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ORIGINAL ARTICLE

TWO YEARS DESCRIPTIVE STUDY OF MACULAR HOLE PATIENTS OPERATED IN DR. KARIADI GENERAL HOSPITAL, SEMARANG

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ABSTRACT

Introduction and Objective: *Macular hole (MH) is vitreomacular interface disorder that could cause visual impairment. Clinical characteristics of MH are important for predicting MH treatment outcomes. This study purpose was to describe MH patients' characteristics and postoperative outcomes in Dr. Kariadi Hospital.*

Methods: *A retrospective study held on January 2021–December 2022 utilizing patients' medical records. Preoperative data: sex, age, symptoms, duration of symptoms, origin, preoperative visual acuity (VA), modified Gass classification stage, macular hole index (MHI), and hole forming factor (HFF) were obtained. Postoperative outcomes data: postoperative VA and anatomical closure were also collected.*

Results: *20(20 eyes) patients were obtained, with 14(70%) female, 12(60%) aged >60 years old, 13(65%) metamorphopsia, 12(60%) central visual loss, 10(50%) preoperative VA 6/24-6/60, 10(50%) duration of symptoms <3 months, and 16(80%) idiopathic origin. OCT (Optical Coherence Tomography) findings revealed base diameter mean was 780,7 um(+ SD 312). 13 patients (65%) stage 3 of MH, 12(60%) MHI <0,5, 12(60%) HFF > 0,9. All patients underwent MH surgery procedures. Postoperative examination showed 10 patients(50%) with VA 6/6-6/20. 11(100%;p<0,001) with preoperative VA>6/60, 10(100%;p<0,001) with duration of symptoms <3 months, 8(100%;p=0,012) with MHI > 0,5, and 11(100%;p<0,001) with HFF > 0,9 (p<0,001) had improved visual acuity and anatomical closure. It also revealed 17(85%) had anatomical closure.*

Conclusion: *The most common characteristics found in MH patients were female sex, age >60 years old, and disorder of idiopathic origin. Preoperative VA, duration of symptoms <3 months before surgery, MHI > 0,5, and HFF > 0,9 were positive prognostic factors for better postoperative functional and anatomical outcomes.*

Keyword*: macular hole, macular hole index, hole forming factor*

INTRODUCTION

Macular hole (MH) is one of the reason of visual impairment that would cause blindness. The stated prevalence of MH in literatures varies substantially. In the Baltimore Eye Study, it was 3.3 per 1000, in Beijing Study it was 0.9 per 1000, and in an Indian study it was 1.7 per 1000. Age 60 or older and female gender are the only two relevant systemic risk factors yet identified.[1,2,3]

Majority of MH origin is idiopathic. It has been assumed that it is vitreomacular interface disorder, which forms as a result of abnormal vitreous traction from incomplete vitreous detachment. MH may resolve, persist stable, or progress to full-thickness macular

holes. MH may also be linked with another conditions like degenerative myopia, diabetic retinopathy, intraocular surgical intervention, etc. These circumstances may have an effect on course of MH.[4]

Numerous studies have been carried out to find the most common symptoms of MH patients. Patients with MH reported experiencing some level of metamorphopsia and central visual loss being the most common symptoms. These symptoms related with the natural course of MH.[5,6]

Optical Coherence Tomography (OCT) are being currently used to observe structural changes of preoperative and postoperative conditions of MH. Various studies on Optical Coherence Tomography (OCT) parameters have been conducted to predict MH anatomical closure and postoperative visual acuity, such as macular hole index (MHI) and hole form factor (HFF).[7,8]

Pars plana vitrectomy (PPV), removal of posterior hyaloid, inner limiting membrane peeling and gas tamponade are common surgical procedures for various types of macular hole with closure rate 60-90%. Almost all types of macular hole show good postoperative visual acuity improvement except for myopic macular hole.[9]

Various studies have investigated the impact of patient characteristics on the development and management of MH. Early detection and treatment of MH are keys to achieve successful outcomes. According to studies, longer symptom duration was associated to less favorable outcomes.[10,11]

The purpose of this study was to describe characteristics of patients with macular hole and the outcomes after surgery in Dr. Kariadi General Hospital.

METHODS

A retrospective study of 20 patients (20 eyes) with MH operated in Dr. Kariadi General Hospital, Semarang was held. Inclusion criteria were all MH patients registered in Vitreo-Retina clinic from January 2021-December 2022, diagnosed and operated by vitreoretina consultants. Exclusion criteria were patients with inconsistency between their ICD-10 diagnosis with medical record diagnosis, patients who had incomplete medical record, patients with complicating and visual obscuring refractive media, and patients with OCT reliability score less than 6/10. All patients underwent pars plana vitrectomy along with membrane peeling utilizing dye and endotamponading agents (SF6 gas/C3F8 gas/silicone oil). All patients also underwent face-down positioning for at least 1 week following the surgery. Patients were followed up by vitreoretina consultants (1-3 months). All patients underwent a thorough eye examination that

included best-corrected visual acuity (BCVA) testing, dilated fundus examination, and OCT examination at first visit, at 12 weeks and as per physician's discretion during the follow-up visits.

