EXTENDED REPORT

Two-year results of surgical removal of choroidal neovascular membranes related to non-age-related macular degeneration

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Purpose: To present the 2-year outcomes of surgical removal of non-age-related macular degeneration (AMD)-related choroidal neovascular membranes and to evaluate any association between visual outcome and baseline clinical factors.

Methods: Retrospective consecutive case series. All patients who had surgery for non-AMD-related choroidal neovascularisation (CNV) between November 1997 and March 2003 under the care of a single surgeon (WA) were included in the study. Baseline data including patient age, duration of subfoveal CNV, preoperative visual acuity (VA), lesion size, lesion components and aetiology were collected. The primary outcome was VA change with secondary outcomes retinal detachment, operative peripheral retinal break formation, CNV recurrence and cataract.

Results: A total of 52 eyes were included in the study. The aetiology of CNV was: punctate inner choroidopathy 21 (40%); idiopathic 8 (15%); pathologic myopia 6 (12%); ocular histoplasmosis syndrome 1 (2%); and other 16 (31%). The mean age of patients was 41 (range 14–72) years. 24-month follow-up was available for 41 (80%) eyes. The mean logMAR equivalent baseline acuity was 1.1 and mean lesion size 1.2 disc areas. An improvement in VA >1 Snellen line was noted in 26 (63%) eyes, whereas 10 (24%) eyes remained the same (within 1 line) and 5 (12%) lost >1 line of acuity. Improvement in VA was associated with worse baseline VA (84% for eyes with VA ≤6/36 vs 31% for those with VA >6/36, $p=0.001$). No evidence of association between 2-year visual outcome and any other baseline factor under study was observed. Peripheral retinal breaks were noted in 5 (10%) eyes at the time of surgery, and 3 (5.8%) eyes developed postoperative retinal detachments. Persistent/recurrent CNV was noted in 17 (33%) eyes. The median time to presentation of CNV in these eyes was 27 (range 2–172) weeks. Five eyes underwent cataract surgery during the follow-up period. The mean age of these patients was significantly higher than the mean age of those who did not require cataract surgery (57 vs 37 years, $p=0.014$).

Conclusions: Surgical excision of non-AMD-related CNV resulted in improvement of VA in the majority of eyes. Worse presenting acuity was associated with better visual improvements.

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A retrospective consecutive case series of surgical removal of choroidal neovascular membranes (CNVM) related to non-age-related macular degeneration (AMD) from a single surgeon was studied. Two-year results of surgery are presented, showing a 63% frequency of improved acuity. Postoperative persistence/recurrence of choroidal neovascularisation (CNV) was noted in 33% of eyes, and 6% developed postoperative retinal detachment. Improved acuity was associated with worse baseline vision.

Subfoveal choroidal neovascularisation is commonly seen in ocular histoplasmosis syndrome, punctate inner choroidopathy (PIC) and myopia, and can be idiopathic. Grossniklaus and Gass presented evidence to support a different histopathological morphology of these non-AMD-related membranes.^{1,2} Surgical excision has recently been shown to be an effective way of stabilising or improving acuity in many eyes with non-AMD-related CNV, but not in AMD.^{3,4} The retinal pigment epithelium lies superficial to the neovascular complex in AMD and is lost with surgical excision of these AMD-related membranes, resulting in loss of the overlying photoreceptors and poor visual outcomes.¹ The present study presents the outcomes of surgical intervention for non-AMD-related CNV performed by a single surgeon over a 5-year period, with particular emphasis on the 2-year results.

