Effect of Blue Laser Intranasal Irradiation on Hyperlipidemia in Patients with Coronary Atherosclerosis

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Abstract

This study was conducted to evaluate the effect of adding blue Laser (405nm) blood irradiation therapy to Statins therapy in managing hyperlipidemia in atherosclerotic patients. Forty patients were assigned randomly to two equal groups, with age ranged between 50-60 years. The study group received twelve intranasal blue laser irradiation sessions, 30 minutes each, besides Statins therapy, while the control group received only Statins therapy (10mg/day), all patients adhered to low-fat diet program. Lipid profiles for all patients were screened before, and immediately after one month of treatment. There was a significant improvement in lipid profile before and after treatment for each group, but there was no significant difference (p > .015) between the study group and the control group. It was concluded that intranasal blue laser blood irradiation (405nm, 5mw, 30 minutes, 12 sessions) adds no extra benefits other than those gained by Statins therapy, while managing lipid profile in atherosclerotic patients.

Key Words: Blue laser blood irradiation – Intranasal – Atherosclerosis.

Introduction

At one time, atherosclerosis was thought to be a degenerative disease that was an inevitable consequence of aging. Research in the last two decades has shown that atherosclerosis is neither a degenerative disease nor an inevitable. On the contrary, atherosclerosis seems to be a chronic inflammatory condition that is converted to an acute clinical event, by the induction of plaque rupture, which in turn leads to thrombosis [1].

One of the causes of atherosclerosis is probably an error in the metabolism of lipids [2]. Hypercholesterolemia and hypertriglyceridemia are both risk factors for atherosclerosis, and eventually, coronary heart disease. Although the association between low-density lipoprotein (LDL) cholesterol and atherosclerosis risk is continuous, it is not linear. The risk of atherosclerosis rises more steeply with increasing LDL-C level. This results in a curvilinear, or log-linear, association [3].

Despite advances in the pharmacotherapy of atherosclerosis, especially the most successful agents used to treat this disease—Statins—we are still searching for the most proper solution which yield the minimum drawbacks. The relative risk of side effects of Statins, especially for long term users, gave rise to investigations of nonpharmacological methods, Laser radiation in particular [4].

A new technique of illumination has been practiced recently. A group of researchers from Canada found that, illumination of nasal cavity using certain red leds with re-tuned dosage and time phase appears to produce similar results of RBC disaggregation, as with Intravenous low level laser therapy. This could be explained by the thin epidermal barrier and high sensitivity of the micro vascular networks in the nasal cavity, which would accommodate a wide variation of light coherency [5].

During an eight year period, patients with atherosclerosis and renal dysfunction have been treated with intravenous He-Ne Laser blood irradiation (632nm). The study has demonstrated a decreased level of total cholesterol (TC), LDL cholesterol and triglycerides (TG) with a simultaneous increase of High density lipoprotein (HDL) cholesterol levels [6].

Considering the new blue Laser irradiation Therapy, Weber found that, the blue Laser has a distinct absorption for porphyrins on account of its wavelength of 400-470nm, and this consequently will apply, especially, to hemoglobin when conducting blood irradiation therapy [7].
From the works of the Armenian Laser scientist Levon Gasparyan (2003), he was able to show that under irradiation of blood with blue Laser light of low power (0.3mW), the rheology of the blood is significantly improved, and as a result the microcirculation is improved too. Furthermore, it was reported that metabolism effects lead to a significant decrease of cholesterol, triglycerides, blood-glucose, and bilirubin [8].

So far, there are only few scientific data of clinical applications of blue laser with patients since it succeeded, just a short time ago, to build a solid blue semiconductor Laser from gallium-nitride. Hence, this study is a trial to investigate the efficacy of such procedures. It will be of valuable benefit in increasing the body knowledge of physical therapy field for helping patients with atherosclerosis.

Material and Methods

This study had been done in the Outpatient Clinic of the Vascular Department, Kasr El Einy Hospital.

Forty patients of both sexes, age range 50 to 60 years, with confirmed diagnosis of coronary atherosclerosis (diagnosed by Intra Vascular Ultrasound IVUS) and hyperlipidemia including one of four characteristics; Serum total cholesterol ≥250mg/dL, triglyceride ≥150mg/dL, HDL <40mg/dl, LDL ≥140mg/dL, were referred to the physical therapy department. They were randomly assigned into two groups: Group (A) was the control group which received only lipid lowering medications (Statins’ derivatives). Group (B) was the study group, receiving Laser blood irradiation sessions three times per week for one month, (a total of 12 sessions), besides Statins derivatives. The random number method with balance was adopted to ensure balanced random allocation of the treatment groups.

