at a dose rate of 45 mg/kg b.wt (Mestry et al., 2017). Five days after streptozocin injection, rats were deprived of food and water overnight, and blood samples were obtained from the lateral tail vein after two hours of oral glucose loading (3 g/kg b.w.). Serum glucose level were measured for each rat. Rats with serum glucose levels higher than 180 mg/dL were considered diabetic and were included in the experiment, while others were excluded.

Laser source

The laser device used in this study is Globus laser therapy (physiolaser 500), and the steps of application are as following:

Detect the following acupuncture points:

BL18: along the longitudinal line of the costal tubercle, lateral to the caudal border of the spinous process of the tenth thoracic vertebra.

BL20: located on the twelfth thoracic vertebra.

BL23: located on the second lumbar vertebra.

CV12: On the linea alba abdominus, with the T10 spinal nerve subcutaneously, anatomically On the anterior median line of the upper abdomen, 20 mm below the xiphisternal synchondroses

ST25: On a horizontal line 5 Tsun above the symphysis pubis and 2 Tsun lateral to the midline (right and left).

CV6: With an anterior cutaneous branch of the 11th intercostal nerve subcutaneously, and anatomically on the anterior median line of the lower abdomen, 10 mm below the umbilicus.

Then remove the hair from these points.

Turn on the device by pressing the power button.

Insert the code.

Set the parameters as follows (select A light, power = 500 Mw, time = 1 min/point).

Animals were then sacrificed by decapitation, and the blood was collected in clean tubes to separate serum for biochemical analysis.

The Pancreas was removed and one part was stored at 20 ° C for antioxidant testing, then the other part was fixed in an appropriate fixative (formalin 10%) for 24 hours. Then it was kept in 70% ethyl alcohol for tissue testing.

Biochemical analyses

Determination of liver function tests: AST and ALT were determined by the colorimetric method (El-Sayed and Yousef, 2021).

ALP was determined by the colorimetric method obtained from, Bio-diagnostic Co. Giza, Egypt (Abd-El-Aziz and Thabit, 2021).

Bilirubin was determined by the colorimetric method (Hegazy et al., 2018).

Total protein was determined by the colorimetric method (Kang et al., 2021). Albumin was determined by the colorimetric method (Barhai et al., 2018).

Determination of kidney function tests: Urea was determined by the enzymatic colorimetric method (Soji et al., 2022). Creatinine was determined by the colorimetric method (Fouad et al., 2017).

Determination of lipid profile: Cholesterol was determined by the colorimetric method (Mishra and Kesari, 2020). Triglyceride was determined by colorimetric method according to (Alsharidah et al., 2018).

Determination of glucose and insulin: Glucose was determined by the enzymatic colorimetric method (Esmaiel et al., 2019). Insulin was evaluated according to the Marschner method (Fernandes et al., 2014).

Histopathological Examinations

The tissue specimens from the pancreas were collected from sacrificed animals and fixed in 10% neutral buffered formalin. The samples were dehydrated in ascending grades of ethyl alcohol embedded in paraffin wax. Sections about 4-5 µm in thickness were prepared and stained with Harries hematoxylin and eosin for microscopical examinations according to (Ren and Zheng, 2022).

Statistical Analysis

The variability degree of the results was expressed as Mean ± Standard Deviation (Mean ± S.D.). The data were statistically analysed using one-way ANOVA analysis of variance (Prism Computer Program), with the least significant difference (L.S.D.) used to test for treatment differences. Results were considered statistically significant when $P<(0.05)$.

RESULTS

Biochemical Results

Liver function tests: ALT values showed a significant increase ($P<0.05$) in all groups when compared with normal (group 1). Groups 3 and 4 showed significant changes ($P<0.05$) in ALT activity in comparison with diabetic control (group 2). There was a significant increase ($P<0.05$) in the level of the AST enzyme in group 2 when compared with control. Groups 3 and 4 showed significant changes ($P<0.05$) in AST activity in comparison with the control (group 2). While the ALP enzyme showed a significant increase ($P<0.05$) in groups 2 and 4 when compared with normal rats, Groups 3 and 4 showed significant changes ($P<0.05$) in ALP activity in comparison with group 2. Total bilirubin was detected to have a significant increase ($P<0.05$) only in group 2 when compared with normal. Groups 3 and 4 showed significant changes ($P<0.05$) in the level of total bilirubin in comparison with group 2 (Table 1, Figs. 2, 3, 4 & 5).