METHOD

All eyes undergoing surgical removal of non-AMD-related CNVM under the care of a single surgeon between November

1997 and March 2003 were included in the study (these dates were chosen to prevent overlap with a previous series from the same institution,⁵ while allowing 2 years of follow-up). The indication for surgery was type II CNV with symptomatic visual loss present for at least 2 months (to give time for spontaneous resolution). Patients older than 50 years were eligible, provided there were no intermediate or large drusen ($\geq 63 \mu\text{m}$) diagnostic criteria of AMD.⁶

The medical charts were reviewed retrospectively. Baseline data collected included patient age at the time of surgery, primary cause of CNVM and any previous treatment received for the CNVM (eg, systemic steroids, argon laser and PDT). Care was taken to document the date of onset of symptoms, the first date the neovascular lesion was documented to be subfoveal (if applicable) and the date of surgery. Preoperative angiograms were graded, and lesion site, size and components were assessed. The neovascular component of the lesion was classified as classic/occult in the standard way.^{7,8}

Peroperative complications, particularly peripheral retinal breaks, were recorded. The surgical technique was similar to that described by Thomas and Kaplan.⁹ A standard pars plana vitrectomy is carried out with peeling of the posterior hyaloid. An angled 33-gauge cannula (Synergetics, O'Fallon, Missouri,

Abbreviations: AMD, age-related macular degeneration; CNV, choroidal neovascularisation; CNVM, choroidal neovascular membranes; PIC, punctate inner choroidopathy; POHS, periodical occupational health survey; SST, submacular surgery trial

Figure 1 Typical preoperative (left picture) and 26-month postoperative appearance (right picture) of an eye with type II choroidal neovascular membranes (CNVM). Preoperative acuity 6/12. Postoperative acuity 6/5. Note the retinal pigment epithelium (RPE) defect at the site of presumed choroidal neovascularisation (CNV) ingrowth (large arrow), with surrounding halo of RPE pallor extending subfoveally, but with maintenance of good function (small arrows). This pallor corresponds to the extent of preoperative subretinal fluid.

USA) is then passed through the retina into the subretinal space. The site of entry is chosen to be at least one disc diameter from the fovea, and close to the edge of the CNV membrane, approaching from either the superonasal or the superotemporal direction, depending on the configuration of the membrane and the retinal blood vessels. A small amount of balanced salt solution is then injected slowly into the subretinal space through the cannula, sufficient to create a small retinal detachment over the membrane. The tip of the cannula is then used to gently probe the membrane to divide any adhesions between it and the surrounding tissue. Subretinal horizontally opposed forceps (Synergetics) are then inserted through the same retinotomy, and the membrane grasped firmly, then slowly extracted, paying attention to avoid tearing the underlying retinal pigment epithelium, or allow bleeding from feeder vessels. As a precaution, the infusion bag is elevated to 90 cm just before membrane removal. Once the membrane is freed and pulled into the preretinal space, the instruments are kept in the eye, and the bag is left elevated for 1 min, before slowly lowering it while watching the feeder vessel for bleeding. If bleeding is noted, the bags are elevated again for another minute. A partial fluid/air exchange is then performed and the entry sites checked, before closing the sclerostomies with 7/0 vicryl. Postoperatively patients are asked to posture face down for 6 h to facilitate reattachment of the macula. Figure 1 shows the typical preoperative and postoperative appearances.

The primary outcome of interest was visual acuity (VA) change relative to baseline at 2 years. Improved VA was defined as more than one Snellen line improvement, same as within

one line and worse as loss of more than one Snellen line. Mean visual acuities were calculated by converting Snellen acuity to a logMAR equivalent. Absent VA values were estimated if there was a valid value both preceding and succeeding the missing data point, and assuming a linear change in logMAR acuity with time. Secondary outcomes were CNV recurrence/persistence, peripheral retinal break, postoperative retinal detachment and cataract surgery.

Logistic and multiple variable linear regressions were used to assess evidence of any association between visual outcome at 24 months and each baseline factor. In the logistic regression model, visual outcome was analysed as dichotomous—improved vs same or worse. In the linear regression model, associations between final VA and baseline factors were assessed after adjusting for differences in baseline VA.

All analyses were conducted in Stata V.8.2 for Windows.

