# Arteriosclerosis - Atherosclerosis

## Low Level Laser Therapy in the Treatment of Arteriosclerosis of the Lower Limbs

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**Abstract**
Twenty patients with arteriosclerosis in the lower limbs were treated by low level laser therapy with lumbar paravertebral application a 20mW continuous wave He-Ne laser(632nm> and simultaneously a 250mW continuous diode laser (830 nm> was applied transcutaneously to the lumbar region by the scanner for 30 minutes 6 days per week for 2 months. The mean value of percentage of success was 87.2%. The results of the study indicate that low level laser therapy can influence beneficially arteriosclerosis in the lower limbs which is generally difficult to treat.

**Introduction**

Arteriosclerosis is a chronic obliterative disease affecting the lower portion of the aorta, its main branches and the arteries supplying the extremities. The condition occurs predominantly in patients between the ages of 45 and 70 years. It is present much more frequently in males than in females. It may be caused by an error in the metabolism of lipids (Oliver, 1955). Buck (1959) believed that the abnormal vascularization of the arterial wall has also been proposed as a significant factor in the development of the disease. Also, the Question of heredity as a factor in the pathogenesis of the disease must be raised (McKusick, 1958). The patient complains of pain in the extremities typical of intermittent calculation and difficulty in walking, finally rest pain is experienced particularly at night, characterized by a sensation of coldness or burning, hyperesthesia and tingling (Abramson, 1974). The purpose of the study was to evaluate the efficacy of low power laser in the treatment of arteriosclerosis. Materials and methods Twenty patients with arteriosclerosis of the lower limbs from the out-patient clinic of the General medicine Department of both Tanta University Hospital and Alhikmah Hospital, Mansoura were included in the study. The male to female ratio was 4:1. The ages ranged from 45 to 69 years. The duration of symptoms ranged from one to 8 months (table 1). The patients were experiencing pain in both calf muscles after walking distances (claudication distance) ranging from 200 to 500 meters. Three patients experienced rest pain at night. Clinical examinations revealed palpable walls of superficial arteries, particularly the dorsalis pedis. In the study, the claudication distance was determined for every patient in meters prior to treatment. Control normal individuals within the patients' age group walked an average of 1500 meters without experiencing calf pain.

**Results**

Pain was relieved in 16 patients who received 3 to 7 courses of treatment. Eight patients were able to walk 1500 meters without experiencing any pain in the calf muscles, hence their rate of

success was 100%. The remaining patients showed improvement from 73% to 95 (table 2). Three patients discontinued treatment for reasons not related to the treatment. One patient, age 69, with 4 months duration and claudication distance of 240 meters showed no improvement after receiving 7 courses of treatment. The mean rate of success was 87.2%.

## Discussion

It was not easy to discuss the treatment of arteriosclerosis and only in the last 20 years have advancements been made. Although physical therapy is only part of the total management of arteriosclerosis of the lower limbs, it could play an important role in the management. No references were found in literature concentrating the use of low level laser therapy in the management of arteriosclerosis. This work has shown that low level laser therapy is capable of increasing the circulation in muscles and, with prolonged treatment, a considerable significant improvement in circulation can be achieved in cases of arteriosclerosis. Low level laser therapy not only influences the superficial circulation but also deep circulation. The mechanism of this action is probably due to the sympathetic effect, but it could also be used on the action of normal skin excitation. It can be assumed that apart from the increase in the pain threshold (Nikolova, 1968) and muscular excitation threshold, there is also an increase in the threshold for sympathicus stimulation (Pabst, 1960). By this paravertebral application, we must concede more importance to the sympathicus action, than to the direct action on the vasometer assumed by some authors (Monode, 1951; Zinn, 1956). The results obtained in the treatment of arteriosclerosis by means of low level laser therapy are certainly based on a number of different effects. First, there is sympathetic action. Also, the analgesic action of this type of current deserves special attention, since it is the cause of the subjective improvement which frequently precedes the objective improvement in cases of sever arteriosclerosis when pain is felt while resting. Also, rest pain did not mean the presence of irreversible pathologic change as the three patients with rest pain showed a good degree of improvement. The patient who showed no improvement after 7 courses of treatment may have an irreversible pathologic change and, this age of 69 years may have also contributed to the failure of treatment.