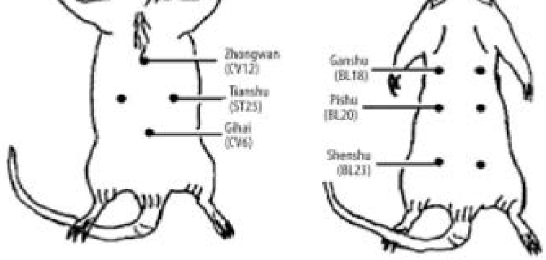

Figure 1: Distribution of acupoints in the rat. In 6 acupoints, 3 points distributed on the ventral side (zhongwan, tianshu, and qihai points) are shown in the left-hand side, and 3 points distributed on the dorsal side (ganshu, pishu, and shenshu points) are shown in the right-hand side (each point is shown by a filled-in circle).

Table 1: Effect of strepocytocin and laser on liver function tests (ALT (IU/l), AST (IU/l), ALP (IU/l) and Total bilirubin (mg/dl).

Parameters Groups	Liver Function Tests			
	ALT (IU/l)	AST (IU/l)	ALP (IU/l)	T. bilirubin (IU/l)
Group(1)	30.6±6.7	69.2±7.5	144.6±9.1	0.538±0.12
Group (2)	85.6±20.0[a]	149.2±31.6[a]	292.6±26.7[a]	1.3±0.57[a]
Group (3)	41.4±5.3[b]	100.6±10.5[b]	145.4±8.7[b]	0.53±0.24[b]
Group (4)	56.8±7.0[ab]	108.2±18.6[b]	206.4±18.6[ab]	0.82±0.21[b]

a → The mean difference is significant when compared with normal at the 0.05 level.
b → The mean difference is significant when compared with group (2) at the 0.05 level.

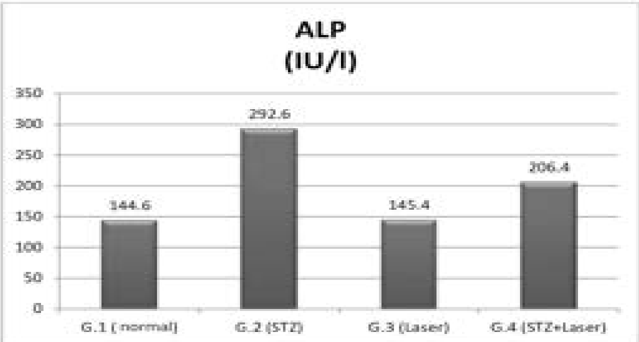

Figure 2: Effect of exposure to laser beam (15 session), for 30 days on serum ALP (IU/L), on diabetic rats induced by single dose of STZ 45 mg/kg b.wt.

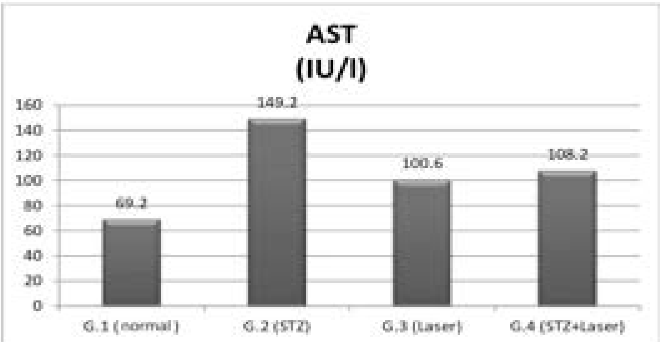

Figure 3: Effect of exposure to laser beam (15 session), for 30 days on serum AST (IU/L) on diabetic rats induced by single dose of STZ 45 mg/kg b.wt.

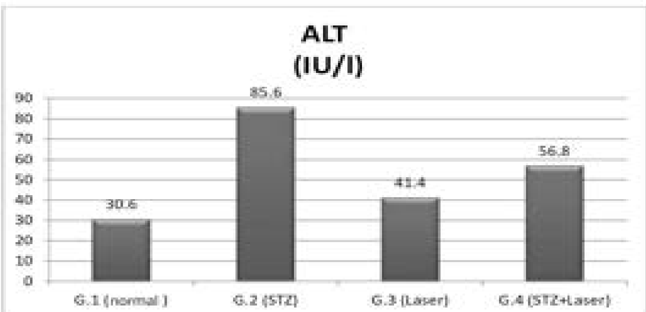

Figure 4: Effect of exposure to laser beam (15 session), for 30 days on serum AST (IU/L) on diabetic rats induced by single dose of STZ 45 mg/kg b.wt.

