Vitrectomy Seems to be Beneficial for Advanced Diffuse Diabetic Macular Oedema not Responding to Laser Treatment.

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VITRECTOMY SEEMS TO BE BENEFICIAL FOR ADVANCED DIFFUSE DIABETIC MACULAR OEDEMA NOT RESPONDING TO LASER TREATMENT.

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Abstract

Background. To evaluate the surgical efficacy of vitrectomy, with optical coherence tomography, in patients with non-ischemic and ischemic diffuse diabetic macular oedema not responding to laser treatment

Methods. Ten eyes from nine patients (aged 46.0±20 years, diabetesduration 12.4 ±4 years) operated with vitrectomy for diabetic macular oedema not responding to laser treatment were evaluated before and six months postoperatively. Retinal thickness was assessed with optical coherence tomography, OCT, measuring the mean values of the centre of fovea and the second and third concentric rings from foveola. Four patients with type 1 diabetes had ischemic and five patients (6 eyes) with type 2 diabetes had non-ischemic diffuse macular oedema diagnosed on fluorescein angiography, FA. All eyes had an attached vitreous diagnosed on OCT.

Results. Mean foveal thickness for the three concentric rings from centre and out was significantly less 6 months postoperatively 437±125 vs. 286±67µm; p=0.027, 426±105 vs. 308±35µm; p=0.019 and 404±69µm vs. 318±29µm; p=0.011 respectively. The decrease in foveal thickness was similar for eyes with and without signs of ischemic maculopathy. There was a trend toward improved visual acuity (VA) 6 months after surgery 0.4; range 0.2-0.6 compared to 0.3; range 0.1-0.5 before vitrectomy; p=0.107).

Conclusion. Vitrectomy seems to be a beneficial treatment for both ischemic and non-ischemic advanced diffuse diabetic macular oedema not responding to laser treatment.

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Introduction

Macular oedema still remains the major cause of visual loss in patients with diabetes [11, 14]. The treatment of clinically significant macular oedema is mainly based on photocoagulation according to the Early Treatment Diabetic Retinopathy Study (ETDRS), which found approximately a 60% reduction of visual loss by laser treatment [3]. However, not all eyes respond to laser treatment and in about 25% of the treated eyes visual acuity decrease by 3 or more lines in spite of photocoagulation [16].

The pathogenesis of diabetic macular oedema is still poorly understood. Leaking microaneurysms and vessels are known to contribute to the oedema, but also the posterior cortical vitreous relation to the macula may influence by tangential vitreomacular traction [15]. Several authors have reported a favourable outcome with resolution of macular oedema and increased visual acuity after vitrectomy in eyes with a tight posterior hyaloid [8, 12]. Furthermore, macular oedema in eyes without a posterior hyaloid membrane has been reported to benefit from vitrectomy [20].

Diffuse macular oedema is characterized on the fluorescein angiography of a deep, diffuse and late fluorescein leakage and/or capillary drop out. Diffuse macular oedema without signs of capillary nonperfusion do not respond better to modified grid laser photocoagulation than diffuse oedema associated with parafoveal ischemia of 6 clock hours or less [17]. If this is the case also for the results after vitrectomy is not studied. In this prospective study we wanted to evaluate the effect of vitrectomy in eyes with diffuse diabetic macular oedema with and without parafoveal ischemia in patients with attached vitreous.

Patients and Methods

At the Department of Ophthalmology, University Hospital in Lund, 700 eyes undergo laser treatment for diabetic retinopathy every year. Out of these, ten eyes from nine diabetic patients (four with type 1 diabetes) with advanced diffuse diabetic macular oedema not responding to repeated laser treatment were included in this prospective study. Two eyes had some lens opacities diagnosed on slit-lamp biomicroscopy, however not dense enough to influence laser treatment.

There were eight women and one man with a mean age of 46.0±20.3 years and diabetes duration of 12.4 ±4.1 years.

