

Original Article

## Clinical Study on the Effect of Exterior Vascular Laser Irradiation Therapy by Live Blood Analysis

Eun-Hyoung Lee, Jae-Ook Jeong, Sung-Soon Min, Su-Jin Song, Won-Il Kim  
Dept. of Internal Medicine, College of Oriental Medicine Dongeui University.

**Objectives :** The purpose of this study was to investigate the effect of exterior vascular laser irradiation therapy by live blood analysis.

**Methods :** We analysed the changing forms of the live blood sample with a microscope before and after exterior vascular laser irradiation therapy of the blood.

**Results :** Rouleau of red cells, erythrocyte aggregation of red cells, thrombocyte aggregation, uric acid crystals, red crystals, and protoplasts in blood were decreased significantly after exterior vascular laser irradiation therapy.

**Conclusions :** This study suggests that exterior vascular laser irradiation will have positive effects in eliminating various effete matters in blood and will have efficacy in the treatment and prevention of cardiovascular system disorders and hyperlipidemia, caused by effete matters, or numbness and arthralgia caused by blood stagnancy and blood circulation disorder.

**Key Words:** low level laser, exterior vascular laser irradiation therapy(EVLI), live blood analysis

### Introduction

Live blood analysis is a test methodology to approach the risk factors of illness, states of immunity, nutritional states of cells, degrees of hidden lesions, or treatments over time. The analysis can accomplish these goals functionally and preventively by observing morphological changes of ingredients constituting blood, which is alive without being chromated and collected through peripheral blood vessel. The process uses high

resolution, dark-field microscopes, interference microscopes, and polarizing microscopes<sup>1)</sup>. Laser treatment, one of the phototherapies, is divided into High Level Laser Therapy(HLLT) and Low Level Laser therapy(LLLT). HLLT that is typical with CO2 lasers destructs and vaporizes cells in a few seconds. It is widely used in the field of surgery since it has the advantage of being able to eliminate lesions without bleeding, edema, or damage to peripheral tissues while performing a surgical operation<sup>2)</sup>. LLLT is known as having biostimulation that changes the activities of cells depending on wavelength, but without a big thermal change. LLLT as phototherapy is one of the warming meridian therapies in terms of Oriental medicine<sup>3)</sup>.

LLLT is divided into Intravascular Laser Irradiation(IVLI) and Exterior Vascular Laser Irradiation(EVLI). IVLI gives

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Correspondence to : Won-Il Kim, Department of Circulatory Internal Medicine, College of Oriental Medicine Dongeui University, YangJung-Dong, San 45-1, Jingu, Pusan, Korea; Tel:82-51-850-8631, Fax:82-51-867-5162, E-mail: omdstar@deu.ac.kr

pain, and is infectious, while EVLI doesn't give pain, and is not infectious. Furthermore, EVLI is semi-permanent, so only it is used.

There are active attempts to apply lasers to prevention and treatment of various diseases such as hyperlipidemia. In relation to its effect, there papers have been produced by Hwang et al<sup>4)</sup> and Shin et al<sup>5)</sup>, Lee et al<sup>6)</sup> regarding IVLI, and Jung et al<sup>7)</sup>'s paper regarding EVLI.

This study shows that the two therapies are both clearing blood therapies. Till now, there has been Gong et al<sup>8)</sup>'s paper regarding the efficacy of IVLI, but there have not been studies that validate the efficacy of EVLI through live blood analysis.

For this purpose, the author conducted live blood analysis of patients with various chief complaints who came to \*\* Oriental Hospital in order to be treated with lasers from 1999 through 2005. Live blood analysis were conducted to those before/after EVLI. Of them, 57 patients who improved with regard to their chief complaints were observed. As a result, this study suggests significant results.

## Materials and Method

### 1. Subjects of Study

Of the patients who came to \*\* Oriental Hospital in order to be treated with lasers from 1999 through 2005 and who were treated with EVLI, this study selected 57 patients to whom treatment was completely provided, live blood analysis was available and improvement of chief complaints was shown after treatment. Those whose treatment interval was too long, or who took medication while in treatment, or took medication related to blood circulation improvement were excluded.