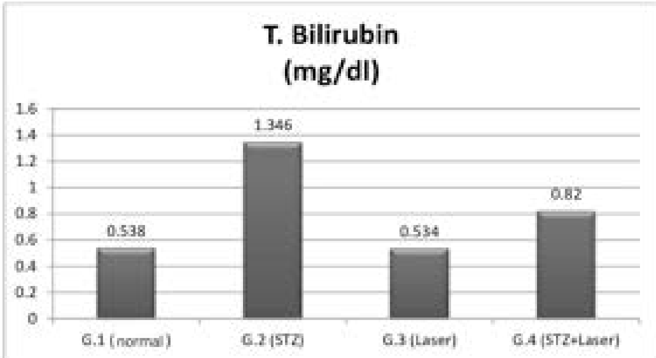

Figure 5: Effect of exposure to laser beam (15 session), for 30 days on serum T. bilirubin (IU/L) on diabetic rats induced by single dose of STZ 45 mg/kg b.wt.

There was a significant increase ($P<0.05$) in the level of al bumin in group 2 when compared with normal, and there was a significant decrease ($P<0.05$) in the level of albumin in group 3 when compared with diabetic control (groups 2) (Table 2, Figs. 6 & 7).

Table 2: Effect of strepocytocin and laser on protein profile (Total protein and albumin).

Parameters Groups	Protein profile	
	Total protein (gm/dl)	Albumin (gm/dl)
Group (1)	5.42±0.37	2.92±0.5
Group (2)	4.9±0.21	4.34±0.7 [a]
Group (3)	5.24±0.30	2.9±0.20[b]
Group (4)	4.54±0.35	3.12±0.37

a → The mean difference is significant when compared with normal at the 0.05 level.
b → The mean difference is significant when compared with group (2) at the 0.05 level.

Kidney function tests: The level of urea showed a significant increase ($P<0.05$) in groups 2 and 4 when compared with normal. Groups 3 and 4 showed a significant decrease ($P<0.05$) in the level of urea when compared with group 2. While creatinine levels increased significantly ($P<0.05$) in group 2 when compared with the normal rats (group 1),

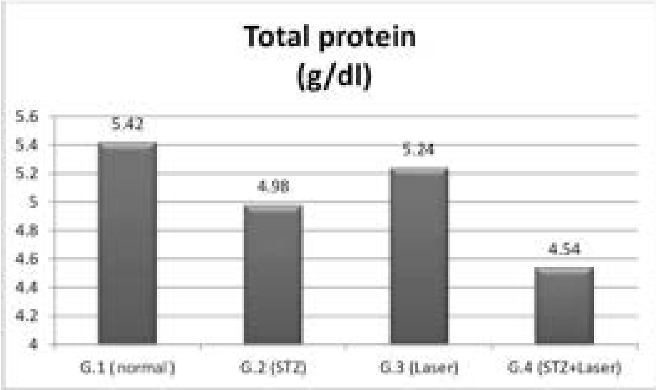

Figure 6: Effect of exposure to laser beam (15 session), for 30 days on serum total protein (gm/dl), on diabetic rats induced by single dose of STZ 45 mg/kg b.wt..

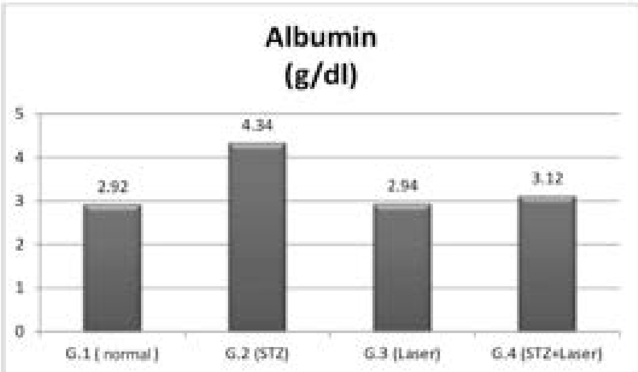

Figure 7: Effect of exposure to laser beam (15 session), for 30 days on serum albumin (gm/dl) on diabetic rats induced by single dose of STZ 45 mg/kg b.wt

Table 3: Effect of strepocytocin and laser on kidney function tests (urea and creatinine).

