MEDICINE

INTERSTITIAL HDR BRACHYTHERAPY AT NON-MELANOMA SKIN CANCER

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Abstract. *Despite a large number of recommendations for the installation of applicators with high-power brachytherapy, there are many controversial questions regarding the choice and placement of applicators, normalization and dose selection. Has been made an assessment the effectiveness of interstitial HDR brachytherapy under irradiation regimen of 32 Gy for 4 fractions when dosing twice a week. 46 patients with histologically confirmed non-melanoma skin cancer other localization were irradiated with MicroSelectron (radioactive source ^{192}Ir) using interstitial HDR brachytherapy. The single focal dose was 8 Gy. The irradiation sessions were carried out 2 times a week, in total 4 fractions. The planning of the treatment process was carried out under 3D CT control. In five years of follow-up after the completion of the full course of interstitial HDR brachytherapy, 96 % of patients had complete regression of the primary tumor process and no radiation complications were observed, and 4 % had local relapses at an average of 18 months after treatment. Thus, the fractionation regime of 8 Gy 2 times a week, totaling 4 fractions, allows achieving a good local control of the primary tumor process. During the study period, no radiation complications were observed in this fractionation regime.*

Keywords: *HDR brachytherapy, interstitial brachytherapy, non-melanoma skin cancer.*

Introduction. Non-melanoma skin cancer includes basal cell, which in the structure is approximately 80 %, and squamous cell carcinoma – 20 %. Every year the frequency of its occurrence grows [1]. This is due to the overall increase in oncopathology. Complete recovery of basal cell carcinoma and squamous skin can be achieved with the modern method of radiotherapy – brachytherapy, which provides the supply of radioactive material, directly to the primary eye. Despite a large number of recommendations for the installation of applicators with high-power brachytherapy, there are many controversial questions regarding the choice and placement of applicators, normalization and dose selection [2, 3]. There was no randomized trial comparing the efficacy of standard fractionation regimens with other regimens. There are recommendations for setting applicators: they can be flexible or rigid, placed in parallel [2, 4, 5]. Taking into account the histological origin of the tumor process, the volume of the tumor, the data of other diagnostic studies are taken into account. With confirmed absence of regional lymph nodes, local irradiation is performed.

Objective. To assess the effectiveness of interstitial HDR brachytherapy under irradiation regimen of 32 Gy for 4 fractions when dosing twice a week.

Materials and methods. In the department of radiotherapy from 2012 to 2017, 46 patients with histologically confirmed basal cell (34 patients – 72 %) and squamous – 13 (28 %) skin cancer were treated. According to the International Classification, the stages were set in patients: $T_1N_0M_0$ – in 16 patients (34 %), $T_2N_0M_0$ – 23 (49 %), $T_3N_0M_0$ – 8 (17 %). The localization of the primary tumor was as follows: cheek – 9 (19 %), forehead – 6 (13 %), scalp – 5 (11 %), ear region – 5 (11 %), lip – 6 (10 %) , nose – 5 (11 %), the temple area – 3 (7 %), the angle of the eye – 5 (11 %), the rest of the body – 3 (7 %). All patients were irradiated with *MicroSelectron* (radioactive source ^{192}Ir) using interstitial HDR brachytherapy. After local anesthesia, patients were administered "hand free" metal needles directly into the tumor process at each irradiation session (Fig. 1). The location of the needles was determined by the need to bring the optimal dose to the tumor with an additional irradiation of 3-7 mm with respect to the visible border of the tumor (Fig. 2).

The number of needles ranged from 2 to 10 depending on the extent of the lesion and closely located critical organs (the lens of the eye, the mandible, etc.). The single focal dose was 8 Gy. The irradiation sessions were carried out 2 times a week, in total 4 fractions. The duration of the entire treatment period is two weeks. The planning of the treatment process was carried out under 3D CT control using *Oncenter software 3.1* (Fig. 3). Optimization of the curative plan was carried out graphically.

