POTENTIALITIES OF USING NEUTRONS IN A COMBINATION WITH LASER EMISSION IN TREATMENT OF PATIENTS WITH BREAST CANCER

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We consider here the radiation-caused reactions and skin damages in 35 patients with recidivations and metastases of the breast cancer that have earlier received radiation treatment with fast neutrons and electrons. To cure these patients we have developed and used special therapeutic treatment based on irradiation with a low-intensity emission of a copper-vapor laser.

At present vast material may be found in the literature on the wide use of low-intensity laser radiation (LILR) in medical radiology that clearly demonstrates its capability to produce healing effect on the radiation-caused damages. Normally the low-intensity laser radiation is used for treatment of local radiation-induced reactions in oncological patients that have received radiation therapy[7] rather than for prophylaxis.[6] The mechanism of protective effects that may produce laser radiation is explained by the fact that short pulses of light can intervene into the chemical reactions and modify the transient states of molecules that exist during short fractions of a second.[5]

The experimental studies have convincingly shown, see for instance Ref. 4 and 12, that laser radiation can modify biological effects in tissues caused by irradiation with neutrons or gamma radiation.

There is a hypothesis proposed to explain the mechanism of the therapeutic effect of LILR. According to this hypothesis, it is, on the one hand, due to interaction of laser radiation with the hemoglobin of blood that favors the transition of the latter to the conformation state that better suits the O_2 transport in organism. On the other hand, it is assumed that a photon of laser radiation may stimulate enhanced creation of the energy "currency" of a cell, it ATF, thus increasing its bioenergetic status.[2]

Since 1989 we have been widely applying (at the Oncological R&D Institute, Tomsk Scientific Center, Siberian "ranch of the Russian Academy of Medical Sciences) to treatment, as well as for prophylactic purposes, of local radiation-induced reactions a "Malakhit" copper-vapor laser installation developed at Tomsk State University. The investigations, we have carried out, show that the copper-vapor laser radiation penetrates into the biological tissues down to about 0.4 mm depth.[1] This result determines the potentiality of using the copper-vapor lasers in prophylaxis of the skin reactions and damages that may occur in patients after the exposure to ionizing radiation or after the neutron therapy.

In the case of irradiation with fast neutrons of 6.3 MeV energy normally used when treating oncological patients the maximum dose of the fast neutron irradiation is at about 1.2 mm depth while that at the standard gamma-therapy at 0.5 cm. The necessity of using laser therapy is caused by the fact that in 20 to 40% patients that have received neutron therapy there occur local radiation-induced reactions and damages of skin and mucosa.[9]

In this paper we discuss some results of using the copper-vapor LILR in treating of local radiation-induced reactions and damages, that can appear at neutron therapy of breast cancer.

MATERIALS AND METHODS

The group of patients observed during this study comprised 35 women 35 to 77 years old who suffered from recidivations and metastases of the breast cancer after they have received a combined therapy. In 21 patients were diagnosed to have local recidivations of the tumor and in the rest 14 there were revealed metastases to the breastbone, breastbone-ribs, and breastbone-collar bone joints, as well as to tissues and lymphatic knots.

At the first stage of the treatment all patients from this group received chemotherapeutic course with antitumor medicines according to CMF schemes.

At the first stage of this study 15 patients received neutron and mixed neutron-photon therapy without the use of a copper-vapor laser. In ten cases patients received, after the neutron therapy, irradiation with the copper-vapor laser to treat the local reactions (wet epidermis) on the skin within the target areas. The laser used delivered 20-ns-duration pulses at a repetition rate of 10 to 15 kHz and two wavelengths (510.6 and 578.2 nm) simultaneously. The dose of irradiation varied from 3 to 4 J/cm^2 per one seance, the seances being given every other day. The total course of treatment was 3 to 5 seances.[3]

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Ten patients with the recidivations and metastases of breast cancer received copper-vapor laser irradiation as a prophylactic treatment of acute radiation-induced reactions and damages of the skin and subcutaneous tissues. In no later than three hours after a neutron therapy seance the target areas of the skin were irradiated with the copper-vapor laser emission at 510.6 nm wavelength, the dose per seance being from 0.5 to 2 J/cm^2. Full course of the treatment was 8 to 15 seances. The dose per seance varied from 0.5 to 2 J/cm^2 depending on the area and on the values of a single and total dose of fast neutron flux incident onto the target area.[8]

In five cases the patients with local recidivations of the breast cancer complicated by an ulcer or by post radiative atrophy of the skin developed on the background of the latter received laser therapy prior to the neutron one, to inhibit the inflammation. Then these patients received therapy of both kinds in combination.[10]

Five patients with recidivations of the breast cancer near the postoperative cicatrice have received, after irradiation by 7 MeV beam of fast electrons from a compact betatron, copper-vapor laser therapy directly on the tumor knots and surrounding intact tissues. The single dose of laser irradiation per seance has been being gradually increased during the treatment from 2 to 30 J/cm^2, the numbers of the laser and electron beam therapy seances being the same. The total dose of the electron irradiation in this case amounted from 60 to 65 Gy.[11]

RESULTS AND DISCUSSION

In ten patients with the developed, after therapy with fast neutrons, epidermatitis that received laser irradiation three times faster regeneration of the skin has been observed as compared to the patients from a control group who received only traditional treatment (with the methyluranyl and other ointments). Moreover, patients with the breast cancer noted termination of pain and itching of the damaged skin area.

The radiation-induced ulcers occurring on the skin after the irradiation with fast neutrons have been developed in 5 of the 15 patients (33%) with the breast cancer who did not receive laser therapy. Those ulcers appeared in the patients in different time, primarily during first years after the neutron therapy.

Unfortunately treatment of already developed radiation-induced ulcers with the laser radiation showed only some positive effect, while no full skinning over occurred. As a result, 3 of 5 patients have been operated. It is important that these patients have been first operated in the beginning of the neutron therapeutic practice.

The cases considered above evidence that use of the copper-vapor laser radiation is advisable during the course of radiation therapy as a prophylactic measure against the radiation-induced skin damages. Thus, in the further clinical investigations no such skin damages have been observed owing to an improved timetable of the neutron therapy and the use of copper-vapor laser therapy as a prophylactic measure.

When using copper-vapor laser irradiation of the target areas in 15 patients with the breast cancer before and after the fast neutron therapy seance no acute skin reactions of I to III degree occurred and no a course of neutron therapy has been interrupted. Moreover, in the period of observations up to one year, neither radiation-induced ulcers on the skin nor fibrosis of the subcutaneous cellular tissue took place. Only in few patients we have observed local radiation-induced reaction of the first degree within the target areas of the skin by the end of the neutron plus laser therapy course. This reaction resulted in a weak erethism or hyperpigmentation of the skin with the cells of peeling. It is worth noting that in this case total dose of the fast neutrons incident on the target area exceeded by 30% the standard tolerance dose of 55 to 65 Gy established for skin and subcutaneous cellular tissue.

The results of clinical approbation of the method proposed, in five patients[11] with recidivations of the breast cancer, who received a combined treatment with fast electrons and laser therapy showed no occurrence of neither local radiation-induced reactions nor any progression in the tumor growth by the end of the treatment. This is considered as the effect of copper-vapor laser therapy. This circumstance allows us to conclude that there is a possibility of increasing the total radiation dose if no complete effect has been achieved when treating oncological patients.

Thus, the results obtained clearly demonstrate high efficiency of using the copper-vapor laser therapy as a measure against the radiation-induced skin damages, as well as damages of other tissues that otherwise can occur at the radiation therapeutic treatment of oncological patients.

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