# EXPERIMENTAL METHODS FOR CLINICAL PRACTICE

# Effect of Intravenous Low-Intensity Laser Irradiation of the Blood on Clinical and Laboratory Parameters of Hepatocellular Insufficiency

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Patients with hepatocellular insufficiency received a course of intravenous laser irradiation of the blood. After the treatment, a positive dynamics of clinical and biochemical indices of the major hepatic syndromes was observed: alleviation of the major clinical symptoms and significant positive changes in biochemical parameters (AST, ALT, bilirubin, alkaline phosphatase, lactate dehydrogenase, and total cholrsterol).

**Key Words:** *hepatocellular insufficiency; intravenous laser irradiation of blood*

Increasing medical and social importance of chronic parenchymal liver diseases is associated with their growing prevalence in the population. Hepatocellular insufficiency as the most dangerous clinical manifestation of parenchymal liver disease determines the severity of patient's condition and adverse outcomes irrespective of the underlying etiologic factor [6]. At the same time, only a small number of conservative treatment modalities are available in these patients, while evidence-based efficacy of the existing drugs is not high. Under these circumstances, the search and study of new therapies for hepatocellular insufficiency seem to be an urgent problem [5,7]. Intravenous laser irradiation of the blood (ILIB) is one of such methods proven as an effective and affordable therapy for chronic parenchymal liver diseases [1,4]. However, its use is associated with a tendency to hypocoagulation, which is undesirable for such patients [1-3].

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The aim of the study was to evaluate clinical and laboratory efficiency of ILIB course for short periods of time at short-term exposure to low-power laser radiation minimizing the potential risk of hypocoagulation.

## MATERIALS AND METHODS

The study involved 86 patients aged 23-72 years, treated at therapeutic and neurological departments of Municipal Hospital No. 13 with clinical and laboratory features of hepatocellular insufficiency syndrome as a manifestation chronic nonspecific liver disease. The main group included 38 patients with chronic nonspecific liver diseases with signs of hepatocellular insufficiency syndrome (22 men and 16 women), who received a course of ILIB during the treatment additionally to the basic therapy. The mean age in this group was 47±12 years ($M$±σ). Intravenous irradiation of the blood with low-intensity laser was performed using Mulat laser appliance (Tekhnika) with semiconductor body. To obtain peripheral venous access, disposable

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flexible light guide (Tekhnika) was inserted into the punctured cubital vein. Irradiation (2 mW laser power) was performed for 15 min once a day over 7 days.

The control group included 48 patients (26 men and 22 women) of Municipal Hospital No. 13 treated for chronic parenchymal liver disease with clinical features of hepatocellular insufficiency. They received no ILIB course along with basic therapy. In this group, the mean age was 50±11 years ($M$±σ).

All patients received essential phospholipids, L-ornithine preparations, vitamins $B_1$ and $B_6$, infusion-detoxication therapy, and food according to the diet's guidelines (Diet No. 5) as a part of the basic therapy.

The diagnosis was established on the basis of clinical presentation, medical history, and characteristic shifts in laboratory parameters. Before inclusion in the study, all patients underwent standard peripheral blood and urine tests, ultrasound examination of the abdomen and hepatobiliary system with measurements of portal vein diameter and visualization of the portocaval anastomoses as well as upper endoscopy (esophagogastroduodenoscopy) with an estimate of the possible risk of bleeding from the upper gastrointestinal tract including this from varicose veins in the esophageal plexus.

Patients in whom ILIB could not be performed due to contraindications as well as patients with a history of cancer, hemorrhagic cerebral blood flow disturbances, clinical manifestations of hemorrhagic syndrome both complicating the course of liver disease and against the background of other diseases, and patients diagnosed with high risk of gastrointestinal bleeding were excluded from the study.

Biochemical parameters of blood plasma were measured on a Hitachi-912 laboratory analyzer (Roche Diagnostics) in accordance with the requirements of the Federal system of external quality control. The blood was taken on days 1 and 8 of the study. We evaluated plasma concentration of total protein, albumin, urea, creatinine, total and direct bilirubin, aspartate aminotransferase (AST), alanine aminotransferase (ALT), lactate dehydrogenase (LDH), alkaline phosphatase (AP), γ-glutamine transpeptidase (GGT), and total cholesterol.

