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INCIDENCE OF RETINAL DETACHMENT AFTER MACULAR SURGERY, A RETROSPECTIVE STUDY

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ABSTRACT

A retrospective non randomised study of 634 macular surgery procedures was undertaken in two academic centres. Idiopathic macular hole (IMH) surgery (n=272) and epiretinal membrane (ERM) surgery (n=362) were performed between 2008 and 2011. We noted the anatomical and functional results of these procedures and we studied serious complications excluding cataract. Minimum follow up was 1 year. No retinal detachment (RD) occurred in patients presenting with an intraoperative or preoperative successfully treated retinal break (RB). The rate of RD occurring after IMH surgery was higher than after the ERM surgical procedure (6.6% vs 2.5%, p=0.02). The rate of RD was higher in patients presenting with stage 2 and 3 IMH than with stage 4 IMH. However, lens status as well as preoperatively treated RD did not influence the rate of RD after macular surgery.

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INTRODUCTION

Retinal detachment remains the most common serious complication of macular surgery. Surgical detachment of the posterior vitreous face and associated peripheral retina anomaly seem to increase the rate of this complication. Careful examination of the peripheral retina is a key issue in preventing retinal detachment occurring after macular surgery. The most frequently reported complications of macular surgery are cataract, high intraocular pressure (IOP), retinal vascular occlusion, intraocular inflammation, endophthalmitis, cystoid macular oedema, phototoxicity, macular holes, retinal breaks (RBs), retinal detachment (RD) and surgery failures (Heier, 1999; Banker, 1997; de Bustros, 1988). The number of operations on the macula has increased over the last 10 years and many authors have reported different procedures for the treatment of idiopathic macular hole (IMH) and epiretinal membrane (ERM).[4]. For the most part, these studies aimed to specify the anatomical and functional results in order to determine the best procedure. The complications of these procedures were mentioned but few attempts have been made to discuss their risk factors (de Bustros, 1988; Ezra E, Gregor, 2004; Freeman *et al*., 1997). The purpose of this study was to evaluate the rate of RD after macular surgery.

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MATERIAL AND METHODS

A retrospective, interventional, clinical case series study examined 634 consecutive eyes of 634 patients undergoing macular surgery in two academic centres between January 2008 and December 2011. No institutional review board approval was required for this retrospective study. Patients suffering from ERM secondary to uveitis, trauma or associated with a simultaneous RD were excluded. Patients without at least 1 year of follow up were excluded as well. All the patients were either reexamined by the authors (about 80%) or last retinal assessment by their ophthalmologist was obtained for patients unable to attend a visit in both centres. We treated 362 eyes for an ERM and 272 for an IMH (stage 2–4 as defined by Gass).15,16 Patient age ranged from 15 to 87 years (mean 66 years). There were 393 females (62%) and 241 males (38%). All patients underwent visual acuity measurement using projected light Snellen charts, an IOP measurement and a careful peripheral retina examination before the surgical procedure with a wide angle viewing system without scleral depression. If a RB was observed before the procedure, argon laser photocoagulation was performed preoperatively. Eyes with ERM underwent minimal central three port pars plana vitrectomy using 20 gauge instrumentation, either a peristaltic or Venturi pump, with maximum depression set between 250 and 400 mmHg and a flow of 7 ml/min.

Most eyes had a posterior vitreous detachment (PVD) at the time of surgery but it was created if none was present. Then microforceps were used to lift the edge of the ERM. If no edge was identified, the membrane was directly grasped. Eyes with IMH underwent a more extensive three□port pars plana vitrectomy using a 20 gauge instrument with peristaltic or Venturi pump with maximum vacuum set between 200 and 500 mmHg and a flow of 7 ml/min. Posterior hyaloid was generally attached and was lifted either with the vitreous cutter probe or with active suction through a blunt cannula. Then the ILM was systematically removed using microforceps. Vitrectomy was completed, especially at the vitreous base, using indentation. Then total fluid–air exchange was done and a non□expanding mixture of air and SF6 or C2F6 was flushed through the eye. Patients were asked to remain in a face down position for 8 days after the IMH surgery. At the end of all procedures, the retinal periphery was examined with a wide□angle viewing system using scleral depression. If an untreated RB was present, cryotherapy was performed. If a retinal detachment was observed during the surgical procedure, the subretinal fluid was drained through the break before an intraocular tamponade procedure was performed. Then the RB was treated with cryotherapy. Forty one procedures (20 for IMH and 21 for ERM) were associated with phacoemulsification and intraocular lens implantation (combined surgery). Of the 272 eyes with an IMH, 29 were pseudophakic. Of the 362 eyes with an ERM, 85 were pseudophakic. All serious postoperative complications except cataract were recorded and functional results were analyzed. Success for IMH was defined by an anatomic closure of the hole. All patients were followed up at 1 month, 6 months and 1 year after the surgery with a careful peripheral retina examination with a wide angle viewing system without scleral depression. The data were analyzed using Fisher's exact test, the $\chi 2$ test, the paired t test and the t test. The threshold of statistical significance was set at $p<0.05$.