The effect of pars plana vitrectomy on ten eyes with clinically significant diabetic macular oedema according to the Early Treatment Diabetic Retinopathy Study (ETDRS), [2] and without posterior vitreous detachment observed on Optical coherence tomography (OCT), was evaluated. Four eyes had ischemic, i.e. parafoveal ischemia, and six eyes non-ischemic diffuse macular oedema diagnosed on a pre-laser treatment fluorescein angiography. Focal photocoagulation according to (ETDRS) treatment guidelines [4] had been performed in all eyes, but with residual thickening of the retina not responding to treatment. The ophthalmologic examination was performed by direct and indirect ophthalmoscopy using a slit lamp. Retinal thickness in the foveal region was measured with a commercially available OCT unit (Carl Zeiss Ophthalmic Systems, model 3000, Humphrey Division, Dublin, California, USA). Six radial linear scans of 3.5 mm length through the center of fixation, rotated at 30˚ were perfomed. Retinal thickness was computed automatically, using OCT retinal mapping software. The average thickness values from each of the three concentric rings from the OCT were used. Patients were examined preoperatively and six months postoperatively.

Vitrtectomy

A standard 3 port pars plana vitrectomy was performed and the central vitreous was removed first. Then the vitreous membrane was engaged with gentle suction from the vitreous cutter above the optic disc and then detached from the optic disc and macular area. In one patient a retinal break was detected peroperatively and treated with laser and air tamponade. No tamponade was used in the other eyes.

Visual acuity

Visual acuity was tested using Snellen Charts at a distance of 6.0 meter.

Photocoagulation

All patients had undergone laser treatment for clinically significant macular oedema according to guidelines from the ETDRS prior to vitrectomy. In case of proliferative retinopathy, patients had been treated with panretinal photocoagulation (4 eyes).

Risk indicators

HbA1c was assessed at the time for surgery.

Analytical techniques

HbA_{1c} levels were analysed by ion-exchange chromatography using commercially available microcolumns (Bio-Rad, Richmond, CA) or by fast liquid chromatography (Kontron Instruments, Milan, Italy). The upper normal reference range for both methods is <5.3%.

Statistical methods

Paired Student`s T-test and Wilcoxon signed-rank test were used for comparison between preoperative and postoperative foveal thickness and Wilcoxon signed-rank test for visual acuity. The SPSS version 11.0 was used for the calculations.

Results

Foveal thickness

In all patients Mean foveal thickness for the three concentric rings from centre and out was significantly less 6 months postoperatively 286±67µm vs.437±125µm; p=0.027, 308±35µm vs. 426±105µm; p=0.019 and 318±29µm vs. 404±69µm; p=0.011 respectively (Fig 1).

In ischemic eyes the mean values after 6 months follow-up compared to start for the three concentric rings from centre and out were 300±79µm vs. 474±106, 323±36µm vs. 447±66µm and 333±25 µm vs. 420±43µm; p=0.068 respectively (Fig 2).

In non-ischemic eyes the mean values after 6 months follow-up compared to start for the three concentric rings from centre and out were 275±63µm vs. 435±143, 296±32µm vs. 429±129µm and 305±27 µm vs. 400±81µm; p=0.138 respectively (Fig 2).

No significant difference in the decrease of macular thickness was seen between ischemic and non-ischemic eyes.

Visual acuity

There was a trend towards improved visual acuity (VA) 6 months after surgery 0.4; range 0.2-0.6 compared to 0.35; range 0.1-0.5 before vitrectomy; p=0.107. Visual acuity was improved in six eyes, unchanged in two and deteriorated in two eyes six months after vitrectomy (Fig 3).

In ischemic eyes VA was improved in two eyes, unchanged in one and deteriorated in one eye.

In non- ischemic eyes VA was improved in four eyes, unchanged in one and deteriorated in one eye. There was no significant difference in the outcome of VA between ischemic and non-ischemic eyes.

Cataract had progressed in the eye which deteriorated in VA and in one eye without visible cataract before vitrectomy. In this eye VA was unchanged.

