PHOTOCOAGULANT LASER TREATMENT IN DIABETIC RETINOPATHY: ADVANTAGES, RISKS, LIMITS

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Abstract

The present paper proposes to point out the major advantages of laser therapy in diabetic retinopathy, alongside with the presentation of main risks and failure causes of this surgical technique. Preventing blindness in patients with diabetes represents not only a national priority, but also a worldwide one, and the dynamics of therapeutical research within diabetic retinopathy has reached a unprecedented level. The high interest in this condition, specific to diabetes mellitus, is reflected in the substantially large number of clinical studies whose objective is the pathogeny and treatment of diabetic retinopathy [1, 2, 3, 4]. If there still are a lot of controversies regarding the pathogeny of diabetic retinopathy, with the various etiopathogenic theories, both supported and contested, worldwide scientists unanimously agree with the threat represented by this condition for the life of diabetes patients. OMS states a terrifying reality: worldwidely, in 2008, there were 1.74 million diabetic patients with extremely low vision (legal blindness) due to diabetic retinopathy. Diabetic retinopathy is the most frequent cause of the new blindness cases reported worldwidely, in the adult population aged between 20 and 74 years old [5]. The arguments and counter-arguments against using photocoagulant laser in certain stages of diabetic retinopathy are based on the experience over a period of 7 years of the "Diabetic Eye" Department in Craiova and are supported by retinophotographic images and retinal tomographies in optical coherence (TOC).

key words*: diabetes mellitus, laser therapy, blindness.*

The Purpose of the Study: due to the fact that we are faced with an epidemic increase of diabetes mellitus worldwidely, including Romania, and the number of patients with retinopathy is proportionally increasing, we considered necessary to present some data from our experience regarding laser therapy, illustrated by eloquent images, bringing arguments, on the one side that this therapy is necessary with encouraging results, and on the other side to show the part played by genetics but also the control of all risk factors, for the predicted results.

Material and Method:

Between October 2002 and January 2010, within the Department of "Diabetic Eye", there were recorded 6945 patients with

diabetes mellitus, with or without diabetic retinopathy. In the present paper, we will present the evolution of 457 patients after laser therapy, over a surveilance period of 3-7 years.

Retinophotographies at 45° and 60° were performed both before and after laser therapy, and, in some special cases, there were performed retinal tomographies, in dynamics, for morphological evidentiation of macular strata and thickness (TOC).

Results. Discussions:

Diabetic retinopathy affects both patients with type 1 and type 2 diabetes mellitus, thus representing one of the most frequent microangiopathic complications of diabetes mellitus [6]. The decrease of sight clearness in patients with diabetes mellitus is produced by two complementary mechanisms:

1. Macular edema (clinically significant macular edema or focal macular edema) – responsible for about 80% of blindness cases;

2. Retinal and/ or papilar proliferation, whose complications involve severe sight loss in approximately 20% of cases.

In many cases, though, the two mechanisms complete each other in patients with severe metabolic disorders and micro and macroangiopathic associated complications, thus dubling the risk for blindness setting in.

Macular edema, therefore, represents the main cause of blindness in active age patients with diabetic retinopathy, worldwidely. In its etiopathogeny there are involved not only the disorders of glucidic and lipidic metabolism, but also the control of blood pressure values. In the speciality literature there are described 3 types of macular conditions of exudative type in diabetic retinopathy:

a. Focal macular edema: it is associated with an exudate ring resulted from a leakage accumulation from macular microanevrisms and consists in the retina thickness on an area of minimum 2 papillary diameters from the macula center. Usually, the laser treatment applied on the exudative area source (microanevrisms) determines the disappearance of focal edema (Figure 1).