Exclusion criteria:
• Hyper lipidemia caused by medication (e.g). β receptors resistant.
• Hypolipidimic drugs other than statins derivatives.

A- Evaluation tools: Lipid profile tests: Lipid tests were performed on plasma (using HITACHI 902 chemistry analyzer, and DIRUI bench top design fully automated chemistry analyzer CS-T240). Tests for triglycerides and LDL cholesterol were performed following a 12-hour fast.

B- Treatment instruments: Low level Laser (gallium-nitride) battery powered pointer device produces blue coherent, monochromatic beam, with the following criteria: Intensity: 5mw, Wavelength: 405nm. The device was connected to a fiber optic wire, which ended with a nasal piece. This wire was responsible for transmission of the light beam, with minimal energy loss.

Treatment procedure: Patients were scheduled for a lipid profile test for two times; one day before the first Laser therapy session, and immediately after the last session. Group (A): Control group, adhered to Statins and low-fat diet sessions for 4 weeks, while Group (B): Underwent 12 sessions of intranasal Low Level Laser Blue irradiation for 30 minutes (in the nose cavity) besides Statins and low-fat diet.

Results

The ages of population shared in the study ranged from 50 to 60 with mean age of 56.4±3.72 for the control group, and mean age of 55.7±3.75 for the study group. There was no significant difference in age ranges as t score =0.593, p-value=0.556. The control group was composed of 12 males and 8 females, while the study group was composed of 10 males and 10 females. Patients who shared in this study had their TC levels ranged from 146 to 460, TG ranged from 97 to 483, LDL ranged from 79 to 341, HDL from 24 to 59, and LDL/HDL value ranged from 2.15 to 8.73.

After intervention in control group, there was a highly significant decrease in TC, LDL, TG, and LDL/HDL i.e.; p=0.0001, but there was no significant increase in HDL after intervention (p=0.869) compared to that before intervention.

Table (1): Statistical analysis of lipid profile levels before and after therapy in control group (A).

<table>
<thead>
<tr>
<th></th>
<th>Before treatment x ±SD</th>
<th>After treatment x±SD</th>
<th>Mean different x ± SD</th>
<th>t</th>
<th>p (95% CI)</th>
</tr>
</thead>
<tbody>
<tr>
<td>TC</td>
<td>285.65±66.574</td>
<td>213.1±53.28</td>
<td>-72.55±13.294</td>
<td>11.62</td>
<td>0.0001**</td>
</tr>
<tr>
<td>HDL</td>
<td>44.1±9.6</td>
<td>44.4±6.61</td>
<td>0.3±2.99</td>
<td>0.17</td>
<td>0.869</td>
</tr>
<tr>
<td>LDL</td>
<td>190.96±51.64</td>
<td>131.73±48.59</td>
<td>-59.23±3.05</td>
<td>9.05</td>
<td>0.0001**</td>
</tr>
<tr>
<td>TG</td>
<td>252.95±70.09</td>
<td>184.85±55.59</td>
<td>-68.1±14.5</td>
<td>5.95</td>
<td>0.0001**</td>
</tr>
<tr>
<td>LDL/HDL</td>
<td>4.44±1.16</td>
<td>2.98±1.08</td>
<td>-1.46±0.08</td>
<td>5.34</td>
<td>0.0001**</td>
</tr>
</tbody>
</table>

TC :Total cholesterol. HDL : High density lipoprotein. LDL: Low density lipoprotein. TG : Triglycerides. ** : Highly significant
After intervention in study group, there was a highly significant decrease in TC, LDL, TG, and LDL/HDL ($p=0.0001$), but there was no significant increase in HDL ($p=0.045$) compared to that before intervention.

At 95% confidence interval, there was no significant difference between changes in the whole four components of lipid profile after treatment in control group in relation to study group, as $p$-value is always $>.015$. Thus we accept the null hypothesis.

Table (2): Statistical analysis of lipid profile levels before and after therapy in study group (B).

