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Possibilities of using a diode high-intensity laser with a wavelength of 940 nm in surgery of benign parotid tumors

Możliwości zastosowania diodowego lasera wysokoenergetycznego o długości fali 940 nm w chirurgii łagodnych guzów przyusznicy

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ABSTRACT

It was revealed that high-intensity laser radiation with a wavelength of 940 nm had a more sparing effect on the tissue of the salivary gland and facial nerve compared to high-frequency electrocautery, causes a smaller size of the injury area. Reparative processes in a laser wound were observed earlier with the formation of a tender scar that didn't disturb gland function. A new method of laser treatment of the parotid tumors can serve as an alternative to the traditional method of resection with diathermic coagulation.

Keywords: benign tumor, parotid gland, surgical treatment, diode lasers.

STRESZCZENIE

Wykazano, że promieniowanie laserowe o wysokiej intensywności i długości fali 940 nm ma bardziej oszczędny wpływ na tkankę gruczołu ślinowego i nerwu twarzewego w porównaniu do elektrokoagulacji o wysokiej częstotliwości, powoduje mniejszy rozmiar obszaru urazu. Procesy naprawcze w ranie laserowej obserwowano wcześniej, wraz z tworzeniem się delikatnej blizny, która nie zaburzała funkcji gruczołu. Nowa metoda leczenia laserowego guzów przyusznicy może służyć jako alternatywa dla tradycyjnej metody resekcji z koagulacją diatermiczną.

Słowa kluczowe: guz łagodny, ślinianka przyuszna, leczenie chirurgiczne, laser diodowy.

Introduction

The modern standard of surgical treatment of benign parotid tumors is to perform organ-preserving radical operations by resection of the part of the gland containing the tumor. It is mandatory to preserve all branches of the facial nerve during resection [1, 2].

High-intensity laser devices are promising for use in surgery. They have cutting, coagulating and bactericidal properties, along with a gentle effect on tissues and a stimulating effect on regeneration processes [3].

Lasers in the infrared spectrum (940 nm) have an increased absorption by oxyhemoglobin, as a result, they can form a blood clot with a high de-

gree of adhesion. The work with a small-diameter quartz light guide (400 microns) allows for precision coagulation of small-diameter vessels and dissection of tissues without additional traumatization of adjacent anatomical structures [4, 5].

The purpose of the study: to develop a method for the surgical treatment of benign parotid tumors using a diode laser with a wavelength of 940 nm.

Material and methods

The study was carried out in the Department of the Maxillofacial Surgery "11 City Clinical Hospital", Minsk, Belarus. The study included 68 patients with benign parotid tumors. Two groups were formed – the main (33 patients) and control (35 patients). Di-

stribution by gender in the main group: women – 22 (66.67%), men – 11 (33.33%). The mean age of patients was 51, the minimum age was 21 years, and the maximum age was 70 years. The control group included 35 patients: women – 21 (60.00%), men – 14 (40.00%). The mean age of the patients was 47 years. There were no statistically significant differences in gender and age between the groups.

In the main group, the tumor was removed by the developed method of anatomical resection of the parotid gland using a surgical diode laser "Diolaz-940-6" (patent No. 21250BY of 11/11/2014). In the control group was performed microsurgical removal of the parotid tumor using an electrosurgical high-frequency device EHVCh-350 Fotek E352.

Surgical treatment of patients was carried out by microsurgical partial, subtotal resection, as well as parotidectomy with preservation of the facial nerve. All operations were performed under endotracheal anesthesia in a standard operating room using an operating microscope. As an operative access, the following were used: access according to Blair, retromandibular, preauricular mini-access and modified Omega-access. The facial postoperative contour defect of the parotid-masticatory region was closed with an SMAS flap (superficial musculoaponeurotic system of the face). The wound was sutured tightly; drainage was not installed in the wound. A pressure bandage was applied to the wound. Sutures were removed on the 7th–10th day. Patients were hospitalized prior to suture removal.

Postoperative monitoring included: the general condition of the patients, the presence of complaints, the intensity of the pain syndrome, the condition of the postoperative wound, the presence and nature of the discharge. The function of the facial nerve was assessed using functional tests immediately after waking up, on the 1st and 7th days after surgery. The results of the samples were evaluated using a scale FNGS 2.0 (Facial Nerve Grading System 2.0).

Statistical research methods. Comparison of groups by quantitative characteristics was carried out by non-parametric criteria. Results are presented as median and quartile range. Comparison of two groups by quantitative characteristics was carried out by the Mann-Whitney test (U).