The subjects totalled 57 persons. They can be divided according to age as follows: in their thirties were 1 (1.80%); those in their forties were 20 (35.10%); those

in their fifties were 16 (28.10%); those in their sixties were 16 (28.00%); and those in their seventies were 4 (7.00%). In terms of gender, males were 23 (40.35%) and females were 34 (59.65%).

### 2. Methodology

#### 1) Exterior vascular laser irradiation therapy

Live blood analyses were conducted on those patients who first came to the hospital, before treatment, and irradiation was made to Naegwan(內關, PC 6) and Sameumgyo(三陰交, SP 6) of the patients for 20 minutes per one session at 40mW, using LAPEX 2000-Meridian, a low level laser apparatus by EVLT. As general clinical treatments are composed of 10 sessions, this study determined the "1st treatment" as follows in order to give it appropriateness as possible: a total of 10 session treatments with interval of a few days. Immediately before and after treatment, live blood analysis was conducted to all the patients who were treated.

#### 2) Live blood analysis

Peripheral blood was collected from the fingertips and put on to the cover glass. It was put over the slide glass within 5 seconds, and the diameter of the blood which was dropped on to the slide glass was limited to 1cm. In order to make it spread evenly, tapping was made from the four sides with 10 times per one side until transparent parts of blood appear. Oil was dropped on the microscope so that live blood could be observed as clearly as possible, and examination was made within 5 minutes. In order to secure as much exactness as possible, one person worked on the examination of all the patients.

As information that may be identified through a microscope, observation was made for the items such as rouleau of red cell, erythrocyte aggregation, thrombocyte aggregation, uric acid crystals, red crystals, protoplast,

**Table 1.** Effect of EVLI Therapy on Rouleau of Red Cell

	Decrease	Maintenance	Increase	Total	<i>p</i>
1st EVLI Group	38 (66.67%)	17 (29.82%)	2 (3.51%)	57(100%)	<i>p</i> < 0.0001
2st EVLI Group	2 (28.57%)	2 (28.57%)	3 (42.86%)	7(100%)	

**Table 2.** Effect of EVLI Therapy on Erythocyte Aggregation of Red Cell

	Decrease	Maintenance	Increase	Total	<i>p</i>
1st EVLI Group	31 (54.39%)	20 (35.09%)	6 (10.53%)	57(100%)	<i>p</i> = 0.0003
2st EVLI Group	1 (14.29%)	4 (57.14%)	2 (28.57%)	7(100%).	

which are frequently used in clinical practice.

### 3. Definitions

#### 1) Rouleau of red cells

Rouleau of red cells refers to the phenomenon in which red blood cells are in a curled state as if coins are piled up. In this state, the red blood cell surface decreases greatly.

Rouleau of red cells can be easily distinguished from erythrocyte aggregation with tapping at a slide under live blood analysis. It often occurs in connection with intake of low proteins, malfunction in pancreas, indigestion due to excessive intake of pro-teins, overwork, stress, smoking, dehydration due to insufficient intake of water and congestion.

#### 2) Erythrocyte aggregation

Hemagglutination refers to a cluster of red blood cells. It is more malignant than rouleau of red cell in that it is not separated even though the slide glass is tapped.

#### 3) Thrombocyte aggregation

A platelet is small plate-shaped substance in blood. It is in such a membraned structure as to be easily fragile. It is a blood substance that is absent of nucleus, and is easily attached to irregular or wound surface. While a normal platelet is present separately, an agglutinated

platelet is clustered.

#### 4) Uric acid crystals

Uric acid crystals is crystal-shaped substance within plasma. This suggests that it is necessary to alkalyfy acidified body.

#### 5) Red crystals

Red crystals is red or orange crystallized tissue that is sometimes seen in protoplast. It is associated with toxins in the intestines due to feces or dregs, maldigestion, constipation, or heavy meal intoxication.