Medical records were reviewed to get the characteristics including sex, age, symptoms, duration of symptoms, origin of MH, visual acuity, and preoperative-postoperative OCT findings and measurement. Visual acuity was assessed using Snellen chart and converted into LogMAR scale for statistical analysis. Fundus examination was done using 20D and 78D Volks© condensing lens. OCT findings and measurement were collected using Cirrus SD-OCT from ZEISS. Macular volumetric assessments consisting of horizontal axial scans with 512 A-scans and B-scans per line with scanning are 6x6 mm, were performed. Only scans with good signal strength were used for analysis. The preoperative OCT image was analyzed using the line tool, the following measurements were made in microns; maximum diameter at base, arm lengths, and macular hole height were obtained. In this study, the patients were divided into two types of anatomical outcomes as defined by Kang.[12,13]

The study was approved by the research ethics committee of Medical Faculty Diponegoro University. Data were analyzed using statistical software program SPSS V26.0. Clinical parameter distribution normality was tested by Shapiro-Wilk test. Two groups based on postoperative VA were compared. Independent *t* test was utilized for variable with a normal distribution. *P* value less than 0.05 was considered statistically significant.

RESULTS

From January 2021-December 2022, there were 45 patients registered with MH in their ICD-10 diagnosis, 25 patients were excluded and 20 patients were included in the study. Demography characteristics of the patients are shown in Table 1.

Table 1. Demography characteristics of MH patients (n=20)

Demography Characteristic	Frequency	%
Sex		
Male	6	30
Female	14	70
Age		
< 60 y.o	8	40
≥ 60 y.o	12	60
Avg (years)	57.3 ± 23	

y.o: years old; Avg: average

A significant proportion of our study subjects, 14 patients (70%) were female, and 12 patients (60%) aged more than 60 years old. The average age of the participants was 57.3 ± 23 years. The youngest participant was 21 years old while the oldest was 67.

Most of MH patients in this study experienced metamorphopsia, 13 (65%). Mostly, the origin of MH in this study is idiopathic, found in 16 patients (80%). The mean base diameter of MH was 780,7 um (± SD 312). Most patients underwent vitrectomy, membrane peeling, and endotamponading with SF6 20% gas, 16(80%). 2 Patients was implanted with silicone oil, and 2 other patients was implanted with C3F8 14% gas. Other characteristics were explained in Table 2.

Table 2. Preoperative characteristics of MH patients (n=20)

Characteristic	Frequency	%
Symptoms		
Metamorphopsia	13	65
Central visual loss	12	60
Central scotoma	1	5
Duration of symptom		
< 3 months	10	50
> 3 months	10	50
Origin		
Idiopathic	16	80
Traumatic	2	10
Myopic	2	10
Preoperative VA		
6/12-6/20	1	5
6/24-6/60	10	50
5/60-3/60	5	25
<3/60	4	20
Lens status		
Phakic	14	70
Pseudophakic	6	30
MH stage		
Stage 2	1	5
Stage 3	13	65
Stage 4	6	30
MHI		
≥ 0,50	8	40
< 0,50	12	60
HFF		
≥ 0,90	11	55
< 0,90	9	45

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Postoperative data was obtained in 1-3 months after the surgery. Postoperative VA data was described in Table 3. Anatomical closure was found on 17 patients (85%). Among them, 12 were type 1 closure and 5 were type 2 closure. 9 out of 12 patients (75%) with type 1 closure had postoperative visual acuity ranged in 6/6-6/20. 1 out of 5 patients (20%) with type 2 closure had postoperative visual acuity ranged in 6/6-6/20. During followup period, there was no MH surgery complication, such as raised intraocular pressure, vitreous hemorrhage, endophthalmitis, cystoid macular edema and retinal detachment.