## Conclusion

Low level laser therapy may be considered in the treatment of peripheral arteriosclerosis.

**Table 1 - Clinical data and claudication distance**

| No | age | sex | Duration of pain in months | Claudication distance in meters |
|---|---|---|---|---|
| 1. | 45 | Male | 7 | 250 |
| 2. | 50 | Male | 6 | 300 |
| 3. | 49 | Male | 4 | Rest pain |
| 4. | 55 | Female | 3 | 360 |
| 5. | 54 | Male | 4 | 380 |
| 6. | 60 | Male | 6 | 200 |
| 7. | 58 | Male | 8 | 320 |
| 8. | 69 | Male | 4 | 240 |
| 9. | 63 | Male | 3 | Rest pain |
| 10. | 60 | Male | 4 | 350 |
| 11. | 62 | Male | 3 | 380 |
| 12. | 59 | Male | 4 | 400 |

| | | | | |
|---|---|---|---|---|
| 13. | 58 | Female | 5 | 450 |
| 14. | 56 | Female | 6 | 500 |
| 15. | 60 | Male | 7 | 300 |
| 16. | 55 | Male | 2 | 250 |
| 17. | 54 | Male | 1 | Rest pain |
| 18. | 60 | Female | 3 | 350 |
| 19. | 64 | Male | 2 | 300 |
| 20. | 58 | Male | 5 | 260 |

**Table 2 - Claudication distance in metres before treatment and the distance walked without experiencing pain after treatement.**

| No | Distance before treatment | Distance after treatment | Improvement |
|---|---|---|---|
| 1. | 250 | 1300 | 84% |
| 2. | 300 | 1450 | 85.8% |
| 3. | Rest pain | 1100 | 73.3% |
| 4. | 360 | 1500 | 100% |
| 5. | 380 | 1500 | 100% |
| 6. | 200 | Discontinued | - |
| 7. | 320 | 1350 | 87.2% |
| 8. | 240 | No improvement | 0% |
| 9. | Rest pain | 1200 | 80% |
| 10. | 350 | Discontinued | - |
| 11. | 380 | 1500 | 100% |
| 12. | 400 | 1500 | 100% |
| 13. | 450 | 1500 | 100% |
| 14. | 500 | 1500 | 100% |
| 15. | 300 | 1500 | 100% |
| 16. | 250 | 1350 | 88% |
| 17. | Rest pain | 1250 | 83.3% |
| 18. | 350 | 1500 | 100% |
| 19. | 300 | 1400 | 91.6% |
| 20. | 260 | Discontinued | - |

Vopr Kurortol Fizioter Lech Fiz Kult. 2001 May-Jun;(3):5-7.

## [Supravascular laser exposure in combined modality treatment of patients with arteriosclerosis obliterans of blood vessels of lower extremities]

[Article in Russian]

**Leont'eva NV, Evdokimova TA, Sedletskaia EIu, Dmitrieva IaV, Zolotnitskaia VP.**

The efficiency of supravascular laser exposure in multiple-modality treatment of patients with atherosclerosis obliterans with distal vascular lesions is demonstrated and the method of noninvasive laser exposure of the lower limbs is validated. Difficulties in the treatment of this category of patients prompted supplementing traditional therapy by supravascular laser exposure in 32 patients. No laser therapy was used in the controls.

Khirurgiia (Mosk). 2003;(4):14-9.

## [Low-intensive laser irradiation in combined treatment of lower limbs atherosclerotic lesions]

[Article in Russian]

Lipatova IO, Arslanova VM, Kriuchkov VI, Markov AN, Sakharov AB.