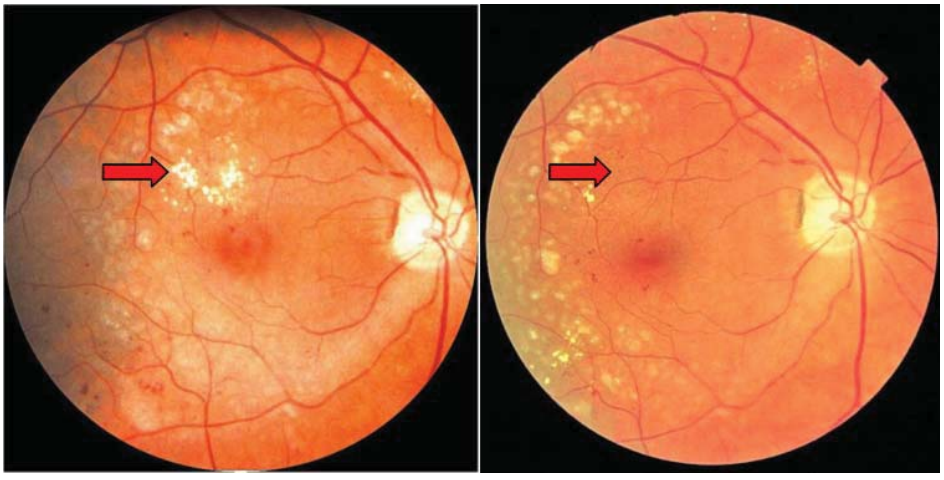

Figure 1. Residual focal macular edema before laser therapy and 2 years after that in a patient with pseudofachia

b. Clinically significant macular edema (CSME) is defined by ETDRS [12, 17] as having one of the following clinical aspects: thickening of central retina on a maximum ray

of 500 μm from the fovea center with an adjacent retinal thickness; or a retina thickening area of at least 1 papillary diameter from the fovea center. The macular laser treatment applied was "shoe horse" shaped, opened towards the papilla, separing the fovea on an area of 1 papillary diameter from its center [6, 7, 8, 5, 6, 9]. We resorted to this technique for avoiding any risks of fovea burning [10, 11, 18, 19].

The response of macular retina to the photocoagulant laser treatment in the case of clinically significant edema is performed at variable time intervals from 6 to 12 months and it is influenced not only by the glycemic control, but also by the lipid metabolism balance and the blood pressure values [12, 17].

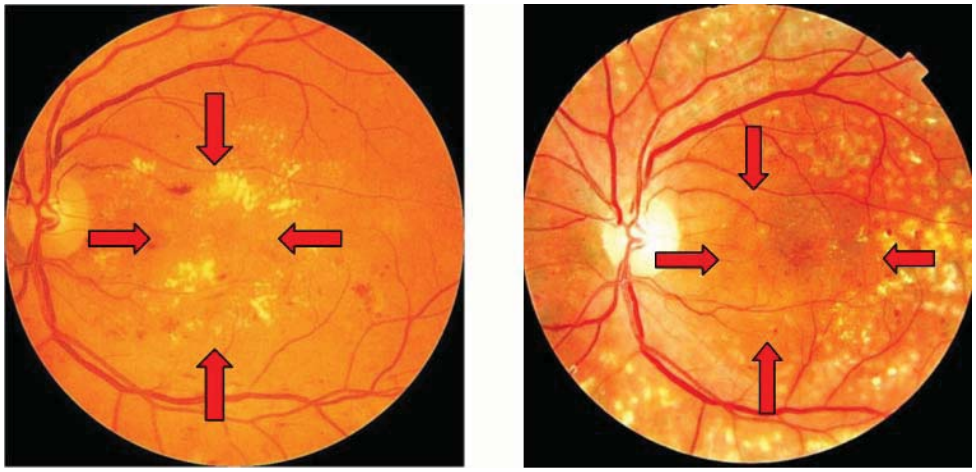

Figure 2. IJ patient with clinically significant macular edema before laser (left-2006) and after laser (right-2010)