RESULTS

The mean follow up was 28 months (range: 12–50 months). Anatomical success was achieved in 91.2% of cases after the first IMH procedures. The functional results were evaluated at 6 months in eyes treated with one procedure only. Median visual acuity increased from 0.8 to 0.5 logMAR ($p<0.05$) (from 32/200 to 64/200 on the Snellen scale) and near vision increased from 0.78 to 0.48 logMAR ($p<0.05$). Visual acuity increased more than two Snellen lines in 74.6% of the eyes. After the ERM procedure, at 6 months, median visual acuity increased from 0.52 to 0.4 logMAR ($p<0.05$) (from 60/200 to 80/200 on the Snellen scale) and near vision increased from 0.58 to 0.36 ($p<0.05$). Visual acuity increased more than two Snellen lines in 41.3% of the eyes. Of the 272 eyes operated on for IMH, we observed 24 anatomic failures or early relapses of the macular hole (8.8%), three cases of elevated IOP (1.1%), one case of central retinal artery occlusion (0.4%) and no endophthalmitis. Of the patients with high IOP, one needed gas extraction and iridectomy, another was treated with timolol and brimonidine, and the last one needed a trabeculectomy 19 months after the initial procedure. We noted two choroidal detachments associated with two RDs. Fourteen RDs were observed intraoperatively (due to superior RB in six cases, temporal RB in two cases, inferior RB in five cases and nasal RB in one case) and treated during IMH surgery. Two of them failed to reattach and were observed postoperatively. We observed postoperative RD in 18 eyes (6.6%), with a mean delay of 42 days and a median of 30 days (range: 9–160 days). Two RDs occurred after the 55 cases of stage 4 IMH (representing 20.2% of IMH). Therefore, RD after stage 4 IMH surgery occurred in only 3.6% of patients but in 7.4% after stage 2 and 3 IMH procedures. This difference was not significant ($p=0.54$). Eight out of 18 RDs were macula on detachments. Among those eight macula□on RDs, only five were symptomatic. Of the 18 RDs after IMH surgery, there were 15 RDs with only one RB (eight were located inferiorly and seven were located in superior quadrants), two RDs with multiple RBs (>5) on 360° and one RD where no RB was found in spite of a careful preoperative peripheral examination with scleral depression. When located superiorly, four RBs were clearly related to the sclerotomy sites. Fourteen RDs were treated with one procedure and four with two procedures. After treatment, the mean visual acuity was 0.77 logMAR (34/200 on the Snellen scale) versus 0.9 (26/200 on the Snellen scale) before the IMH treatment. Three patients had to keep a silicone tamponade with a poor functional result. Closure of the macular hole was observed in all of these complicated cases. Open in a separate window IOL, intraocular lens; MAR, minimum angle resolution; RD, retinal detachment; RB, retinal break; M, male; F, female. For the 362 eyes operated on for ERM, we observed four postoperative macular holes (1.1%). We also found one intravitreal haemorrhage (0.3%) in a diabetic retinopathy and one endophthalmitis (0.3%) We observed two cases of RD during the ERM procedures (due to superior RBs) without recurrence of RD during the follow up. We observed nine postoperative RDs (2.5%), with a mean delay of 88 days and a median of 70 days (range: 14–225 days). Maculae were on in seven eyes and the RD was asymptomatic in two of them. Nine RDs occurred after ERM surgery. There were three RDs with inferior RB, five RDs with superior RB and one RD with a macular hole. When located superiorly, the RBs were related to the sclerotomy sites in four of them. Seven RDs were treated with one procedure and two were treated with two procedures. After RD treatment, the mean visual acuity was unchanged.

