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SHORT COMMUNICATION

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Long-term results after surgical extraction of subfoveal choroidal neovascular membranes with and without haemorrhage in age-related macular degeneration

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Abstract *Background:* Surgical extraction has been suggested as a treatment of choroidal neovascular membranes. We demonstrate the long-term results of our patients regarding complications, risk of recurrence and development of visual acuity. *Methods:* We have retrospectively evaluated the charts and reexamined the patients who underwent surgical extraction of choroidal neovascular membranes (CNV) because of age-related macular degeneration (AMD) between March 1994 and December 2000 in the Department of Ophthalmology of the Benjamin Franklin Clinic, Berlin. Fifty-two eyes of 49 patients with a minimum follow-up of 12 months after pars plana vitrectomy with CNV extraction and SF6-endotamponade were included. Initially, in 15% of all eyes the lesions were obscured by intravitreal haemorrhage. All visible lesions were located subfoveally. In 40% of all eyes the lesion was predominantly classic; 21% of the lesions were predominantly occult and 23% of the lesions were comprised of more than 50% haemorrhage. The maximum follow-up was 80 months, the mean 46 months. *Results:* The median initial visual acuity was 0.08 (range: hand movements to 0.4) and the median final visual acuity was not significantly different at 0.067 (range: non lux to 0.4). A loss of less than three lines of visual acuity occurred in 65.4% of our patients. During follow-up, 25% of eyes developed a rhegmatogenous retinal detachment and 19.2% of all eyes suffered from recurrence of CNV. At the end of the follow-up, three eyes (5.8%) suffered from nontreated retinal detachment and three eyes (5.8%) had recurrent CNV lesions. All eyes showed a retinal pigment epithelium defect at the site of former CNV. *Conclusion:* A stabilisation of visual acuity in individual patients with CNV because of AMD can be achieved by surgical extraction, yet the defect of the RPE and the risk of complications limit the benefit. We consider the surgical extraction of CNV from AMD in patients with low initial visual acuity who are not amenable to PDT.

Introduction

In age-related macular degeneration (AMD) the development of an exudative form with subfoveal choroidal neovascularization (CNV) carries the highest risk of severe visual loss. The macular photocoagulation study (MPS) could demonstrate only a limited benefit of laser coagulation of subfoveal CNVs in AMD in subgroups of patients [11]. De Juan and Machemer first described a surgical approach for extraction of subretinal haemorrhage and fibrovascular tissue resulting from exudative AMD [5]. The technique of surgical CNV extraction was refined in the following years [16]. Feasibility of extraction, visual stabilisation and, in individual cases, im-

provement of visual acuity were reported [3, 8, 16]. But with increasing follow-up time, a recurrence rate of up to 30–46%, complicating retinal detachments and subretinal haemorrhages were observed. In addition, defects of the retinal pigment epithelium and the choriocapillaris at the site of former CNV limiting the visual outcome were found [13, 17]. In spite of these clinical findings after CNV extraction, several patients reported on subjective visual stabilisation and reductions of disturbing metamorphopsia and central scotoma [6, 14]. However, long-term results with more than 2 years of follow-up are not published yet. The submacular surgery trial, a set of randomised and prospective trials designed to examine the effects of submacular surgery, is still in progress [15].

In addition to CNV extraction alone, techniques including the relocation of foveal retinal tissue onto intact RPE were introduced in order to improve the visual outcome. Macular translocation was developed and propagated [10, 2, 7, 22, 1]. To date, only few results of prospective studies concerning these new methods are available, although these techniques are performed by several surgeons worldwide. In the light of the technical difficulties of macular translocation and the discrepancy between patient expectations and mean visual outcome, we decided to evaluate the long-term results of CNV extraction.

Patients and methods

We retrospectively revised the charts of 102 patients who underwent surgical removal of CNV from AMD between 1994 and 2002 in our department. All patients were contacted and invited to come to the department for a follow-up examination. Thirty-eight patients were re-examined. Patients underwent assessment of visual acuity documented as Snellen equivalents, localisation of fixation and ophthalmoscopy. In case of macular oedema or suspicion of leakage from CNV, fluorescein angiography was performed.

If the patient was not able to attend an examination at our hospital, we asked the referring ophthalmologist to complete a standard form concerning visual acuity, localisation of fixation and status of the anterior segment and the posterior pole. Data of seven patients were provided by the referring ophthalmologist and the data of the remaining seven patients were taken from the latest documents in the charts. In total, 52 eyes of 49 patients with a follow-up of at least 1 year could be included in this study.