Fig. 1. A set of metal needles for ^{192}Ir source movement in interstitial brachytherapy in MicroSelectron (external needle diameter is 8 mm, inner diameter is 5 mm, maximum needle length is 20 cm)

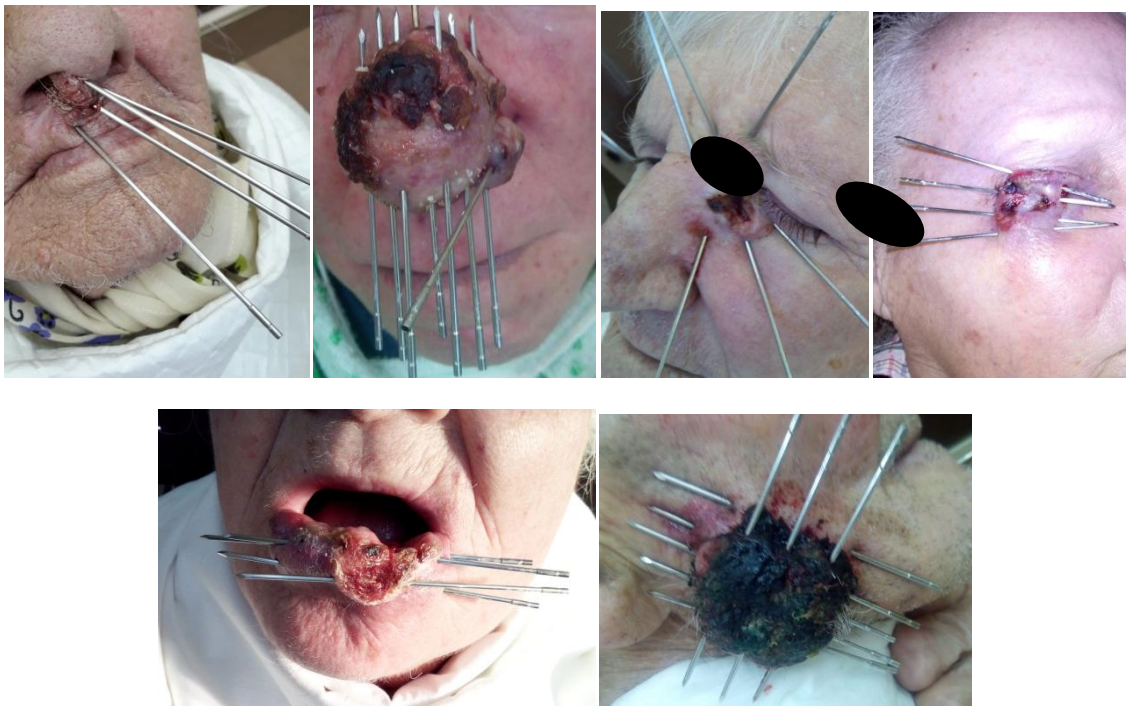

Fig. 2. An example of setting metal needles by "hand free" for various localizations of the tumor process

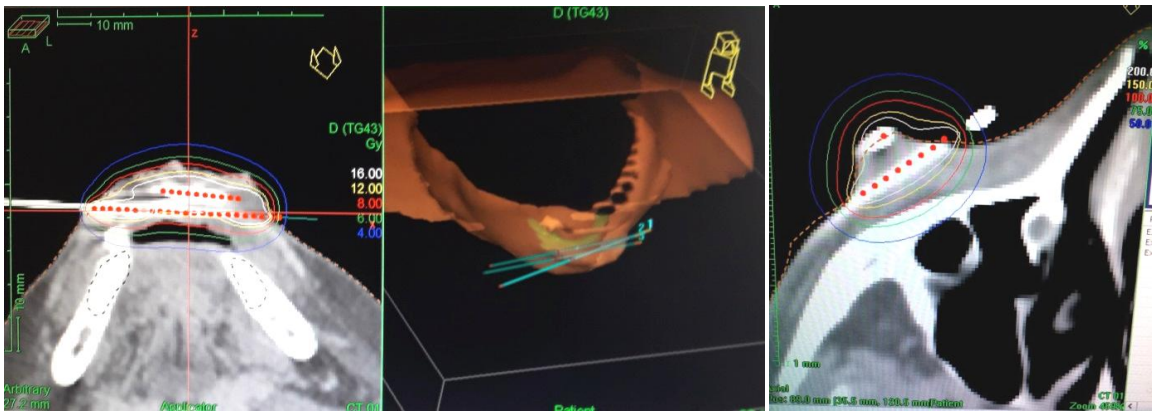

Fig. 3. Example of an isodose distribution in 3D CT planning for interstitial HDR brachytherapy of squamous cell carcinoma of the lower lip (left) and basal cell carcinoma of the right cheek (right)