<table>
<thead>
<tr>
<th>Component</th>
<th>Before treatment</th>
<th>After treatment</th>
<th>Mean difference</th>
<th>t</th>
<th>p (95% CI)</th>
</tr>
</thead>
<tbody>
<tr>
<td>TC</td>
<td>259.4±59.87</td>
<td>187.95±50.96</td>
<td>−71.45±8.91</td>
<td>9.08</td>
<td>0.0001**</td>
</tr>
<tr>
<td>HDL</td>
<td>39.45±10.9</td>
<td>42.55±8.94</td>
<td>3.1±1.96</td>
<td>2.14</td>
<td>0.045*</td>
</tr>
<tr>
<td>LDL</td>
<td>177.46±54.14</td>
<td>117.59±46.29</td>
<td>−59.87±7.85</td>
<td>7.58</td>
<td>0.0001**</td>
</tr>
<tr>
<td>TG</td>
<td>212.45±108.2</td>
<td>139.05±64.9</td>
<td>−73.4±43.3</td>
<td>5.37</td>
<td>0.0001**</td>
</tr>
<tr>
<td>LDL/HDL</td>
<td>4.79±1.83</td>
<td>2.86±1.26</td>
<td>−1.92±0.57</td>
<td>7.05</td>
<td>0.0001**</td>
</tr>
</tbody>
</table>

TC: Total cholesterol.
HDL: High density lipoprotein.
LDL: Low density lipoprotein.
TG: Triglycerides.

**: Highly significant, $p \leq 0.05$.**

Table (3): Comparison between the amounts of change in mean of lipid profile levels after treatment in control group versus study group.

<table>
<thead>
<tr>
<th>Component</th>
<th>Change in control group (A)</th>
<th>Change in study Group (B)</th>
<th>t</th>
<th>p (95% CI)</th>
</tr>
</thead>
<tbody>
<tr>
<td>TC</td>
<td>−72.55±13.294</td>
<td>−71.45±8.91</td>
<td>0.109</td>
<td>0.913</td>
</tr>
<tr>
<td>HDL</td>
<td>0.3±2.99</td>
<td>3.1±1.96</td>
<td>1.213</td>
<td>0.232</td>
</tr>
<tr>
<td>LDL</td>
<td>−59.23±3.05</td>
<td>−59.87±7.85</td>
<td>0.062</td>
<td>0.951</td>
</tr>
<tr>
<td>TG</td>
<td>−68.1±14.5</td>
<td>−73.4±43.3</td>
<td>0.297</td>
<td>.768</td>
</tr>
<tr>
<td>LDL/HDL</td>
<td>−1.46±1.22</td>
<td>−1.92±1.22</td>
<td>1.190</td>
<td>0.241</td>
</tr>
</tbody>
</table>

TC: Total cholesterol.
HDL: High density lipoprotein.
LDL: Low density lipoprotein.
TG: Triglycerides.
Discussion

The reason for choosing lipid profile as a sole method of assessment was based on the fact that LDL/HDL ratio is considered as a valuable tool in evaluating coronary heart disease risk. Numerous reports show LDL-C/HDL-C to be a more accurate predictor of risk than LDL-C alone. Currently, this is the most practical approach available. Atherosclerotic patients have high tendency toward hyperlipidemia represented by elevated Total cholesterol, triglycerides and LDL, while decreased levels of HDL, thus significant increase in LDL/HDL ratio might be noted. Current research suggests risk of death from cardiovascular disease begins to increase significantly around a ratio of 3.3-3.7 [9].

Results of this study have shown that there is no significant difference of adding blue Laser blood irradiation sessions to atherosclerotic patients who are on Statins therapy, in purpose of restoring normal lipid profile.

The first study conducted to proof the effect of intranasal red laser in treating hyperlipidemia was presented by Jing-quan, he has randomly assigned 30 patients with hyperlipidemia into two groups, 15 in control group, 15 in (Intranasal Low Intensity Low Laser Therapy) ILILT group, then he treated ILILT group with LGAL Diode at 650nm and 5mW for 45 minutes each time, which was done once a day for seven days. This procedure was repeated one more time after a period of five days for rest. He found that fat adjusted function by low level laser nose cavity irradiation therapy is relatively weak in comparison to Statins therapy, but on consideration of safety, laser nose cavity irradiation has a significant applicable value for those of ineffective diet control [10].

Jing-quan and Kemalov [4] proposed an explanation to the previous study as follows: Laser therapy can activate enzymes in blood, which can decompose over-fat in blood, thus reducing blood fat. In addition, it can break off some molecular bonds in glucose of blood, thus glucose alcohol decomposition produce ATP energy, and red cell obtain enough energy, as a result, its deformability increases. Meanwhile, there is a decrease in platelet aggregation which originally suffered an increase, due to increased levels of serum oxidized LDL [11], this leads to improvement in blood viscosity and hemorheological properties [10]. Low level laser therapy might also raises and restores the negative surface charge of the RBCs, rebalancing the play with electrolytes, and restoring their natural state of the RBCs repelling each other.

