Surgical Laser Treatment and Photodynamic Therapy of Tumors Located in Ocular Adnexa

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Laser treatment of tumors that arise in ocular adnexa has great potential. It enables to provide a minimally invasive therapy, especially when it is used for removing various hemangiomas. Photodynamic therapy (PDT) is an alternative method of treatment for cancer patients with a relatively advanced recurrent disease in ocular adnexa. It enables to avoid an aggressive surgical treatment and often to avoid enucleation. This paper reports our experience in using various lasers for the treatment of different lesions in ocular adnexa.

Since 1986 the total of 441 patients with both 604 benign and 144 malignant tumors in ocular adnexa underwent laser treatment (usually only one procedure). We used different systems of lasers. The Nd:YAG laser was used only for surgical treatment. PDT was provided for 60 patients, in most cases with advanced (T_{3-4}) cancer. Copper vapour laser was used for the treatment of 25 patients with angiomas, mostly for the treatment of port wine stains. As the immediate result of surgical Nd:YAG laser treatment of 579 benign tumors, all of them fully disappeared. As the immediate result of surgical Nd:YAG laser treatment of 105 malignant tumors, 84 (T_{1-2}) tumors fully disappeared, however, for 21 advanced tumors (T_{3-4}) PDT was provided 1–5 days after Nd:YAG laser destruction. There were no injures of the eyeball during these procedures. There was no bleeding noticed as a laser-related complication during laser treatment and only 4 complications of scarring. According to our observations, surgical laser treatment in most cases is the method of choice for the removal of both benign and nonadvanced malignant tumors from ocular adnexa. PDT in combination with Nd:YAG laser destruction makes possible radical treatment with an excellent cosmetic and functional effect for recurrent advanced (T_{3-4}) cancer.

Key words: Nd:YAG laser, copper vapour laser, PDT, tumors, ocular adnexa

INTRODUCTION

From 5 to 9% of all skin cancers arise on the eyelid (1). Basal cell carcinoma made up 90% of malignant eyelid neoplasms, followed by squamous cell carcinomas and sebaceous cell carcinomas. During 1997–2001, 539 new ocular adnexa cancer cases (188 males and 351 females) were registered in Lithuania (Table 1). In 2001, there were 102 new ocular adnexa cancer cases in Lithuania.

Table 1. **New ocular adnexa cancer cases in Lithuania, 1997–2001**

Years	Male	Female	TOTAL
1997	29	76	105
1998	31	58	89
1999	44	82	126
2000	43	74	117
2001	41	61	102
Total	188	351	539

Inverted follicular keratosis and seborrheic keratosis is a common benign lesion found on the eyelids of older individuals.

Squamous cell papillomas are the most frequent benign eyelid lesions. Xanthelasmas are generally bilateral, yellow-tan in color, and flat. Most of them are only a cosmetic problem. Benign vascular eyelid lesions include capillary hemangiomas and cavernous hemangiomas. Capillary hemangiomas are most common, occuring in 1 of every 200 live births. Nevi frequently occur on the eyelid or lid margin.

A great number of cosmetically disturbing cutaneous lesions are localized in the periocular region

(2). While various approaches for treatment such as excision (3), electrocauterization or cryosurgery (4, 5) often show unsatisfactory results (6, 7), the use of laser technology is of increasing interest. Laser treatment of tumors that arise in ocular adnexa, has a great potential. It enables to provide a minimally invasive therapy, especially when used for removing various hemangiomas (8–10). Port wine stains are effectively treated with lasers too, and there is no satisfactory non-laser treatment. PDT is the alternative method of treatment for cancer patients with a relatively advanced recurrent disease in ocular adnexa. It enables to avoid aggressive surgical treatment (11, 12) and often to avoid enucleation.

Correct selection of patients is the most difficult part of laser treatment. Thus the physicians using a laser must be familiar with the conventional procedure, since laser is the only tool replacing other ones (13, 14). This paper reports our experience in using various lasers for the treatment of different lesions in ocular adnexa.