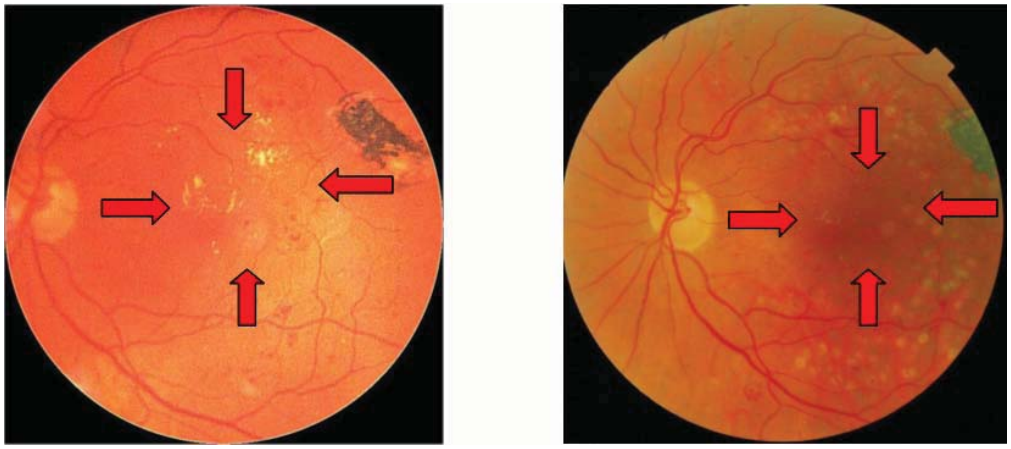

Figure 3. SI patient, clinically significant edema and chorioretinal scar after an extracted intraocular foreign body, before laser (left-2005) and after laser (right-2009)

It is remarkable the fact that, no matter how late the laser effect manifests itself, this was persistent in time, over a period of 3-7 years, the macular edema not showing any post laser therapy recurrences.

c. Exudative macular plaque is defined as a compact agglomeration of hard exudates, situated in the fovea center. Its presence shows an old macular suffering, most of the time associated with dyslipidaemia.

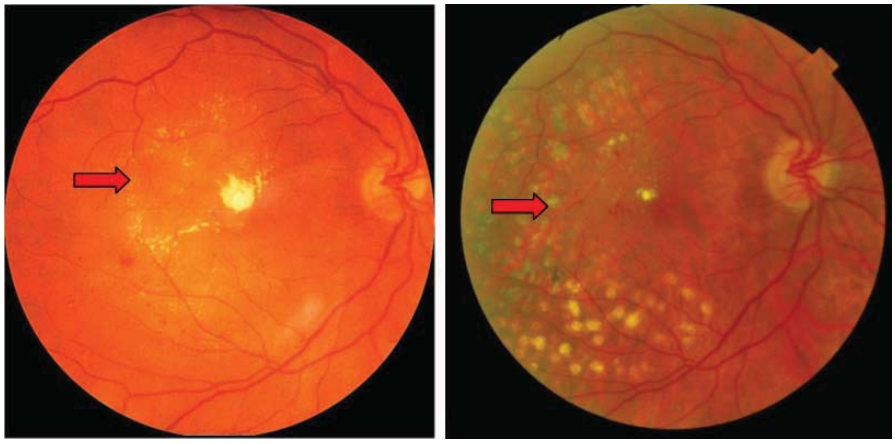

Figure 4. Patient SI, clinically significant macular edema (CSME) before laser (left-2005) and after laser (right-2009).

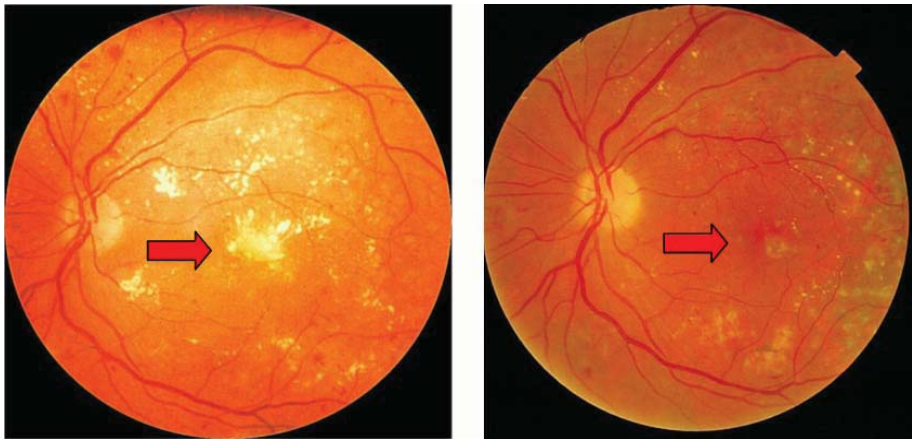

Figure 5. BT patient, with exudative macular plaque before laser (left-2007) and after laser (right, 2010)