The rationalization for using blue laser type was based on the assumption that blue laser provide tissues with higher energy than red laser, and the more energy given to blood cells, the more ATP will be produced, and the better its overall function [13]. Also the findings of Romberg [12] could favor the use of blue laser. He stipulated a graph demonstrating the greater absorbability of blue (405) laser by Hemoglobin than red (632), infra red (805), or Green (532) laser. According to Romberg: Up till now, it was believed that especially irradiation in the red range was particularly effective, due to the absorption spectrum of cytochrome-C-oxidase in the respiratory chain with a stimulation of the ATP-synthesis. The originally Russian studies were all carried out with red light Laser of the wavelength 632, 805nm of the helium-neon-Laser, because in the beginning there was no Laser in the shorter wave range (green or blue) available. When red Laser light is conducted through the bloodstream, the veins light up in bright red, because the red light is not absorbed thoroughly by erythrocytes. So, it should make sense to use blue Laser light for Laser blood irradiation as well. When blue Laser light is conducted into a vein, we practically will not see any blue shining through the skin since the “red” erythrocytes are absorbing blue light virtually completely.

According to the work of Csoma [13], ultraviolet B (UVB) laser is highly effective for the treatment of inflammatory skin diseases. Since UVB irradiation has been shown to exert both local and systemic immunosuppression. Such findings could produce beneficial action when dealing with atherosclerotic inflammatory process.

The rationalization for using intranasal technique was built upon the fact that there is a rich

![Fig. (3): Mean value of change in lipid profile components after treatment in control group versus study group.](image-url)
vascular capillary bed just beneath the thin walls surrounding the nasal cavity. These capillaries are specifically designed for rapid passage of fluids through the vascular wall, and out into the dry air. The vascular walls in this region are particularly thin and sensitive, making them highly receptive to any biostimulation. The amount of blood flow to this area is considerable, and it is higher per unit of tissue than the blood flow to the brain, liver or muscle [10]. What adds to this technique a superior advantage, over intravenous technique, is its non-invasive nature.

Different studies have confirmed that, the optimum time for treatment must exceeds 20 minutes, as a very short period of time might not irradiate a considerable amount of blood cells, and thus does not yield notable changes. Besides the study which stressed that short period of time might increase immune activity while longer period of irradiation is accompanied by immunosuppressive effect [15].

The results of this study showed that there was a noticeable improvement in the levels of the four measured components of lipid profile, but there was no significant difference between the scores of the two groups. The findings of the current study may be attributed to the fact that Statins, as a powerful modifier of lipid profile, has depicted its efficacy in both groups, thus masking the effect of Laser in the study group.

Statins target hepatocytes and inhibit HMG-CoA reductase, the enzyme that converts HMG-CoA into mevalonic acid, a cholesterol precursor, thus cutting the process of cholesterol synthesis from its beginning [15]. While the proposed theory for Laser irradiation depends on modification of the current cholesterol level through de-oxidizing ox-LDL, and activation of certain enzymes in blood, i.e.: SOD [17].

The immediate post treatment evaluation might contribute to non-significant results to some extent. The length of the period after which post treatment evaluation was done, has met some contradictory opinions among different researchers. Lew (2010) [5], who studied the effect of Laser on hemo-coagulation, reported greatest effect immediately after the end of the assigned number of sessions, while Kovalyova [6], who studied the effect of combined Laser technique on dyslipidemia, reported a great difference between assessing the levels of cholesterol immediately after treatment, and after one month of treatment. The latter found that hyperlipidemic action of CLT has been distinctively revealed in one month after the performed treatment, with efficient reduction of TC level [18].

By reviewing the last facts, and how low level laser blood irradiation affect the patients, we could reach to the fact that wave length of 405, intensity 5mw and duration 30 minutes per session, three sessions per week for successive four weeks if combined with Statins therapy, could not cause superior improvements to using Statins alone. And consequently Blue Laser could not add any significant benefits to patients on Statins therapy. Thus we accepted the null hypothesis. The next step in this research series would be assessing the sole efficacy of blue laser on hyperlipidemic patients to study group, versus sole effect of Statins therapy on the control group, in addition to considering a sufficient distance in time between the end of sessions and the final lipid profile assessment.

Conclusion:

On the basis of the present data, it was possible to conclude that low level blue laser blood irradiation therapy with the used parameters, did not add significant changes when combined with Statins therapy, in the management of dyslipidemia in atherosclerotic subjects.

Recommendations:

Further investigations are needed to determine the effect of blue laser blood irradiation on hyperlipidemic patients under different doses of Statins therapy and taking the duration of administration in consideration.

References


