Cataract Surgery in Patients with Diabetes mellitus

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Key words: dry eye; retinopathy; miosis; macular edema; phacoemulsification

Received: 30. 3. 2017
Accepted: 12. 2. 2018

Abstract

Ophthalmic complications of diabetes are one of the leading causes of visual loss and blindness in the working population worldwide. Globally, an estimated 422 million adults were living with diabetes in 2014. According to the World Health Organisation, this number will rise to an estimated 592 million by 2035. Cataract is a clouding of the eye lens. Surgery is indicated when cataract causes significant visual impairment. Several clinical studies have shown that cataract development occurs more frequently and at an earlier age in diabetic compared to nondiabetic patients. Cataract surgery is the most frequent ophthalmic surgical procedure and has an excellent outcome. However, diabetic patients may have more complications and a poor visual outcome. They are prone to ocular surface disease, intraoperative complications, corneal oedema in the early postoperative period and an increased incidence of cystoid macular oedema in patients with retinopathy. Anterior capsular contraction is also more frequent. A good prognosis is expected in patients with good systemic and ophthalmological preoperative, operative and postoperative management.

Citirajte kot/Cite as: Šivec Trampuž I, Pfeifer V, Urbančič M. [Cataract Surgery in Patients with Diabetes mellitus]. Zdrav Vestn. 2018;87(3–4):159–66.

DOI: 10.6016/ZdravVestn.2526

1 Introduction

Cataract is a clouding of the lens. When opacification of the lens is so pronounced that it causes significant visual impairment it requires surgery. Cataract surgery with phacoemulsification and intraocular lens insertion is the most frequent ophthalmic intervention. Immediate postoperative visual acuity is excellent, provided there have been no surgery-related complications and other changes that could affect visual acuity. (1,2,3)

Many people with cataract have other systemic and ophthalmic disorders that can significantly affect the outcome of the surgery. Among the more frequent diseases seen in patients with cataract is diabetes mellitus. (1,2,3)

Diabetes mellitus (DM) is the main cause of blindness in active population in the developed world. According to the World Health Organisation (WHO), in 2014, there were 422 million adults with diabetes worldwide, and the number of patients is still increasing. According to the WHO's estimates, this num-

ber is expected to reach 592 million by 2035. (4,5)

DM affects all ocular structures. The most severe ophthalmic complication of DM is diabetic retinopathy, as the proliferative form of this disease and diabetic macular oedema may cause deterioration of visual acuity and, in extreme cases, blindness. (6-8)

In diabetic patients cataract occurs more frequently and at an earlier age. In those under 65 years of age it is three- to four-times more frequent and in those after 65 years twice as common as in people without DM. The risk for the onset of cataract increases with the duration of DM and poor metabolic control. The most frequent type of cataract is the age-related or senile variant of the disease, and the occurrence of cortical and posterior polar cataract is more likely (Figure 1). (1-3,9)

Cataract surgery is aimed at improving visual acuity and visibility of the back of the eye. Good visibility of the posterior segment of the eye is important for monitoring as well as adequate and timely treatment of diabetic retinopathy and other pathological changes that may be seen in this eye segment. (1,2,9,10)

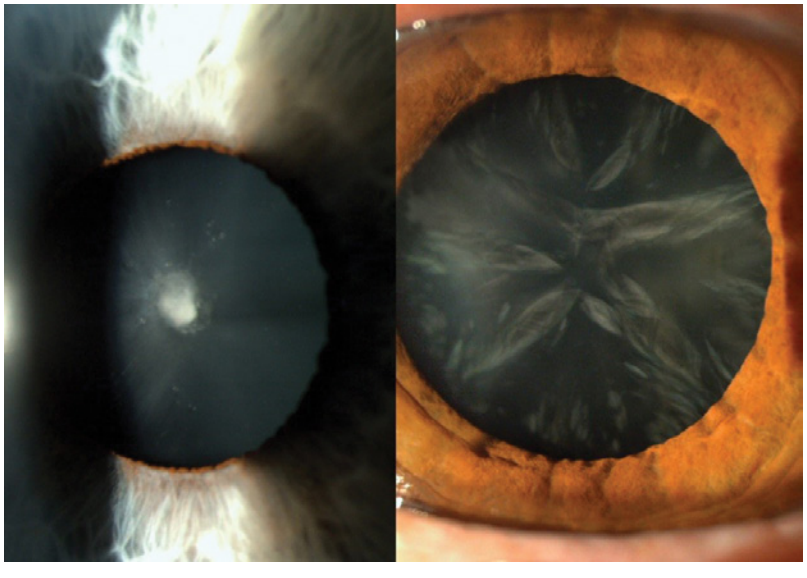

Figure 1: Posterior polar cataract (left), cortical cataract (right).