RESULTS

A total of 52 eyes of 50 patients underwent surgical excision of non-AMD-related CNVM during the study period. The mean age of patients at the time of surgery was 40 (range 14–72; SD 13.4) years. In all, 31 patients were female and 19 male. Table 1 summarises the aetiology of CNV. Sixteen eyes had received prior treatment with systemic steroids alone (9 eyes with PIC, 2 myopic and 5 with other diagnoses), 2 with argon laser alone (one PIC and one pseudoxanthoma elasticum) and 2 with argon laser and systemic steroids (one PIC and one periodical occupational health survey (POHS)). Treatment response in all

Table 1 Aetiology of choroidal neovascularisation in study eyes

Aetiology of CNV	Number of eyes (n = 57)	Number with: 24-month follow-up (n); number with better/same/worse acuity at 24 months*			
		n	Better	Same	Worse
Punctate inner choroidopathy	21	20	11	7	2
Idiopathic	8	4	3		1
Myopia	6	4	2	1	1
Diabetic macular laser scar	3	3	2		1
Choroidal rupture	2	1	1		
Peripapillary	1	1	1		
Multifocal choroiditis	2				
Panuveitis and multifocal choroiditis	2	2	1	1	
Toxoplasmosis	2	2	2		
Sarcoidosis	1	1	1		
Drusen (non-AMD)	1	1		1	
Pseudoxanthoma elasticum/angioid streaks	1				
Central serous retinopathy	1	1	1		
Presumed ocular histoplasmosis syndrome	1	1	1		

AMD, age-related macular degeneration; CNV, choroidal neovascularisation.

Visual acuity change at 24 months by diagnosis.

*Better acuity, >1 Snellen line improvement; same, within 1 line; worse, >1 Snellen line deterioration.

cases was thought to be insufficient to obviate the need for surgery. None had received prior treatment with photodynamic therapy. Preoperative fluorescein angiograms were available in 48 of 52 (92%) eyes. Of these, 44 of 48 lesions were subfoveal, and 4 of 48 were judged not to be subfoveal at the preoperative angiogram. The median lesion size was 1.2 disc areas (range 0.2–2.9, SD 0.77). Angiographically the CNV component was graded as classic, with no occult component in 45 of 48 (94%) angiograms, predominantly classic in 2 (4%) and occult with no classic in 1 (2%). In 2 of 48 eyes, haemorrhage was judged to occupy >50% of the total lesion area. In no eyes was a pigment epithelial detachment noted.

One patient has been excluded from the presentation of acuity data. She was a 25-year-old woman who reported an acuity of hand motions vision in the operative eye (and count fingers in the otherwise normal fellow eye) 4 years postoperatively, despite a good macular appearance with no sign of CNV recurrence. No other follow-up visits were attended either before this or subsequently. Electrophysiological testing was performed, which showed a normal pattern electroretinogram and full-field electroretinogram in both eyes, a normal pattern reversal visual evoked potential in the non-study eye, and a pattern reversal visual evoked potential with a major positivity at 110 ms of amplitude 8 μ V (mildly reduced and delayed) in the study eye. This was consistent neither with her low reported acuity nor with acute zonal occult outer retinopathy, and non-organic visual loss was suspected.

Table 2 presents the VA outcomes. One-year follow-up was available for 47 of 51 (92%) eyes, and two-year follow-up for 41 of 51 (80%) eyes. The main reason for loss to follow-up was patients being discharged back to their regional ophthalmology department and subsequently not attending the requested review appointments. At the 24-month visit, 26 of 41 (63%) eyes had improvement of more than 1 Snellen acuity line, 10 of 41 (24%) eyes were the same and 5 of 41 (12%) worse. None of these 41 eyes deteriorated between the 12- and 24-month review appointments, and four eyes gained Snellen acuity and moved from the "same" group to the "improved" group. Both of the two eyes with haemorrhage >50% of the total lesion area had improved acuity at 2 years.

The frequency of recurrent CNV using all available follow-up (not just 2-year data) was 16 of 52 (31%), and of persistent CNV 1 of 52 (2%). The timing of recurrence could be estimated in 15 of these eyes, and the median time to recurrence was 27 weeks (range 48 days–40 months). One eye first developed a recurrence >4 years postoperatively, having been definitely recurrence free at the 48-month visit. All other recurrences presented within the first two postoperative years. Improvement in VA at 2 years was noted in 9 of 14 (64%) eyes with persistence or recurrence, and in 18 of 27 (67%) eyes without recurrence. Subsequent management of CNV was repeat surgery in 4 eyes, systemic steroids in 1 eye and no treatment in 12 eyes. Among eyes undergoing repeat membranectomy surgery, two had improved acuity at 24 months, one

the same at 24 months, and one improved acuity at 12 months with no further follow-up (all acuities relative to baseline).