Table 2. **Lasers used for the treatment of tumors in ocular adnexa**

Laser type	Wave length (nm)	Timing of radiation	Delivery of beam	Power on the tip of fiber (W)
Nd:YAG (solid)	1064	Continuous wave, long pulsed, medium pulsed	Fiber optic cable, Sapphire tips	10–60
Gold vapour	628	Medium pulsed	Fiber optic cable	0.05–0.3
Copper vapour	511; 578	Medium pulsed	Fiber optic cable	0.3–1

PATIENTS AND METHODS

Since 1986, a total of 441 patients with 604 benign and 144 malignant tumors in ocular adnexa underwent laser treatment. Most of patients underwent only one treatment procedure. We used different systems of lasers. Table 2 lists the types of the lasers used by us. The Nd:YAG laser was used only for surgical treatment. The power on the tip of the fiber usually varied from 15 to 40 W. Surgical Nd:YAG laser treatment was applied for 102 patients with 105 cancer lesions (89 basal cell cancer foci, 13 squamous cell cancer foci and 3 others malignant lesions) and for 275 patients with 579 benign tumors. The size of tumors varied from 0.1 cm^2 to 10.4 cm^2.

Two, three or even four surgical laser treatment procedures were provided for the large malignant tumors. Figure 1 presents advanced recurrent basal cell carcinoma before treatment (Fig. 1a), after the first procedure of Nd:YAG laser treatment (Fig. 1b), one month after surgical laser treatment (Fig. 1c).

PDT was provided for 60 patients in most of cases with advanced (T_{3-4}), recurrent cancer. Histological verification revealed squamous cell carcinoma in 17 cases (there was one patient with Ca anaplasticum) and basal cell carcinoma in 39 cases. There were two lesions of lentigo maligna, one lesion of recurrent melanoma, and one lesion of recurrent adenocystic carcinoma. The size of tumors varied from 1 cm^2 to 6 cm^2. Most of patients underwent two to four PDT treatment procedures. Topical photodynamic therapy utilizing delta-aminolevulinic acid-induced protoporphyrin IX photosensitisation was

Table 3. **Laser treatment experience in ocular adnexa**

Lesions	Number of lesions	Lasers used		
		Nd:YAG	Gold vapour (PDT)	Copper vapour
Malignant:	**144**	**105**	60 (21 together with Nd:YAG)	–
squamous cell carcinoma	21	13	17 (9 together with Nd:YAG)	–
basal cell carcinoma	119	89	39 (9 together with Nd:YAG)	
others	4	3	4 (3 together with Nd:YAG)	–
Benign:	**604**	**579**	–	**25**
hemangiomas	69	46	–	23
capillary	30	25	–	5
cavernous	21	21	–	–
port wine stains	18	–	–	18
moles	70	70	–	–
papillomas	358	358	–	–
keratomas	37	37	–	–
xanthelasmas	37	35	–	2
others	33	33	–	–
Total:	**748**	**684**	60 (21 together with Nd:YAG)	**25**

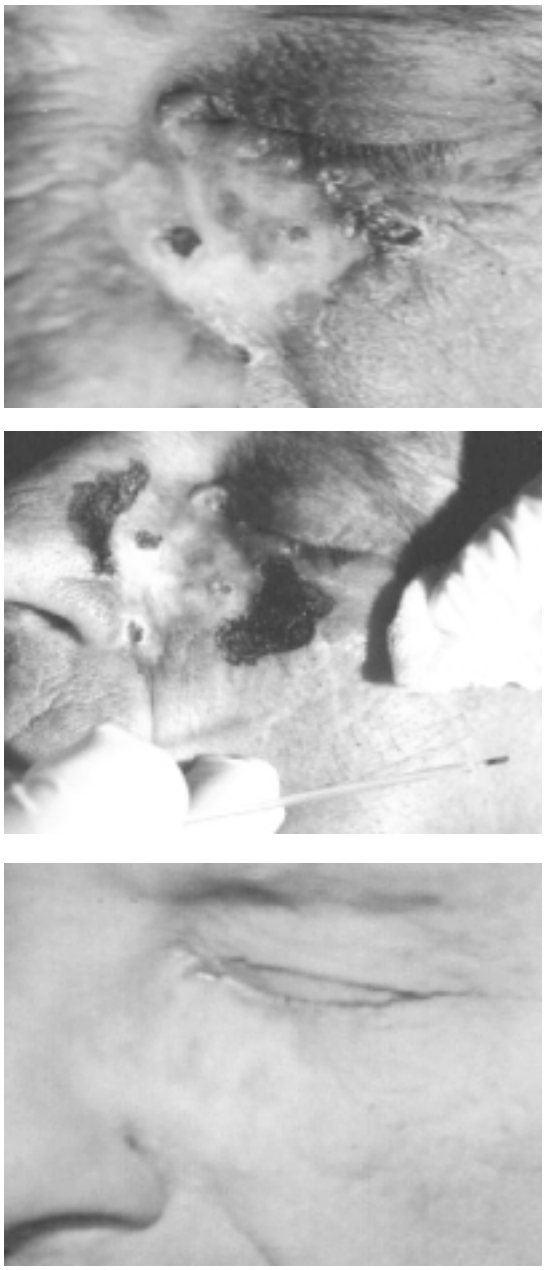

Fig. 1. Advanced recurrent basal cell carcinoma:
a – before treatment, b – after the first procedure of laser treatment, c – one month following laser treatment