ERM, epiretinal membrane; F, Female; FGE, fluid–gas exchange; I, inferior; M, male; MAR, minimum angle resolution; MH, macular hole; N, nasal; PVR, proliferative vitreoretinopathy; RB, retinal break; RD, retinal detachment; S, superior; T, temporal; V, vitrectomy.We found more RDs after the IMH procedures (6.6%) than after the ERM procedures (2.5%) ($p=0.02$, $\chi 2$test). The extent of the detachment was limited to the surface around RB in most cases. The differences between the rates of RD in pseudophakic, phakic and combined groups were not significant; therefore, the rate of RD was not related to lens status. No complication was observed in cases of combined surgery for ERM. The mean axial length was 23.2 mm (range: 21.3–25.7 mm) for eyes with RD after ERM surgery compared to 23.9 mm (range: 21.3–29.3 mm) for all eyes treated for ERM procedure. The mean axial length was 23.6 mm (range: 21.9–25.2 mm) for eyes with RD after IMH surgery and 23.7 mm (range: 21.5–26.8 mm) for all eyes that underwent the IMH procedure. The effects of preoperative and intraoperative peripheral retinal status and their therapeutic consequences on the postoperative RD rate were reviewed. Surgical procedures with no preoperative and intraoperative retinal anomaly had a 6.2% risk of RD for IMH and a 1.7% risk for ERM.

Table 1. Retinal detachments after idiopathic macular hole surgical procedure

Number	Gender	Age	IOL	Stage	Log MAR preop	Log MAR post	Intra operative anomaly
1	M	67	1	3	1.00	0.70	No
2	M	58	1	3	0.52	0.22	No
3	F	78	0	3	0.70	0.70	Schisis
4	M	66	0	3	0.70	0.30	No
5	M	71	0	3	0.70	0.70	No
6	M	70	0	4	0.52	2.30	No
7	M	70	0	3	0.60	0.60	No
8	M	69	0	3	0.70	1.00	RD
9	F	61	0	3	2.00	1.00	RD
10	M	66	0	2	0.70	0.30	No
11	M	52	0	2	0.70	0.52	No
12	M	63	0	3	1.70	0.70	No
13	F	71	0	4	0.52	0.30	No
14	F	63	0	3	1.00	0.80	No
15	M	72	0	3	0.52	1.30	No
16	F	64	0	3	1.30	0.80	No
17	M	73	0	3	1.00	0.70	No

Table 2. Severe complications of macular surgery

	IMH (n=272)	ERM (n=362)
Retinal detachment	18 (6.6%)	9 (2.5%)
Anatomical failure	24 (8.8%)	NA
Macular hole	NA	4 (1.1%)
Elevation of IOP	3 (1.1%)	0 (0.0%)
Vascular complication	1 (0.4%)	1 (0.3%)
Endophthalmitis	0 (0.0%)	1 (0.3%)

IMH, idiopathic macular hole; ERM, epiretinal membrane;
IOP, intraocular pressure; NA, non‐applicable.

Table 3. Retinal detachments after ERM surgical procedure

Number	Gender	Age	Lens status	Pre Op Log MAR	Post Op Log MAR	Intra operative anomaly	RD delay (days)	Macula	R Blocalisation	Treatment
1	M	70	Phakic	0.60	0.40		14	on	2 NI	1 V+FGE
2	F	67	Phakic	0.52	0.40	Posterior RB / FGE	225	on	1 TI	1 V+FGE
3	F	70	Phakic	0.52	0.30		167	on	1 T	1 V+FGE
4	M	65	Phakic	1.70	1.52		41	on	2 S	1 V+FGE
5	M	66	Phakic	0.30	1.00		70	on	1 S	3 V+FGE
6	F	70	Pseudophakic	1.00	2.30	Retinoschisis / Cryo and FGE	117	off	1 MH RVP	1 V+FGE
7	M	73	Pseudophakic	1.00	1.00		14	on	1 S	1 V+FGE
8	F	64	Phakic	0.30	0.30		129	on	1 TI	1 V+FGE
9	M	67	Phakic	0.80	0.40	Retinoschisis / Cryo and FGE	14	off	PVR	2 V+FGE

Totals of 21 and 29 eyes benefited from transpupillary laser in treatment of a RB before the IMH and ERM procedure, respectively; after IMH surgery no RD occurred and after ERM surgery one case of RD occurred because of a new RB. When a RB without RD was found and treated by cryotherapy during the procedure (14 cases in IMH and 8 cases in ERM), no postoperative RD was observed. No postoperative RD occurred after the 19 cases of ERM secondary to primary successful RD surgery (macular pucker).

DISCUSSION

Of the complications of macular surgery, retinal detachment is the most sight‐threatening event. Cataract is the most frequent but the easiest to treat; chronically high IOP rarely occurs after macular surgery and endophthalmitis is very uncommon (Gaudric, 1997; Haritoglou *et al*., 2004). Vitrectomy is a well‐known risk factor for retinal break and retinal detachment. In 1995, Sjaarda *et al* showed that iatrogenic retinal breaks had an incidence for IMH surgery similar to pars plana vitrectomy in other indications [Kelly *et al*., 1991]. The location of these breaks tended to be inferior and temporal after macular hole surgery, unlike other procedures in macular surgery.