Peroperative retinal breaks were noted in 5 of 52 (10%) eyes. One patient required lensectomy at the time of CNV removal due to operative posterior lens capsule trauma. Postoperative retinal detachment developed in 3 of 52 (5.8%) eyes. The first of these was macula-on and developed 13 days postoperatively and was due to an entry site break. In the second case, a macula-on detachment presented 25 months postoperatively and was due to round holes in the lattice. In the third case, a retinal detachment developed 11 days postoperatively and was thought to be due to a macular hole induced at the time of CNV removal. In all three eyes retinal reattachment was achieved and VA was improved relative to baseline at last review (duration of follow-up 48, 48 and 12 months).

Forty-six eyes were phakic at the time of original vitrectomy. Excluding the eye with peroperative lens trauma necessitating peroperative lensectomy, four eyes underwent subsequent cataract surgery (mean follow-up 42 months, range 24–60 months). The mean follow-up time was similar for eyes requiring cataract surgery and for those which did not (42 vs 38 months). The mean age at the time of vitrectomy of patients who went on to require cataract surgery was 57.3 versus 36.6 years for those who did not require cataract surgery ($p = 0.014$). No patient <40 years at the time of vitrectomy required cataract surgery with follow-up up to 5 years. This included the four eyes which underwent repeat vitrectomy for visually significant recurrence of choroidal neovascularisation.

Worse baseline VA was correlated with improvement in VA ($R = 0.45$, $p = 0.003$, fig 2). When acuity was considered as a dichotomous variable (ie, $\geq 6/30$ or $<6/30$), worse baseline acuity was associated with a greater frequency of visual improvement (21/25 (84%) vs 5/16 (31%), $p = 0.001$). After

Figure 2 Scatterplot of preoperative visual acuity (logMAR equivalent) versus baseline VA. Solid line represents no change in acuity, and dashed lines represent approximately one Snellen acuity line (logMAR change of 0.18). Aetiology of choroidal neovascularisation (CNV) represented by differing marker points as shown.

Table 2 Distribution of patients by visual acuity change from baseline at specified times after surgery, and mean baseline acuity and improvement in logMAR equivalent acuity for the study group at these visits

	12 months (n=47)	24 months (n=41)	36 months (n=30)	48 months (n=21)	60 months (n=14)
Visual acuity change, n (%)					
Improved >1 Snellen line	25 (53)	26 (63)	21 (70)	15 (71)	8 (57)
Same (≥ 1 Snellen line)	15 (32)	10 (24)	6 (20)	2 (10)	3 (21)
Deteriorated >1 Snellen line	7 (15)	5 (12)	3 (10)	4 (19)	3 (21)
Mean logMAR equivalent acuity at baseline*	1.11	1.07	1.11	1.14	0.86
Change in mean logMAR equivalent acuity	-0.3	-0.36	-0.41	-0.43	-0.23

*Mean baseline logMAR acuity for the population of eyes with follow-up to the specified time point.

adjustment for differences in baseline VA, we found little evidence of any association between the magnitude of logMAR acuity change at 24 months and patient age ($p = 0.17$), lesion size ($p = 0.21$) and duration of surgery ($p = 0.65$). Timing of surgery relative to onset of symptoms ($p = 0.74$) and timing of surgery relative to timing of presentation ($p = 0.53$) were not found to be associated with worse visual outcomes. The mean time to surgery from symptoms was quite long (25 weeks), with only two eyes having surgery within 4 weeks of symptoms. There was insufficient power to evaluate an association between improvement in acuity at 24 months and subfoveal lesion site, CNVM occult component, haemorrhage >50% of lesion, previous argon laser treatment, previous corticosteroid treatment or CNVM recurrence. Table 1 summarises the VA change relative to diagnosis. No significant association was observed between diagnosis and VA improvement.

