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Efficacy of Focal Photocoagulation to Maintain or Achieve Best Corrected Visual Acuity ≥20/40, In Eyes With Diabetic Macular Edema

Dulce Milagros Razo-Blanco-Hernandez[1], Diana Alejandra Bermudez-Zapata[1], Sandra Marieli Romo-Rodriguez[1], Virgilio Lima-Gomez[1*]

1. Hospital Juarez de Mexico, Av. IPN 5160 Colonia Magdalena de las Salinas, CP 06770, México City, México. Phone: (52) 5557477624.

Abstract

Objective: To identify the efficacy of focal photocoagulation to maintain or achieve best corrected visual acuity (BCVA) ≥20/40 in eyes with clinically significant macular edema (CSME) that had a focal angiographic pattern.

Material and methods: Non-experimental, retrospective, longitudinal, descriptive study in type 2 diabetic patients of any gender, who had CSME with focal angiographic pattern, who received focal photocoagulation from January to October 2012, with a register of BCVA before and 3 weeks after photocoagulation. 101 eyes from patients aged 35-74 years (mean 60.1±8.15) were assigned to one of two groups: 1, with BCVA before treatment <20/40 (n=60), and 2, with BCVA ≥20/40 (n=41). The proportion of eyes with BCVA≥20/40 after treatment was identified, in the sample and within each group.

Results: In group 1 BCVA improved in 34 eyes (56.7%), did not change in 15 (25%), and worsened in 11 (18.3%); in group 2 BCVA improved in 10 eyes (24.4%), did not change in 18 (43.9%) and worsened in 13 (31.7%). Post treatment BCVA was ≥20/40 in 57 eyes (56.4%, 95% confidence intervals 46.8-66.1%), 21 of them from group 1 (36.8%) and 36 from group 2 (63.2%).

Conclusion: Treating CSME with focal photocoagulation was efficacious to maintain BCVA ≥20/40 in 87.8% of eyes with that rank of vision preoperatively, and to achieve BCVA ≥20/40 in 35% of eyes without it. Early detection and treatment of CSME is required to increase the proportion of eyes with BVCA that provides visual independence, preferably when visual function is still good.

Corresponding author: Virgilio Lima-Gomez MD, PhD. Ophthalmology service, Hospital Juarez de Mexico, Av. IPN 5160 Colonia Magdalena de las Salinas, CP 06770, México City México. Phone: (52) 5557477624. Email: vlimag@eninfinitum.com

Running Title

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Key Words

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Introduction

Diabetic retinopathy is a chronic and specific complication of diabetes mellitus,[1] and the leading cause of visual loss in working-aged population worldwide. [2,3] A common cause of visual impairment in diabetic retinopathy is diabetic macular edema, which reduces the resolution power of the eye as a result of fluid accumulation in the macula, the region of the retina responsible for best corrected visual acuity (BCVA). [4]

The fluid that thickens the macula may leak from microaneurisms or from dilated capillaries adjacent to zones without circulation; retinal fluorescein angiography reveals a focal pattern of leakage in the first case, and a diffuse pattern in the second. [4] Regardless of the angiographic pattern, the Early Treatment Diabetic Retinopathy Study (ETDRS) identified clinical features of diabetic macular edema associated with the risk of developing moderate visual loss (MVL, doubling of the visual angle, a reduction of 3 lines of vision in a logarithmic visual acuity chart), that are known as "clinically significant macular edema (CSME)":

- Thickening of the retina at or within 500 µm of the center of the macula
- Exudates at or within 500 µm of the center of the macula, if associated with thickening of the adjacent retina
- A zone or zones of retinal thickening one disc area or larger, any part of which is within one disc diameter of the center of the macula [5]

The risk of MVL is greater when the center of the macula is involved; the incidence of MVL is reduced by more than 50% for patients who undergo appropriate photocoagulation surgery, compared with those who are not treated. [6] Focal photocoagulation is the standard treatment for eyes with CSME with a focal angiographic pattern. [6]

In the ETDRS vision improved for a minority of patients, and the goal of treatment with photocoagulation was to stabilize visual acuity; visual improvement after photocoagulation in the ETDRS occurred more frequently in patients with initial BCVA worse than 20/40, while those with initial vision ≥20/40 had less room to show an improvement; patients with CSME and excellent function should be considered for treatment before visual loss occurs. [6]

The overall incidence of MVL in eyes treated with photocoagulation was 13% in a 3 year period, in the ETDRS; [7] recent studies have identified that over a third of the eyes with CSME treated with photocoagulation improve their BCVA. [8-11]

Although BCVA can improve after focal photocoagulation for CSME, the delay in the diagnosis may limit achieving a functional level that can provide visual independence. In a previous study from our population, 69% of patients with CSME had BCVA <20/40 at the moment of diagnosis; [12] consequently some patients may improve their vision or may not develop MVL, without reaching BCVA ≥20/40.