Parameters Groups	Kidney Function Tests	
	Urea (mg/dl)	Creatinine (mg/dl)
Group (1)	26.8±10.6	0.7±0.2
Group (2)	53.0±15.5 [a]	1.4±0.6 [a]
Group (3)	26.4±5.7[b]	0.7±0.1[b]
Group (4)	47.2±8.3 [ab]	0.46±0.2[b]

a → The mean difference is significant when compared with normal at the 0.05 level.
b → The mean difference is significant when compared with group (2) at the 0.05 level.

groups 3 and 4 showed a significant decrease (P<0.05) in the level of creatinine when compared with group 2 (Table 3, Figs. 8 & 9).

Lipid profile: Triglycerides showed a significant increase (P<0.05) in groups 3 and 4 when compared with normal. Group 3 showed significant changes (P<0.05) in the level of triglyceride when compared with group 2. A significant

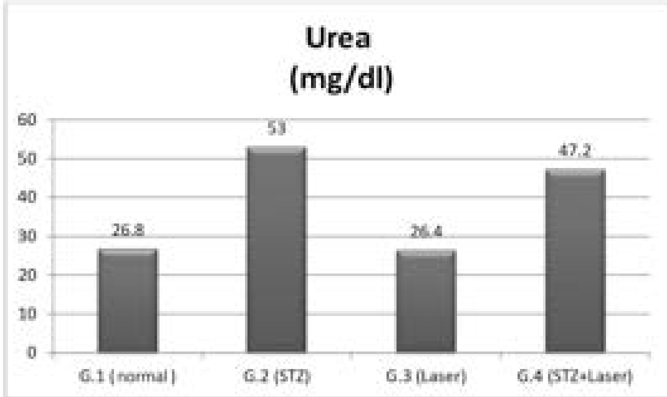

Figure 8: Effect of exposure to laser beam (15 session), for 30 days on serum Urea (mg/dl) on diabetic rats induced by single dose of STZ 45 mg/kg b.wt.

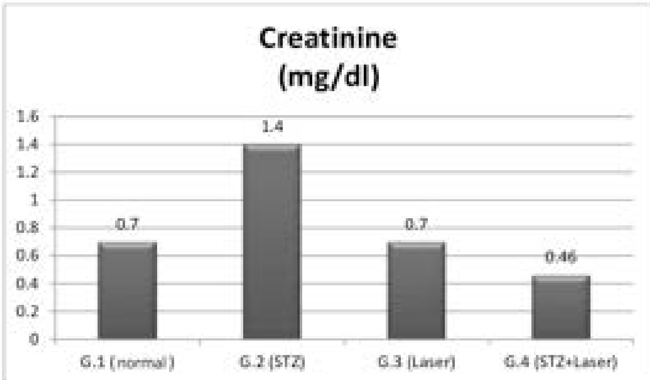

Figure 9: Effect of exposure to laser beam (15 session), for 30 days on serum Creatinine (mg/dl) on diabetic rats induced by single dose of STZ 45 mg/kg b.wt.

increase (P<0.05) was detected in the level of cholesterol in group 2 when compared with normal. Groups 3 and 4 showed significant changes (P< 0.05) in the level of cholesterol when compared with group 2. When compared to normal, the lipase enzyme showed a significant decrease (P<0.05) in groups 2 and 4. Group 3 showed significant changes (P<0.05) in the level of lipase when compared with group 2 (Table 4, Figs. 10, 11, 12).

Table 4: Effect of strepocytocin and laser on lipid profile (Triglyceride, Cholesterol and Lipase).

Parameters Groups	Lipid Profile		
	Triglyceride (mg/dl)	Cholesterol (mg/dl)	Lipase (mg/dl)
Group (1)	99.4±45.7	77.6±13.8	32.2±2.2
Group (2)	104.2±19.8	121.6±25.2 [a]	11.6±2.1 [a]
Group (3)	137.0±34.7 [ab]	81.0±12.0[b]	29.6±5.5[b]
Group (4)	112.6±22.0 [a]	74.6±11.0[b]	18.4±4.0 [a]

a → The mean difference is significant when compared with normal at the 0.05 level.
b → The mean difference is significant when compared with group (2) at the 0.05 level.