DISCUSSION

The present study found that eyes undergoing surgical removal of non-AMD-related choroidal neovascular membranes had an 88% likelihood of having a same or better VA at 2 years. This was in the setting of a single-centre, single-clinician consecutive case series. Worse baseline VA was found to correlate with greater magnitude of visual improvement. No other factors were found to be associated with change in VA. We believe that VA can take some time to improve postoperatively. Indeed, in the present study, the mean change in acuity steadily rose from 1 to 4 years postoperatively (table 2).

Recurrent or persistent CNV was seen in 17 (33%) eyes, a figure comparable to other case series, although lower than the 58% in the submacular surgery trial (SST)-H trial.^{10 11} This difference is likely due to the rigorous angiographic follow-up in the SST and the fact that 10 (20%) eyes had <2 years follow-up in the present study. Recurrent CNV remained untreated in 71% of cases in the present study, and did not seem to be

associated with worse visual outcomes although the size of the present study was insufficient to properly evaluate this. Recurrences were often small, self-limited and less visually significant than the original CNV (eg, fig 3).

Peripheral retinal breaks were noted at the time of surgery in a relatively high 10% of cases. This was similar to the figure reported in the submacular surgery trial (14/112, 12.5%). This rate of peripheral break formation is higher than that after macular hole surgery,¹² and is thought to be inherent to the nature of the procedure. The authors postulate that this is due to the necessity for repeated insertion of relatively large, angled instruments (subretinal cannula, subretinal forceps).

Nuclear sclerotic cataract is a common complication of vitrectomy. The present study found that patients undergoing cataract surgery after vitrectomy were significantly older than those not requiring cataract surgery. Indeed, no patient <40 years of age at the time of vitrectomy required cataract surgery with follow-up as long as 5 years. This is consistent with the findings of others.^{13–15} Oxidative lens damage the likely mechanism of postvitrectomy cataract formation.^{16 17} A younger lens probably has less baseline cumulative oxidative damage; therefore it is understandable that it might take longer for a cataract to develop postoperatively.

The visual outcomes in the present study are comparable to the reported results in other larger ($n > 50$) case series of surgical removal of POHS-related CNVM (table 3).^{10 11} The results of these studies and the present study are better than those of the POHS/idiopathic eyes in the SST-H, which had a 55% frequency of successful outcome (same or better vision) at 2 years, but only a 27% frequency of improved vision.⁴ This may be due to the different populations of patients in the current study and in the SST. Indeed subgroup analysis in the SST showed a 76% success rate in the group with worse vision at baseline, a success rate not dissimilar to that of these other non-randomised case series, suggesting that case selection can influence visual results. The present study population was from

Figure 3 Thirty-seven-year-old woman with idiopathic choroidal neovascularisation (CNV) in the left eye. (A–C) Preoperative appearance, VA counting fingers. (D–F) Colour photograph and fluorescein angiographic appearance 15 months postoperatively. VA 6/9 despite small recurrence (arrows).

Table 3 Visual outcome of subfoveal choroidal neovascularisation in non-AMD-related CNV

Management	Study	Diagnosis	n	Follow-up	Visual acuity change from baseline*		
					Improved	Same	Worse
Surgery	Present study	Mixed	57	24 months	63%	24%	12%
	Holekamp <i>et al</i> ¹¹	POHS	117	Variable	40%	41%	19%
	Berger <i>et al</i> ¹⁰	POHS	63	Variable	35%	44%	21%
	SST ⁴	POHS idiopathic	103	24 months	28%	26%	48%
Photodynamic therapy with verteporfin	Rosenfeld <i>et al</i> ¹⁸	POHS	22	24 months	45%	36%	18%
	Chan <i>et al</i> ⁹	Idiopathic	17	12 months	59%	35%	6%
Natural history	SST ⁴	POHS idiopathic	97	24 months	21%	37%	40%
	VIP ²⁰	Myopia	39	24 months	13%	31%	57%
	Ho <i>et al</i> ²¹	Idiopathic	19	Variable	32%	63%	5%
	TAP ²²	AMD	207	24 months	10%	13%	77%

AMD, age-related macular degeneration; CNV, choroidal neovascularisation; POHS, periodical occupational health survey; SST, submacular surgery trial; TAP, technical advisory panel; VIP, verteporfin in photodynamic therapy.