Fluorescein angiograms were re-evaluated in order to classify predominantly classic and predominantly occult lesions and the proportion of haemorrhage of each lesion according to MPS criteria [11]. In 15% (8 of 52) of all eyes the lesions were obscured by intravitreal haemorrhage. All visible lesions were located subfoveally, 40% (21/52) of the lesions were predominantly classic, 21% (11/52) were predominantly occult and 23% (12/52) were comprised of more than 50% haemorrhage. The surgical approach consisted of a standard pars plana vitrectomy with the induction of posterior vitreous detachment. The CNV was extracted through a retinotomy temporal and superior to the macula, and the vitreous cavity was filled with 25% sulfurhexafluoride (SF6) gas in most cases. No treatment of the retinotomy was performed in the majority of cases. In some cases the standard procedure was modified with additional cataract surgery or silicone oil tamponade.

Results

Fifty-two eyes of 49 patients, among them 29 women and 20 men, were included. The mean age at surgery was 74 years (minimum 60 years, maximum 92 years). The minimum follow-up period was 12 months. The mean follow-up was 46 months, the maximum 80 months.

Prior to surgery two eyes had a history of laser coagulation of juxtafoveal CNV and two eyes had a history of injection of intravitreal recombinant tissue plasminogen activator (rTPA) for subretinal haemorrhage. Eight eyes were pseudophakic. Two eyes had a history of glaucoma, one eye was reported to be amblyopic and one eye was reported to have suffered from retinal branch vein occlusion.

Fluorescein angiographies of all eyes were re-evaluated according to the MPS criteria. Eight lesions could not be classified because of obscuring intravitreal haemorrhage. All other lesions were subfoveal. Twenty-one lesions were classified as predominantly classic, 11 lesions were predominantly occult and 12 lesions comprised of more than 50% haemorrhage.

Intraoperatively, 25 µg rTPA was applied into the subretinal space of eight eyes with extended subretinal haemorrhage prior to extraction of the CNV. In three eyes with extensive subretinal haemorrhage and exudative retinal detachment, silicone oil was used for endotamponade. In four eyes, cataract surgery with implantation of an intraocular lens was combined with CNV extraction. Peripheral retinal tears were found in 11 of 52 eyes (21.2%) and were treated either with cryopexy or laser coagulation.

Postoperatively, 13 of 52 eyes (25%) suffered from rhegmatogenous retinal detachment that in most cases appeared within 4 weeks from the initial surgery. One eye showed a retinal detachment with a macular hole, which was treated by repeated vitrectomy and instillation of silicone oil. One eye developed a macular pucker with a macular hole within 27 months from initial surgery and underwent repeated vitrectomy with instillation of concentrated thrombocytes and SF6 gas. One eye with initial subretinal haemorrhage showed an extensive subretinal haemorrhage postoperatively. Overall, further vitreoretinal surgery was performed in ten eyes (19.2%), with instillation of silicone oil in six eyes (11.5%). Three patients who had refused further surgery presented with long-standing total retinal detachments at the latest follow-up examination. The rate of postoperative retinal detachment was not influenced by the intraoperative use of subretinal rTPA or the appearance of peripheral retinal tears. The risk of postoperative retinal detachment was comparable for eyes with predominantly classic lesions and vitreous or subretinal haemorrhage (24 and 25%, respectively), whereas the rate of retinal detachment in eyes with predominantly occult lesions was a little lower (18.2%). Surgery for cataract was performed within the follow-up period in 27 of 40 phakic eyes (67.5%).

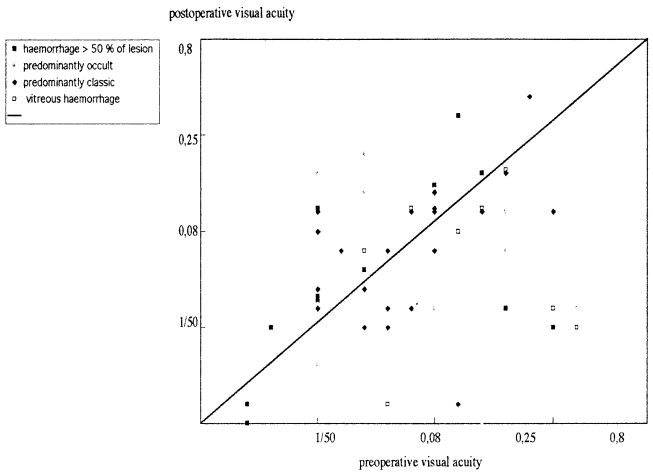

Fig. 1 Preoperative and long-term postoperative visual acuity of 52 eyes of 49 patients who underwent surgical extraction of CNV because of AMD