The outcome of cataract surgery is generally excellent; however, in patients with DM the probability of postoperative complications and worse visual acuity is greater. There can be several reasons for the worse outcome of the cataract surgery because DM affects all the eye structures. Patients with diabetes are expected to present with dry eye syndrome and related problems. An unexpected narrowing of the pupil may occur during the intervention, while more frequent postoperative complications include corneal oedema and anterior capsular contraction; there is also the possibility of progressive diabetic retinopathy and associated with that cystoid macular oedema. (1-3,6,7,10-18)

2 Preoperative assessment of the eye condition

An optimal outcome of the cataract surgery greatly depends on an accurate preoperative assessment of the eye condition. The consistency between visual acuity and intraocular lens opacification is assessed. Cataract surgery is indicated only when the cataract considerably affects the visual acuity. If visual acuity is worse than it could be expected with respect to the level of intraocular lens opacification, the reason for poor vision should be sought in other eye conditions. We must accurately assess the condition of the tear film, the cornea, the iris, the presence of any neovascularisation of the iris and/or the angle, the presence of diabetic retinopathy (DR) and diabetic macular oedema (DMO). In addition to a clinical examination, patients should undergo an optical coherence tomography (OCT) to exclude the presence of DMO. (2,6,7,15-16,18-20,32)

3 Eye surface and tear film

DM is one of the major systemic risk factors for dry eye syndrome. The prevalence of dry eye syndrome in DM patients over 65 years of age ranges between 15–33 %; it increases with age and correlates with the level of glycated haemoglobin. According to some studies, up to 54 % of patients with DM have either symptomatic or asymptomatic dry eye syndrome. (21)

In patients with DM, dry eye syndrome is a consequence of the lacrimal unit dysfunction. It is characterised by changed osmolarity and instability of the tear film, damaged corneal surface and decreased sensitivity. Hyperglycaemia affects reduced tear formation through neuronal connections and structural changes in the tear gland, affects a decreased blinking frequency and a changed content of the tear film. (21)

In 2001 Dogru et al. described changes in the ocular surface in patients with DM, peripheral neuropathy and poor metabolic control. They presented with significantly decreased corneal sensitivity, deteriorated tear film stability and a reduced quantity of tears; there were fewer goblet cells with metaplasia of the conjunctival epithelium present. (12)

Diabetes mellitus also causes changes in the cornea itself. Thus, changes occur in the epithelial cells, the Bowman's membrane, in the stroma and the Descemet's membrane. Epithelial damage and erosions occur. Due to changes in the eye surface and tear film reepithelisation slows down. Patients with DM are more susceptible to infections, which, combined with a slower re-epithelisation, poses a greater risk of corneal ulcer. Also, blepharitis and hordeola occur more frequently in these patients. (12,13,22)

Jiang has found that the symptoms and tear film stability after cataract surgery in patients with DM temporarily deteriorated and their recovery took longer than in patients without DM (Table 1). (11,21)

Dry eye my cause an error in the biometric measurements that serve as a basis for choosing an appropriate intraocular lens, which may result in a residual refractive error after the procedure. (23)

Table 1: The incidence of dry eye syndrome in patients with DM and in a control group without DM (Jiang et al.).

Postoperative period	Control group	Group with DM
1 week	8.1 %	17.1 %
1 month	0 %	4.8 %
3 months	0 %	0 %

4 Corneal oedena in the early postoperative period

Corneal transparency is ensured by active and passive mechanisms of maintaining relative dehydration of strongly hydrophilic stroma via the undamaged epithelial and endothelial tissue layers. DM related endothelial damage contributes to the occurrence of corneal oedema after cataract surgery. Tsaouris et al. have found that in the first weeks after cataract surgery in patients with DM corneal oedema occurred more frequently than in those without DM, i.e. in 14.3 % vs. 4.5 %, respectively. Persistent corneal oedema was present in 0.16 % of the population irrespective of the presence or absence of DM. (15,22,24,25)