Seventy-one subjects entered this study. The control group consisted of 12 healthy subjects, the comparative group included 15 patients who received standard therapy of vascular diseases but without physiotherapy. The study group consisted of 44 patients whose treatment was supplemented with laser irradiation. Angiography, ultrasonic dopplerography, laser flowmetry, oxygenometry were applied for control of treatment efficacy. Regional ischemia was evaluated with detection of pO2 of foot. LT increased oxygenation of foot soft tissues in patients with low primary pO2 and decreased in ones with higher. As a result the number of patients with low pO2 ($0 < pO2 < 20$) decreased from 13.7 to 4.5%, with middle pO2 ($20 < pO2 < 40$) increased from 27.3 to 50.0%, with high pO2 ($pO2 = 40$) decreased from 59.0 to 45.5%. Redistribution in favor of $20 < pO2 < 40$ is regarded as normalizing effect of LT. It is concluded that LT increases oxygenation of foot soft tissues in patients with low primary pO2 and decreased in ones with higher.

Lik Sprava. 2002;(8):98-102.

## [Low intensity laser radiation in complex therapy of patients with vascular obliterating atherosclerosis of low extremities]

[Article in Russian]

Klimenko IT, Shuvalova IN.

It is shown that laser therapy used in a multiple-modality treatment of patients with obliterating atherosclerosis of vessels of the interior limbs presenting with stage I-III ischemia permits achieving a substantial clinical effect manifested subjectively by fewer compliants or disappearance thereof in a proportion of patients, which fact is corraborated by objective findings such as increase in peripheral, volumetric blood flow and lower degree, in some patients, of ischemia of the extremities, improvement in processes of microcirculation and hemocoagulation. The use of laser radiation and pneumocompression combined in treatment of patients with chronic arterial insufficiency of the lower extremities of atherosclerotic genesis has been shown to have a more marked and appreciable effect. The studies made broaden our possibilities of conservative non-medicamentous treatment of obliterating atherosclerosis of vessels of the lower extremities.

Vopr Kurortol Fizioter Lech Fiz Kult. 1998 Jul-Aug;(4):31-6.

## [The combined action of infrared radiation and permanent and alternating magnetic fields in experimental atherosclerosis]

[Article in Russian]

Zubkova SM, Varakina NI, Mikhailik LV, Bobkova AS, Maksimov EB.

Paravertebral exposure to infrared radiation (0.87 micron, 5 mW) and permanent magnetic field in combination with one- and two-semiperiodic alternative magnetic fields (50 Hz, 15-30 mT) was studied in respect to the action on adaptive reactions in animals with experimental atherosclerosis. Complex consisting of infrared radiation, permanent magnetic field and one-semiperiodic pulse alternative magnetic field was most effective in restoration of vasomotor-metabolic and immune disturbances accompanying development of atherosclerosis.

## Dynamics of lipid metabolism and peripheral blood flow rates in patients with atherosclerosis in conjunction with renal dysfunction after the course of combined laser therapy.

Kovalyova T V et al.

During an 8 year period patients with atherosclerosis and renal dysfunction have been treated with intravenous laser blood irradiation (ILBI). The study has demonstrated a decreased level of total cholesterol, LDL cholesterol and triglycerides with an simultaneous increase of HDL cholesterol levels. No pharmaceuticals were given during the treatment period. The authors state that ILBI results in a stable hypolipidemic situation which prevents atherogenesis in patients with metabolic disorders, particularly in patients with renal pathologies.

## [Low intensity laser irradiation in therapy of elderly patients with occlusive artery diseases]

[Article in Russian]

**Korkushko AO, Chupryna GN.**

Shown in the paper is a novel complex approach to the treatment of occlusion affections of arteries by He-Ne and infrared laseropuncture. As many as 80 patients having a history of the above health problem 5 years in duration were kept under medical supervision. Patient age ranged between 50 to 78 years. Laseropuncture was carried out with the aid of the infrared laser stimulator [symbol: see text]-001 (wavelenth 0.89 mm with continuous-wave pulse operation, pulse power 8 W) and 111 He-Ne laser (wavelength 0.63 mm, power density 5 mW/cm2, spot diameter 25 mm). 88.2 percent of patients derived apparent therapeutic benefit, 11.8 percent demonstrating a satisfactory clinical effect.