Review of outcomes of several interventional studies. Natural history outcomes are presented where available. Natural history of subfoveal CNV secondary to AMD included for comparison.

*Improved acuity, >1 Snellen line improvement; same, within 1 line; worse, >1 Snellen line deterioration.

the UK, and the most common cause of the CNV was PIC. This is in contrast with the North American-based SST, in which 85% of patients had POHS. Baseline VA was worse in the present study than in the SST. The SST showed that worse baseline acuities were associated with better outcomes—a trend we also observed in the present study. therefore, we might expect better overall visual outcomes.

Other treatments have been used for the treatment of type II choroidal neovascular membranes, including photodynamic therapy (PDT) and systemic corticosteroids. Rosenfeld *et al*¹⁸ noted an 82% frequency of same or better vision at 2 years in their uncontrolled, prospective, open-label study of PDT with verteporfin for ocular histoplasmosis. Chan *et al*¹⁹ noted a 92% frequency of same or better vision at 12 months in a small prospective series of PDT with verteporfin for idiopathic CNV in a Chinese population (table 3). All patients had good visual outcomes in the small phase 1 and 2 study of verteporfin treatment for non-AMD-related CNVM described by Sickenberg *et al*.²³ There are a number of other smaller retrospective case series of PDT with verteporfin for non-AMD-related CNVM, and most of them also claim very good visual results.^{24–31} Postelmans *et al*,³² however, emphasise that PDT with verteporfin is not without its risks in these often young patients.

Systemic corticosteroids have been said to be beneficial in patients with choroidal neovascularisation secondary to PIC and multifocal choroiditis. Several retrospective case series describe good visual outcomes after steroid therapy,^{33–35} sometimes combined with PDT.³⁶ There is histological evidence to support an inflammatory process being involved in angiogenesis in multifocal choroiditis, even in the absence of other signs of ocular inflammation.³⁷

Many of these case series of therapies for type II choroidal neovascularisation, including those in the present study, are plagued by a lack of a control group against which to compare the treatment. It is important to note that generally the natural history of type II CNVM is better than that for AMD (table 3). Although the natural history of subfoveal CNVM is now well documented in POHS⁴ and myopia,²⁰ and to a lesser degree for idiopathic membranes,²¹ there is little natural history data for CNVM related to PIC and multifocal choroiditis. To date the only proved treatment for subfoveal CNVM due to POHS or idiopathic is surgery, with demonstrated efficacy in patients with acuities worse than 20/100.

The present study has shown the safety of surgery for non-AMD-related subfoveal CNVM in a UK population, and supports the notion that surgery be considered particularly for those with an acuity of 6/36 or worse.

