ORIGINAL ARTICLES – Clinical science

Natural outcomes of stage 1, 2, 3, and 4 idiopathic macular holes

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Abstract

Aims—A study was carried out to ascertain the natural outcome of each stage of idiopathic macular hole.

Methods—One hundred and fifty four eyes with different stages of idiopathic macular holes were retrospectively studied: stage 1 (40 eyes), 2 (25 eyes), 3 (58 eyes), and 4 (31 eyes).

Results—Of 27 of 40 eyes with a stage 1 lesion with posterior vitreous attachment to the macula initially, nine (33%) eyes developed a full thickness macular hole. No stage 1 lesions with posterior vitreous separation from the macula initially progressed to full thickness holes. Twenty one (84%) of 25 eyes with a stage 2 lesion, 32 (55%) of 58 eyes with a stage 3 lesion, and five (16%) of 31 eyes with a stage 4 lesion underwent macular hole enlargement during the median follow up period of 3 years. Visual acuity decreased two or more lines of Snellen equivalent during the follow up period in 12 (30%) eyes with a stage 1 lesion, 17 (68%) eyes with a stage 2 lesion, 17 (29%) eyes with a stage 3 lesion, and four (13%) eyes with a stage 4 lesion. The percentage was significantly higher in eyes with stage 2 lesions than the other stages ($p < 0.01$).

Conclusion—The results suggest that the different stages of idiopathic macular holes have different natural outcomes, and the management depends on the stage at presentation.

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In 1988, Gass¹ proposed that tangential traction on the fovea by an attached posterior cortical vitreous was the main pathophysiological mechanism of the development of an idiopathic macular hole. He classified macular holes into four stages: stage 1, macular cyst; stage 2, early full thickness macular hole; stage 3, fully developed macular hole with posterior vitreous attachment (PVA); and stage 4, fully developed macular hole with complete posterior vitreous separation (PVS). He also hypothesised that surgical peeling of the vitreous cortex could prevent stage 1 lesions from becoming full thickness holes. Since then, vitrectomy has been used to treat stage 1 lesions, and its benefits have been reported.^{2–4}

However, a recent, prospective, randomised, multicentre clinical trial could not prove its efficacy.⁵

The traditional belief has been that therapy is ineffective once a full thickness macular hole develops. In 1991, Kelly and Wendel⁶ initially obtained good results using vitrectomy and gas tamponade in eyes with stage 3 and 4 macular holes. Subsequent to this report, surgeons have performed vitreous surgery in eyes with fully developed macular holes and reported its applicability.^{7–15} Recently, stage 2 macular holes also have been treated surgically.^{16, 17}

When considering surgery, the benefits must be balanced against the risks and compared with the natural course. In this case, the benefits of vitreous surgery – that is, the release of vitreous traction that presumably arrests full thickness macular hole development, promotes hole closure, or improves visual function, must be weighed against the surgical risks and the clinical course without the surgery. The surgical efficacy is still questioned,^{18–21} because only limited natural history data are available for eyes with macular holes.^{5, 22–28} To investigate the natural outcome of idiopathic macular holes, we reviewed the records of patients with stage 1, 2, 3, or 4 macular holes that were diagnosed after establishment of the Gass classification.¹

Subjects and methods

We studied retrospectively 154 patients (154 eyes) with idiopathic macular holes classified according to the Gass classification¹: stage 1 (macular cyst), 40 eyes; stage 2 (full thickness macular hole $\leq 400 \mu\text{m}$ with PVA around the hole²⁹), 25 eyes; stage 3 (full thickness macular hole $> 400 \mu\text{m}$ with PVA around the hole), 58 eyes; and stage 4 (full thickness macular hole $> 400 \mu\text{m}$ with PVS from the hole), 31 eyes. All patients had been examined within 3 months from symptom onset and followed for more than 1 year at the Schepens Retina Associates, Boston, from 1989 to 1994. The patients ranged in age from 48 to 84 (median 64) years. In patients with bilateral disease, only the initially affected eye was studied.