Table 3. Preoperative predictive factor and postoperative visual acuity

Characteristic	Postoperative VA	Freq.	%
Preoperative VA			
> 6/60 (n=11)	6/6-6/20	10	90,9
	6/24-6/60	1	9,1
	< 6/60	0	0
Total		11	100
< 6/60 (n=9)	6/6-6/20	0	0
	6/24-6/60	4	44,4
	< 6/60	5	55,6
Total		9	100
Duration of symptoms			
< 3 months (n=10)	6/6-6/20	9	90
	6/24-6/60	1	10
	< 6/60	0	0
Total		10	100
> 3 months (n=10)	6/6-6/20	0	0
	6/24-6/60	2	20
	< 6/60	8	80
Total		10	100
MHI			
≥ 0,50 (n=8)	6/6-6/20	7	87,5
	6/24-6/60	1	12,5
	< 6/60	0	0
Total		8	100
< 0,50 (n=12)	6/6-6/20	3	25
	6/24-6/60	4	33,3
	< 6/60	5	41,7
Total		12	100
HFF			
≥ 0,90 (n=11)	6/6-6/20	8	72,7

	6/24-6/60	3	27,3
	< 6/60	0	0
Total		11	100
< 0,90 (n=9)	6/6-6/20	2	22,2
	6/24-6/60	2	22,2
	< 6/60	5	55,6
Total		9	100

Postoperative VA data based on partition of preoperative VA, duration of onset, MHI, and HFF were also compared in Table 4.

Table 4. Comparison of postoperative visual acuity

Characteristic	Mean LogMAR (± SD)	P Value
Preoperative VA		<0.001*
≥ 6/60	0.41 (±0.25)	
< 6/60	1.11 (±0.44)	
Duration of symptoms		
< 3 months		<0.001*
≥ 3 months	0.39 (±0.22)	
MHI	1.08 (±0.45)	
		0.012*
≥ 0,5	0.81 (±0.18)	
< 0,5	1.27 (±0.44)	
HFF		0.001*
≥ 0,9	0.42 (±0.23)	
< 0,9	1.10 (±0.48)	

*Significant (P<0.05); using independent *T*-test

DISCUSSION

This study subject comprised of 20 patients. Most of patients aged more than 60 years old and were female. This is consistent with largest reported studies held in 5 year period from 2012 to 2017 that stated the age of MH patients are relatively older than 60 years old. This study also showed that almost two third of participants are female.[14]

We disclosed that majority of MH patients complained about metamorphopsia and central visual loss in this study. From a meta-analysis study done by Chen et al, metamorphopsia is significantly related with MH and could be used as an independent index to evaluate visual function before and after surgery. Previous studies also spotlighted findings in this study, that central visual loss is one of main clinical manifestations of MH.[5,6,15]

This study also found that most cases are idiopathic. It was suitable with another studies, that idiopathic MH were the most common type of MH, accounting for about 60-80%

of cases.[16] 4 patients in this study were found with another origins (2 with myopic MH, 2 with traumatic MH). Prevalence rates of patients with high myopia to become myopic MH ranging from 3% to nearly 30%. Several studies have also explored the incidence of traumatic MH. Although traumatic MH is a rare condition, but the outcomes of this condition is good if the early surgical intervention done.[1,16,17]

This study revealed that majority of patients had preoperative visual acuity ranged in 6/24-6/60 and stage 3 or 4. Many studies aligned with our study, showing that most of patients with MH had preoperative visual acuity ranged in 6/30-6/60. It was also correlated with the postoperative visual acuity. Several studies with large samples also showed that most patients with MH had stage 3 of MH based on OCT examination. This may be due to that symptomatic and noticeable MH more to be found on MH stage 3 and stage 4. These studies support our findings on stage of MH which patients had in Dr. Kariadi General Hospital. Preoperative visual acuity could be related with diameter of macular hole, duration of onset to surgery, and other vitreomacular pathological conditions beside of macular hole itself.[18,19]

9 patients involved in this study, had "counting finger" visual acuity. Mostly, these patients had greater diameter of MH and longer duration of onset. 3 patients had significant level of diabetic retinopathy and 2 patients had severe myopic conditions. Several studies found that MH could occur in patients with diabetic retinopathy. Tsui et al conducted a retrospective study involving 21 patients found that patients with progressive diabetic retinopathy had worse preoperative visual acuity. These could be due to more severe vitreofoveal traction and macular edema, accompanying the MH. One systematic review study showed that myopic macular hole patients had worse preoperative visual acuity. Presence of higher axial length foveoschisis, retinoschisis, and posterior staphyloma may contribute to this result.[8,20]

Postoperative examination showed 10 (50%) patients had visual acuity ranged 6/6-6/20. This study also showed that better postperative visual acuity mostly found in patients with better preoperative visual acuity. Ullrich et al and Roth et al revealed that MH patients with better preoperative visual acuity were related with the better postsurgical prognosis based on functional and anatomical outcomes. These studies also found that better preoperative visual acuity correlated with the faster duration of postsurgical recovery.[21,22]