The results of treatment were monitored monthly for the first 4 months, then for 1 time per quarter (patients were examined by a radiation therapist, ultrasound, CT, and MRI, if necessary).

Results. Patients could observe a small bleeding immediately after the extraction of needles, after a few minutes it stopped. The needles were removed from the tumor process after each irradiation session, so patients felt comfortable between the factions. At the same time, the risk of infection was reduced, which is often observed with the introduction of flexible applicators for the entire treatment period.

Edema of surrounding tissues after the introduction of needles usually passed by the evening of the same day as the irradiation session. This allowed the next time to bring more accurately the dose to the tumor. In all patients 2-3 weeks after the end of the course of interstitial brachytherapy local radiation reactions were observed in the form of temporary hyperemia of surrounding healthy tissues, to which 60-80 % of the total dose was administered according to the recommendations.

After 3-4 observations in all patients, the radiation reactions died down and at the site of irradiation crusts were formed, under which a new young tissue was formed.

Figures 4-7 show patients before and after treatment. In five years of follow-up after the completion of the full course of interstitial HDR brachytherapy, 96 % of patients had complete regression of the primary tumor process and no radiation complications were observed, and 4 % had local relapses at an average of 18 months after treatment (1 – in the patient with cancer of the lower lip with repeated injuries of the irradiated site in the post-ray period, 1 – with repeated relapse of the auricular cancer after surgical treatment).

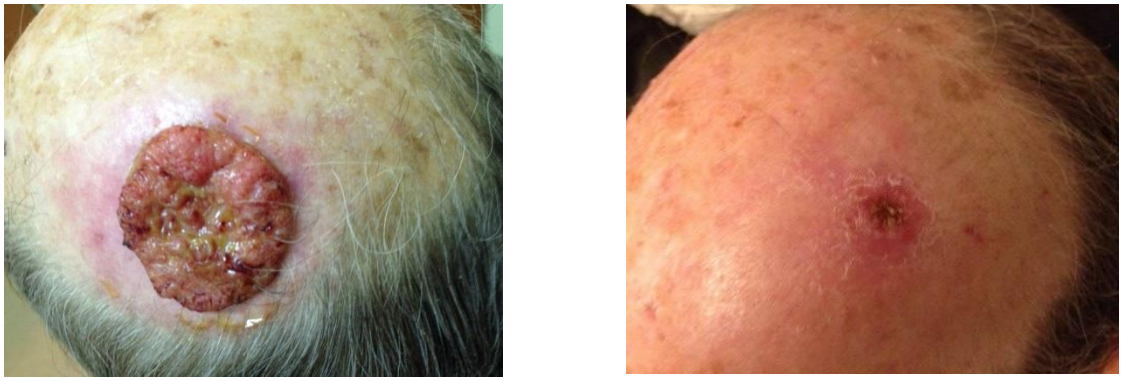

Fig. 4. Patient R. with basal cell carcinoma of the scalp skin before (left) and 3 weeks after (right) interstitial HDR brachytherapy

