European Journal of Ophthalmology / Vol. 15 no. 6, 2005 / pp. 712-717

Risk factors of massive suprachoroidal hemorrhage during extracapsular cataract extraction surgery

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PURPOSE. *To estimate retrospectively the incidence, predisposing factors, and possible mechanisms precipitating massive suprachoroidal hemorrhage (MSCH) development during cataract extraction surgery.*

METHODS. *The study was conducted on 6639 consecutive cataract extractions performed between 1994 and 2002. All of the procedures were carried out using traditional nucleus expression methods. The study cases comprised 19 patients who developed intraoperative MSCH. The remaining 6620 patients served as the control group. Baseline systemic and ocular characteristics, as well as intraoperative factors, were analyzed. Categorical variables were analyzed using the chi-square test and the Fisher exact test.*

RESULTS. *The incidence of MSCH during cataract surgery was 0.28%. Highly significant risk factors included high myopia, glaucoma, and diabetes ($p<0.01$). Atherosclerotic vascular diseases and/or hypertension were less significantly related to the condition ($p<0.05$). There was no significant relationship between MSCH formation and age, sex, side of the cataract, history of ocular trauma, or inflammation. The incidence of MSCH did not differ between patients operated on with extracapsular or intracapsular cataract extraction.*

CONCLUSIONS. *Attention to multiple preoperative and intraoperative ocular and systemic variables may allow the identification of, and prophylaxis for, patients at greater risk for MSCH. (Eur J Ophthalmol 2005; 15: 712-7)*

KEY WORDS. *Cataract surgery, Massive suprachoroidal hemorrhage, Risk factors*

Accepted: May 8, 2005

INTRODUCTION

Massive suprachoroidal hemorrhage (MSCH) is defined as a hemorrhage into the suprachoroidal space extensive enough to cause extrusion of the intraocular contents outside the eye or to force the inner retinal surfaces into or near apposition ("kissing"). It is a rare but potentially catastrophic complication of many surgical procedures including cataract extraction (1-5), glaucoma filtering surgery (6), penetrating keratoplasty (7, 8), pars plana vitrectomy, and scleral buckling procedure (9-11).

It is universally accepted that any unavoidable reduction in the intraocular pressure during the surgical procedure is a key pathologic factor leading to the occurrence of this serious complication. Intraocular hypotony always results in an increased transmural pressure gradient in the long or short posterior ciliary arteries. It remains to be determined, however, why and when an artery is likely to rupture and cause the complication. The most frequently discussed risk factors include advanced age, systemic cardiovascular diseases (especially arterial hypertension), intraoperative tachycardia, high myopia, glaucoma, aphakia or pseudophakia, and intraocular inflammation (6-8, 10-13).

Few reports are available on this rare complication. Moreover, those that have examined the problem concentrate on different types of surgical interventions and are thus biased with respect to different incidences for the potential risk factors in the studied groups, e.g., penetrating keratoplasty will often be accompanied by aphakia or pseudophakia (7). As a result, there are significant differ-

1120-6721/712-06$15.00/0

ences of opinion among authors as to the incidence, role, and contribution of particular risk factors in the development of this dangerous complication.

Specifically, there is a scarcity of data in the literature concerning risk factors for MSCH during cataract surgery (1). Most available articles concern only the incidence of MSCH for cataract extraction dependent on the surgical technique applied (2-5, 14, 15). In the few reports, the conclusion is limited to the statement that risk is reduced with small incision cataract extraction (3, 4, 14). The purpose of this report is to analyze 19 cases of massive suprachoroidal hemorrhage that occurred during 6639 cataract extractions, all of which were carried out using traditional methods. We discuss the incidence, predisposing factors, and possible mechanisms precipitating intraoperative suprachoroidal expulsive hemorrhage development.

METHODS

We reviewed retrospectively a series of 6639 cataract extractions performed between 1994 and 2002. Among them were 19 patients who developed intraoperative MSCH and they formed the study cases. The remaining 6620 patients served as the control group. The surgeries were performed in 2854 men and 3785 women. The age of the patients ranged from 21 to 98 years. In the analysis were included 471 intracapsular (ICCE) and 6168 extracapsular (ECCE) cataract extractions.

