

Laser Treatment of Radiation Injuries of Skin and Underskin Tissues

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URGENCY OF A PROBLEM

The given work today has two practical applications:

1. The treatment of persons who have got under radioactive (ionizing) irradiation by an accident or on occasion.
2. The treatment of oncology patients with beam reactions after a beam therapy on accelerators or radioactive sources.

In our time radiation injury cases are rare. The opportunity of nuclear terrorism is more real: more than 800 cases of plunder and losses of radioactive materials were registered in the world up to 2005.

Oncological clinics with beam therapy are in each country. But some of patients receiving beam therapy (5 % - 10 % from all) cannot finish a course of beam therapy because of change of blood structure or beam burns of skin (initial beam reactions).

Secondary beam reactions - the defeats of internal bodies appearing at patients through some time after carrying out of beam treatment are not less dangerous.

Laser therapy can help such patients in the treatment these beam reactions. But it used now in Saint Petersburg, Russia only [1, 2].

Theoretical bases of laser therapy of radiation injuries

Laser therapy can to speed up regeneration of tissue in irradiated areas and removal struck cells from organism. It can to increase blood microcirculation and to restore phagocytic abilities of leukocytes. So it can normalize a common immunity of an organism.

We have more than 20 years experience of clinical application of various methods of low-energy infra-red (IR) laser radiation for treatment of patients with infectious, neurologic, oncological, skin and endocrinology diseases testified to an opportunity with the help of dosed laser actions to restore the functions of alive cells of various tissues lost because of illnesses in part.

From the other hand the low-energy IR laser radiation can not lead to uncontrolled growth of cells. It was shown at the base of Energy Model of Carcinogenesis [3 - 5].

In the beginning of our researches we have used local laser influences on the injured tissues for normalization of their metabolism. Then we understood, that if we shall irradiate some areas and organs responsible for work of any system of an organism, we can expect normalization of work of this system as a whole. We have named such laser therapy by "system laser therapy».

The results of our restoration of phagocytes activity of leukocytes allocated from blood of patients with a sepsis or HIV-infection in vitro are presented in next table.

Table 1. Change phagocytic activity of the leukocytes allocated from blood of patients

Diagnosis	Phagocytic index. (60% - 64% in norm)		Phagocytic number. (6,3 - 7,0 in norm)	
	Before laser	After laser irradiation	Before laser	After laser irradiation
Urology sepsis	30%	58%	3,4	6,2
HIV infection	38%	60%	3,8	6,3

The special laser « Laser Baby-Sun » with IR radiators matrix was created for acting on internal tissue or organs.



Fig. 1. The therapeutic laser - « Laser Baby-Sun »

Our laser therapy methods are based on results of intensity of laser radiation in various hypodermic tissue and organs calculations and on calculations of laser energy absorbed in any kind of tissue.

Treatment of initial beam reactions of oncological patients

At the first time we have investigated the regress of cancer tissue after beam therapy in laser and control group of patients. We did not find any differences. It means that IR laser influence doesn't cause photoreactivation effect.

The first treatment of initial beam reactions was carried out in Institute of Roentgenoradiology, St. Petersburg by means of laser irradiated the same areas of organism right after a session of beam therapy in 1996.

The group of such patients with tumors of thyroid glands, larynx, prostate gland, uterus cervix cancer, nasopharynx and mammary gland received course of beam therapy on the ROCUS-M facility (gamma-radiation) and LUE-15 (electron accelerator). The primary radiation reactions emerge in 60 % of patients on average.

The laser therapy resulted in a reduction in the frequency of manifestation of primary radiation reactions from 60 % to 15 %.

The duration (severity) of these reactions was also decreased from 5-13 days in the control groups to 3-5 days in the laser group.

Laser therapy of late radiation reactions in oncology patients

The late radiation reactions in forms of radiation damages of inner organs are developing in 10-30 % of patients after the radiation therapy.