#### 6) Protoplasts

Protoplast is a large gray cell cluster. The initial state of arteriosclerotic spot shows the necessity of reducing intake of cholesterol<sup>9)</sup>

### 4. Analysis of Data

Before/after treatment, erythrocyte aggregation, thrombocyte aggregation, whether uric acid crystals, red crystals, and protoplasts changed or not were analyzed with frequency and percentage depending on when the finding of abnormal blood decreased, when there was maintenance, and when the finding of abnormal blood increased. And then, a statistical test was made with Chi-Square Test.

**Table 3.** Effect of EVLI Therapy on Thrombocyte Aggregation

	Decrease	Maintenance	Increase	Total	<i>p</i>
1st EVLI Group	33 (57.89%)	23 (40.35%)	1 (1.75%)	57(100%)	<i>p</i> < 0.0001
2st EVLI Group	4 (57.14%)	1 (14.29%)	2 (28.57%)	7(100%)	.

## Results

### 1. Rouleau of red cells

As a result of observing rouleau of red cells before/after 1-10 EVLIs, "decrease after treatment" was found in 38 cases (66.67%), "maintenance" was found in 17 cases (29.82%), and "increase after treatment" was found in 2 cases (3.51%). This demonstrates that ten of EVLI significantly affect the decrease of rouleau of red cells ( $p < 0.0001$ ).

As a result of observing rouleau of red cells before/after 11-20 EVLI, "decrease after treatment" was found in 2 cases (28.57%), "maintenance" was found in 2 cases (28.57%), and "increase after treatment" was found in 3 cases (42.86%)(Table 1).

### 2. Erythrocyte aggregation

As a result of observing erythrocyte aggregation before/after 1-10 EVLI, "decrease after treatment" was found in 31 cases (54.39%), "maintenance" was found in 20 cases (35.09%), and "increase after treatment" was found in 6 cases (10.53%). This demonstrates that ten of EVLI significantly affect the decrease of erythrocyte aggregation ( $p = 0.0003$ ).

As a result of observing erythrocyte aggregation before/after 11-20 EVLI, "decrease after treatment" was found in 1 case (14.29%), "maintenance" was found in 4 cases (57.14%), and "increase after treatment" was

found in 2 cases (28.57%)(Table 2).

### 3. Thrombocyte aggregation

As a result of observing thrombocyte aggregation before/after 1-10 EVLI, "decrease after treatment" was found in 33 cases (57.89%), "maintenance" was found in 23 cases (40.35%), and "increase after treatment" was found in 2 cases (1.75%). This demonstrates that ten of EVLI significantly affect the decrease of thrombocyte aggregation ( $p < 0.0001$ ).

As a result of observing thrombocyte aggregation before/after 11-20 EVLI, "decrease after treatment" was found in 4 cases (57.14%), "maintenance" was found in 1 case (14.29%), and "increase after treatment" was found in 2 cases (28.57%)(Table 3).

### 4. Uric acid crystal

As a result of observing uric acid crystals before/after 1-10 EVLI, "decrease after treatment" was found in 30 cases (52.63%), "maintenance" was found in 21 cases (36.84%), and "increase after treatment" was found in 6 cases (10.53%). This demonstrates that ten of EVLI significantly affect the decrease of uric acid crystals ( $p = 0.0004$ ).

As a result of observing uric acid crystals before/after 11-20 EVLI, "decrease after treatment" was found in 3 cases (42.86%), "maintenance" was found in 2 cases (28.57%), and "increase after treatment" was found in 2

**Table 4.** Effect of EVLI Therapy on Uric Acid Crystals

	Decrease	Maintenance	Increase	Total	<i>p</i>
1st EVLI Group	30 (52.63%)	21 (36.84%)	6 (10.53%)	57(100%)	<i>p</i> = 0.0004
2st EVLI Group	3 (42.86%)	2 (28.57%)	2 (28.57%)	7(100%)	.