BCVA ≥20/40 is a functional level that provides visual independence, and that was used as a cutoff point in the ETDRS to identify patients with a higher probability of visual improvement; eyes with that functional level might also lose vision after photocoagulation, and may or may not preserve BCVA ≥20/40. Although visual improvement after photocoagulation is frequent in recent studies of CSME, the proportion of eyes that has BCVA ≥20/40 after treatment has not been identified recently.

A study was conducted to identify the efficacy of focal photocoagulation to maintain or achieve BCVA ≥20/40 in eyes with CSME who had a focal angiographic pattern.

Material and methods

A non-experimental, retrospective, longitudinal, descriptive study was conducted in diabetic patients with CSME of a general hospital in Mexico City, from October

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1st to November 25th 2012. The study was authorized by the Institutional Review Board from the Hospital where it was conducted.

One hundred and one type 2 diabetic patients of any gender, with any diabetic retinopathy level, who had CSME with focal angiographic pattern, had undergone focal photocoagulation from January 1st 2012 to October 31st 2012, and who had a register of BCVA before and 3 weeks after photocoagulation were included. Patients were excluded if they had any other macular disease, vitreoretinal diseases which reduced BCVA, a thickened posterior vitreous, any media opacity that prevented a fundus photograph from being obtained, and if they had not attended the three week visit.

The files from patients treated with focal photocoagulation during the study period, who fulfilled the selection criteria were reviewed; CSME in all eyes was diagnosed by the same retina specialist, using dilated biomicroscopy, according to the definition of the ETDRS. Each eye was assigned to one of two groups: group 1, with BCVA before treatment < 20/40 (n=60, 59.4%, 95% C.I 49.8-69.0%), and group 2, with BCVA ≥20/40 (n=41, 40.6%, 95% C.I 31.0-50.2%).

The evolution of BCVA in each eye, and the incidence of moderate visual loss were identified in the sample and in each group. The study variable was the presence of BCVA ≥20/40 under subjective refraction, on the day of photocoagulation and 3 weeks after it.

The proportion and 95% confidence intervals (C.I.) of eyes with BCVA≥20/40 three weeks after treatment was identified, in the sample and within each group.

Results

Age in the sample ranged 35-74 years (mean 60.1±8.15); 48 eyes were from females (65.8%), diabetes duration mean was 15.3 ± 6.9 years, and fasting blood glucose mean was 166.63± 45.66mg/dl. Fifty patients received oral hypoglycemient drugs (68.5%), 22 received insulin (30.1%) and 7 were only treated with diet (6.9%). Forty three eyes were from patients who had arterial hypertension (58.9%), and 6 from patients with diabetic nephropathy (8.2%).

Retinopathy level was mild non-proliferative in 24 (23.8%), moderate non-proliferative in 27 (26.7%), severe non-proliferative in 8 (7.9%), and proliferative in 42 (41.6%).

Three weeks after treatment, BCVA improved in 44 eyes (43.6%, 95% C.I 33.9-53.2%), did not change in 33 (32.7%, 95% C.I 23.5-41.8%), and worsened in 24 (23.8%, 95% C.I 15.5-32.1%); 9 eyes (8.9%, 95% C.I 3.4-14.5%) developed moderate visual loss. BCVA was ≥20/40 in 59 eyes (58.4%, 95% C.I 48.8-68.0%), and <20/40 in 42 (41.6%, 95% C.I 32.0-51.2%).

GROUP 1

Twenty one eyes had proliferative diabetic retinopathy(35%); center point thickness mean decreased from 183.33 ± 54.57 µm before photocoagulation to 178.53 ±35.01 µm after it, and macular volume mean decreased from 8.05 ±0.62 to 8.03 ±0.69 mm^3. BCVA mean was 0.22 ± 0.11 before photocoagulation; it improved in 34 eyes (56.7%), did not change in 15 (25.0%), and worsened in 11 (18.3%). 5 eyes developed moderate visual loss (8.3%), and 21 eyes achieved ≥20/40 BCVA (35.0%, 95% C.I 22.9-47.1%). The proportion of eyes with non-proliferative diabetic retinopathy that achieved ≥20/40 BCVA (12/39, 30.8%) did not differ from the proportion of eyes with proliferative retinopathy that achieved it (9/21, 42.9%, p=0.3).