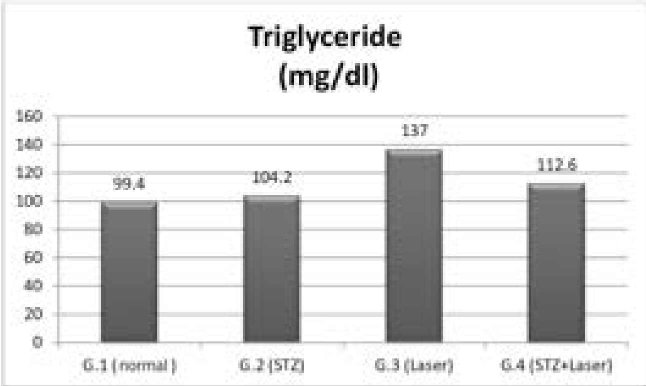

Figure 10: Effect of exposure to laser beam (15 session), for 30 days on serum Triglyceride (mg/dl) on diabetic rats induced by single dose of STZ (45 mg/kg b.wt.).

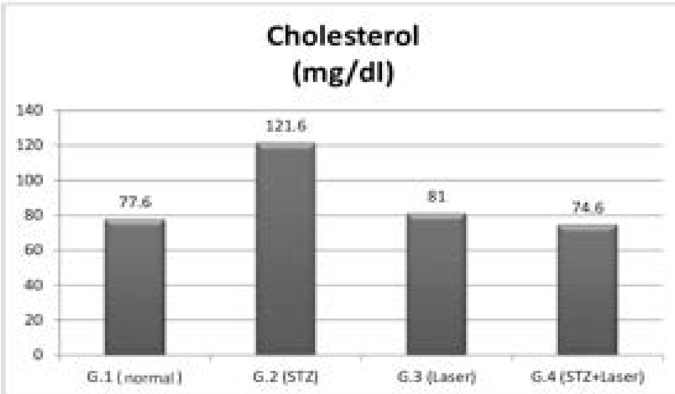

Figure 11: Effect of exposure to laser beam (15 session), for 30 days on serum Cholesterol (mg/dl) on diabetic rats induced by single dose of STZ (45 mg/kg b.w.)

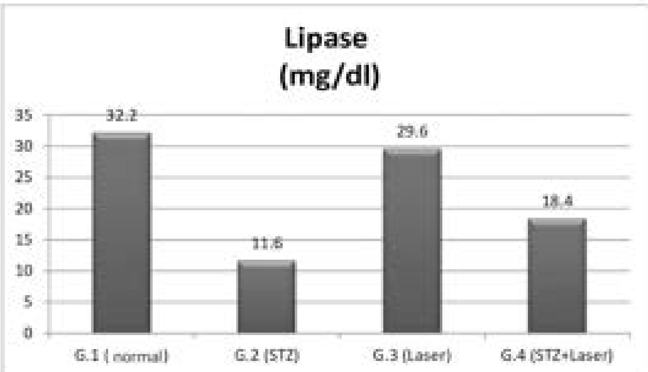

Figure 12: Effect of exposure to laser beam (15 session), for 30 days on serum Lipase (U/L) on diabetic rats induced by single dose of STZ (45 mg/kg b.wt.)

Glucose and insulin: There was a significant increase (P 0.05) in pre-glucose values in groups 2 and 4 when compared with the normal group. Groups 3 and 4 showed significant changes (P<0.05) in pre-glucose when compared with group 2. Glucose levels significantly increased (P<0.05) in groups 2 and 4 when compared with normal. Group 4 showed significant changes (P<0.05) in glucose when compared with diabetic control (group 2). While insulin and C-peptide levels decreased significantly (P<0.05) in groups 2 when compared to the normal group, Groups 3 and 4 showed significant changes (P<0.05) in insulin when compared with group 2 (Table 5, Figs. 13, 14, 15, 16).

Table 5: Effect of strepocytocin and laser on glucose (mg/dl) and insulin (mg/dl).

Parameters Groups	Glucose & Insulin		
	Pre- Glucose	Glucose	Insulin
Group (1)	106.8±22.1	90.0±17.7	3.82±1.0
Group (2)	467.16±61.7^{a}	533.8±94.4^{a}	0.78±0.5^{a}
Group (3)	120.0±22.6^{b}	101.6±24.5	4.12±0.8^{b}
Group (4)	397.3±123.3^{ab}	251.3±53.8^{ab}	1.98±0.7^{b}

a → The mean difference is significant when compared with normal at the 0.05 level.
b → The mean difference is significant when compared with group (2) at the 0.05 level.