Surgical technique

After creating a conjunctival flap, incision of the corneal limbus was carried out at 11 o'clock with a Graefe knife. To perform ECCE the cystotome was inserted into the anterior chamber and a series of small radial tears was made in the anterior capsule. Extension of the incision to 120º usually allowed safe passage of the nucleus. The nucleus was removed in one piece by alternate gentle pressing with Daviel's spoon on the inferior cornea and on the globe above the corneal limbus at 12 o'clock with anatomic forceps. The wound was sutured partially and the cortex of the lens was then grasped and aspirated with the infusion-aspiration cannula. Intraocular lens was implanted to the posterior chamber using standard technique, with special forceps and viscoelastics. The incision was closed with four or five single sutures of 10-0 nylon. The conjunctiva was closed with running 8-0 suture.

To perform ICCE the limbal incision was extended to 160º-180º. The lens was removed in one piece, typically using a standard cryoextraction and only sometimes a Weber loop.

A peripheral iridectomy was created routinely. As the lens was extracted, the pupil was constricted with acetylcholine or carbachol injected into the anterior chamber. In some cases the lens was implanted into the anterior chamber. The wound was closed in a manner similar to ECCE technique.

General anesthesia was rarely used – only in 313 (4.7%) patients. Most patients – 6326 (95.3 %) – were operated on under local retrobulbar anesthesia. Typically, 3 mL of a 1 to 1 mixture of 0.5% bupivacaine hydrochloride and 2% lidocaine was injected retrobulbarly. This was supplemented with Van Lint facial nerve block and oculopression. No epinephrine was used for local anesthesia. The average time from retrobulbar injection to surgery was 10 minutes.

Diagnosis and treatment of MSCH

MSCH was diagnosed on the basis of the following signs: shallowing of the anterior chamber, iris prolapse, expulsion of the lens and vitreous outside the eye, dark retinal and choroidal detachment, and loss of the red reflex. If the condition occurred, the open globe was immediately pressed with a cottonoid and the wound was closed with sustainable sutures. In a case of intraocular content extrusion, the prolapsed structures were repositioned or cut out. Intravenous acetazolamide (500 mg or 1000 mg) was always given. Patients with high blood pressure were treated with intravenous administration of hypotensive agents.

Intraoperative diagnosis of MSCH was verified in all patients using sonographic examination, performed initially with a Sonomed scanner and since 1995 with a SSA 140 A Toshiba scanner, equipped with both B-mode imaging and a color Doppler option.

Data analysis

The following factors were analyzed: age, sex, medical history (hypertension, diabetes, other vascular diseases), ocular history (the presence of high myopia with an axial length >26 mm, clinically diagnosed glaucoma, previous intraocular inflammation, or trauma), type of cataract extraction, type of anesthesia, and laterality of the affected eye.

In patients with MSCH, the following factors were additionally analyzed: lens status, especially the opacity of the lens, previous ocular surgical procedures, tachycardia and/or increased systemic blood pressure, and Valsalva-type maneuvers during surgery. Cataract classification was completed according to Kanski (16).

Statistical analyses were performed to determine if the pre-and intraoperative characteristics of the patients who developed MSCH differed from those who did not. Categorical variables were analyzed using the chi-square test and the Fisher exact test. The age distribution between the two groups (case study and control) was compared using an unpaired t-test.

RESULTS

The incidence of MSCH in this study was found to be 0.28% (19 cases among 6639 consecutive cataract extractions).

The clinical characteristics of the patients with MSCH are shown in Table I. All but one (no. 10) underwent surgery with the aid of local anesthesia. It is worth noting that the presence of conditions considered to be predisposing factors for MSCH were identified in the history of nearly all the patients who actually had this complication. In the majority of patients with MSCH the cataract was classified as mature or hypermature; nevertheless, low visual acuity in the remaining cases may also be indicative of advanced opacity of the lens.

