Some Histological Changes in Thoracic Aorta Associated with Laser Therapy in Experimentally Hypertensive Rats

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Abstract: The aim of the present study is to investigate the possible histological changes following laser therapy in the thoracic aorta of rats subjected to experimentally hypertensions. Studies were conducted on 35 adult female albino rats; five rats were served as a normal healthy control group. The remaining 30 rats were subjected to experimental induction of hypertension and divided into two equal groups (15 rats each) as treated and untreated subgroups. Hypertension was induced by daily oral administration of L-NAME (50 mg/kg b.w) for one month. A tail cuff was used to measure blood pressure, Laser Therapy used, for a total of 16 minutes, each acupoint received 4 minutes (3 time / week). After 1.5 and 3 months from treatment, rats were anesthetized with light ether, sacrificed and heart and aorta were dissected out, fixed in 10% formal saline for 24 hours, histologically processed and examined. Results revealed significant (P<0.05) decrease in blood pressure in rats treated with laser and became near normal. Microscopic examination of aorta showed intima with little endothelial cell drop and media smooth muscle cells proliferated with uniform thickness and regular arrangement. In conclusion, treatment with laser has favorable effect on blood pressure without deleterious effect on histological changes of thoracic aorta in rats.

Key words: Blood Pressure · L-NAME- Laser · Cuff · Mice

INTRODUCTION

Hypertension is a great population burden; it is a major public health issue in developed as well as developing countries [1]. More than a quarter of the world’s population suffered from it during 2000 and it is expected to increase to almost 30% by 2025 [2].

Hypertension is a common health problem in Egypt. It has a high prevalence due to its rates of awareness, treatment and control are low. In 60% of patients, hypertension is complicated by the presence of other cardiovascular risk factors, which adds to increased cardiovascular morbidity and mortality. In the same time, management of hypertension in Egypt is not easy because of treatment costs as well as interruption of therapy [3].

Laser therapy is described as a treatment with low intensity laser light. Generally, it was given at modest levels below the onset of thermal damage and at non-ionizing wavelengths in the red to near infrared portion of the spectrum. Scientists and physicians recommend the Laser therapy with high marks across a broad range of medical conditions since over 40 years from the clinical and research points of view. Cardiovascular disease is among the medicinal conditions in which laser therapy has been shown to excel [4].

It was reported that Infra-red laser irradiation induce a significant reduction in the arterial pressure level, so it could be effective in correcting the disturbances in hemodynamic [5].

Laser therapy was recorded to have antihypertensive and antioxidant effects in stage I hypertension with the ability to decrease the total peripheral resistance [6].
Moreover, the use of laser puncture was reported to reduce the dose of hypertensive drugs [3].

The current work was carried out to investigate the possible effect of laser therapy on histological changes of blood vessels in hypertensive rats, taking the thoracic aorta as a model.

**MATERIAL AND METHODS**

**Experimental Animals:** The study was conducted on a total number of 35 adult female albino rats (100-150 g b.w) kept at Animal House of National Research Centre, Giza, Egypt during 2014 under routine managemental system. Five rats were served as a normal healthy control group. The remaining 30 rats were subjected to experimental induction of hypertension and divided into two equal groups (15 rats each) as treated and untreated subgroups.

**Experimental Design:**

- Hypertension was induced by daily oral administration of L-NAME (obtained from Across organics New Jersey USA), with a dose of 50 mg/kg/b.w; for one month [7]. L-NAME was dissolved with 1 ml saline for each rat and was given freshly prepared using a metallic stomach tube. Rats of the control group were given distilled water in the same manner.

- Blood pressure was measured in all rats using a tail cuff connected to a mercury manometer and a pressure transducer connected to a signal amplifier (ML 125 NIBP, AD Instruments, Australia) one month after administration of L-NAME then midway of treatment and at the end of treatment.

- Laser therapy was applied using the energy output of the treatment 5 w/cm² for a total of 16 minutes, each acupoint was received 4 minutes of treatment, all rats' baseline data were recorded before treatments, Then data were collected 1.5 and 3 months post treatment,. During the treatment period, each animal received 3 treatments per week for 12 weeks [8].

- For the histopathological examination: rats were anesthetized with light ether, sacrificed and aorta was dissected out, fixed in 10% formal saline for 24 hours, histologically processed[9] and stained with Harris’s haematoxylin and eosin (H and E). The H and E stained slides were examined using Leica Quin 500 Image Analyzer (LEICA Imaging systems Ltd, Cambridge, London).

- Statistical analyses: values were computed and expressed as mean ± SEM. Significance was tested using one-way ANOVA at P < 0.05.

**RESULTS**

**Blood Pressure:** Data presented in table (1) show that L-NAME-induced hypertension in injected rats with significant(P<0.05 ) increase in systolic blood pressure when compared with the control.

In rats treated with laser either after 1.5 (group 1) or 3 (group 2) months, significant (P<0.05) decreases in systolic blood pressure were recorded when compared with laser untreated group and became near control.