5 Small pupils and surgically induced pupillary constriction

Neovascularisation of the iris and/or the angle is a sign of a progressing diabetic damage of the eye with pronounced ischaemia, which increases the possibility of intra- or postoperative complications in cataract surgery. As a result of neovascularisation of the iris, a pronounced ischaemia and neuropathy, the pupil is often constricted and does not dilate easily. Small pupil is also more frequently seen after panretinal laser photocoagulation in vitrectomy. Small pupil renders the performance of cataract surgery more difficult and increases the risks of intraoperative complications. Thus a small pupil may cause intraoperative damage to the iris, lens capsule, zonule and a loss of the vitreous. (3,26,27)

Mechanical eye trauma, such as cataract surgery, can induce intervention-related narrowing of the pupil (myosis). A number of studies have indicated a more frequent occurrence of myosis during surgery in patients with DM. In 2003, Mirza published a study on the pupil size before incision and after completed phacoemulsification in patients with DM and in a control group without DM (Table 2). A surgically induced myosis increases the risk of perioperative and postoperative complications. (3,26,27)

Table 2: The pupil size before incision and after completed phacoemulsification in patients with DM and in a control group without DM (Mirza et al.).

	Control group	Group with DM
Pupil size before surgery;	7.65 (± 0.89) mm	7.38 (± 0.95) mm
Pupil size after surgery	7.63 (± 1) mm	7.11 (± 1.2) mm

6 Anterior capsular phimosis

Narrowing or phimosis of the anterior lens capsule occurs as a consequence of fibrous proliferation of the remaining lens epithelial cells that produce collagen. In patients with DM, a statistically significant phimosis occurs three months after surgery, while some evidence of phimosis is noted already in the first month. Phimosis is more apparent in patients with already present retinopathy, and more frequent in those with increased permeability of the blood-ocular barrier. Phimosis of the anterior lens capsule may affect the transparency of the eye background and renders laser photocoagulation more difficult. (6,7)

7 Diabetic retinopathy and diabetic macular oedema

Diabetic retinopathy (DR) is the most common late complication of DM (Figure 2). Diabetes retinopathy occurs in almost one third of diabetic patients, and after 20 years of living with the disease in practically all of them. About one third of patients with DR presents with severe vision-threatening changes. In the past, it was believed that cataract surgery accelerated the progression of DR and DMO. Some authors of recent studies believe that DR progression is a consequence of the natural course of the disease, and the exacerbation of DMO after the cataract surgery is due to pseudophakic cystoid macular oedema or Irvine-Gass syndrome. (8,10,17-19,33)

Squirrel et al. believe that uneventful cataract surgery does not accelerate postoperative DR progression and that possible exacerbation of the condition is a consequence of the natural course of the disease and poor glycaemic control. After surgery, macular oedema is more common though generally transient

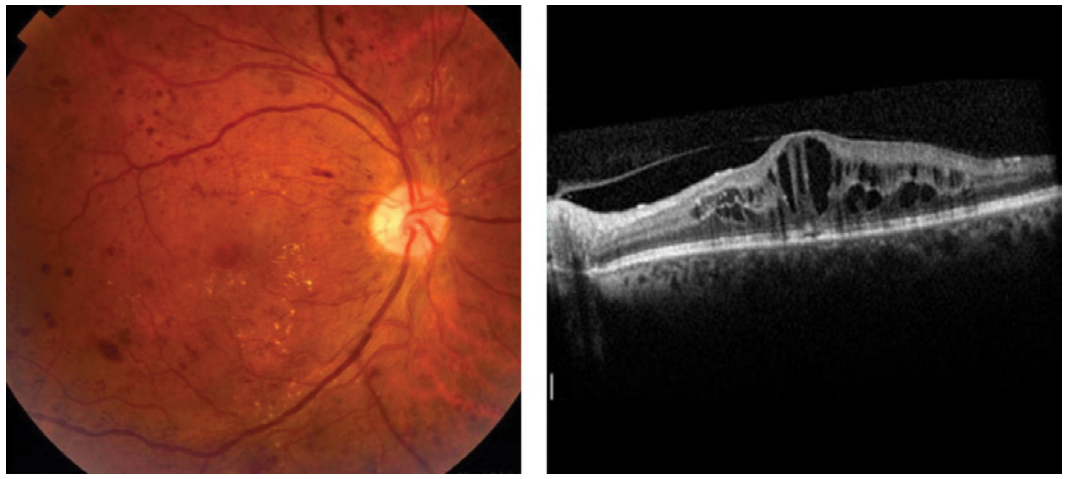

Figure 2: Diabetic retinopathy (Figure on the left – colour picture of the eye background), CMO (Figure on the right – OCT cross-section through the macula).