Metabolic control

Mean HbA1c level at time for surgery was 8.2±1.9. There was no correlation between the level of HbA1c with neither retinal thickness nor visual acuity at time for follow-up.

Discussion

Diabetic macular oedema not responding to laser treatment still is an unanswered question and a big problem. By what mechanism, precisely, does treating with laser, absorbed deep to the retina reduce thickening and improve inner retinal circulation? Why do some cases of significant macular oedema respond dramatically to treatment and other cases not at all? The questions are many. In a previous study we showed that 6 % (3/47) of eyes with diffuse macular oedema did not respond to laser treatment, and in 30% macular oedema resolved, but with a development of subretinal fibrosis [13]. Furthermore, Lee & Olk showed that grid pattern photocoagulation for diffuse macular oedema stabilized visual acuity in 61% and that a decrease in VA was seen in 25% [11].

In the present study we could show a beneficial effect of vitrectomy in eyes with diffuse macular oedema not responding to laser treatment, something that has also been reported by other authors [6, 7, 12, 20]. However, most other studies have not made the distinction between ischemic or not ischemic macular oedema. We made the classification whether ischemic maculopathy was present or not upon a preoperatively carried out fluorescein angiography and found no differences in outcome regarding neither visual acuity nor retinal

thickness between the two groups. However, since the cases were few, the decrease in retinal thickness did not reach significant levels for either of the groups when calculating the results separately. Thus the results must be taken with caution.

The mechanism by which macular oedema is reduced with vitrectomy is not clear. The possibility to estimate the status of the posterior hyaloid on clinical examinations by biomicroscopy is limited. With the OCT this identification is more accurate [5], and hence the description of the vitreous status more precise. It has been suggested that posterior hyaloidal traction might cause a shallow macular detachment and that vitrectomy can reduce this traction [12], something that also has been confirmed in a study by Kaiser et al [10]. However, positive results in reducing macular oedema with vitrectomy, have also been demonstrated in eyes with a detached posterior vitreous prior to operation [8, 18, 20]. In such cases other pathogenetic mechanisms have been discussed, such as improved perifoveal microcirculation [9] and increased oxygen levels after vitrectomy [19], resulting in retinal vasoconstriction and reduced leakage [1]. In the present study all patients still had an attached posterior hyaloid membrane prior to vitrectomy. And thus, no comparison in the results between patients with or without an attached vitreous was possible.

Mean retinal thickness decreased significantly from 437µm before surgery until 286 µm six months postoperatively, whereas there was only a trend in improvement of visual acuity. This may be due to the relatively short follow up time and the fairly small sample size. However, when considering that only 17% of eyes focally laser treated in the ETDRS had any improvement in visual acuity [1], the result in the present study with an improvement in visual acuity in 6/10 eyes is rather good and one might have been even better since visual acuity was influenced of progressing cataract in two eyes. And even more, when taking in account that the present eyes had advanced, long standing diffuse macular oedema not responding to repeated laser sessions, something that may have caused persistent functional

disturbance in the photoreceptors. One may speculate that vitrectomy at an earlier stage had resulted in an even better visual outcome. To further investigate this, it is necessary not only to evaluate retinal morphology but also retinal function assessed by multifocal electroretinography in vitrectomised eyes with different duration of macular oedema. Something we are planning to do in future studies.

In conclusion, vitrectomy significantly reduces macular thickness in both ischemic and non-ischemic diffuse diabetic macular oedema not responding to laser treatment, but the effect on visual acuity is less pronounced.

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Figure legends.

Figure 1. Central, inner and outer rings represent the three concentric rings assessed with the OCT.

Number 1 represents before vitrectomy and number 2 after.

Figure 2. Central, inner and outer rings represent the three concentric rings assessed with the OCT with (yes) and without ischemic maculopthy.

Number 1 represents before vitrectomy and number 2 after.

Figure 3. Visual Acuity before (x-line) and after vitrectomy (Y-line).