Preoperative intraocular pressure in the involved globe exceeded 17 mmHg in more than half of the patients. The presence of intraoperative risk factors for MSCH was identified in 9 patients (47%), in whom a sudden increase in blood pressure predominated.

Table II presents the characteristics of patients with MSCH and those free of the complication, who were regarded as controls.

The incidence of the following factors was shown to be significantly higher in the affected group than in the controls: high myopia ($p<0.01$), glaucoma ($p<0.01$), diabetes ($p<0.01$), hypertension ($p<0.05$), and atherosclerosis ($p<0.05$). The distribution of such variables as age, sex, side of cataract, ocular trauma/inflammation, and method of cataract extraction did not differ between subjects with MSCH and the controls.

TABLE I - CLINICAL CHARACTERISTICS OF ALL PATIENTS WITH MASSIVE SUPRACHOROIDAL HEMORRHAGE

Patient	Age, yr/sex	Past medical and ocular history	Type of cataract	Visual acuity before surgery	IOP (mmHg) before surgery	Type of surgery	Factors contributing to hemorrhage
1	74/F	High myopia	Immature	0.1	14.6	ECCE	-
2	68/M	High myopia	Mature	CF	15.9	ECCE	-
3	58/M	High myopia, blunt trauma	Mature	HM	26.6	ICCE	-
4	58/F	Diabetes, glaucoma	Mature	0.02	12.2	ECCE	-
5	60/M	Glaucoma, uveitis	Hypermature	LP	21.0	ECCE	-
6	77/M	High myopia	Immature	0.05	12.2	ECCE	Coughing attack
7	69/M	Glaucoma	Hypermature	LP	22.4	ICCE	-
8	63/M	Hypertension, diabetes	Immature	0.1	18.9	ECCE	≠ Blood pressure
9	67/F	Hypertension, atherosclerotic vascular disease	Immature	0.1	18.9	ECCE	≠ Blood pressure
10	83/M	Hypertension, atherosclerotic vascular disease, glaucoma	Mature	CF	37.2	ECCE	Tachycardia
11	67/F	Atherosclerotic vascular disease, glaucoma	Hypermature	LP	14.6	ECCE	-
12	84/F	Hypertension, diabetes	Mature	HM	17.3	ECCE	-
13	68/F	Atherosclerotic vascular disease, glaucoma	Hypermature	LP	46.9	ECCE	-
14	85/F	Atherosclerotic vascular disease	Immature	0.4	17.3	ECCE	≠ Blood pressure
15	65/F	None	Hypermature	HM	15.0	ECCE	-
16	72/F	High myopia	Mature	HM	10.1	ECCE	Tachycardia
17	84/F	Hypertension, diabetes	Immature	0.1	20.6	ECCE	Coughing attack
18	82/F	Hypertension, diabetes, atherosclerotic vascular disease, high myopia	Mature	CF	12.2	ECCE	≠ Blood pressure
19	77/F	Atherosclerotic vascular disease	Immature	0.2	12.2	ECCE	≠ Blood pressure

IOP = Intraocular pressure; ECCE = Extracapsular cataract extraction; ICCE = Intracapsular cataract extraction; CF = Count fingers; HM = Hand motions; LP = Light perception

DISCUSSION

The incidence of MSCH in our material (0.28%) was somewhat higher than that found by other authors during cataract extraction surgery (1, 2), though the difference is not statistically significant. The figure most often cited is 2 per 1000 procedures (5, 17). One factor that may account for this difference is that our study population was characterized as having a relatively high incidence of such risk factors as hypertension (14%), diabetes (8%), and atherosclerotic vascular diseases (17.2%). In Ram et al's (18) material the incidence of cardiovascular diseases was 4.1% and diabetes 3.8%. In one Italian series (19) these figures are even lower: 1.5% and 2.2%, respectively.