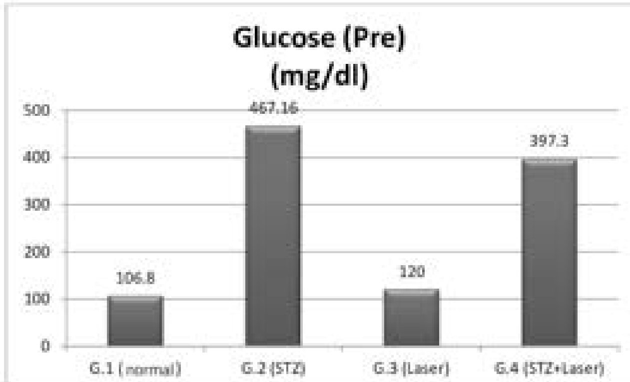

Figure 13: Glucose levels in groups before treatment with laser sessions (15 sessions) for day 30

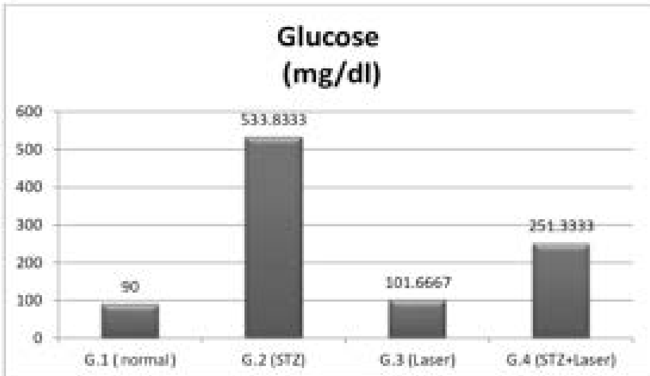

Figure 14: Effect of exposure to laser beam (15 session), for 30 days on serum glucose (mg/dl), on diabetic rats induced by single dose of STZ 45 mg/kg b.wt.

Pathological results

The normal group (group 1) showed a normal histological

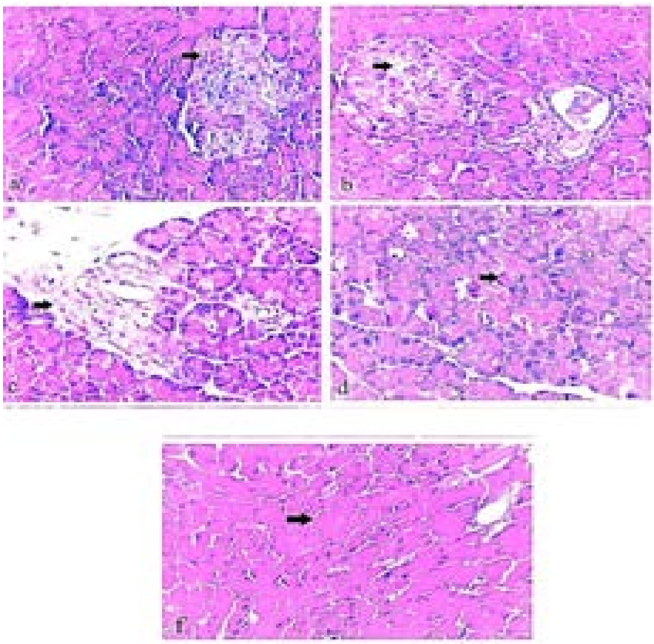

Figure 15: Photomicrograph of comparative figure of The normal group (group 1) showed a normal histological structure of the pancreas (Fig. 15a). The pancreas of diabetic control (group 2) showed severe necrosis and vacuolation of B-cells of Langerhans (Fig. 15 b), with extensive dilatation and congestion with inflammatory edoema (Fig. 15 c). The pancreas of group 3 showed haemorrhage with RBCs infiltration (Fig. 15 d). The pancreas of group 4 showed necrosis and vacuolation of pancreatic acini (Fig.15 e). (H&E., X 400).

