Anatomical and Visual Outcome following Macular Hole Surgery at a Tertiary Eye Care Centre in Nepal

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ABSTRACT

Introduction: Macular hole (MH) leading to central vision loss is common in the elderly. This study aimed to explore the anatomical and functional outcome of MH surgery at a tertiary eye care setting in Nepal.

Methods: This retrospective, interventional case series study included patients who had undergone MH treatment with pars plana vitrectomy, membrane peeling and perfluoropropane gas (C3F8) from 2007 January to 2010 August and had completed three months of follow up. The best corrected visual acuity (BCVA) and anatomical status of MH assessed with bio-microscopy and optical coherence tomography (OCT) at six weeks, three months and at the last follow-up following surgery were recorded.

Results: A total of 36 cases with the age range of 11 - 73 years and the mean age of 53.2 years (19.3 S.D) were included in the study. The mean duration of decreased vision was 11.1 months (12.1 S.D). Idiopathic macular hole comprised of 31 cases (86.1 %) and traumatic of five cases (13.9 %). The mean follow-up period was 9.4 months. The MH closed in 27 cases (75 %) at six weeks and in 28 cases (77.8%) at three months and at the last follow-up. The vision had improved in 36 % of cases, with more than 2 lines in 27.8 %, and was stable in 27.7 % of cases during the the last follow-up. The anatomical success rate was higher in the idiopathic MH (80.65 %) than in the traumatic (60 %) and visual acuity improved in 45 % of cases in the idiopathic and 20 % in the traumatic cases.

Conclusions: The overall anatomic success rate was 78 % and improvement in visual acuity was seen in one -third of cases. The success rate was higher among idiopathic MH than in traumatic.

Keywords: *Anatomical success, macular hole, perfluoropropane gas, visual acuity, vitrectomy*

INTRODUCTION

Macular hole is a posterior segment problem of the eye leading to central vision loss. Idiopathic macular hole occurs primarily in the elderly, with female predominance after the sixth decade of life although macular holes due to secondary causes like trauma and high myopia are seen in young adults.[1] Macular hole is usually diagnosed late as patients are unaware of this problem due to its characteristics feature of gradual painless diminution of vision. More than a century following the first description of macular hole by Henry Noyes in 1871,[2] Kelly and Wendell first reported the successful closure of macular holes by pars plana vitrectomy and membrane peeling in 1991, with the anatomical success rate of 58 %.[3] Subsequent series have been reported since then, with higher anatomic and functional success using various surgical techniques in selected cases.[1, 4,5]

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Anatomical and physiological success largely depends on the size and duration of MH [6,7] but late presentation, costly surgical set-up for pars plana vitrectomy and lack of trained man power further complicate the timely treatment of MH in developing nations like Nepal.

To the best of our knowledge, there are no published case series regarding the outcome of macular hole surgery in Nepal. We hope this study will be useful to explore the anatomical and visual outcome following macular hole surgery at our hospital set up.