Sov Med. 1990;(3):21-3.

## [Intravenous laser irradiation of the blood in occlusive vascular diseases of the extremities]

[Article in Russian]

Shval'b PG, Zakharchenko AIa, Sigaev AA, Kataev MI.

The authors analyze the results of clinical application of intravenous He-Ne laser irradiation of the blood in patients with obliterating diseases of the limb vessels. Starting from 1984, this method was employed in the treatment of 133 patients, of these 102 ones with atherosclerosis obliterans of the lower limb vessels, 17 with endarteritis obliterans, and 14 with Raynaud's syndrome. Intravenous laser therapy proved to the most effective in atherosclerotic involvement of the vessels, when positive result was achieved in 77.5 percent of patients. The length of remission was up to 6 months. the method of treatment is described.

Circulation. 1992 Feb;85(2):756-68.

## Percutaneous delivery of low-level laser energy reverses histamine-induced spasm in atherosclerotic Yucatan microswine.

**Gal D, Chokshi SK, Mosseri M, Clarke RH, Isner JM.**

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BACKGROUND. Previous in vitro experiments performed in our laboratory have shown that low-level laser energy may produce prompt reduction in isometric tension of vascular smooth muscle. The present study was designed to extend these previous in vitro findings to an in vivo model and thereby investigate the hypothesis that laser light delivered percutaneously in vivo could successfully reverse arterial spasm. METHODS AND RESULTS. Spasm defined as greater than 50% reversible reduction in luminal diameter persisting for greater than or equal to 5 minutes was successfully provoked by injection of histamine (100-400 micrograms/kg) in 13 arteries among 10 atherosclerotic Yucatan microswine; the magnitude of histamine-induced vasoconstriction was then documented angiographically by repeated injections of contrast media for as long as 30 minutes (controls). After return of angiographic luminal diameter to baseline, spasm was reproduced with a second injection of histamine into the same artery. Representative wavelengths generated by ultraviolet (UV), visible, and infrared lasers were then delivered percutaneously via conventional fiberoptics to the site of spasm, and angiographic assessment was repeated for as long as 30 minutes (treatment trial). In three arteries treated with UV (351 nm) light from an excimer laser, angiographic luminal diameter narrowing decreased from 100% to 23.9%, 50.0% to 9.3%, and 76.0% to 42.3%, respectively. The magnitude of laser-induced increase in luminal diameter was 50.2 +/- 22.7%, which was significantly greater than the magnitude of relaxation observed spontaneously during the control trials (10.9 +/- 9.8%, $p = 0.02$). Visible light from a helium-neon (632 nm) laser accomplished complete reversal of histamine-induced spasm in two of four arteries; in the remaining two arteries, luminal diameter narrowing percentages were reduced from 57.0% to 20.0% and from 76.5% to 30.8%, respectively. The magnitude of helium-neon laser-induced relaxation (55.8 +/- 17.9%) was again significantly greater than that observed during the control trials (0.9 +/- 1.9%, $p = 0.01$).

Finally, infrared irradiation from a diode-pumped neodymium:yttrium aluminum garnet (1,064 nm) laser decreased histamine-induced luminal diameter narrowing in three arteries from 100% to 21.4%, 56.0% to 8.7%, and 68.3% to 35.3%, respectively. The magnitude of infrared laser-induced improvement in luminal diameter narrowing was 53.0 +/- 23.3%, which was significantly greater than that observed during the control trials (12.9 +/- 10.7%, $p = 0.01$). In three additional arteries, fiberoptic sham trials (without laser irradiation) failed to produce relaxation of histamine-induced spasm. **CONCLUSIONS**. These findings document for the first time that light-induced relaxation of vascular smooth muscle, previously documented in vitro, may be reproduced in vivo.