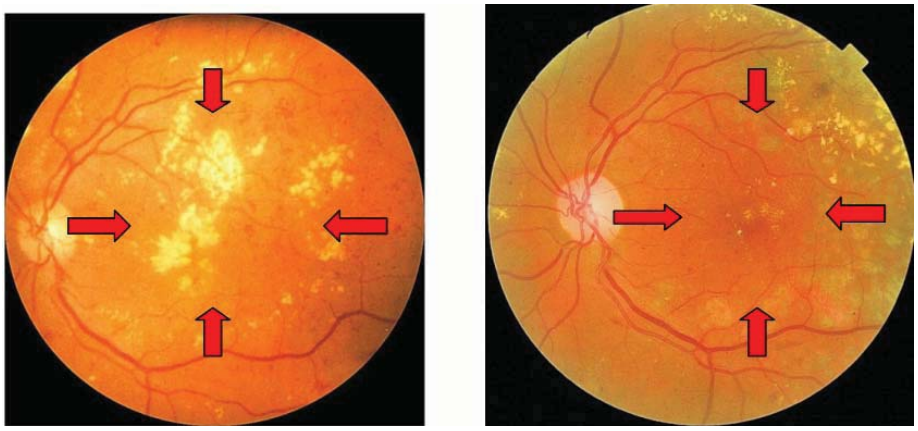

Figure 6. CM patient, with exudative macular plaque before laser (left-2006) and after laser (right, 2010).

The therapeutic response to laser treatment of this particular and extremely severe edematous diabetic maculopaty is installed in time, but in the cases studied by us we found the maintaining of the effect for long periods of time.

Another point to note is that, regardless of the evolution of the retinopathy, from the nonproliferative, to proliferative form which

required retinal panphotocoagulant laser, macular edema, even in this severe form, has not recurred after laser therapy.

In this case, we noticed an almost complete reabsorbtion of exudative macular lesions, without **restitutio ad integrum,** the macular structure being ireversibly altered, possibly due to its oldness.

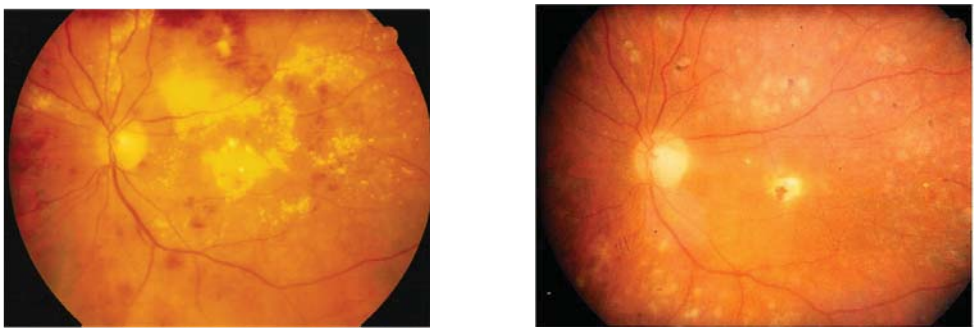

Figure 7. AE patient with massive exudative macular plaque and with NVE before laser (left-2002) and after laser (right- 2009).

The most real assessment of diabetic macular edema is performed by the technique of retina TOC, which allows not only retina illustrations, but also the measurement of central cornea thickness (Figure 8) [13, 3].