METHODS

This is a retrospective, interventional case series study conducted at the Tilganga Institute of Ophthalmology (TIO), a tertiary eye care centre of Nepal, from January 2007 to August 2010. Ethical approval was obtained from the Ethical Committee of the Institutional Review Board. Inclusion criteria included stage 2 to stage 4 idiopathic and traumatic MHs treated with pars plana vitrectomy, membrane peeling and perfluoropropane gas (C3F8) and followed by a follow-up duration of at least three months. Macular hole associated with other macular pathology limiting visual acuity, like non-proliferative or proliferative diabetic retinopathy, age-related macular degeneration, high myopia, previous retinal detachment surgery or concomitant retinal detachment, and cases with vitritis, posterior uveitis, retinal vein occlusion and those with a follow-up period of less than three months following surgery were excluded from the study. The staging of MH was determined bio-microscopically with a slit-lamp examination according to Gass Classification and by optical coherence tomography (OCT).[8] The maximum linear dimension (MLD) as defined by the greatest linear distance along the smallest hole aperture was recorded.[6] The pre-operative data included were age, sex, duration of visual symptoms, laterality, ocular trauma prior to visual problem, best-corrected visual acuity (BCVA), and the MLD of macular hole. The intra-operative data recorded were type of vitrectomy (20 G and 23/25 G vitrectomy), presence or absence of ERM, use of intravitreal triamsinolone, indocyanine green, ILM peeling and any other intra-operative complications. Intravitreal triamsinolone was used in all cases for the visibility of complete posterior vitreous detachment (PVD). If no PVD was present, the elevation of the posterior hyaloids was induced via suction of the vitrectome. An epiretinal membrane (ERM) was removed if present. Indocyanine green, 0.5 %, 0.2 ml, was injected intravitreal in five cases and a peeling of the inner limiting membrane (ILM) was performed with intraocular end-gripping forceps in all cases. Fluid - air exchange was followed by flushing with 50 ml of C3F8 16 % gas prior to closure of sclerotomies. Patients with concurrent visually significant cataract underwent phacoemulsification with intra-ocular lens implantation at the same setting. The intra-operative period was uneventful in all cases. After surgery, oral acetazolamide 250 mg was prescribed three times a day for three days and oral analgesics as and when necessary. Patients were advised to maintain a face-down positioning for at least seven days. Patients were prescribed topical medications containing an antibiotic and steroid combination (chloramphenicol and dexamethasone) every two hourly, cycloplegics (Tropicamide) at bed time for a week and antiglaucoma medications in cases with raised intraocular pressure. Topical medications were reduced in a tapering dose and stopped at the end of six weeks. The post-operative data included were BCVA using Snellen chart, grading of cataract in phakics, clinical and OCT evaluation of macular hole and intraocular pressure (IOP) at six weeks, three months and at the last follow-up.

Postoperative anatomical success was defined as flattening of the macular hole with no sub-retinal fluid. Visual acuity was then converted to a logarithm of the minimum angle resolution algorithm to convert into a line score to record the number of lines gained or lost after surgery. Data was tabulated and analyzed using SPSS 11 (SPSS Inc; Chicago, IL, USA). The Spearman's rank correlation coefficient was used to assess the correlation of age with anatomic success.

RESULTS

A total of 36 patients (36 eyes) with the age ranging from 11 - 73 years and the mean age of 53.2 years (19.3 S.D) were included in the study. Females slightly outnumbered males, comprising of 19 cases (58.3 %) and 17 cases (41.7 %) respectively. Nearly half of the patients were in the age range of 60 - 75 years (Table 1).

Table 1. Age and gender distribution of patients.

Age group	Male	Female	Total (%)
< 15 years	1(2.78)	1 (2.78)	2 (5.55)
15 - 30 years	5 (13.89)	0	5 (13.89)
30 - 45 years	1(2.78)	0	1 (2.77)
45 - 60 years	3 (8.33)	8 (22.22)	11 (30.55)
60 - 75 years	7 (19.44)	10 (27.78)	17 (47.22)
Total	17 (47.22)	19 (52.78)	36 (100)

The mean duration of decreased vision was 11.1 months (12.1 S.D). Nearly three-fifths (58.77 %) of the patients had a history of decreased vision of within six months whereas one-fifth (22.2 %) had a history of

poor vision of more than a year (Table 2).

Table 2. Duration of decreased vision.

Duration	Frequency(%)
< 1 month	3 (8.3)
1-3 months	9 (25)
3-6 months	9 (25)
6-9 months	1 (2.8)
9-12 months	6 (16.7)
>12 months	8 (22.2)
Total	36 (100)

Idiopathic macular hole comprised of 31 cases (86 %) and the rest were due to trauma (14 %). The macular hole was of stage 3 - 4 in 34 patients (94.4 %) with right eye involvement in 21 cases (58.3 %). The MLD of the macular hole ranged from 249 μm to 1222 μm with the mean MLD of 677.1 μm among the available macular OCT (29/36). A 20-gauge vitrectomy was performed in 12 cases (33.3 %) and 23/25 gauge vitrectomy in 24 cases (66.7 %) (Table 3).