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REFERENCES

- Grossniklaus HE, Gass JD. Clinicopathologic correlations of surgically excised type 1 and type 2 submacular choroidal neovascular membranes. *Am J Ophthalmol* 1998;**126**:59–69.
- Gass JD. Biomicroscopic and histopathologic considerations regarding the feasibility of surgical excision of subfoveal neovascular membranes. *Trans Am Ophthalmol Soc*. 1994;**92**: 91–111; discussion 6).
- Hawkins BS, Bressler NM, Miskala PH, *et al*. Surgery for subfoveal choroidal neovascularization in age-related macular degeneration: ophthalmic findings: SST report no. 11. *Ophthalmology* 2004;**111**:1967–80.
- Hawkins BS, Bressler NM, Bressler SB, *et al*. Surgical removal vs observation for subfoveal choroidal neovascularization, either associated with the ocular histoplasmosis syndrome or idiopathic: I. Ophthalmic findings from a randomized clinical trial: Submacular Surgery Trials Group H Trial, SST Report No.9. *Arch Ophthalmol* 2004;**122**:1597–611.
- Eckstein M, Wells JA, Aylward B, *et al*. Surgical removal of non-age-related subfoveal choroidal neovascular membranes. *Eye* 1998;**12**(Pt 5):775–80.
- Bird AC, Bressler NM, Bressler SB, *et al*. An international classification and grading system for age-related maculopathy and age-related macular degeneration. The International ARM Epidemiological Study Group. *Surv Ophthalmol* 1995;**39**:367–74.
- Macular Photocoagulation Study Group. Subfoveal neovascular lesions in age-related macular degeneration. Guidelines for evaluation and treatment in the macular photocoagulation study. *Arch Ophthalmol* 1991;**109**:1242–57.
- Barbazetto I, Burdan A, Bressler NM, *et al*. Photodynamic therapy of subfoveal choroidal neovascularization with verteporfin: fluorescein angiographic guidelines for evaluation and treatment—TAP and VIP report No. 2. *Arch Ophthalmol* 2003;**121**:1253–68.
- Thomas MA, Kaplan HJ. Surgical removal of subfoveal neovascularization in the presumed ocular histoplasmosis syndrome. *Am J Ophthalmol* 1991;**111**:1–7.
- Berger AS, Conway M, Del Priore LV, *et al*. Submacular surgery for subfoveal choroidal neovascular membranes in patients with presumed ocular histoplasmosis. *Arch Ophthalmol* 1997;**115**:991–6.
- Holekamp NM, Thomas MA, Dickinson JD, *et al*. Surgical removal of subfoveal choroidal neovascularization in presumed ocular histoplasmosis: stability of early visual results. *Ophthalmology* 1997;**104**:22–6.
- Ezra E, Gregor ZJ. Surgery for idiopathic full-thickness macular hole: two-year results of a randomized clinical trial comparing natural history, vitrectomy, and vitrectomy plus autologous serum: Moorfields Macular Hole Study Group Report no. 1. *Arch Ophthalmol* 2004;**122**:224–36.
- Thompson JT. The role of patient age and intraocular gas use in cataract progression after vitrectomy for macular holes and epiretinal membranes. *Am J Ophthalmol* 2004;**137**:250–7.
- Cherfan GM, Michels RG, de Bustros S, *et al*. Nuclear sclerotic cataract after vitrectomy for idiopathic epiretinal membranes causing macular pucker. *Am J Ophthalmol* 1991;**111**:434–8.
- Melberg NS, Thomas MA. Nuclear sclerotic cataract after vitrectomy in patients younger than 50 years of age. *Ophthalmology* 1995;**102**:1466–71.
- Barbazetto IA, Liang J, Chang S, *et al*. Oxygen tension in the rabbit lens and vitreous before and after vitrectomy. *Exp Eye Res* 2004;**78**:917–24.