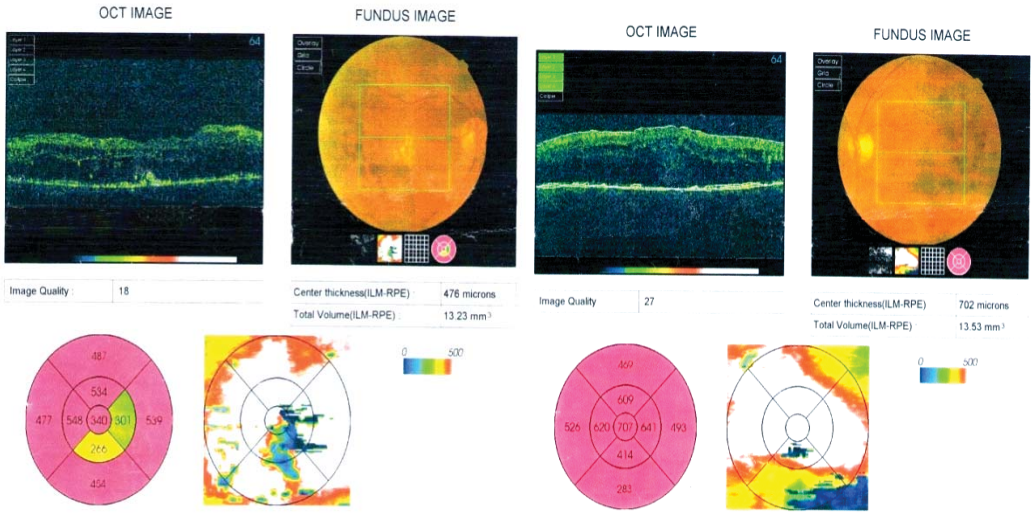

Figure 8. Retina tomography in optical coherence with clinically significant macular edema in OD-476μ (left) and OS-702μ (right).

Proliferative diabetic retinopathy represents the stage of diabetic retinopathy marked by the appearance of retina neo-formation and/ or papillary vessels in whose pathogeny there interfere a multitude of growth factors (vascular proliferation) [14, 15, 16, 2, 13, 16].

The presence of retina new vessels (NVE-New Vessels Elswere) marks the existence of a relatively restricted retina ischemia, localized in the area of those new vessels, and the therapeutical answer to laser therapy is, most of the time, accurate and persistent, thus being observed the involution of these new vessels, a fact also mentioned in major unanimously recognized studies (figure 9) [7, 6].

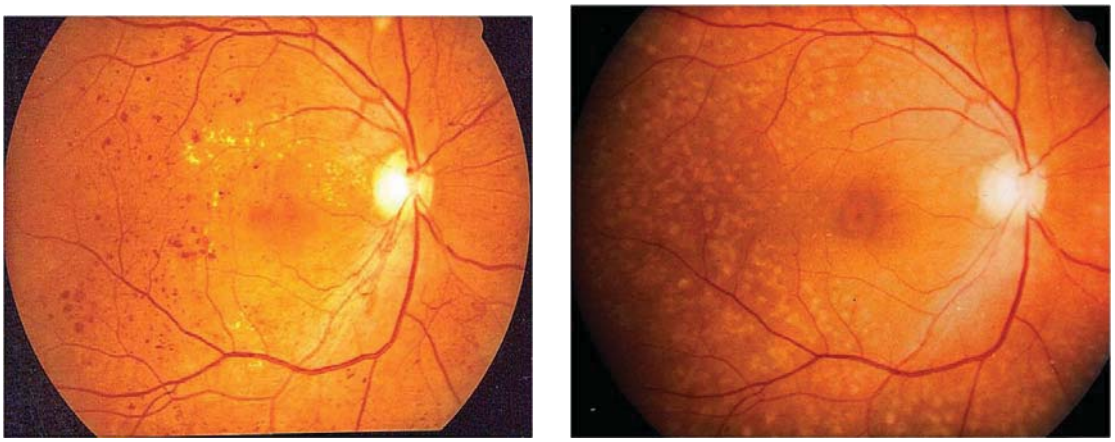

Figure 9. CC patient with NVE and focal macular edema before laser (left, 2002) and after laser (right-2010)