Table 3. Characteristics of the macular hole and types of vitrectomy

Etiology	Idiopathic	Trauma
	31 (86.1 %)	5 (13.9 %)
Stage of macular hole	Grade 2	Grade 3 - 4
	2 (5.6 %)	34 (94.4 %)
Laterality	Right eye	Left eye
	21 (58.3 %)	15 (41.7 %)
Macular hole size(MLD)	< 400 micron	> 400 micron
	4 (13.8 %)	25 (86.2 %)
Type of vitrectomy	23/25 G Vitrectomy	20 G Vitrectomy
	24 (66.7 %)	12 (33.3 %)

The last follow-up period ranged from 3 - 36 months with the mean follow-up of 9.4 months (8 S.D). One-third of the cases followed up for three months and nearly one-fifth followed up for more than a year (Table 4).

Table 4. Duration of follow up.

Follow-up	Frequency (%)
Up to 3 months	12 (33.33)
3 - 6 months	6 (16.67)
6 - 9 months	4 (11.11)
9 - 12 months	5 (13.9)
12 - 15 months	2 (5.55)
15 - 18 months	3 (8.33)
> 18 months	4 (11.11)
Total	36 (100)

The macular hole was closed (anatomical success rate) in 27 cases (75 %) at the six-weeks follow-up. Likewise, the macular hole was closed in 28 cases (77.8 %) at follow up visits of 3 months and at the last follow-up (Table 5).

Table 5. Anatomical status of macular hole following vitrectomy.

Duration	Close (%)	Open (%)
6 weeks	27 (75)	9 (25)
3 months	28 (77.78)	8 (22.22)
Last follow up	28 (77.78)	8 (22.22)

Before surgery, the BCVA was between 6/18 - 6/60 in half of the total cases and one-fifth had a BCVA of less than 3/60 and only one case (2.8 %) had visual acuity of 6/6 - 6/18. During the last follow-up, four cases (11 %) had good vision of 6/6 - 6/18. Nearly three fifths (58 %) of the cases had their visual acuity between 6/18 - 6/60 whereas six cases (16.7 %) had a visual acuity of less than 3/60. The visual acuity improved in 36 % of cases, with more than 2 lines in 27.8 % and was stable in 33 % of cases during the last follow-up. Only 16.7 % of the cases underwent cataract surgery and the rest had various grades of cataract during the the last follow-up (Table 6).

Table 6. Best corrected visual acuity before and after macular hole surgery.

Visual acuity	Baseline	6 weeks	3 months	Last follow up (%)
6/6 - 6/18	1 (2.8)	2 (5.55)	3 (8.34)	4 (11.11)
<6/18 - 6/60	18 (50)	23 (63.89)	23 (63.89)	21 (58.33)
<6/60 - 3/60	7(19.45)	5 (13.89)	3 (8.34)	5 (13.89)
<3/60 - 1/60	10 (27.8)	6 (16.67)	7 (19.44)	6 (16.67)
Total	36	36	36	36

Anatomical success (80.6 %) and visual improvement (45 %) was higher in the idiopathic origin than in the traumatic, (60 %) and (20 %) respectively. Among the total four cases with MLD of MH < 400 micron, the

anatomical success and visual improvement by > 2 lines was 100 % whereas in those with MLD of MH > 400 micron, the anatomical success was seen in 17 cases (68 %) and visual improvement in 5 cases (26.3 %). The anatomical success and visual improvement was higher in the age group of above 60 years, comprising of 16 cases (84.2 %) and nine cases (47.36 %) (Table 7).

The mean intraocular pressure (IOP) at day one of the post-operative period among the 23/25 G vitrectomy cases (24 cases) was 11.7 mmHg whereas the mean IOP of the 20G vitrectomy cases (12 cases) was 12.6 mmHg. In 23/25 G vitrectomy, the best-corrected visual acuity (BCVA) improved in 33.3 % of cases, with two or more lines improvement in 16.7 % whereas in 20 G vitrectomy, the BCVA improved in 41.6 % of cases, with two or more lines improvement in 33.3 % during the last follow-up.