In all cases, the differences were considered statistically significant at $p < 0.05$. Statistical processing of the results was carried out using a licensed software package Statistica 10.0 (SNAXAR207F394425FA-Q).

Results

Laser resection method. The volume of resection depended on the size and localization of the parotid tumor. When the tumor was localized in the region of one of the poles of the gland, with exophytic tumor growth, laser partial resection was performed. Laser subtotal superficial parotidectomy was performed in cases when the tumor occupied a significant part of the superficial lobe or in multinodular lesions of the superficial lobe. When the tumor was localized in the deep lobe, laser subtotal deep resection was performed with preservation of the superficial lobe; in case of a recurrent process, parotidectomy was performed with preservation of the branches of the facial nerve.

The skin incision was made with a scalpel. Further, all stages of tissue dissection were carried out only with the help of a surgical semiconductor laser (wavelength of 940 nm) quartz light guide (diameter of 400 microns). For tissue dissection, the contact method of exposure was used, in a continuous mode of radiation supply and power 4W.

Depending on the localization of the tumor, the SMAS flap was formed with its base towards the auricle or towards the buccal region. Departing from the tumor borders by 5–8 mm, a sequential dissection of the glandular tissue was carried out along the interlobular connective tissue with simultaneous coagulation of the vessels and excretory ducts with a laser beam.

Vessels and excretory ducts up to 2 mm in diameter were coagulated precisely along the length of the structure or simultaneously with dissection of the interlobular tissue.

In the main group, at the time of awakening after endotracheal anesthesia, the function of the facial nerve was not impaired in 27 (81.82%) patients (no more than 4 points on the FNGS 2.0 scale). 5 (15.15%) patients had moderate dysfunction (5–9 points), 1 (3.03%) had severe dysfunction (10–14 points).

In the control group, at the end of the operation, the function of the facial nerve was normal in 24 (68.58%) patients (4 points on the FNGS 2.0 scale). In 9 (25.71%) patients had moderate neuropathy (5–9 points), in 2 (5.71%) – severe dysfunction neuropathy (10–14 points). There were no statistically significant differences between the groups ($p = 0.53$).

In the main group, on 1st day after surgery, the function of the facial nerve was not impaired in 28 (84.85%) patients (4 points on the FNGS 2.0 scale). 4 (12.12%) – had moderate (5–9 points), 1 (3.03%) – severe dysfunction (10–14 points).

In the control group, on the 1st day, the function of the facial nerve was normal in 22 (62.85%) patients (4 points on the FNGS 2.0 scale), in 11 (31.43%) – moderate neuropathy were determined (5–9 points), 1 (2.86%) had severe dysfunction (10–14 points). There were also no statistically significant differences between the groups ($p = 0.46$).

In the main group, on the 7th day after the operation, the function of the facial nerve was normal in 30 (90.91%) cases (4 points on the FNGS 2.0 scale), in 2 (6.06%) – were signs of moderate dysfunction (5–9 points), 1 (3.03%) – severe neuropathy (10–14 points).

In the control group, on the 7th day, the function of the facial nerve was normal in 25 (71.43%) patients (4 points on the FNGS 2.0 scale), in 9 (25.71%) patients, signs of moderate neuropathy were determined (5–9 points), 1 (2.86%) patient had severe neuropathy (10–14 points) of the facial nerve. There were no statistically significant differences between the groups ($p = 0.52$).

In addition to the function of the facial nerve in the postoperative period, patients with salivary stasis in the wound were identified. In the main group, accumulation of saliva in the wound was noted in 2 (6.06%) cases, and in the control group – in 7 (20.00%) ($p = 0.09$).

Hemorrhagic complications were detected in 2 (5.71%) patients from the control group ($p = 0.16$).

Conclusion

The proposed method of anatomical resection allows dissection strictly along the interlobular spaces without damaging the lobules, directly dissecting the tissues with a laser beam using the contact method. In this case, persistent laser coagulation of blood vessels and salivary ducts occurs. The method is ergonomically effective, as it does not involve the use of the mosquito-coagulator-scissors triad. The use of a light guide of a laser device significantly optimizes the process of tissue dissection by reducing the number of manipulation movements, does not obscure the view, thereby reducing the duration of surgery. It is difficult to compare achieved results because of lack of the similar articles in data base PubMed/MEDLINE.

The developed method of anatomical laser resection of the parotid gland can serve as an alternative to the traditional method of resection using various techniques of high frequency electrosurgery and be the method of choice.

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Conflict of interest statement

The authors declare no conflict of interest.

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