Park *et al* found 3% RBs and 14% RDs for macular hole, and most locations were in the inferior quadrants [Banker, 1997] These results were higher than expected when compared to ERM surgery (no retinal breaks and 5% RDs). Tabandeh *et al* noted that among 438 eyes undergoing macular hole surgery, RD occurred in only 8 eyes (1.8%) [Park, 1995]. These differences are surprising and deserve further study to better assess the risks of macular surgery. In our study, the anatomical and functional success rates are in accordance with the literature [Ezra, 2004; Kelly , 1991]. We found more RDs after IMH procedures (6.6%) than after ERM procedures (2.5%). The location of the RB leading to a RD affected an inferior quadrant more frequently than a superior one after IMH, but only 33% of RBs after ERM were inferiorly located, as in other reports in the literature.[2,3]. The time to RD after surgery is shorter after IMH surgery than after ERM surgery. Of all RBs, 22% were related to the sclerotomy sites after IMH surgery but 78% were not. The rate of RD was higher in stage 2 and 3 IMH. The stronger depression necessary to induce PVD, the traction involving the vitreous base during the complete peripheral vitrectomy as well as the intraocular gas tamponade are factors increasing the risk for RD after an IMH procedure. However, it should be remembered that the parameters of the vitrectomy device were not the same for all patients in this retrospective study. However, the risk of RD after induced posterior vitreous detachment must be emphasised as there is about a 4% attributable risk of RD secondary to the peeling of posterior cortical vitreous. It probably explains the significant difference between IMH and ERM, as preoperative PVD is present in almost all cases of ERM.The mechanisms of RD after macular surgery are complex. The role of perpendicular tractions on the vitreous base, which are proportional to the withdrawal movement of the probe and also to the strength of the depression, is of prime importance especially when shaving the vitreous base with a deep scleral indentation. These factors might have accounted for intraoperative breaks or early RDs. The secondary contraction of the vitreous base due to a gas bubble in IMH surgery might explain RD occurring more than 1 month after vitrectomy.

In short, unseen or unsuccessfully treated RBs are more likely to be located anywhere in the peripheral retina whereas secondary breaks due to gas traction on the vitreous base are mostly inferior. Careful inspection of the retina is warranted as the retina generally only detaches itself over a very small area around the RB. Other patients may develop severe proliferative vitreoretinopathy after surgery, which is simply a continuation of the initial disease. We followed several patients presenting with thick, rapidly growing ERM who developed spontaneous RD before operation. The presence of an untreated preoperative peripheral break or peripheral degeneration, makes the patient a high risk candidate for developing postoperative RD. When performing vitrectomy at the vitreous base, traction forces must be lowered by reducing the vacuum or the flow. The cutting speed can also be increased to 1000–2000 cuts/min in order to reduce the flow. In the future, vitreolysis techniques could reduce the iatrogenic effects of macular surgery. At the end of this retrospective study, we changed our parameters for 20 gauge vitrectomy. We used a maximum depression of 180 mmHg with a 20 gauge probe and a maximum flow of 4 mL/min. The cutting rate is set at 1500 cuts/min. In the last 160 vitrectomies for ERM, we had no RD and we had only two RDs in the last 100 cases of IMH. Although preliminary, these findings seem to be in accordance with the suspected role of vitreous retinal traction during peripheral vitrectomy. In our study, the rate of RD seems to be independent of lens status, but the number of pseudophakic eyes as well as the combined procedures was probably not sufficient to draw decisive conclusions.20 Moreover, the axial length did not influence the rate of RD even if the number of myopia cases with AL higher than 26 mm was small. Diabetes was not a risk factor for RD. However, we treated only a few cases of diabetic retinopathy [Wendel, 1993] cases. In this study, preoperative RBs were treated with transpupillary argon laser 3 weeks before the surgery. In these cases we observed no postoperative RDs; nor did the RBs seen intraoperatively and treated by cryotherapy develop RDs. Surprisingly, we did not find a higher rate of RD in ERM occurring after a primary RD surgery (macular pucker), in contrast to other published series.

This confirms the importance of a careful peripheral retina examination at the end of each procedure. Retinal detachment remains the most common serious complication of macular surgery and its prevention is essential. Surgeons must be cautious as RD can occur long after surgery. Furthermore, the absence of preoperative PVD increases the risk for RD in IMH. Preintraoperative and intraoperative treatment of breaks is of major importance to reduce postoperative RD. Patient information on symptoms, extensive inferior vitrectomy and careful postoperative follow up of the peripheral retina are indicated to detect asymptomatic peripheral break in order to minimise adverse outcomes.

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