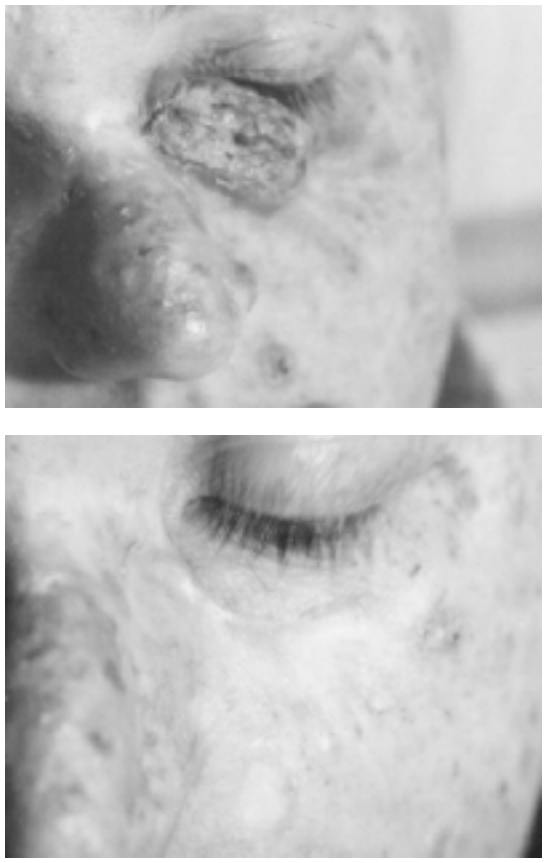

Fig. 2. Advanced recurrent cancer: a – before laser treatment, b – months following treatment

evaluated as a treatment modality for 11 nonmelanoma T_{1-2} skin malignancies of the eyelids and periocular skin.

Copper vapour laser was used for the treatment of 25 patients. Two xanthelasmas and 23 angiomas (mostly port wine stains) were treated with yellow light from this laser.

The size of port wine stains varied from 2 cm^2 to 10 cm^2. All patients with port wine stains underwent two or more laser treatment procedures. One patient underwent six procedures until the port wine stains fully disappeared.

Table 3 presents our experience in laser treatment of tumors in ocular adnexa.

All but three surgical laser treatment procedures where provided with local anesthesia (2% lignocaine solution usually was used). PDT for 18 patients was painful. For the rest it was painless. During PDT, usually general analgesia with intramuscular injection of baralgine or dipidolore solution was used. Copper vapour laser treatment was usually provided without anesthesia.

RESULTS AND DISCUSSION

The immediate results of surgical laser treatment prove a complete disappearance of both 579 benign and 84 (T_{1-2}) malignant lesions. There was no bleeding noticed as a laser-related complication during Nd:YAG laser destruction, and there were only four complications of scarring (15). Scarring was noticed in patients with advanced recurrent cancer 2–3 months after Nd:YAG laser treatment together with PDT. Injections of kenalog were used to remove the scars.

There was only one recurrence of hemangioma and two recurrences of xanthelasmas among all pa-

tients with benign tumors in ocular adnexa after Nd:YAG laser treatment. Eighty-four cancer patients, for whom Nd:YAG laser surgery alone was applied, were followed up for the period from 8 to 139 months. (mean, 49.6 months). During this period disease recurrence was noted in four patients. One of them was primary patient, therefore radiotherapy was prescribed for him. The rest three patients had received radiotherapy before they underwent Nd:YAG laser destruction, therefore PDT was prescribed for two of them. For the rest patient, a wide excision of tumors with plastic surgery was provided.

As the immediate results of 47 patients with advanced cancer in ocular adnexa, 41 tumors in 41 patients for whom PDT was applied completely disappeared. Significant necrosis was found in 6 tumors. Disease recurrence was noted in 14 patients 3–34 months after PDT. In all these cases PDT was repeated.