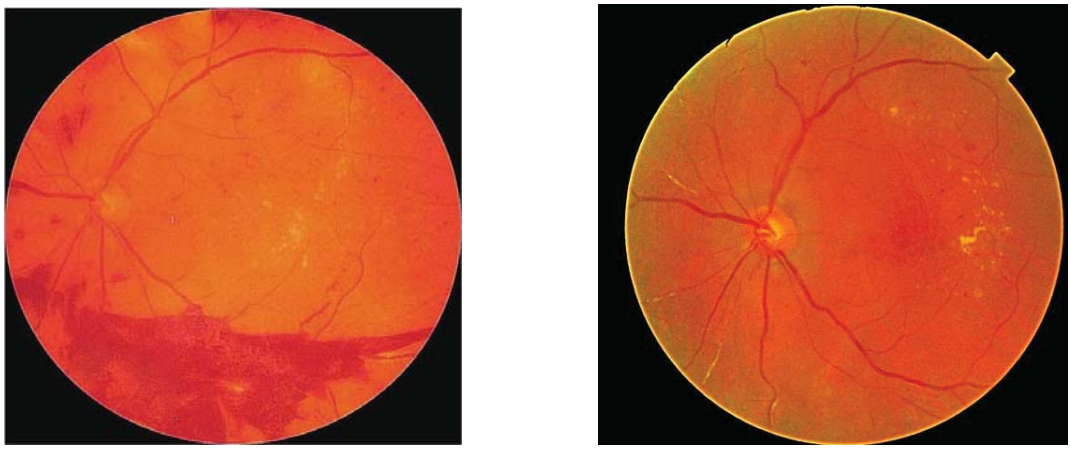

Figure 10. ZE patient, with proliferative diabetic retinopathy and pre-retinal haemorrhage before laser (left 2005) and after laser (right 2009).

In some particular cases, where retina new vessels were accompanied by extended pre-retina haemorrhages, the laser therapy efficiency led not only to the disappearance of new vessels, but also to the complete involution of these extremely dangerous haemorrhages, due to their high bleeding potential (Figure 10).

We should underline the fact that the stage of diabetic retinopathy, when laser therapy is initiated, is extremely important for the long-term visual prognosis of the respective patient: the more severe proliferative retinopathy is, the higher the risk of complications leading to sight loss.

The presence of papillary new vessels (NVD'New Vesssels on the Disk) constitutes a severity indicator for diabetic retinopathy, specialty studies indicating that this type of new vessels illustrates the presence of extended ischemia, which affects over 1/3 of the retina surface [5, 1]. Due to this fact, the involution of papillary new vessels under laser treatment is more difficult to obtain in time, but in our case the results were spectacular, after one year being observed the almost complete regression of the new vessels network on the papilla (Figure 11).

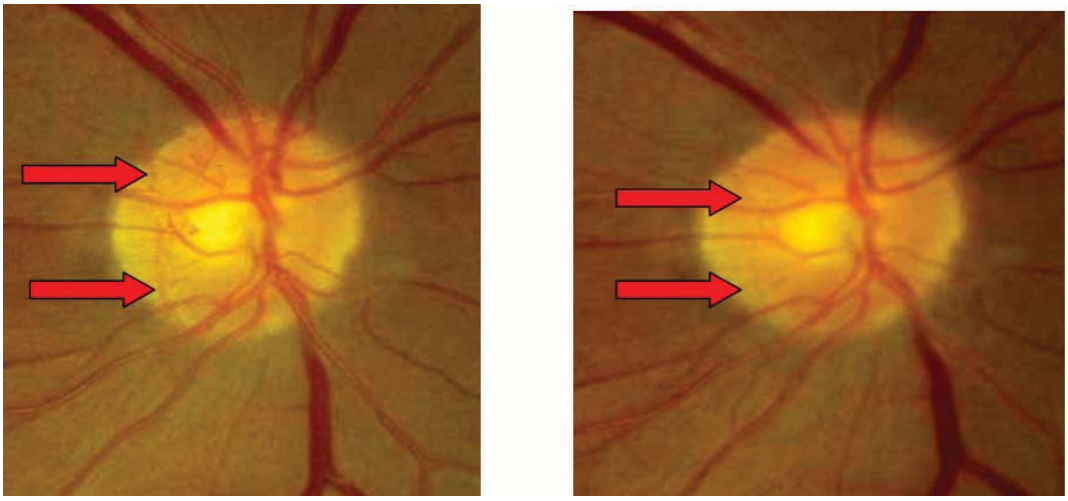

Figure 11. P.Z patient, with papillary new vessels, before laser (left-Jan 2009) and after laser (right-Jan 2010).