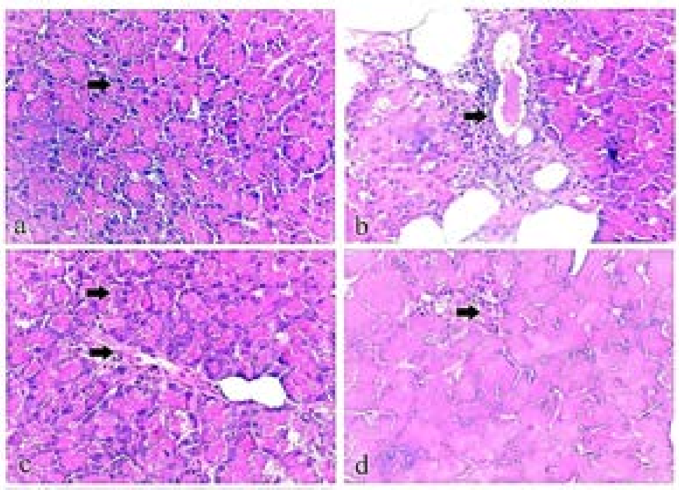

Figure 16: Photomicrograph of comparative figure of the normal group showed normal architecture of the pancreas (Fig. 16 a). The pancreas of group 2 showed severe congestion and thickening of blood vessels with inflammatory edoema (Fig. 16 b). The pancreas of group 3 showed haemorrhage with RBCs infiltration and mild congestion of blood vessels (Fig. 16 c). The pancreas of group 4 showed minimal vacuolation of pancreatic islets (Fig. 16 d).

structure of the pancreas (Fig. 15a). The pancreas of diabetic control (group 2) showed severe necrosis and vacuolation of B-cells of Langerhans (Fig. 15 b), with extensive dilatation and congestion with inflammatory edoema (Fig. 15 c). The pancreas of group 3 showed haemorrhage with RBCs infiltration (Fig. 15 d). The pancreas of group 4 showed necrosis and vacuolation of pancreatic acini (Fig. 15 e). The pancreas of the normal group showed normal architecture of the pancreas (Fig. 16 a). The pancreas of group 2 showed severe congestion and thickening of blood vessels with inflammatory edoema (Fig. 16 b). The pancreas of group 3 showed haemorrhage with RBCs infiltration and mild congestion of blood vessels (Fig. 16 c). The pancreas of group 4 showed minimal vacuolation of pancreatic islets (Fig. 16 d).

DISCUSSION

Diabetes is due to either the pancreas not producing enough insulin or the cells of the body not responding properly to the insulin produced. Type 1 diabetes is characterized by autoimmune destruction of insulin-producing cells in the pancreas by CD4+ and CD8+ T cells and macrophages infiltrating the islets, usually leading to absolute insulin deficiency. Type 2 diabetes is due to a progressive insulin secretory defect on the background of insulin resistance (Fagninou et al., 2019). STZ is the most common method for inducing diabetes in animal models today (Wszola et al., 2021).

STZ induces injury in the β-cells of the islets of Langerhans due to a decrease in insulin secretion, which further leads to the induction of diabetes and related complications (Guo et al., 2021).

In the present study, we observed the clinical manifestations, glucose, and body weight, using a 45 mg/kg dose of Streptozotocin to ensure the induction of diabetes in rats. Hyperglycemia, hypoinsulinemia, polyphagia, polyuria, and polydipsia accompanied by weight loss were observed in rats exposed to Streptozotocin. The present study results are in agreement with those of former researchers (Nagarchi et al., 2015) and (Akbarzadeh et al., 2007), but they used 50 mg/kg, and 60 mg/kg BW streptozotocin, respectively.

Acupuncture with laser therapy is a combination of acupuncture therapy with modern technology in the form of light therapy. Laser acupuncture uses lasers to stimulate acupuncture points (Sebayang et al., 2020). As for the exposure of healthy rats to the laser in acupuncturing points (BL18, BL20, BL23, CV12, ST25, CV6), as shown in group 3, There was no significant change in hepato-renal function, cholesterol, lipase, glucose, insulin, and C-peptide, While the results showed a defect in triglyceride when compared with the normal group. Histopathologically exposure to laser showed vacuolation of the pancreatic acini and vacuolation of the epithelial lining of the pancreatic acini. Blood vessels suffered from hemorrhage inside pancreatic acini and were filled with RBCs, besides slight dilatation with thickening of the blood vessels with inflammatory cells.

In a previous study an increase in serum triglyceride concentrations was observed in irradiated animals (Mafra et al., 2020).

It was said that the photo biological-photochemical phenomena caused by laser radiation to the tissues are similar to photosynthesis carried out by plants. To enable the visible light of low energy to affect any living biological system, the energy-carrying photons must be absorbed by electrons belonging to a photoreceptor or chromophore of the target biological system (Karoussis et al., 2018).

There are very promising and exciting LLLT applications with enormous potential in cell-based therapies. Many of these applications exploit the reciprocal interplay between upregulation of mitochondrial adenosine triphosphate (ATP) and downregulation of reactive oxygen species (ROS) in oxidatively stressed cells. The root cause for mitochondrial ATP upregulation in response to irradiation of cells with red-to-near infrared (R-NIR) light is the absorption of R-NIR photons by cytochrome c oxidase (CCO) (Sommer et al., 2019).