The incidence of MSCH for cataract surgery is found to depend on the surgical technique applied. With large-incision extracapsular cataract extraction technique, the incidence of MSCH varies between 0.13% and 4% (1, 2, 14). All our patients were operated on using traditional nucleus expression methods. Payne et al (5), who used the same methods, found the incidence of MSCH to be somewhat lower with ECCE than with ICCE, though, as in our material, the difference was not statistically significant. Similar observations were made by Speaker et al (12), but the overall incidence of MSCH in their series of over 30,000 cataract patients amounted to only 0.16%.

However, a decrease in the incidence of MSCH during cataract surgery has mirrored the evolving popularity of phacoemulsification. Erriksson et al (4), who compared ECCE and phacoemulsification, found that the risk of MSCH was 0.13% with the former and only 0.03% with the latter – the difference being highly statistically significant. Davison (3), using phacoemulsification, reported a 0.06% incidence of MSCH. As might be expected, with small incision cataract surgery, hemodynamic conditions and intraocular pressure remain more stable throughout the procedure, thus contributing to the reduced risk of MSCH.

The purpose of this study was to identify the contribution of different risk factors to the development of MSCH during cataract surgery using ECCE and ICCE. We were able to identify three risk factors for which differences in incidence were the greatest between the patients who developed MSCH and the controls: diabetes, high myopia, and glaucoma ($p<0.01$). The incidence of two other factors – hypertension and atherosclerotic vascular diseases – was also significantly higher in the patients with MSCH ($p<0.05$). No significant differences between the case and control groups were observed with respect to age, sex, the side of the cataract, and the method of cataract extraction (ECCE and ICCE). We also found no associations between the history of ocular trauma or ocular inflammation and type of anesthesia in the two groups analyzed.

It is interesting to note that the factors mainly predis-

TABLE II - CLINICAL CHARACTERISTICS OF THE GROUP OF PATIENTS WITH MASSIVE SUPRACHOROIDAL HEMORRHAGE AND THE CONTROL GROUP

Variables	MSCH (n = 19)	Control (n = 6620)	p value
Age, yr, mean ± SD (range)	71.6±8.8 (58–85)	69.1±11.2 (21–98)	>0.05
M/F, n (%)	7 (36.8) 12 (63.2)	2847 (43.0) 3773 (57.0)	>0.05
History of hypertension, n (%)	6 (31.6)	927 (14.0)	<0.05
Diabetes mellitus, n (%)	5 (26.3)	531 (8.0)	<0.01
Atherosclerotic vascular diseases, n (%)	7 (36.8)	1138 (17.2)	<0.05
High myopia (axial length >26 mm), n (%)	6 (31.6)	252 (3.8)	<0.01
History of glaucoma, n (%)	6 (31.6)	549 (8.3)	<0.01
History of ocular inflammation, n (%)	1 (5.3)	139 (2.1)	-
History of ocular trauma, n (%)	1 (5.3)	183 (2.8)	-
ECCE, n (%)	17 (89.5)	6151 (92.9)	>0.05
ICCE, n (%)	2 (10.5)	469 (7.1)	>0.05
Type of anesthesia, general/local, n (%)	1 (5.3) 18 (94.7)	312 (4.7) 6308 (95.3)	>0.05
Right eye/left eye, n (%)	11 (57.9) 8 (42.1)	3515 (53.1) 3105 (46.9)	>0.05

MSCH= Massive suprachoroidal hemorrhage; ECCE= Extracapsular cataract extraction; ICCE= Intracapsular cataract extraction

posing to the occurrence of MSCH during cataract surgery were more local than general. During cataract surgery in glaucoma, the intraocular pressure may decrease rapidly from its abnormally high level thus giving rise to transient augmentation of the transmural pressure within the ciliary arteries and this can result in their rupture. It is virtually universally agreed that glaucoma seriously predisposes to the occurrence of MSCH. High incidences of glaucoma among patients with MSCH were found by Speaker et al (12), Ingraham et al (7), Chu et al (20), Wirostko et al (21), and others, although none of these authors specifically studied a population of patients undergoing cataract surgery. It is important to add that, according to some views, even asymptomatic increases in intraocular pressure in excess of 17 mmHg may be a predisposing factor in the occurrence of MSCH (12). Our findings seem to support this notion, as 9 of our patients with hemorrhage (47%) had an intraocular pressure above 17 mmHg.