**Table 5.** Effect of EVLI Therapy on Red Crystals

	Decrease	Maintenance	Increase	Total	<i>p</i>
1st EVLI Group	17 (29.82%)	30 (52.63%)	10 (17.54%)	57(100%)	<i>p</i> = 0.0044
2st EVLI Group	1 (14.29%)	5 (33.30%)	1 (14.29%)	7(100%)	.

**Table 6.** Effect of EVLI Therapy on Protoplasts

	Decrease	Maintenance	Increase	Total	<i>p</i>
1st EVLI Group	26 (45.61%)	25 (43.86%)	6 (10.53%)	57(100%)	<i>p</i> = 0.0012
2st EVLI Group	2 (28.57%)	4 (57.14%)	1 (14.29%)	7(100%)	.

cases (28.57%)(Table 4).

### 5. Red crystal

As a result of observing red crystals before/after 1-10 EVLI, "decrease after treatment" was found in 17 cases (29.82%), "maintenance" was found in 30 cases (52.63%), and "increase after treatment" was found in 10 cases (17.54%). This demonstrates that ten of EVLI significantly affect the decrease of red crystals (*p*=0.0044).

As a result of observing red crystals before/after 11-20 EVLI, "decrease after treatment" was found in 1 case (14.29%), "maintenance" was found in 5 cases (71.42%), and "increase after treatment" was found in 1 case (14.29%)(Table 5).

### 6. Protoplast

As a result of observing protoplasts before/after 1-10 EVLI, "decrease after treatment" was found in 26 cases (45.61%), "maintenance" was found in 25 cases (43.86%), and "increase after treatment" was found in 6 cases (10.53%). This demonstrates that ten of EVLI significantly affect the decrease of protoplasts (*p*=0.0012).

As a result of observing protoplasts before/after 11-20 EVLI, "decrease after treatment" was found in 2 cases (28.57%), "maintenance" was found in 4 cases

(57.14%), and "increase after treatment" was found in 1 case (14.29%)(Table 6).

## Discussion

Oriental phototherapy stimulates meridians using modernized physical instruments, increasing and smoothing the flow of Qi and blood, resulting in curing diseases. It uses natural or artificial lights. Physical factors used as light therapy include sunlights, ultraviolet rays, visible rays, infrared rays, and laser beam. If meridians are stimulated with these radiation energies, they are controlled on the whole, which results in healing<sup>10</sup>.

A laser is a kind of light which is greatly amplified by stimulating atoms or molecules in an excited state from the outside and making them radiate light that is in regular waves. Lasers increase the energy level when photons are absorbed in substances. Atoms that absorb energies from photons are enhanced to an excitation state from the ground state. However, since atoms in an excitation state are unstable, they immediately and voluntarily return to the ground state. At this time, a laser is generated through spontaneous emission wherein stored energy is released in the form of emission proton<sup>11</sup>). Differences of lasers from general rays are characterized by strong straightness, one color,

and generation of very strong energy<sup>12)</sup>.

In 1917, Albert Einstein provided a theoretical basis for the development of lasers with the principle of magnetic radiation in his quantum theory<sup>11)</sup>. In 1958, Townes and Schawlow suggested the theory of lasers. Maiman first introduced the Rubi laser to medical science in 1960, and in the 1970s Mester reported that radiation of the He-Ne laser to human body acts on local vasodilation, analgesia and anti-inflammation<sup>15)</sup>.

Laser treatment, a kind of phototherapies, is divided into HLLT such as CO<sub>2</sub> laser and Nd :YAG laser, and LLLT such as 633nm He-Ne gas laser, 830nm GaAlAs semi-conductor laser, and 904nm GaAs semi-conductor laser. HLLT destructs and vaporizes cells in a few seconds. It is widely used in the field of surgery since it has the advantage of being able to eliminate lesions without bleeding, edema, or damage to peripheral tissues while performing a surgical operation. LLLT is known as having biostimulation that changes the activities of cells depending on wavelength, but without a big thermal change<sup>16)</sup>.