Laser radiation seems to act as a photo-stimulant, triggering a series of photochemical reactions that, in turn, can cause changes in cellular metabolisms, such as protein signaling (Karoussis et al., 2018).

LLLT stimulates low levels of Reactive Oxygen Species (ROS). ROS are well known to stimulate cellular proliferation at low levels, but inhibit proliferation and kill cells at high levels (Farivar et al., 2014).

The latest systematic review in 2019 showed that studies on acupuncture in DM mostly used manual acupuncture modalities. Selection of a manual acupuncture modality in patients with DM can increase the risk of infection in patients with uncontrolled blood glucose. Thus, a laser acupuncture modality can be used as a therapeutic option (Jusuf et al., 2021).

The laser-treated group showed improvement in most of the parameters, such as, decrease in blood sugar, and hepato-renal function. However, an increase in triglycerides was seen in this experiment compared to the other groups.

It was shown that a combination of metformin and acupuncture improved body mass index; body weight; fasting insulin, FBS, triglyceride, low-density lipoprotein cholesterol, and high-density lipoprotein cholesterol levels (Firouzjaei et al., 2016) and (Sui et al., 2020).

BL-23 (Shenshu) is one of the back-shu points (the points of bladder meridian, located on the back) that has a close relationship with kidney function (Yang et al., 2021).

In contrast to previous studies, LLLT did not suppress cholesterol synthesis but caused a redirection of serum lipids to fat reserves (in sedentary conditions) and an improved supply of substrate for energy expenditure (in trained conditions) (Aquino et al., 2013).

High levels of sugar in the blood cause damage to the liver cells, resulting in increased SGOT and SGPT levels, and the stimulation of the acupuncture points GB34 and BL18 results in a decrease in SGOT and SGPT levels (Jufriansjah et al., 2018).

Based on the results of histopathological kidney cells in mice with renal impairment, it can be concluded that exposure to 650 nm laser with 1 J energy results in a reduction of damaged cells (necrosis) and an increase of normal cells with the improvement of renal tubular cells. Therefore, the exposure to 650 nm LLLT on acupuncture points Shenshu (BL-23) has the ability to proliferate the renal tubular cells of mice (Astuti et al., 2017). The results were interpreted as LLLT facilitating differentiation of myofibroblastic cells during the early stages of the cicatricial repair process. Additionally, LLLT also appears to modulate the inflammatory response by downregulating lymphocyte proliferation Wavelength laser parameters also affect the ability of cell proliferation (Astuti et al., 2017).

Laser acupuncture at BL20 point in diabetes mellitus could increase beta-cell percentage and Langerhans area, and reduce fasting blood glucose level (Rayegani et al., 2017).

Both manual and laser acupuncture have been shown to improve the histological findings of Langerhans islets in type 2 diabetic rats. The morphology and cell density of Langerhans islets showed improved results with laser acupuncture. Both manual acupuncture and laser acupuncture are safe to use with minimal side effects (Jusuf et al., 2021).

The application of laser acupuncture stimulation to OLETF rats significantly reduced blood glucose concentrations, and this could be an effective treatment for type-2 diabetes mellitus (Nakamura et al., 2014).

It was mentioned that the acupoints, Zhongwan (CV12), Quchi (LI11), Hegu (LI4), Xuehai (SP10), Zusanli (ST36), and Yinlingquan (SP9) can improve glomerular filtration and reduce urinary albumin excretion rate (Feng et al., 2018).

ACKNOWLEDGMENTS

I would like to thank my professors who helped me complete the research. I would like to thank Dr. Zainab Al-Amjad "PhD in Clinical Pathology at the Faculty of Veterinary Medicine, South Valley University" for her assistance in working and reading the histological results.

CONFLICT OF INTEREST

The author declares that there is no conflict of interest regarding the publication of this article.

NOVELTY STATEMENT

The current study proved the effect of laser in treating diabetes, but the difference in this study is the 6 selected acupoints, as these points together have not been tested in previous research. Also, the mechanism of exposing these points to laser beams superficially without using needles to puncture, or any electrodes that penetrate the skin has not been used much in the treatment of diabetes with laser.

AUTHORS CONTRIBUTIONS

Dr. Abdel Rahim and Dr. Rana designed the study and manuscript. Dr. Mahmoud also contributed to the design and revision of the manuscript. It is also responsible for the laser device part. Heba implemented the project in practice, analyzed the data, and edited the draft manuscript.

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