Detailed medical histories were obtained. Complete ocular examinations, including corrected Snellen visual acuity (VA), slit-lamp biomicroscopy, indirect ophthalmoscopy, stereoscopic fundus photography and

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Table 1 Characteristics at baseline

Characteristic	Macular hole stage			
	1 (n=40)	2 (n=25)	3 (n=58)	4 (n=31)
Sex (%):				
Men	11 (28)	7 (28)	14 (24)	9 (29)
Women	29 (72)	18 (72)	44 (76)	22 (71)
Age (years):				
Mean	63	60	65	67
Range	52-78	50-74	48-82	50-84
Follow up duration (years):				
Median	3	3	3	3
Range	1-5	1-5	1-5	1-5

fluorescein angiography, and a scanning laser ophthalmoscope were performed. We diagnosed stage 1 macular holes based on the biomicroscopic findings, which showed a focal, mild deviation of the inner retinal surface instead of foveal depression, but no retinal defect.¹ Increased transmission of choroidal fluorescence within a capillary free zone in the early transit phase without evidence of late staining on fluorescein angiography, absence of central absolute scotoma, and a mild VA decrease aided the diagnosis of stage 1 lesions.¹ A scanning laser ophthalmoscope and a Watzke-Allen test also helped differentiate macular holes from other conditions with similar symptomatology.²⁹⁻³¹ With a reticle, a masked observer measured the diameter of the macular holes and the surrounding retinal detachments in the colour photographs. The sizes of the optic disc or vessels were used as standards. The diameters of the stage 2, 3, and 4 holes at the final examination were considered to have enlarged if the measurements were more than 20% greater than the initial values.²⁷ The vitreous condition was studied and documented photographically using an aspherical, +58.6 dioptre preset lens (El Bayadi-Kajiura lens) with a slit-lamp, which allowed observation of the dynamics of the vitreous condition with high magnification in the macular area.^{32,33}

The χ^2 test with or without Yates's correction and the Mann-Whitney U test were used for statistical analysis.

Results

BASELINE CHARACTERISTICS

Table 1 shows the sex and age distributions

Figure 1 Changes of visual acuity (VA) in each stage of idiopathic macular hole. (□) Eyes in which the VA improved two or more Snellen lines. (▨) Eyes with stable VA. (■) Eyes in which the VA decreased.

and the duration of the follow up periods for patients with stage 1, 2, 3, and 4 idiopathic macular holes. No statistically significant difference was observed in these variables among the four groups.

STAGE 1 MACULAR HOLES

Of 40 eyes with a stage 1 lesion, 13 (33%) eyes had PVS from the macula, and 27 (68%) had PVA around the macula at the initial examination. Of the 13 eyes with PVS initially, the lesions resolved in 10 (77%) eyes and remained in three (23%) at the final examination. PVS from the macula developed in 11 eyes during the follow up period. Of these 11 eyes, the lesions resolved in nine (82%), remained stable in one (9%), and progressed to a full thickness hole in one (9%), the last of which developed a full thickness hole before PVS occurred. Of 16 eyes with persistent PVA, the lesions progressed to full thickness macular holes in eight (50%), and remained unchanged in eight (50%). Thus, of 40 eyes with a stage 1 lesion initially, nine (23%) eyes had a full thickness macular hole at the final examination. The percentage of eyes that developed a full thickness macular hole was significantly lower in eyes with PVS initially (0%, 0/13) than in eyes with PVA initially (33%, 9/27) ($p < 0.05$). The follow up duration was not different between the two groups (median, 3 years).

The median initial VA was 20/30 (range 20/20 to 20/70). During the follow up period, 12 (30%) eyes had an improved VA of two or more Snellen lines, 16 (40%) remained the same, and 12 (30%) had a decreased VA of two or more lines (Fig 1). All nine eyes that developed a full thickness macular hole had decreased VA of two or more lines. The percentage of eyes with decreased VA was significantly lower in eyes with PVS initially (0%, 0/13) than in eyes with PVA (44%, 12/27) ($p < 0.03$).

STAGE 2 MACULAR HOLES

Of 25 eyes with a stage 2 lesion, 21 (84%) eyes had an enlarged macular hole; the remaining four (16%) eyes had a hole that remained stable during the follow up period. Four (57%) of seven eyes in which PVS from the macula developed during the follow up and 17 (94%) of 18 eyes in which PVA persisted during the follow up had an enlarged hole; in two eyes that developed PVS, the macular hole enlarged even after PVS occurred.