Clinical symptoms were assessed by questioning. The patients were asked to report the presence or absence of symptoms (yes/no) on day 1 of the study and report the same symptom on day 8 in case of the absence of significant improvement.

The data were statistically analyzed using Microsoft Excel 3.4 and Biostatistics 4.03 software. Quantitative parameters were presented as mean and standard error of the mean ($M$±$m$). Statistical significance of differences between two independent quantitative parameters was assessed using Mann–Whitney $U$ test. Differences were considered significant at $p<0.05$.

## RESULTS

The total protein level decreased ($p>0.05$) in the main group and insignificantly increased ($p>0.05$) in control group (Tables 1, 2).

The changes in albumin levels in the main group against the background of ILIB were insignificant ($p>0.05$); similar dynamics was observed in the control group (insignificant decrease, $p>0.05$; Tables 1, 2).

**TABLE 1.** Dynamics of Laboratory Parameters in the Main Group ($M$±$m$)

| Parameter | Start of treatment | End of treatment | Dynamic, % | $p$ |
|---|---|---|---|---|
| Protein, g/liter | 72.9±9.2 | 71.6±9.6 | -1.70 | >0.05 |
| Albumin, g/liter | 32.5±8.5 | 32.3±6.5 | -0.40 | >0.05 |
| Urea, mmol/liter | 7.0±4.8 | 5.6±5.1 | -19.80 | >0.05 |
| Creatinine, μmol/liter | 88.1±31.4 | 77.7±26.4 | -11.70 | >0.05 |
| Bilirubin, μmol/liter | 98.3±20.5 | 46.7±21.8 | -52.50 | <0.05 |
| direct | 62.6±17.6 | 27.5±14.9 | -56.0 | <0.05 |
| indirect | 35.4±9.7 | 19.1±9.2 | -45.80 | >0.05 |
| AST, U/liter | 215.8±48.4 | 68.2±49.5 | -68.40 | <0.05 |
| ALT, U/liter | 121.0±33.0 | 51.3±31.3 | -57.60 | <0.05 |
| AP, U/liter | 591.6±101.7 | 372.6±104.5 | -37.00 | <0.05 |
| GGT, U/liter | 1067.3±438.5 | 376.8±291.1 | -64.70 | >0.05 |
| LDH, U/liter | 774.9±98.4 | 541.5±73.4 | -30.00 | <0.05 |
| Cholesterol, mmol/liter | 3.6±0.9 | 5.4±0.7 | +48.01 | <0.05 |

**TABLE 2.** Dynamics of Laboratory Parameters in the Control Group (*M*±*m*)

| Parameter | Start of treatment | End of treatment | Dynamic, % | *p* |
|---|---|---|---|---|
| Protein, g/liter | 74.7±3.6 | 75.1±3.2 | 0.60 | >0.05 |
| Albumin, g/liter | 33.4±8.3 | 31.0±6.2 | -6.90 | >0.05 |
| Urea, mmol/liter | 6.4±6.1 | 6.8±5.1 | 6.50 | >0.05 |
| Creatinine, μmol/liter | 86.6±51.2 | 85.1±34.9 | -1.80 | >0.05 |
| Bilirubin, μmol/liter | 101.8±20.7 | 54.7±22.1 | -46.30 | <0.05 |
| direct | 64.7±16.2 | 32.3±14.2 | -50 | <0.05 |
| indirect | 36.2±10.1 | 22.3±9.9 | -38.40 | >0.05 |
| AST, U/liter | 180.5±39.6 | 92.2±40.5 | -48.90 | <0.05 |
| ALT, U/liter | 111.2±26.5 | 57.9±23.1 | -47.90 | <0.05 |
| AP, U/liter | 569.6±106.1 | 420.8±101.3 | -26.10 | <0.05 |
| GGT, U/liter | 757.0±316.0 | 397.7±306.8 | -47.50 | >0.05 |
| LDH, U/liter | 723.7±99.9 | 568.7±97.5 | -21.41 | >0.05 |
| Cholesterol, mmol/liter | 3.9±1.3 | 5.1±1.3 | +30.00 | >0.05 |

Blood urea level was 7.0±4.8 mmol/liter in the main group at the time of entry into the study and decreased by 19.8% by the end of the study; this parameter increased by 6.5% in the control group ($p>0.05$; Tables 1, 2). Creatinine levels were reduced by 11.7% in patients of the main group on day 8; its reduction by 1.8% was recorded in the control group ($p>0.05$). Total bilirubin was reduced by 52.5% in the main group ($p<0.05$) and by 46.3% in control group ($p<0.05$; Tables 1, 2). Thus, reduction in total bilirubin was by 6.2% more pronounced in the ILIB group.