All patients with post-operative complications like transient rise in IOP and retinal detachment had anatomical success. The vision improved with more than two lines following retinal detachment surgery whereas in cases with high IOP, the vision at the last follow-up was worse than the pre-operative visual acuity. During the subsequent follow-ups, the two cases had transient rise in intra-ocular pressure and one case was diagnosed as primary angle closure glaucoma and these were managed successfully with anti- glaucoma medications. One case had retinal detachment at one month follow-up and was managed with scleral buckle, pars plana vitrectomy, endolaser and silicon oil temponade.

Table 7. Anatomic success and visual outcome at the last follow-up

Characters	Types	Total cases	Anatomic success	Visual improvement
Macular hole type	Idiopathic	31	25 (80.6 %)	14 (45 %)
	Traumatic	5	3 (60 %)	1 (20 %)
Macular hole size	< 400 μ	4	4 (100 %)	4 (100 %)
	> 400 μ	25	17 (68 %)	5 (26.3 %)
Age groups	> = 60 years	19	16(84.2 %)	9 (47.36 %)
	< 60 years	17	12 (70.6 %)	6 (35.29 %)
	Total	36	28	15

These was correlation between age and anatomic success of the macular hole, but it was not statistically significant (Spearman's rank correlation coefficient, r = 0.63, p = 0.37), (Table 8).

Table 8. Correlation of age with anatomic success of the macular hole surgery at the last follow-up

Age group (Years)	Anatomic al success	Percent	Anatomical failure	Percent	Total	p-value
≤ 30	4	57.1 %	3	42.9 %	7	
30 - 50	3	75.0 %	1	25.0 %	4	
50 - 70	15	88.2 %	2	11.8 %	17	0.37
≥ 70	6	75.0 %	2	25.0 %	8	
Total	28	77.8 %	8	22.2 %	36	

DISCUSSION

Surgical treatment with pars plana vitrectomy, membrane peeling and intrvitreal tamponade with gas or silicon oil is indicated for the management of full thickness macular holes (stage 2 - 4) whereas grade 1 macular holes have a high rate of spontaneous resolution (50 %).[9] In our series, despite the longer duration of macular hole and varying grades of cataract at the last follow-up, the overall success rate was 78 % with improvement in visual acuity in one-third of cases. The mean age of patients in our series was 53.2 years, which was lower as compared to that of the series by Posselt et al.[10] (71 years; age range 62 - 78 years), HirneiB et al.[11] (67 years; age range 50 - 78 years), Schurmans et al.[1] (69 years; age range 51 - 82 years); Ullrich et al.[7] (68 years; age range 50 - 80 years). This disparity in the ageing pattern could be due to the lower life expectancy and the inclusion of cases with traumatic macular hole of the younger age patients in our series. The female predominance for macular hole in our series was similar to those in other series.[1,7,10,11] The mean duration of decreased vision in our series (11 months) was longer than that mentioned in other studies.[1,10] This might be due to the tendency of late presentation for ocular consultation of our cases. The reason for delayed consultation could be due to the lack of awareness of the seriousness of the problem, lack of trained manpower for vitrectomy surgery and due to poor transportation facilities from the remote areas of the country. The idiopathic MH seen in the maximum number of cases in our series may be because of the commonest etiology seen worldwide, including in Nepal. Although not a common problem, young patients also presented to our hospital set-up with a macular hole of traumatic origin.

The mean follow-up period of 9.4 months in our series was similar to that of the majority of other studies. [1,7,12.] The overall anatomical closure rate in our series was 78 %, with 80.6 % in the idiopathic group and 60 % in the traumatic group during the last follow-up. Our anatomical success rate in idiopathic cases were nearly similar to the series by Gupta et al.[6] (86 %) but was

lower than in the series by Posselt et al.[10], (96 %), Muesseler et al.[12] (100 % and 96 %), and Kwok et al.[13] (92.3 %). The better results in their series could be due to the ICG assisted complete peeling of ILM which is thought to yield a better anatomical success rate.[10,13,14] In our series, there was a correlation between age and the anatomical success of macular hole but it was not statistically significant (Spearman's rank correlation coefficient, $r = 0.63$, $p = 0.37$). Less anatomical success in the early age groups could be due to the predominant traumatic MH and the higher success in the elderly group having idiopathic MH. Again, the relatively lower anatomical success among the age group >70 years may be due to the longstanding chronic MH.