The median initial VA was 20/60 (range 20/30 to 20/200). During the follow up period, VAs decreased two or more lines in 17 (68%), and no eyes had improved VAs (Fig 1): three (43%) of seven eyes in which PVS from the macula developed and 14 (78%) of 18 eyes in which PVA persisted had decreased VAs.

STAGE 3 MACULAR HOLES

The macular holes enlarged in 32 (55%) of 58 eyes, and remained stable in 26 (45%).

During the follow up period, PVS from the macula developed in 16 (28%) of 58 eyes. The percentage of eyes with an enlarged macular hole was significantly lower in eyes that developed PVS (25%, 4/16) than in eyes that did not (67%, 28/42) ($p < 0.02$).

The median initial VA was 20/200 (range 20/30 to 20/400). The VAs improved two or more lines in two (3%) eyes, were stable in 39 (67%), and decreased in 17 (29%) (Fig 1).

STAGE 4 MACULAR HOLES

Of 31 eyes with stage 4 lesions, the macular holes enlarged in five (16%) eyes, remained stable in 25 (81%), and resolved in one (3%).

The median initial VA was 20/200 (range 20/30 to 20/400). VAs improved two or more lines in three (10%) eyes, remained stable in 24 (77%), and decreased in four (13%) (Fig 1).

COMPARISON AMONG STAGES

The percentage of enlarged macular holes during the follow up period was significantly higher in stage 2 (84%) than in stages 3 (55%) or 4 (16%), and also higher in stage 3 than in stage 4 ($p < 0.01$).

The percentage of decreased VAs of two or more lines was significantly higher in stage 2 (68%) than in the others (stage 1 30%; stage 3 29%; and stage 4 13%) ($p < 0.01$) (Fig 1).

Discussion

Our results suggest that the different stages of idiopathic macular holes have different natural outcomes.

(1) Only 23% (9/40) of eyes with stage 1 lesions progressed to full thickness macular holes. Even when eyes with PVS from the macula were excluded – that is, eyes in which a full thickness macular hole rarely develops,^{5 25} the percentage was 33% (9/27).

(2) Most (84%) stage 2 lesions enlarged, and VAs decreased. Of the four stages of idiopathic macular holes, stage 2 has the highest risk of decreased VA.

(3) Stage 4 lesions have a more favourable prognosis – that is, less frequent hole enlargement than stage 2 or 3 lesions.

Because the purpose of this study was to determine the natural outcomes of each stage of macular holes, we cannot speculate on the surgical effect. However, when evaluating the therapeutic effect, we must compare the benefits with the risk and the natural outcomes. Because eyes with stage 2 macular holes are most likely to suffer VA loss during the natural course of the disease, stage 2 lesions seem to best respond to surgical treatment if surgical outcomes and complications in each stage are not different. In fact, no significant difference is present in vitrectomy results between stage 2 lesions and stage 3 and 4 lesions.^{6 7 9–17} If the use of vitrectomy to treat macular holes carries a risk of VA deterioration,^{6 7 10–14 19–21} the surgery for stage 3 and 4

lesions must be more carefully considered than for stage 2 lesions, because the risk of decreased VA during the natural history is less in stage 3 or 4 than in stage 2. Evaluating the surgical effect on stage 1 lesions is more difficult, because we must compare not only the surgical and natural outcomes^{2–4 18} but also improved treatment for full thickness macular holes.^{6–17}

Establishing the diagnosis of macular hole is sometimes difficult and requires detailed fundus observation. However, this study had adequate inclusion criteria, which should have minimised the potential error. In the present study, the percentages of eyes with decreased VA, development of a full thickness hole from a cyst, or an enlarged hole agreed with those of previous studies.^{5 17 22–28}

In this series, we determined the natural outcomes of the four stages of idiopathic macular holes. Because their outcomes vary, the management of idiopathic macular holes must be based on their stage at presentation. Our findings are important not only in terms of the management but also the future research of idiopathic macular holes, especially when a prospective clinical trial is conducted to investigate the value of vitreous surgery and the natural outcome of macular holes.

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