Patients treated with PDT were followed up for a period from 12 to 132 months (on the average 72 months). At present, 14 of these patients have been free of cancer for more than 3 years and 24 patients for 10–18 months. Two patients died 6 an 4 years following treatment without cancer (they were 86 and 91 years old). There was progression of the disease in the rest patients, and enucleation was provided for 3 of them. There was no bleeding during and after PDT, and there were four complications of scarring in the lower eyelid. In these cases, patients with advanced recurrent cancer underwent Nd:YAG laser destruction followed by PDT. It should be noted that there were scars in the eyelid of two patients after surgical treatment before Nd:YAG laser destruction and PDT. Good cosmesis and functional results were achieved in most patients. Figure 2 presents a patient with advanced (T_4), recurrent cancer before laser treatment (Fig. 2a) and 2 months after it (Fig. 2b).

As the immediate results in 13 patients with T_{1-2} cancer in ocular adnexa for whom topical ALA-mediated PDT was applied, there were no recurrences of malignant tumor. Good cosmesis and functional results achieved in all patients (16).

As regards 18 patients with port wine stains, treated with the copper vapour laser, the color of the treated lesions was similar to that of normal skin and no scar was formed in any patient. But in all the cases selective photothermolysis was the treatment of long duration. At least three courses were necessary until an excellent effect was achieved.

CONCLUSIONS

1. Surgical Nd:YAG laser treatment of malignant T_{1-2} tumors in ocular adnexa has a great potential. It enables to provide a minimally invasive therapy with good cosmesis and functional results.

2. Surgical Nd:YAG laser treatment is the method of choice for removing various benign lesions located in ocular adnexa, especially hemangiomas.

3. Photodynamic therapy (PDT) is an alternative method of treatment for cancer patients with a relatively advanced recurrent disease in ocular adnexa. It enables to avoid aggressive surgical treatment and often to avoid enucleation.

4. Port wine stains are effectively treated with copper vapour laser, and there is no satisfactory non-laser treatment.

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AKIES PRIEDŲ NAVIKŲ GYDYMAS CHIRURGINIAIS IR SPECIALIOSIOS PASKIRTIES LAZERIAIS

S a n t r a u k a

Piktybiniai akių priedų navikai sudaro 5–9% odos vėžio. Dažniausiai pasitaiko epitelinės kilmės odos priedų navikai. Šalinant tiek gėrybinius, tiek piktybinius akių priedų navikus, labai svarbu minimaliai traumuoti aplinkinius sveikus audinius, išsaugoti kokybišką organų funkciją ir gauti gerą kosmetinį efektą, todėl dažnai yra pasirenkamas gydymas lazeriais. Chirurginiu Nd:YAG lazeriu verta šalinti daugelį gėrybinių akies priedų navikų, taip pat nedideli T_{1-2} bazoląstelinio vėžio ir T_1 plokščialąstelinio vėžio židiniai. Šis lazeris radikaliai pašalina įvairias kavernozines hemangiomas, gerokai sumažindamas įprastos operacijos apimtį. Kavernozinių hemangiomų operacijos Nd:YAG lazeriais yra „sausos“ – bekraujės ir kosmetiškos.

Selektyvi fototermolizė, naudojant geltoną šviesą skleidžiančius lazerius, kol kas yra vienintelis efektyvus „vyno dėmių“ gydymo metodas.

Kaip alternatyvą akies pašalinimui, fotodinaminį gydymą verta taikyti ligoniams, kuriems nustatytas recidyvuojantis, vietiškai išplitęs akies priedų vėžys.

Gydant lazeriais labai svarbu teisingai parinkti ligonius. Kiekvienas konkretus lazeris priklausomai nuo jo bangos ilgio ir galios veikia skirtingai. Lazeriais operuojantis chirurgas turi žinoti, kada ir kokį lazerį rinktis kiekvienu konkrečiu atveju.

Nuo 1986 m. 441 ligoniui chirurginiais ir specialiosios paskirties lazeriais pašalinome 604 gėrybinius ir 144 piktybinius akies priedų navikus. Šiame straipsnyje pateikiame savo patirtį, įgytą gydant skirtingais lazeriais 748 įvairios histogenezės akių priedų navikus.

Raktažodžiai: Nd:YAG lazeris, vario garų lazeris, FDT, akių priedų navikai