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EFFECT OF LASER RADIATION ON TUMORS IN THE EXPERIMENT

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Abstract
The current task facing medical science and practical health care of our time is the fight against the most dangerous disease of humanity - malignant tumors. Many researchers of various specialties in many countries of the world are working on this problem. Various radiation sources have long been used to treat malignant tumors. The invention of optical quantum generators (lasers) is one of the most significant and promising discoveries of the second half of the twentieth century. Therefore, it is quite natural that the emergence of a new type of radiation - radiation from optical quantum generators (lasers) - has not gone unnoticed.

Keywords: Laser, monochromaticity, density, radiation power, energy illumination, radiation dose, irradiation time, melanoma, anesthesia, dissemination.

Introduction
Such unique properties of lasers as monochromaticity, high directivity of radiation, possibility of sharp focusing and creation of high-power densities on small areas, open up great possibilities of their application for destruction of malignant tumors. Recently, in a sufficient number of literature works have accumulated, in which the authors managed to experimentally demonstrate the destructive effect of laser radiation on tumor cells. In the initial stages, pulsed solid-state lasers on ruby and neodymium glass were mainly used to affect the tumor, and less often - gas optical quantum generators [1-3].
According to some experimenters, the pulse mode of operation of medical lasers is not always desirable or even harmful when used in an oncology clinic. The use of solid-state pulsed lasers with high energy leads to the occurrence of high pressures caused by evaporation of the substance of the irradiated object. The so-called reactive recoil of the evaporating substance occurs, which is often encountered in technology, for example, during pulsed heating of a substance or during fuel combustion. The evaporation pressure on the surface of an object can be enormous and reach values significantly exceeding hundreds and sometimes thousands of atmospheres. This can explain the widespread use of powerful pulsed lasers in instrument-making technology for punching holes in solid materials, such as diamonds [4,5].
Powerful continuous gas lasers, in particular carbon dioxide (CO_2) lasers, have been widely used in research. They generally do not require complex cooling systems during operation. Continuous operation allows these lasers to be used as a cutting tool, a source of radiation for malignant tumors, and for diagnostics.
For the therapy of malignant tumors, a defocused laser beam is used. The specialist performing the irradiation must know in advance the dimensions of the beam cross - section on the object,

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the power density per unit of irradiated surface. To perform irradiation of malignant tumors with a defocused beam of radiation, knowledge of the following basic concepts is necessary [6]:

1. Irradiation mode: Irradiation mode is the optimal irradiance required to irradiate a given type of tumor. **Irradiance is determined by the formula:**

$H = P_{out} / S$ (1)

Where: H - irradiance (W/cm²)
P - output power of the installation manipulator
S - laser spot area (cm²)

2. Radiation dose. The radiation dose is the amount of light energy that must be delivered to 1 cm² of the tumor for its complete destruction. **The radiation dose is determined by the formula:**

$W = H * t$ (2)

Where: W - radiation dose (J/cm²)
H - irradiance (W/cm²)
t - irradiation time (seconds)
3. Irradiation time Irradiation time is the time during which the tumor must be irradiated for its complete destruction.

The irradiation time is determined by the formula:

$t = W / H$ (3)

The mode, dose and time of irradiation for each type of tumor are determined experimentally.

Basic parameters of tumor irradiation

Types of tumors	Main parameters		
	Energy illumination H (W/ ^{cm2})	Radiation dose W (J/ ^{cm2})	Irradiation time t (c)
Pigmented melanoma	1.2 - 1.5	400 - 500	250 - 450
Squamous cell carcinoma	2 -2.5	500 - 600	200 – 300

Experimental technique.

The impact of pulsed lasers is painless due to the short pulse duration (thousandths of a second). Anesthesia is especially necessary for repeated irradiations, when the bulk of the tumor is destroyed and exposed healthy tissues fall into the irradiation zone. Extensive ulcerated tumors, not covered by skin, can be irradiated without anesthesia. However, in such cases, anesthesia is still required when irradiating the edges of the tumor, when it is necessary to capture healthy areas of tissue [7]. Irradiation of superficial tumors in humans is carried out under local novocaine anesthesia with 0.5% novocaine solution. However, the technique of anesthesia for skin tumors, especially melanoma, should differ from the generally accepted technique of local anesthesia in surgery. Close delivery of novocaine to the tumor can lead to dissemination of tumor cells.

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Conclusion

Based on this, it is necessary to inject novocaine into the tissues surrounding the tumor from two points located at a distance of 10 cm from the proximal and distal sides of the tumor. Long needles (9-12) cm were used, which were inserted to the tumor node no closer than (3-5) cm. Such anesthesia turned out to be quite sufficient for painless irradiation. For squamous cell skin cancer, the most optimal irradiation mode is H = (2 ÷ 2.5) W at a irradiation dose of W = (500 ÷ 600) J per 1 cm^2, for pigmented melanoma H = (1 ÷ 1.5) W / cm^2 at a irradiation dose of W = (400 ÷ 500) J per 1 cm^2. The depth of the lesion with a single exposure to laser radiation does not exceed h = (2 ÷ 2.5) cm. Therefore, with a large depth of the lesion, after the rejection of necrotic masses, repeated irradiation is carried out with an interval not exceeding (4 ÷ 5) days. In some cases, when there were advanced deeply penetrating tumors, it was necessary to carry out irradiation more than (2 ÷ 3) times.

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