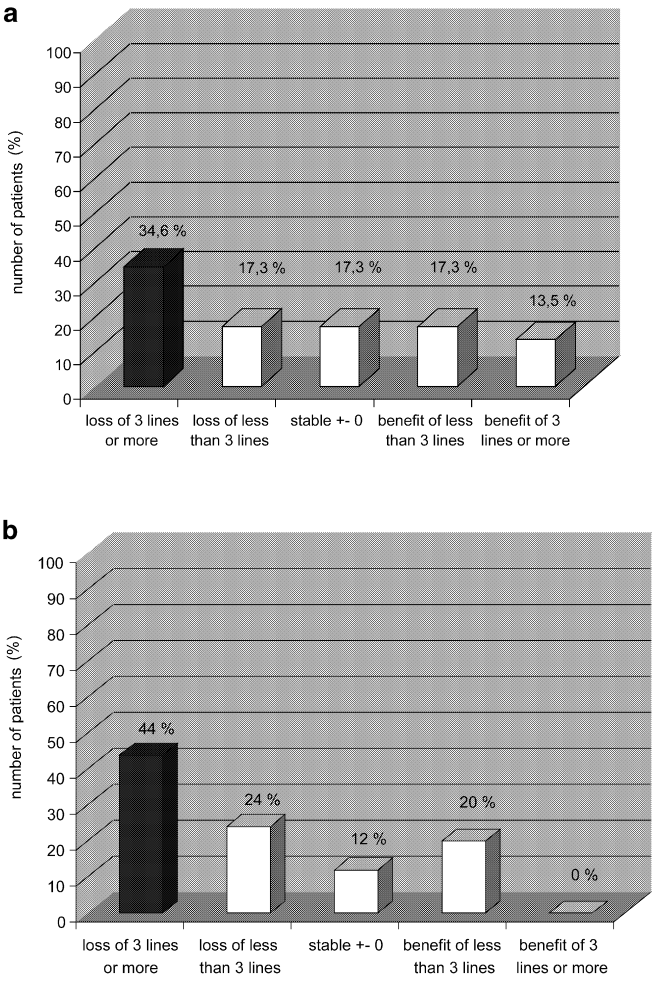

Fig. 2 a Benefit or loss of visual acuity at final assessment of all 52 eyes; 65.4% of all eyes lost less than three lines. **b** Benefit or loss of visual acuity at final assessment of eyes with an initial visual acuity of 0.1 or better; 56% of eyes with initial visual acuities of 0.1 or better lost less than three lines

During follow-up, recurrences of CNV occurred in ten eyes (19.2%). In the group of eyes with predominantly classic lesions the recurrence rate was 24% (5/21), whereas 18.2% (2/11) of eyes with predominantly occult lesions developed recurrent CNV. Among the 20 eyes with vitreous or subretinal haemorrhage due to CNV, three eyes (15%) suffered from recurrence. Four of all eyes with recurrent CNV were treated with laser coagulation of the recurrent juxtafoveal lesion, one eye was treated with two sessions of photodynamic therapy (PDT), one eye was re-operated with surgical extraction of recurrent CNV, and four eyes did not undergo additional therapy. At the time of final examination, three eyes showed persistent recurrence (5.8%), among them one eye after laser coagulation, one eye after two sessions of PDT and one eye without therapy for recurrence.

The median visual acuity prior to surgery was 0.08 (range: hand movements to 0.4). The median of the best postoperative visual acuity achieved was 0.1 (light perception to 0.4). The median final visual acuity was 0.067 (nulla lux to 0.4). Neither postoperative retinal detachment nor recurrence of CNV had a significant impact on median outcome visual acuity (0.067 and 0.1, respectively). For the three different groups of lesion composition no significant difference in median initial and median final visual acuity was found (see Fig. 1).

Overall, 34 eyes (65.4%) lost less than three lines of visual acuity. Among those, seven eyes (13.5% of all eyes) had a benefit of three lines or more (maximum: seven lines). Eighteen of all 52 eyes (34.6%) lost three or more lines of visual acuity. Among those 18 eyes were 8 eyes that lost six lines or more (15.4% of all eyes; see Fig. 2a). Twenty-one of all eyes (40.4%) had a final visual acuity of 0.1 or better.

Before surgery, 25 eyes had a visual acuity of 0.1 or more. In this subgroup, 14 eyes (56%) lost less than three lines. Among those, five eyes (20% of eyes with visual acuity initially better than 0.1) had gained one or two lines, but no eye gained three or more lines. Eleven of the 25 eyes in this subgroup lost three lines or more (44%). Seven of the 25 eyes lost six lines or more (28%) and thus accounted for the majority of visual losses of six lines or more of all eyes examined (87.5%; see Fig. 2b). However, final visual acuity was 0.1 or better in 14 eyes of the 25 eyes (56%).

Localisation of fixation at the final examination was tested in 24 eyes. Fixation was “eccentric” in all eyes, in most cases located at the margin of the RPE defect (see Fig. 3). When patients were repeatedly asked for fixation of a test figure, fixation steadily returned to the same localisation in 19 eyes (79.2%).