Risks of Laser Treatment in Diabetic Retinopathy

a. **Complications of diabetic retinopathy** like persistent intravitrous haemorrhages and neovascular secundary glaucoma, within the context of an **incomplete or insufficient therapy** (non-compliance with the optimal frequency of sessions and/or with the recommended minimum number of impacts per session);

b. **Deficitary technique**, especially the application of non-systematized, over-dimensioned laser impacts over the foveola center or over the retina vessels;

c. **Unappropriate monitoring of patients after laser therapy**, their control temporization, respectively.

Complications of diabetic retinopathy, due to an insufficient or inefficient laser therapy induced by a multitude of factors: factors connected to the patient's status (severity of diabetic retinopathy, disbalances of the glucidic and lipidic metabolisms, non-compliance with the laser treatment); factors independent on the patient (non-transparent intraocular environments that impede the eye bottom visibility, cataract surgery, associated general diseases, anticoagulant treatment etc).

Deficitary technique represents one of the biggest problems of laser therapy because the post laser therapy scars are irreversible and its functional consequences are extremely unpleasant for the patient (decrease of eyesight, central scotomas etc).

Incorrect patient monitoring after laser therapy is one of the major risks because the evolution of laser therapy patient is, most of the time, unpredictable and full of complications.

Laser therapy failures are frequently connected to the following factors:

- severity of diabetic retinopathy;
- disbalances of glucidic and/ or lipid metabolisms (Figure 12);
- incomplete or interrupted laser treatment;
- severe general associated diseases (myocardial stroke, venous thromboses requiring anticoagulant treatment);
- interrupted monitoring of post laser therapy evolution.

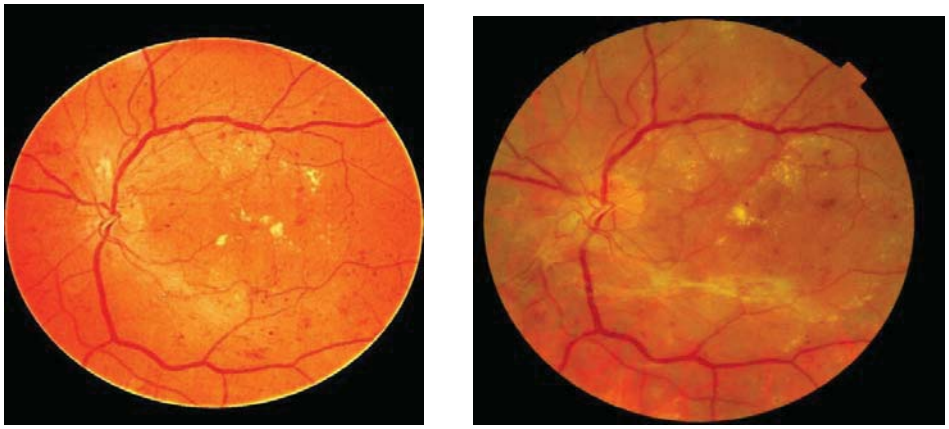

Figure 12. AL patient with proliferative diabetic retinopathy before laser (left) and 4 months after its start (right) within the context of major metabolic disbalances

Conclusions:

- macular edema represents the major cause of blindness in patients with diabetes melitus, whose single efficient and long-lasting solution was photocoagulant laser treatment;
- laser therapy mostly reduced the risk of sight loss through the regression and even complete disapearance of macular lesions after photocoagulation;
- the duration of laser therapy effect, the older and more severe the lesions are, the later their regression;
- proliferative diabetic retinopathy optimally responded to laser retina panphotocoagulation, as far as a long-term metabolic and haemodynamic balance was preserved;
- the greatest benefit of laser therapy was that of preventing the complications of diabetic retinopathy, by a percentage under 1% of compete panphotocoagulation patients with neovascular secundary glaucoma.

Acknowledgement: Many thanks for LIONS CLUB Lystrup Denmark for material and logistical support in the establishment and operation of the "Diabetic Eye" Department in Craiova. Many thanks also to Mrs. Prof. Katrin Sjoelie, from Odense Denmark, for the permanent counseling and scientific training of medical staff.

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