GROUP 2

Twenty eyes had proliferative diabetic retinopathy; center point thickness mean changed from 173.45 ± 32.46 µm before photocoagulation to 176.68±27.93µm after it, and macular volume mean changed from 7.51 ±0.71 to 7.50 ±0.81 mm^3. BCVA mean before photocoagulation was 0.67 ± 0.16; it improved in 10 eyes (24.4%) did not change in 18

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(43.9%) and worsened in 13 (31.7%). Four eyes developed moderate visual loss (9.8%) and in 5 eyes BCVA dropped below 20/40 (12.1%, 95% C.I 2.1-22.2%). Thirty six eyes maintained a BCVA ≥20/40 (87.8%, 95% C.I. 77.8-97.8%). The proportion of eyes with non-proliferative diabetic retinopathy that maintained BCVA ≥20/40 (18/20, 90%) did not either differ from that found in eyes with proliferative retinopathy (18/21, 85.7%, p=0.9)

Visual improvement was more common in group 1 than in group 2, a higher proportion of eyes in group 2 maintained BCVA than in group 1; these differences were statistically but not clinically significant (Table 1).

A final BCVA ≥20/40 was more common in group 2 (87.8%) than in group 1 (35%, p=0.0000001, RR 2.51, 95%C.I. 1.74-3.61). The difference persisted in eyes with non-proliferative diabetic retinopathy (90% group 2, 30.8% group 1, p=0.00001, RR 2.92, 95% C.I. 1.79-4.79) and in eyes with proliferative diabetic retinopathy (85.7% group 2, 42.9% group 1, p=0.003, RR 2, 95% C.I. 1.18-3.38).

Focal photocoagulation was efficacious to maintain or achieve ≥20/40 BCVA in 57 eyes (56.4%, 95% C.I 46.8-66.1%); 36 eyes with ≥20/40 BCVA maintained this function (87.8%, 95% C.I 77.8-97.8%), 21 eyes with <20/40 (35.0%, 95% C.I 22.9-47.1%) achieved ≥20/40 BCVA.

Discussion

In the management of DME, laser surgery is a well proven treatment with very good efficacy; [13] the number needed to treat to prevent one case of moderate visual loss over 3 years is 8. [14] The ETDRS investigators had suggested that the reduced rate of moderate visual loss was mostly due to the effect of early focal photocoagulation, which should be considered for all eyes with CSME, as it leads to less chances of moderate visual loss, less loss of color vision, minor visual field changes and an increased chance of visual improvement;[15] the study found that this latter outcome was uncommon. [13]

It is frequent to identify large changes in retinal thickness and BCVA in patients with greater retinal thickness before therapeutic interventions for CSME[16] but addressing the proportion of eyes with BCVA ≥20/40 is not a rule. A recent study that compared photocoagulation with other therapies identified that visual improvement was more common in eyes with center point thickness before treatment <350 µm; [17] the study also stated that the outcome was not different between eyes with different baseline retinal thickness after 12 weeks, but it did not report the final proportion of eyes with BCVA ≥20/40.

Estabrook et al. identified that the benefit of grid photocoagulation in eyes with diffuse diabetic

TABLE 1. Evolution of BCVA in each group

	Group 1 (n=60)		Group 2 (n=41)		p	Relative Risk
Improved	34	56.7% (95% C.I 44.1-69.2%)	10	24.4% (95% C.I 11.2-37.5%)	0.001	1.69 (95% C.I 1.22-2.35)
Without change	15	25.0% (95% C.I 14.0-36.0%)	18	43.9% (95% C.I 28.7-59.1%)	0.04	0.69 (95% C.I 0.46-1.04)
Worsened	11	18.3% (95% C.I 8.5-28.1%)	13	31.7% (95% C.I 17.4-46.0%)	0.12	0.72 (95% C.I 0.45-1.15)
MVL*	5	8.3% (95% C.I 1.3-15.3%)	4	9.8% (95% C.I -0.7-18.8%)	0.5	0.93 (95% C.I 0.51-1.71)

* moderate visual loss

macular edema was higher with baseline center field thickness values between 300 and 399 µm;[18] all the patients in the present sample had a focal angiographic pattern; eyes with diffuse or cystoid edema, which are usually associated with a poorer prognosis, were not evaluated. Although lens opacities were common, as an effect of age, visual impairment was not attributed to them, since patients with cataract affecting the visual axis were excluded; the lack of improvement in group 1 was only related to the dysfunction caused by CSME.

Cheung et al. pointed out that even with adequate laser therapy, reversal of visual loss in diabetic retinopathy is uncommon.[19] In the present sample only 21 of the 34 eyes with baseline BCVA< 20/40 whose vision improved achieved ≥20/40 (61.7%); in the remaining 13 BCVA would not provide visual independence, despite being better than that before photocoagulation.

If BCVA <20/40 was considered visual loss before photocoagulation, the procedure would only be efficacious to revert it in 35% of the eyes; 71.9% of the eyes whose BCVA was ≥20/40 after photocoagulation had that vision rank before the procedure.