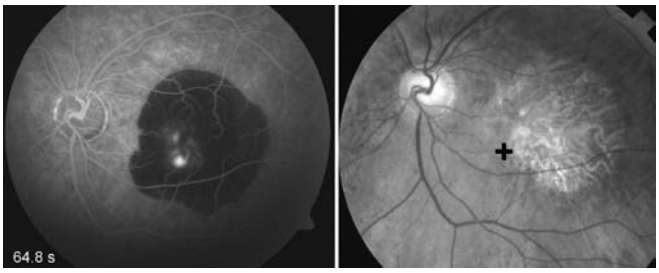

Fig. 3 Preoperative fluorescein angiography with subretinal haemorrhage (*left*), visual acuity 0.16. Photograph of the same eye 38 months after surgical CNV extraction and cataract surgery, visual acuity 0.32 (*right*). Fixation stable at the nasal inferior margin of the RPE defect

Discussion

In this study we analysed the data of all of our patients who underwent surgical extraction of CNV because of AMD with a follow-up of more than 12 months. Postoperatively, reduction of exudation from CNV was observed as has been reported before [13, 17, 6, 14, 4]. However, CNV extraction has been shown to result in a circumscribed RPE damage with secondary defects in the retina and choriocapillaris [20] and consecutive central scotomas [12]. Lopez and co-workers showed that surgically removed CNV contains RPE and photoreceptor inner and outer segments [9]. These findings seem to account for limited visual results regardless of initial visual acuity in the presented and previous studies.

During follow-up, the recurrence rate was 19.2% in all eyes of our patients and further treatment was applied to six of these ten eyes. At the end of follow-up, only three eyes (5.8%) showed a recurrent exudative lesion. Other studies report on recurrence rates from 8 to 40% within 6 to 24 months [13, 17, 6, 14]. As the follow-up time of our patients is at least 12 months with a maximum of 80 months, our study more precisely reflects the long-term effects of surgical CNV extraction. Spontaneous transformation of recurrent exudative CNV to non-exudative subretinal fibrosis might even occur during the postoperative course of several years.

On the other hand, patients did not profit in terms of improving visual acuity. Median initial visual acuity in our patients was below reading ability, so that a loss or a gain of three lines might be of value, but is usually below the patient's expectation. In addition, visual function is more than visual acuity for single optotypes. Especially central scotomas limit the patient's ability to use the eye in reading or writing. Still, subjectively most patients felt their vision to be more stable after the exudative lesion was reduced to a non-exudative RPE damage or subretinal fibrosis. Our data on fixation suggest that a long-standing, non-exudative lesion might enable the patients to recruit areas of undamaged complexes of retina, RPE and choriocapillaris for fixation. Consequently, the use of technical visual aids in reading or writing is more successful.

According to our data, patients with better initial visual acuity seem to have a lower chance of benefit from the surgical extraction of CNV, while the risk of losing more than three lines seems to be higher than in the total group of patients.

Compared to other studies, the rate of complications, especially the risk for retinal detachments, appears to be high in our patients [13, 18, 6, 14]. Complicating retinal detachment was found in 25% of our eyes within 4 weeks of initial surgery. All but three eyes with longer standing retinal detachments were successfully re-operated with no impact on final visual acuity. No significant risk factors for complicating retinal detachment could be identified in our study by analysing the type of initial CNV lesion or intraoperative procedure.

Our data concerning postoperative retinal detachment or CNV recurrence might reflect a slightly lower risk of eyes with predominantly occult lesions compared to eyes with predominantly classic or haemorrhagic lesions. Yet, the number of patients in each group is too low to prove significance.

Comparison of our data with the results of photodynamic therapy with verteporfin (PDT), which was introduced into the clinical routine only in 2000, is tempting. Within 2 years with repeated PDT, 53% of patients with subfoveal predominantly classical lesions lost less than three lines of visual acuity [19] and 46% of patients with predominantly occult lesions lost less than three lines of visual acuity [21]. In our patients, 65.4% of eyes had lost less than three lines of visual acuity at the end of a mean follow-up of 46 months after surgical CNV extraction. Nevertheless, comparison is difficult, because initial visual acuities were better in the patients studied in the PDT trials than in our patients. Besides, bias might be included in our study, because patients with good visual results might have had a better motivation to attend further examinations at our department. However, the rate of complications is higher in surgical CNV extraction than in non-invasive PDT.

Consequently, we consider surgical extraction of CNV for patients whose CNV lesions are not amenable to PDT and who have low initial visual acuities. We would discuss the chance of benefit and the risk for complications of surgical CNV extraction with patients who present with extended subretinal or vitreous haemorrhage resulting from CNV or longer-standing occult lesions with low initial visual acuities and operate in order to achieve a stabilisation of visual acuity on a low level.

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