Majority of patients with duration of onset <3 months could reach postoperative visual acuity ranged 6/6-6/20 and all patients with this range of duration had anatomical closure. A systematic review representing 940 eyes has been conducted by Murphy et al. This study showed a linear relationship between predicted probability of closure and BCVA with symptom duration. A prospective cohort study by Essex et al involving patients with idiopathic MH,

reported that duration of >9 months reduced postoperative closure rate. It speculated that an increase in duration might lead to an increase in the hole diameter along with the appearance of epiretinal membranes, which expand the hole and impede closure.[10,23]

We found all patients with MHI $\geq$ 0,5 and HFF $\geq$ 0,9 had improved visual acuity and anatomical closure. Mostly, patients in these groups also had an excellent postoperative visual acuity. Various studies have been published, describing the role of macular hole measurements and derived indices like HFF, MHI, diameter hole index (DHI), and tractional hole index (THI) to predict anatomical closure and visual gain following MH repair surgery. A study conducted by Venkatesh et al revealed that MHI correlate significantly with MH closure and 2-months postoperative BCVA. Another study done by Ruiz-Moreno et al also showed that MHI corelates with 3-months postoperative BCVA. This may be due to that MHI are largely affected by the height of the hole which is indicative of the amount of antero-posterior traction and/or retinal cystic spaces. When the component of traction is eliminated through surgical procedure, it may increase the chance of closure.[24,25,26]

Ullrich et al found that eyes with a HFF of > 0,90 show a markedly higher closure rate. This finding supports the results of our study. The HFF reflects the relationship between the sum of the lengths of the separated photoreceptors on both sides and base of MH. Theoretically, the exposed RPE layer is completely covered postoperatively when HFF is >1.[21]

Anatomical closure was found on 17 patients (85%) in this study. 3 patients had nonclosure condition of MH after the surgery. Many studies showed that MH surgery has excellent anatomical outcomes. Ch'ng et al have done a retrospective study bringing in 258 patients and showed that anatomical closure rate was 89,92%. Murphy et al showed that primary closure was achieved in 81,5% of 940 eyes wih MH. Preoperative visual acuity, length of time a hole been present before surgery, and macular hole size are proven affecting postoperative hole closure.[10,14]

3 patients had nonclosure condition of MH after the surgery. 2 of these patients had a degenerative myopia, and 1 had a chronic macular hole (duration of symptoms >1 year). Alkabes et al showed myopic MH closure rate is highly variative. Several studies revealed that closure rate was on excellent percentage (>80%). Meanwhile, studies published by Sulkes et al and Patel et al disclosed closure rate were 62,9% and 60% respectively. Many reasons could contribute to closure failure, such as greater axial length, posterior staphyloma, and many factors which related to greater anteroposterior traction of foveomacular structure.[27,28]

1 patient in this study had nonclosure condition during observation period due to chronic MH. This patient underwent vitrectomy procedure, membrane peeling, and C3F8 gas

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tamponade. Surprisingly, 1 year after the surgery, this patient had significant improvement of visual acuity and anatomical closure. Shukla et al and Tam et al reported that closure rate of chronic MH was 33% to 80% utilizing conservative membrane peeling. Large hole and persistent foveal tissue defect are suggested to be the culprit of nonclosure condition and affecting the functional outcomes. However, it needs more study to find a better surgical method to overcome chronic MH.[29,30]

This study was the first study conducted in Dr. Kariadi Hospital describing about MH patients characteristics. It used observational method and utilized patients' medical record. Natural characteristics, like origin of disease and duration of symptoms were carefullly included. This study also captured anatomical characteristics utilizing OCT-based measurement and parameters. All of these aimed to give a better perspective about diagnosis, management, and prognosis of MH.

Retrospective study in nature is one of some limitations of this study. Additionally, the lack of sample size made this study could not conclude a strong association between preoperative conditions with anatomical and functional outcome. This study also only took MHI and HFF as the OCT parameters to see the anatomical characteristics relation with the outcomes of surgery. Lastly, a limited time of follow-up caused this study could not assess the long-term result and complication of MH surgery.

CONCLUSION

From 20 patients with MH at Dr. Kariadi General Hospital, we discovered that female sex and age >60 years old as the most common characteristics for MH. Most patients assessed with idiopathic origin of MH. This study also showed MH patients with better preoperative visual acuity, duration of symptoms <3 months before surgery, MHI $\geq$ 0,5 and HFF $\geq$ 0,9 had better functional and anatomical outcomes.

Further research can be carried out with a larger sample size, using cohort prospective model, including a more specific preoperative-intraoperative data, newer anatomical parameters like macular hole area index (MAI) and three-dimension macular hole configuration, and more detailed postoperative management to give a better perspective of MH patients' characteristics and its correlation with the outcomes in MH patients.

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