The overall visual success (6/18 and better snellen acuity) in our series was 11 %, unlike in the series by Gupta et al. (33 %).[6] The better results in their series could be due to the concurrent phacoemulsification with intraocular lens implantation among all phakic patients. The relatively lower visual outcome in our series could be due to the varying grades of cataract where only 16.7 % of the cases had undergone cataract surgery till the study period and inclusion of traumatic macular hole that are usually associated with retinal pigment epithelial change and macular scar limiting good visual recovery.

Among the cases with the macular hole of < 400 micron, the anatomical success and visual improvement of more than two lines was achieved in 100 % in our study, unlike in the series of Gupta et al.[6] with anatomical success of 93 % and visual success of 42 % among the cases with the macular hole of < 400 micron. But the sample size of our series was quite small. Likewise, among the cases with the macular hole of > 400 micron, the anatomical success was 77 % and visual success 20 % in the series of Gupta et al.[6] Our results were nearly similar to their findings, with the anatomic success of 68 % and visual improvement in 26.3 %. Likewise, in the series of Posselt et al.[10], the improvement in visual acuity was found in five cases (35.7 %) and unchanged in three eyes (21.4 %) out of a total of 14 eyes. The final visual acuity was 20/50 or better in 55 % of cases. In our series, vision was unchanged in 33.3 % of cases with visual improvement in 13 cases (36 %). The functional results of our study were nearly correlated with their series. In our study, though the improvement in BCVA was higher among cases who underwent 20G vitrectomy than in those with 23/25 G vitrectomy, we can't compare the results because of the difference in numbers between the two groups. Regarding the BCVA, among the cases who underwent combined cataract and macular hole surgery, it is hard to the visual improvement was because of cataract surgery or because of macular hole surgery. This is a limitation of the study.

Various techniques for the surgical treatment of macular hole have been reported. Schurmans et al.[1] had reported 100 % anatomical success rate and improvement of two or more visual acuity lines in 85 % of cases following ILM peeling, endodrainage and heavy silicon oil tamponade. No one developed retinal detachment following surgery, unlike in our series where one was found to have retinal detachment during the fourth week follow-up. The added advantage of heavy silicon oil tamponade was that there was no need of face down positioning. Likewise, macular hole surgery done by Moere et al.[4] using the similar technique reported the anatomical success of 97.5 % in non-chronic macular hole (macular hole duration of < 12 months) and 72.7 % in chronic macular hole with mean line of improvement in vision of two lines in phakic, compared with 4.2 lines in the group that underwent cataract surgery concurrently or at the time of silicon oil removal. Ando et al.[5] have reported the improved anatomic success following ILM peeling with ICG (100%) as compared with ILM peeling without ICG (85.7 %) and with simple PPV with complete PVD and FAE with face down positioning for a week (85.4%). But there was no significant change in visual outcome among the different surgical procedures. Some studies had concluded that though the anatomic success is better with ICG, the relatively poor visual outcome may be due to the toxic effects of ICG.[5 15,16]

In our series, ILM peeling without the use of any ILM staining agents like ICG was done in the majority of cases (86 %) but the anatomical success and visual outcome were not different among the two groups. Although the sample size of the ICG users was very small because routine ICG use is not possible, in developing nations like Nepal results were encouraging due to its high cost.

We were unable to correlate the anatomical and visual success rate among cases with pre-existing PVD and surgically-induced PVD cases due to lack of adequate information in the medical records in this retrospective case series.

CONCLUSIONS

Despite the relatively long duration of macular hole and various grades of cataract in our series, the overall anatomic success rate was 78 % and improvement in visual acuity was present in one-third of cases (36 %) during the last follow-up. The success rate was higher among the idiopathic than in the traumatic macular hole and with a smaller macular hole size. The concurrent

phacoemulsification and intraocular lens implantation along with the use of ICG might help to increase our overall anatomical and visual success in selective cases in the future.

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