The group of patients with uterus cervix cancer with late radiation reactions in form of rectum or urinary bladder bleeding was selected for the laser therapy.

After the completion of laser treatment the patients were observed within no less than 2 years with control examination in 2-3 months.

The results of these researches are presented in next tables.

Table 2. Frequency and the periods of clinical remission of radiolesions

Group	Number of patients	Frequency of full clinical remissions		Period until full remission, Days
		Number	%	
Control	20	18	90	25
Laser group	20	20	100	10

It is enough to note that the traditional treatment did not make it possible to attain complete clinical remission.

Table 3. Frequency and the periods of exacerbation of radiolesions

Group	Number of patients	Frequency of recidivation		Periods until recidivation of radiolesions, Days
		Number	%	
Control	20	8	40	146

Laser group	20	2	10	264
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These results show the efficiency of laser therapy. The period until exacerbation has increased nearly twice. This index is very important for oncology patients.

Then we used laser therapy as method of prophylaxis of radiation reactions and received positive result [1].

Laser therapy for prophylaxis of radiation reactions

This task was set us in 2003 and implemented at the Institute of Roentgenoradiology, Saint Petersburg in scope of ISTC Project 1958.

The group of 230 patients with prostate cancer received radiation therapy (RT.) during the period from 2004 to 2005. The control group included 80 patients who received only the radiation therapy. The laser group consisted of 150 patients.

To assess the effectiveness of the laser therapy the following criteria were taken: PCA level dynamics; regression degree of tumor focus, duration and evidence of the radioreactions of rectum, urinary bladder and skin of the irradiation fields.

The results of this study are presented in next tables.

Radio reactions of a rectum and/or urinary bladder in patients with prostate cancer

Group	Number of patients	Radio reactions			
		Frequency		Beginning, days after RT start	Duration (X±m), days
		un.	%		
Control	80	42	52,5	17±2	11±2
Laser	150	48	32	23±4	7±2

Skin radioreactions in patients with prostate cancer

Group	Number of patients	Radio reactions					
		no		weakly marked		clearly marked	
		abs.	%	abs.	%	abs.	%
Control	80	43	53.8	30	37.4	7	8.8

Laser	150	110	73.3	38	25,3	2	1,3
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The control of the immune status of patients has show that laser action can normalised the compoud of blood our patientson. This effect was the most significant in group patients, who received irradiation of immunocompetent areas (laser system therapy), it was very low at patients who received irradiation only skin irradiated by an electronic beam (laser local therapy) and are not fixed in control group.

The Head Radiation Therapy Department of Roentgenoradiology Institute stated the following in the protocol of these clinical trials:

« We think it appropriate to introduce the like facilities into all institutions involved in radiation therapy of malignant neoplasms ».

We would like to note, that the laser equipment costs much more cheaply in comparison with cost of accelerators or radioactive souses.

Laser treatment of patients with radiation sickness in the clinic of Moscow « Institute of Biophysics »

Patients, which have ever received radiation damage in any district of Russia , are registered in the clinic of the Institute of Biophysics, Moscow.

Laser therapy were applied to treatment of patients of a surgical and neurologic diseases. This division is conditional.

The group of surgical patients were subdivided into 4 groups.

Patients of the first group underwent surgery and received laser treatment, since the conservative treatment could not be successful because of a high irradiation dose received and a large lesion area.

The laser therapy immediately decreased the pain syndrome and reduced the exudative process. After 5 sessions the painful sensations, discomfort and edema were observed to steadfastly reduce.

The laser therapy facilitated the process of operative preparation and further surgery of these patients with successes.

Example of clinical observation. Patient D. 45-year-old (Fig 2) Diagnosis: Consequences of acute radiation disease of severe degree caused by extremely nonuniform beta-gamma irradiation (bone-marrow syndrome of medium degree), acute local radiation lesions of the posterior surface of thorax of extremely severe IV degree.