As regards high myopia, there is also a consensus among authors suggesting that it might be a factor predisposing to MSCH during eye surgery (10-12). We found an eyeball length in excess of 26 mm in 31.6% of patients with MSCH and in only 3.8% of the controls. The mechanism by which high myopia may produce MSCH may be one of at least three: it decreases the rigidity of the scleral wall, it stretches the vessels, making them thin and friable, and finally, the myopic eye has a larger intraocular area in which choroidal effusions can form and this can serve to magnify the detrimental effect of intraocular pressure reduction.

Our last factor and the one most significantly related to the occurrence of MSCH was diabetes. Other authors, however, have not reported similar results (7, 8, 10-12). A possible explanation is that a substantial number of our diabetic patients had not been properly managed and so at surgery, their diabetes was not well regulated and their vasculopathy more advanced.

Our results indicate that circulatory disorders also contribute to triggering MSCH formation in patients undergoing cataract surgery. Nonetheless, not all studies have supported this conclusion. In our group of patients with MSCH, we found an increased incidence of hypertension (31.6% in comparison to 14% among the controls) and other atherosclerotic vascular diseases (36.8%). Speaker et al (12) found hypertension in 40% of patients with hemorrhage and in as many as 31% of control patients who had undergone a variety of ophthalmic surgical procedures. The very high prevalence of hypertension in their control population may serve as an explanation, but the authors fail to comment on such a high rate of this disease among their ophthalmologic patients. Apart from Speaker et al's (12) study, many other contributors report a significant correlation between circulatory diseases (arterial hypertension/atherosclerosis) and the formation of expulsive hemorrhage (7, 21).

Although the incidence of cardiovascular diseases is considered to increase with advancing age, we did not find any significant relationship between the age of the patients and MSCH formation. We share this conclusion with the majority of other authors (6, 10-12, 17). In contrast to this, Price et al (8) reported that the mean age of patients with MSCH was lower than in the control group.

In common with other authors (7, 11-13) we found no effect of sex, laterality of the operated eye, history of ocular inflammation, and trauma on the development of massive suprachoroidal hemorrhage.

Among our patients who had hemorrhage, only one was operated on under general anesthesia and therefore we cannot draw any conclusions with regard to the type of anesthesia and formation of the hemorrhage. Nevertheless, no significant differences in the incidence of MSCH between local and general anesthesia has been found by other authors (8, 11, 12).

Several authors (9, 11, 12) have speculated on the importance of intraoperative factors, such as a sudden increase in the systolic blood pressure, tachycardia, coughing, straining, or Valsalva-type maneuvers during surgery, as a risk for MSCH development. Five out of our 19 patients with MSCH (26.3%) had elevated intraoperative blood pressure, 2 (10.5%) had an incident of tachycardia, and 2 (10.5%) had a coughing attack.

Elevated pulse rates and systemic blood pressure during surgery may increase stress across a necrotic or weak vessel wall and cause its rupture. A sudden impairment of venous return and increase in systolic arterial blood pressure, characteristic for the Valsalva maneuver, may result in an increase in choroidal blood volume and generate an excessive pressure gradient across the ciliary artery wall (9).

The results of this study suggest that the cause of MSCH during cataract extraction surgery is multifactorial. Although it may not be possible to control or remove all the risk factors for MSCH, knowledge of these factors helps to identify patients who are at an increased risk for this complication. Increased attention to preoperative re-

duction in IOP, careful monitoring, and effective control of intraoperative pulse rates and systemic blood pressure may be beneficial to the outcome of the surgery by minimizing the risk and consequences of a massive suprachoroidal hemorrhage.

The authors do not have any commercial or proprietary interest in the products or company cited in the article.

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