- 17 **Holekamp NM**, Shui YB, Beebe DC. Vitrectomy surgery increases oxygen exposure to the lens: a possible mechanism for nuclear cataract formation. *Am J Ophthalmol* 2005;**139**:302–10.
- 18 **Rosenfeld PJ**, Saperstein DA, Bressler NM, *et al*. Photodynamic therapy with verteporfin in ocular histoplasmosis: uncontrolled, open-label 2-year study. *Ophthalmology* 2004;**111**:1725–33.
- 19 **Chan WM**, Lam DS, Wong TH, *et al*. Photodynamic therapy with verteporfin for subfoveal idiopathic choroidal neovascularization: one-year results from a prospective case series. *Ophthalmology* 2003;**110**:2395–402.
- 20 **Blinder KJ**, Blumenkranz MS, Bressler NM, *et al*. Verteporfin therapy of subfoveal choroidal neovascularization in pathologic myopia: 2-year results of a randomized clinical trial—VIP report no. 3. *Ophthalmology* 2003;**110**:667–73.
- 21 **Ho AC**, Yannuzzi LA, Pisicano K, *et al*. The natural history of idiopathic subfoveal choroidal neovascularization. *Ophthalmology* 1995;**102**:782–9.
- 22 **Bressler NM**. Photodynamic therapy of subfoveal choroidal neovascularization in age-related macular degeneration with verteporfin: two-year results of 2 randomized clinical trials—TAP report 2. *Arch Ophthalmol* 2001;**119**:198–207.
- 23 **Sickenberg M**, Schmidt-Erfurth U, Miller JW, *et al*. A preliminary study of photodynamic therapy using verteporfin for choroidal neovascularization in pathologic myopia, ocular histoplasmosis syndrome, angioid streaks, and idiopathic causes. *Arch Ophthalmol* 2000;**118**:327–36.
- 24 **Busquets MA**, Shah GK, Wickens J, *et al*. Ocular photodynamic therapy with verteporfin for choroidal neovascularization secondary to ocular histoplasmosis syndrome. *Retina* 2003;**23**:299–306.
- 25 **Liu JC**, Boldt HC, Falk JC, *et al*. Photodynamic therapy of subfoveal and juxtafoveal choroidal neovascularization in ocular histoplasmosis syndrome: a retrospective case series. *Retina* 2004;**24**:863–70.
- 26 **Mimouni KF**, Bressler SB, Bressler NM. Photodynamic therapy with verteporfin for subfoveal choroidal neovascularization in children. *Am J Ophthalmol* 2003;**135**:900–2.
- 27 **Shah GK**, Blinder KJ, Hariprasad SM, *et al*. Photodynamic therapy for juxtafoveal choroidal neovascularization due to ocular histoplasmosis syndrome. *Retina* 2005;**25**:26–32.
- 28 **Spaide RF**, Freund KB, Slakter J, *et al*. Treatment of subfoveal choroidal neovascularization associated with multifocal choroiditis and panuveitis with photodynamic therapy. *Retina* 2002;**22**:545–9.
- 29 **Spaide RF**, Martin ML, Slakter J, *et al*. Treatment of idiopathic subfoveal choroidal neovascular lesions using photodynamic therapy with verteporfin. *Am J Ophthalmol* 2002;**134**:62–8.
- 30 **Wachtlin J**, Heimann H, Behme T, *et al*. Long-term results after photodynamic therapy with verteporfin for choroidal neovascularizations secondary to inflammatory chorioretinal diseases. *Graefes Arch Clin Exp Ophthalmol* 2003;**241**:899–906.
- 31 **Parodi MB**, Di Crecchio L, Lanzetta P, *et al*. Photodynamic therapy with verteporfin for subfoveal choroidal neovascularization associated with multifocal choroiditis. *Am J Ophthalmol* 2004;**138**:263–9.
- 32 **Postelmans L**, Pasteels B, Coquelet P, *et al*. Severe pigment epithelial alterations in the treatment area following photodynamic therapy for classic choroidal neovascularization in young females. *Am J Ophthalmol* 2004;**138**:803–8.
- 33 **Rechtman E**, Allen VD, Danis RP, *et al*. Intravitreal triamcinolone for choroidal neovascularization in ocular histoplasmosis syndrome. *Am J Ophthalmol* 2003;**136**:739–41.
- 34 **Flaxel CJ**, Owens SL, Mulholland B, *et al*. The use of corticosteroids for choroidal neovascularisation in young patients. *Eye* 1998;**12**(Pt 2):266–72.
- 35 **Dees C**, Arnold JJ, Forrester JV, *et al*. Immunosuppressive treatment of choroidal neovascularization associated with endogenous posterior uveitis. *Arch Ophthalmol* 1998;**116**:1456–61.
- 36 **Leslie T**, Lois N, Christopoulou D, *et al*. Photodynamic therapy for inflammatory choroidal neovascularisation unresponsive to immunosuppression. *Br J Ophthalmol* 2005;**89**:147–50.
- 37 **Dunlop AA**, Cree IA, Hague S, *et al*. Multifocal choroiditis: clinicopathologic correlation. *Arch Ophthalmol* 1998;**116**:801–3.

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