The proportion of eyes improving in the sample (43.5%) did not differ statistically from that of a previous study in our population (38.4%, p = 0.4), which also evaluated eyes with focal CSME; the proportion of eyes with BCVA <20/40 in that study (51.1%) did not either differ from that found in the present study (59.5%, p = 0.2) [10] Although the incidence of visual improvement was consistent, the proportion of eyes with BCVA ≥20/40 after focal photocoagulation had not been reported.

According to the results in the current study, up to 66.1% of the eyes with CSME could maintain or achieve BCVA ≥20/40; the proportion could vary according to the distribution of preoperative BCVA < 20/40, which emphasizes the need of a timely diagnosis, in order to offer the patient a better opportunity of having visual independence.

Conclusion

Focal photocoagulation in patients with CSME was efficacious to maintain BCVA ≥ 20/40 in 87.8% of eyes with that rank of vision preoperatively, and to achieve BCVA ≥20/40 in 35% of eyes with BCVA<20/40 before treatment.

References

1. Ciulla T, Amador A, Zinman B. Diabetic Retinopathy and Diabetic Macular Edema, Pathophysiology, screening and novel therapies. Diabetes Care 2003; 26: 2653-2654.
2. Klein BE. Overview of Epidemiologic Studies of Diabetic Retinopathy. Ophthalmic Epidemiol 2007; 14(4): 179-183.
3. Yau JWY, Rogers SL, Kawasaki R, Lamoureux EL, Kowalski JW, Bek T, et al. Global Prevalence and Major Risk Factors of Diabetic Retinopathy. Diabetes Care 2012; 35(3): 556-564.
4. Byeon SH, Chu YK, Hong YT, Kim M, Kang HM, Kwon OW. New insights into the pathoanatomy of diabetic macular edema: Angiographic Patterns and Optical Coherence Tomography. Retina 2012;32(6):1087-1099.
5. The Early Treatment Diabetic Retinopathy Study Research Group. Photocoagulation for diabetic macular edema. Early treatment diabetic retinopathy study report number 1. Arch Ophthalmol 1985; 103: 1796-1806.
6. American Academy of Ophthalmology Retina Panel. Preferred Practice Guidelines. Diabetic Retinopathy. San Francisco CA: American Academy of Ophthalmology; 2008 (4th printing 2012).
7. Early photocoagulation for diabetic retinopathy. ETDRS report number 9. Early Treatment Diabetic Retinopathy Study Research Group. Ophthalmology 1991; 98: 766-785.

8. Diabetic Retinopathy Clinical Research Network. A randomized trial comparing intravitreal triamcinolone acetonide and focal/grid photocoagulation for diabetic macular edema. Ophthalmology 2008; 115: 1447–49.
9. Zaidi ZA, Jacob MK. Effect of macular photocoagulation on visual acuity of Omani patients with clinically significant macular edema. Oman J Ophthalmol 2009; 2: 62-66.
10. Lima-Gómez V, Razo-Blanco Hernández DM. Characteristics associated with visual improvement after focal photocoagulation in diabetic macular edema. Cir Ciruj 2012; 80: 311-319.
11. Shresta A, Maharjan N, Shresta A, Thapa R, Poudyal G. Optical Coherence tomographic assessment of macular thickness and morphological patterns in diabetic macular edema: Prognosis after modified grid photocoagulation. Nepal J Ophthalmol 2012; 4 (7): 128-133
12. Lima-Gómez V, Olivares Morales OE, Razo Blanco-Hernández DM, Hernández-Rojas ML. Visual déficits at the time of diagnosing clinically significant macular edema in Mexican diabetics. Salud Publica Mex 2008; 50: 354-355.
13. American Academy of Ophthalmology. Basic and Clinical Science Course. Section 12 Retina and Vitreous. San Francisco, American Academy of Ophthalmology; 2012.
14. Dowler J. Laser management of diabetic retinopathy. J R Soc Med. 2003; 96: 277–279.
15. Early treatment diabetic retinopathy study research group. Photocoagulation for diabetic macular edema. Early treatment diabetic retinopathy study report number 4. Int Ophthalmol Clin 1987; 27: 265-272.
16. Diabetic retinopathy clinical research network. Relationship between optical coherence tomography-measured central retinal thickness and visual acuity in diabetic macular edema. Ophthalmology 2007; 114:3:525-532.
17. Soheilian M, Ramezani A, Yaseri M, Mirdehghan S, Obudi A, Bijanzadeh B. Initial macular thickness and response to treatment in diabetic macular edema. Retina 2011; 31:8:1564-1573.
18. Estabrook EJ, Madhusudhana KC, Hannan SR, Newsom RS. Can optical coherence tomography predict the outcome of laser photocoagulation for diabetic macular edema? Ophthalmic Surg Lasers Imaging 2007; 38: 478-483.
19. Cheung N, Mitchell P, Wong TY. Diabetic retinopathy. Lancet. 2010; 10:124-36.