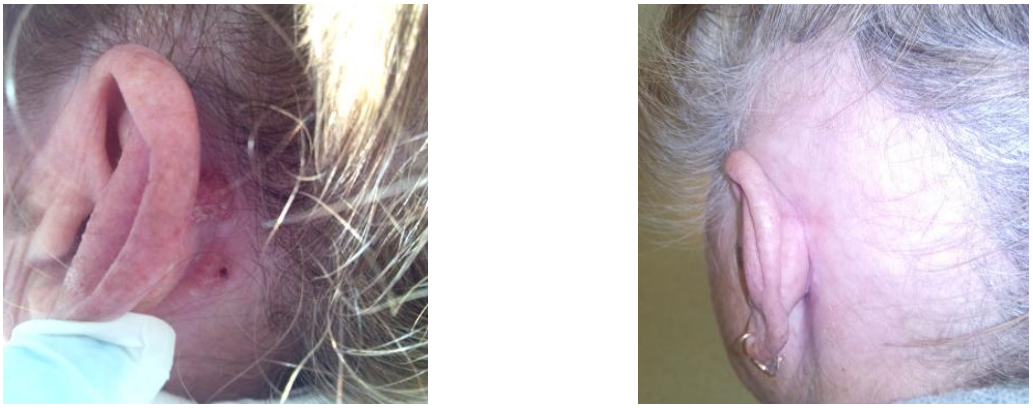

Fig. 5. Patient L. with squamous cell carcinoma in the left ear region before (left) and 2 years after (right) interstitial HDR brachytherapy

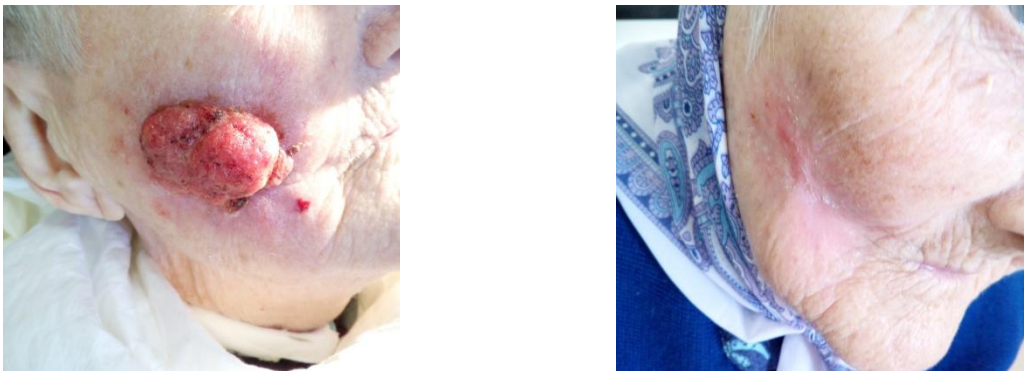

Fig. 6. Patient H. with basal cell carcinoma of the skin of the right cheek before (left) and 2 years after (right) interstitial HDR brachytherapy

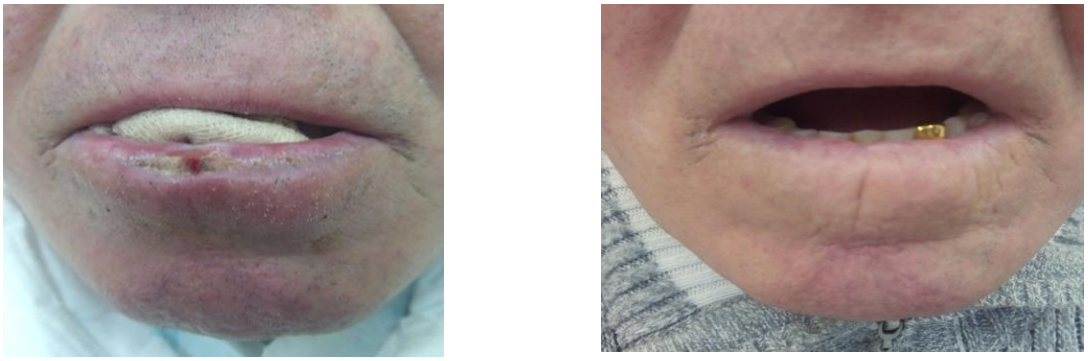

Fig. 7. Patient X. with squamous cell carcinoma of the lower lip before (left) and 5 years after (right) interstitial HDR brachytherapy

Conclusions. Thus, the fractionation regime of 8 Gy 2 times a week, totaling 4 fractions, allows achieving a good local control of the primary tumor process. At the same time, the patient's state of health between fractions improves significantly; the probability of infection joining during treatment is reduced. During the study period, no radiation complications were observed in this fractionation regime.

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