Regarding diastolic blood pressure, data showed no significant changes after 1 month of injection with L-NAME when compared with the control group. However, laser treatment, induced insignificant change in diastolic blood pressure of hypertensive rats in group 1 and significant decrease in group 2 as compared with untreated hypertensive rats.

<table>
<thead>
<tr>
<th>Parameters</th>
<th>Systolic pressure</th>
<th>Diastolic pressure</th>
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<tbody>
<tr>
<td>Control (normal)</td>
<td>72.14 ± 0.73</td>
<td>58.16 ± 1.16</td>
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<tr>
<td>Hypertensive</td>
<td></td>
<td></td>
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<tr>
<td>After 1 month</td>
<td>119.00 ± 3.92*</td>
<td>62.4 ± 5.1</td>
</tr>
<tr>
<td>After 4 month</td>
<td>113.3 ± 5.3*</td>
<td>72.6 ± 0.3 *</td>
</tr>
<tr>
<td>Hypertensive and Laser treatment 1</td>
<td>85.5 ± 7.5*</td>
<td>64 ± 7*</td>
</tr>
<tr>
<td>Hypertensive and Laser treatment 2</td>
<td>84.6 ± 7.5 **</td>
<td>60.6 ± 6.2 **</td>
</tr>
</tbody>
</table>

* P< 0.05
Fig. 1: Transverse sections of aorta of a) control rat shows the normal histological structure of the tunica intima, tunica media and tunica adventitia; b) a hypertensive rat after a month and a half shows irregularity in the structure of the elastic fibrils in the tunica media and deterioration in the formation of elastic lamellae were observed; c) a hypertensive rat of a hypertensive rat after three months shows the typical three-layer structure of the aortic wall was not clear and intimal thickness increased with irregular intima; d) a hypertensive rat with after 1.5 month of laser treatment shows progression of aorta intima and endothelial structure are attenuated and e) a hypertensive rat with after three months of laser treatment shows intima is smooth with little endothelial cell drop and media smooth muscle cells proliferated with uniform thickness and regular arrangement (H and E, Scale bar:20 µm).

**Histological Results:** Microscopic examination of sections from the aorta of rats after daily oral administration of L-NAME for 1 months showed irregularity in the structure of the elastic fibrils in the tunica media and deterioration in the formation of elastic lamellae (Fig. b) as compared with the control group. (Fig. a). On the other hand, in L-NAME injected group without laser treatment, the typical three-layer structure of the aortic wall was not clear, with irregular increased intimal thickness (Fig. 1c).
Laser treatment for 1.5 month, induced improvement in intima and endothelial structure (Fig. 1d) which become more clear after three months whereas intima showed little endothelial cell drop and media smooth muscle cells proliferated with uniform thickness and regular arrangement (Fig. 1e).

**DISCUSSION**

Laser acupuncture is the irradiation of acupuncture points with low intensity laser which is alternative to invasive acupuncture needling. Laser acupuncture was effective at stage I and II of hypertensive disease [10].

The results of the present study showed that the laser therapy applied on hypertensive rats lead to reduction blood pressure levels. In this respect, Flachskampf et al. [11] confirmed that the Laser acupuncture treatment was a safe and effective treatment of hypertension. Also, Tomimura et al. [12] found that hypertensive rats treated with laser revealed a decrease in blood pressure levels. On the other hand, these results come in contrary with those of Yu et al. [13] who found that acupuncture did not produce better results than other treatments for hypertension or stroke. Moreover, the current results disagreed with the results of Awad et al. [3] who found that Laser acupuncture can transitorily reduce postmenopausal complaints, but does not alter blood pressure or serum lipids at the same time.

The present results also discordance with the results of Macklin et al. [14] who found that acupuncture, are unlikely to achieve clinically meaningful reductions in systolic blood pressure or diastolic blood pressure for the average patient with mild-to-moderate hypertension.

The mechanism of laser acupuncture that reduces blood pressure is not well understood, however, Linnéa [15] showed that laser therapy induced arteriolar dilation and vastly improved blood flow in the micro-vascular bed of the rat mesentery as well as increased production of nitric oxide. Moreover, Ihsan [16] observed accelerated collateral circulation and increased microcirculation in rabbits exposed to laser therapy after femoral artery occlusion and also induced changes in blood flow and microcirculation thus promote healing by controlling ischemia, hypoxia and edema after injury. Involvement of nitric oxide, neurotransmitters, aldosterone, endothelin and angiotension II and acetylcholine, opioid in the brain cell were suggested to have acupuncture antihypertensive effect [17].

Tsai and, Wang [18] said that Laser acupuncture treatment had a positive effect on reduction of blood pressure through adjusting autonomic nervous system balance, autonomic dysfunction may cause abnormal blood pressure, via excitation of the sympathetic nervous system and inhibition of the parasympathetic nervous system, Long-term imbalances in the autonomic nervous system may lead to various cardiovascular and other chronic diseases.

Regarding histological changes, no available literature were traced for the direct effect of laser on the histological structures of the thoracic aorta and further detail histological changes will be carried out.

**CONCLUSION**

Laser therapy has beneficial effect on hypertension as indicated by the changes in systolic and diastolic blood pressure and the histological changes of thoracic aorta.

**REFERENCES**