Looking over the clinical applications in China where more active studies are being made, LLLT has been much studied in neurological disorders such as ischemic encephalopathy, head injuries, spinal cord injuries, dementia, epilepsy, schizophrenia and cardiovascular disorders such as arrhythmia, myocardial infarction, angina pectoris. In addition, it is widely used for urinary system disorders such as chronic nephritis, hyponoia, uremia; respiratory system disorders such as pneumonia, bronchial asthma, bronchitis; and other various diseases such as oblitering phlebitis, rheumatoid arthritis, skin ulcer, optic papillitis, labor pains, damages to soft tissues, burn.

Looking over domestic clinical applications using LLLT, it is mainly used for wound, muscle ache, backache, hyperlipidemia, hypertriglyceridemia, hypercholesterolemia, headache, dizziness, stroke, etc<sup>17)</sup>.

In Oriental medicine, laser is one of warming meridian therapy<sup>18)</sup>. Jang et al<sup>17)</sup> said that LLLT is similar to the action of “augmenting Qi and tonifying the kidney, warming the fire of the vital gate”. LLLT uses superficial vessels in terms of Oriental medicine. It is considered that it prevents diseases through clearing blood and removing the blood stagnation by stimulating the defensive principle and blood that are distributed in superficial vessels.

Rouleau of red cells refers to the phenomenon in which red blood cells are in a curled state as if coins are piled up<sup>9)</sup>. It often occurs in connection with intake of low proteins, malfunction in pancreas, indigestion due to excessive intake of proteins, overwork, stress, smoking, dehydration due to insufficient intake of water and congestion. Also, it appears when blood that was put on to the slide is not quickly smeared<sup>19)</sup>.

In relation to this, Kim<sup>9)</sup> reported that the symptom arises when imbalance of electric charge in plasma is caused by physical or psychological stress, and it leads to decrease of oxygen and nutrients due to blood circulation disorder, accompanying chronic fatigue and maldigestion.

It is erythrocyte aggregation that is worse than rouleau of red cells, and it arises when the flow of oxygen and blood is greatly delayed. It refers to the phenomenon in which red blood cells are aggregated, similar to what is found in a patient with cold agglutinin<sup>20)</sup>. It is deemed that it is associated with indigested lipids or concentration of protein. It is regarded that it is caused by insufficient exercise, deficiency of minerals, toxicity of metals, stress, allergies, insufficiency of hydrochloric acid in the stomach. It is mainly found in chronic regressive diseases such as arthritis, combined bone marrow tumor, diabetes, myocardial infarction, and patients whose intake of alcohol increased.

In relation to the descriptions above, Kim et al<sup>9)</sup>

presented the possibility of correlation among the three phases in red blood cell rouleau of red cells, and Kim et al<sup>1)</sup> also suggested that it was more adequate to identify them as one rather than to separate them as three phases when treating a patient.

Kim et al<sup>1)</sup> regarded rouleau of red cells as an item to reveal the state of Qi to some extent, considering that it is often found in patients who have continuous and strong physical/psychological stress, and Gong et al<sup>8)</sup> regarded it as a concept similar to circulatory disorders by stagnation of Qi and blood stasis. Similarly, the author also deems that the rouleau of red cells and the erythrocyte aggregation suggest a blood circulation disorder and the state of turbid blood.

According to this study, those cases (66.67%) wherein red blood cell rouleau of red cells decreased after treatment after the 1st treatment were much more frequent than those cases of "increased" (3.51%) or "maintenance" (29.82%), and those cases (54.39%) wherein erythrocyte Aggregations that decreased were more frequent than those cases of "increased" (10.53%) or "maintenance" (35.09%). This demonstrates that the therapy has significant effects like the results of Kim et al and Gong et al' study regarding after IVLI. Also, it is considered that it will work on blood circulation disorders or cardiovascular system disorders. However, since, in the case of the second treatment, results of "maintenance" or "increased" were more frequent than those of "decreased", no effects were found.