Direct bilirubin decreased by 56% ($p<0.05$) in the main group and by 50% (*i.e.* by 6% lower; $p<0.05$) in the control group.

AST activity decreased by 68.4% in the main group ($p<0.05$) and by 48.9% in the control group ($p<0.05$). Thus, the more pronounced reduction in AST activity (by 19.5%) was detected in ILIB group over the 8-day period.

ALT activity decreased by 57.6% in the main group ($p<0.05$) and by 47.9% in the control group (*i.e.* by 9.7% less, $p<0.05$).

LDH activity decreased by 30.0% in the main group ($p<0.05$) and by 21.4% in the controls, but the result was not statistically significant in this group.

AP in the main group decreased by 37% ($p<0.05$). In the control group, the relative decrease was 26.1% ($p<0.05$).

In the main group we observed decreased GGT activity by 64.7%, in the control group it was reduced by 47.5% ($p>0.05$ in both groups).

Cholesterol concentration increased by 48.01% in the main group ($p<0.05$) and by 30% in the control group, but the latter result was not statistically significant.

**TABLE 3.** Dynamics of Clinical Symptoms in Patients with Hepatocellular Insufficiency in the Compared Groups on Days 1 and 8 of the Study

| Symptom | Control (*n*=48) | | | | | ILIB (*n*=38) | | | | |
|---|---|---|---|---|---|---|---|---|---|---|
| | before treatment | | after treatment | | dynamics, % | before treatment | | after treatment | | dynamics, % |
| | abs. | % | abs. | % | | abs. | % | abs. | % | |
| Itching | 37 | 77 | 27 | 56 | 21 | 30 | 79 | 14 | 37 | 42 |
| Asterixis | 34 | 71 | 29 | 60 | 11 | 28 | 74 | 22 | 58 | 16 |
| Sleep rhythm disorders | 45 | 94 | 32 | 66 | 28 | 37 | 97 | 12 | 32 | 65 |
| Asthenia | 48 | 100 | 23 | 48 | 52 | 38 | 100 | 11 | 29 | 71 |
| Dyspepsia | 48 | 100 | 29 | 61 | 39 | 38 | 100 | 20 | 53 | 47 |

Table 3 shows the changes in subjective clinical symptoms based on the questioning.

Thus, traditional therapy supplemented by 7-day course of low-intensity ILIB was followed by significantly more pronounced decrease in total and direct bilirubinemia, transaminase activity, LDH and AP levels, and increase in total cholesterol. Addition of ILIB course to the treatment was also accompanied by reliable and significant regression of clinical symptoms and complaints. The 7-day course of low-intensity ILIB in addition to the traditional treatment of hepatocellular insufficiency did not significantly improved the parameters of protein metabolism, urea and creatinine levels as well as GGT activity.

## REFERENCES

1. V. V. Korzhova, V. M. Antokhin, and Kh. M. Mushref, *Lazer. Med.*, **5**, No. 3, 44-49 (2001).
2. T. V. Kuraeva, V. V. Babenko, and A. L. Sokolov, *Gastrobyulleten'*, Nos. 1-2, 49 (2000).
3. V. V. Makashova, A. M. Polyakova, V. V. Malyeev, *et al.*, *Ter. Arkhiv*, **73**, No. 11, 26-30 (2001).
4. V. V. Nedogoda, Z. S. Skvortsova, and V. V. Skvortsov, *Lazer. Med.*, **5**, No. 3, 41-42 (2001).
5. V. V. Skvortsov, Z. S. Skvortsova, and E. M. Skvortsova, *Fizioterapevt,* No. 7, 28-34 (2009).
6. C. Abittan and C. Lieber, *Clin. Perspect. in Gastroenterol.*, Nos. 9-10, 257-263 (1999).
7. T. Berki, *Laser in Medicine Science*, **3**, 35 (1998).