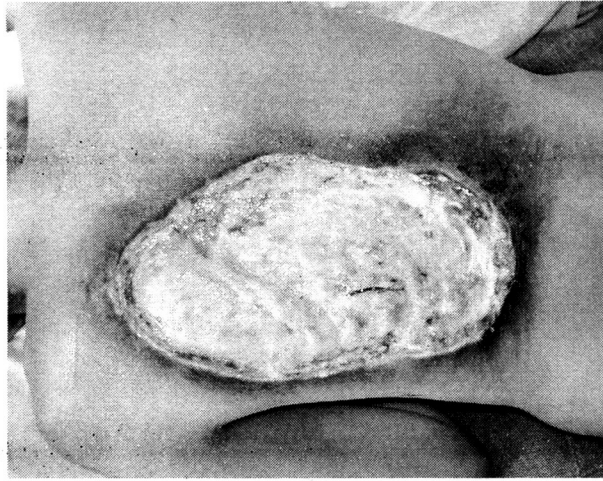


Fig. 2. Radiation ulcer before the laser therapy.

The patient complained of severe pain and discomfort in the wound area.

Goal of the laser therapy: analgesia, improvement of affected tissue trophism, normalization of microcirculation, regional blood circulation, exchange and metabolic processes of reparation and regeneration, as well as stimulation of the local immune system. The patient received laser procedures every day. He was enduring them well.



Fig. 3. Radiation ulcer after the laser therapy.

After the laser therapy course all clinical presentations were considerably reduced. The wound became clean; there were no signs of inflammation and necrosis; essential epithelization of the wound was observed (Fig. 3)

We have considered this case in such a detail, as we think it to be one of the first-in-the-world efficient applications of the laser therapy for treatment of the acute radiation disease.

The second group consisted of 7 patients with radiation burns of the 2nd - 3rd degree of severity and recurrent late radiation ulcers.

This group was annually examined in dynamics and received two courses of the laser therapy. This group is characterized by local ulceration of former radiation actions and recurrence at an interval of one-three times a year.

Some patients have been under observation for more than 20 years.

After introduction of the laser therapy into the complex treatment acute attacks were reduced. Four patients have acute attacks no more than once a year and three patients have no recurrence of late radiation ulcers after the application of the laser therapy.

The third group of patients consisting of 10 individuals included patients with wounds of the 2nd - 3rd degree of severity with cicatricial atrophic processes and changes in previously affected areas. These patients also received two courses of the laser therapy with a positive effect. Three patients recovered practically completely: the skin color restored, the skin pattern was normalized and the nail plates became healthy. In the rest patients, desquamation and hyperkeratosis areas disappeared.

The forth group consist of nine liquidators of the accident at the Chernobyl Nuclear Power Plant subjected to low-dose irradiation. All patients had a combined pathology of the locomotor apparatus and peripheral nervous system.

The most of this group reported on lessening of the pain syndrome after the third or forth session of laser therapy.

This study has demonstrated that the laser therapy methods holds much promise for complex treatment of serious radiation lesions both during the acute period and during subsequent periods.

Thus, these investigations on the use of low-energy laser therapy methods for treatment of radiolesions have demonstrated a high efficiency of this treatment.

Conclusions

1. Our researches have shown high efficiency of laser treatment of radiation injuries of various tissue. Application of only this therapy has made it possible to save life of many patients and to the most of our patients increase the quality of their life[2].
2. We have made the first step to decision of this scientific problem.

For continuation of works on this direction we should like to invite scientists from foreign countries to take part in our investigations.

Our co-operation can be carried under direct contracts with our institute – Ioffe Physico-technical institute, e-mail: victorovs@mail.ru postioffe@ioffe.mail.ru or

within the framework of a new Project of International Science Technology Center (ISTC) –
ISTC : <http://www.istc.ru> or e-mail: istcinfo@istc.ru

3. Such project is planned to name:

«Laser and nano technologies in treatment of oncological diseases and radiation injuries»/

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