Thrombocyte aggregation is caused by loss of rebounding in platelets. More activated thrombocyte aggregation constrains permeation in capillary vessels and accelerates blood coagulation, which may result in blood circulation system disorders<sup>21)</sup>. Also, blood coagulation may cause migraine headache, tinnitus, cardioplegia, and stroke. It may be said that this implies the state of blood circulation disorder, blood stagnancy, or turbid blood.

This study suggests that, since those cases (57.89%) wherein thrombocyte aggregation decreased after the 1st treatment are more frequent than "increased" (1.75%) or "maintenance" (40.35%), EVLI has significant efficacy in prevention and treatment of blood circulation system disorders. Decrease of thrombocyte aggregation after the 2nd treatment was more than "increased" or "maintenance" cases, but not significantly in terms of statistics.

Uric acid crystals are crystal-shaped substances within plasma. Excessive uric acid in blood causes maldigestion to meat, in particular, food containing much purine such as entrails. In addition, uric acid crystals may cause inflammation between cells, and uric acid may cause kidney disorders when it is precipitated in ureter or blood capillaries of the kidney. This suggests that it is necessary to alkalyfy acidified body.

Red crystals are red or orange crystallized tissues that are sometimes seen in protoplast. The reason that it is reddish is because of actinomycin which is an antibiotic derived from *Streptomyces* of various species. A patient who has this symptom often shows enterotoxism, which is like bacteria that produce excreta in the intestines. It is associated with toxins in the intestines due to feces or dregs, maldigestion, constipation, or heavy meal intoxication.

Protoplast is a large gray cell cluster. The initial state of an arteriosclerotic spot shows the necessity of reducing intake of cholesterol. Kim et al reported that many protoplasts are found in patients with tumors. This is associated with blood circulation disorder and subnormality of immunologic function<sup>9)</sup>.

As seen above, foreign substances in the plasma such as uric acid crystals, red crystals, and protoplast are associated with the concept of stagnation of Qi and blood stasis and turbid blood.

Those cases (52.63%) wherein uric acid crystals in blood decreased after the 1st treatment were more

frequent than those of "maintenance" (36.84%) or "increased" (10.53%); those cases (29.82%) wherein red crystals decreased or "maintenance" (52.63%) were frequent than those of "increased" (17.54%); and those cases (45.61%) wherein protoplast decreased were more frequent than those of "maintenance" (43.86%) or "increased" (10.53%). This suggests that EVLI has significant effects also on foreign substances, which is in the same context of the result of Kim et al), Gong et al)8) study through IVLI. Through these results, this study suggests that EVLI will have efficacy in gout, joint related disorders, intestinal gas, constipation, blood circulation disorder, arteriosclerosis. However, although with regard to those cases wherein uric acid crystals decreased after the 2nd treatment were more frequent than those of "increased", it is not considered as statistically significant.

In the course of exploring the effect of EVLI through live blood analysis, this study has found that live blood analysis may be helpful in making diagnosis in terms of Oriental medicine and determining effects before/after treatment, and that the He-Ne laser treatment as EVLI may have significant effects in decreasing rouleau of red cells, erythrocyte aggregation, thrombocyte aggregation, uric acid crystals, red crystals, protoplast. Based on these findings, this study suggests that EVLI will have positive effects in eliminating various effete matters in blood and will have efficacy in the treatment and prevention of cardiovascular system disorders and hyperlipidemia, caused by effete matters, or numbness and arthralgia caused by blood stagnancy and blood circulation disorder.

Since EVLI doesn't give pain, and is not infectious, it is expected that it may be applied to children, the elderly or patients with adult diseases, for which retaining the needle is difficult to be used, as alternative therapy of acupuncture and moxibustion treatment.

This study has significance in validating the effects of

EVLI. However, since there were no results observed comparatively with IVLI, it was difficult to identify the number of times for maximum effects of treatment, though it has identified the effects of 10 session treatment, which is mainly used in general clinical treatment.

In order to clarify the effects of live blood analysis in the future, objective dimensional criteria and evaluation methodology with regard to observing samples should be established, and dialectical methodology of live blood analysis should be studied in terms of Oriental medicine. In addition, this study suggests that comparative validation through blood test is necessary.

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