and occurring within the Irvine-Gass syndrome. Also, the development of clinically relevant macular oedema after surgery is more likely attributable to the natural course of the disease. A similar finding was reported by Dowler et al., who found that macular oedema which had been present before surgery did not resolve spontaneously, while that occurring only after surgery was of transient nature, which confirms the belief that a postoperative oedema is a pseudophakic cystoid macular oedema occurring within the Irvine-Gass syndrome. Kim and Chu et al. also noted an increased risk for the onset of pseudophakic cystoid macular oedema in patients with DR. (10,17-20)

Prior to the planned cataract surgery it is important to accurately evaluate the grade of DR and DMO. In addition to a clinical examination with a biomicroscope, we perform an optical coherence tomography (OCT) and possibly also fluorescein angiography. The DMO present before surgery is frequently the cause of poor postoperative visual acuity and therefore it is generally treated prior to cataract surgery. If, due to the cataract, the transparency of the eye background is poor and laser photocoagulation is not feasible, the patient should be operated on as soon as possible so that the treatment for DR can be started at the earliest convenience. (10,19,20)

Chew recommends early treatment of DR patients by laser photocoagulati-

Table 3: Comparison of visual acuity in patients with early and delayed treatment of DR one year after the intervention (Chew et al.).

Visual acuity 1 year after the intervention	Early treatment	Delayed treatment
> 20/40	46 %	36 %
> 20/100	73 %	55 %
< 5/200	8 %	17 %

on, i.e. before or soon after the cataract surgery, since the postoperative visual acuity in these patients is better than in patients whose treatment was delayed (Table 3). In 64.3 % of patients with early treatment, visual acuity improved by two or more lines a year after the intervention, and only 8 % of these patients see less than 5/200. On the other hand, 59.3 % of patients with delayed treatment improve by two or more lines after one year, but as many as 17 % of them see less than 5/200. Poor prognosis for vision is mainly due to complications of proliferative DR and chronic DMO. (32)

In the case of a clinically relevant cataract in patients with DMO and poor transparency of the eye background, it is sensible to combine cataract surgery with intravitreal application of an anti-VEGF biological agent. Cheema et al. reported exacerbation of DMO in only 5.71 % of patients with combined treatment and as much as 45.45 % deterioration in the control group that did not receive intravitreal application of anti-VEGE bevacizumab. (28)

8 Preoperative preparation of patients and cataract surgery

Any relevant ophthalmic pathology should be treated prior to cataract surgery. In the presence of severe or very severe non-proliferative DR, proliferative DR or DMO, the patient should receive appropriate treatment prior to cataract surgery. Cataract surgery may only be performed after DR has been treated and stabilised. In the event that retinal state cannot be assessed due to poor transparency of the ocular background with progressive cataract, the patient is referred for surgery within one month. Three days before the intervention the patient should be prescribed a topic nonsteroidal anti-inflammatory drug (NSAID) and a corticosteroid. Whenever possible, the surgical intervention is carried with stable DM, i.e. well controlled glycaemia, arterial hypertension and stable DR. (2,6,7,15,16,18-20)

9 Surgical tehnique

A minimally invasive surgical technique with minimum use of ultrasound and less fluid flow through the eye is recommended. Contact with the iris should be avoided. During the intervention, the iris is not being expanded due to possible bleeding from neovascularisation. Capsulorhexis should be greater than usual, as in patients with DM postoperative phimosis of the anterior lens capsule is more common. Phimosis of the anterior lens capsule may worsen the transparency of the eye background so much that it renders the performance of laser photocoagulation or vitrectomy difficult. In certain cases in patients with proliferative DR and DMO the best approach is a combined intervention, i.e. cataract surgery with simultaneous vitrectomy. (2,6,7,15,16,18,19,29,32)

Multifocal or toric intraocular lenses with a larger diameter of the optic are suitable for patients with DM, since they provide good transparency of the ocular background after surgery. The transparency is important in the event that laser treatment of vitreoretinal intervention is required later on. Due to the probability of vitreoretinal intervention with silicone oil emulsification, in patients with advanced DR hydrophilic acrylic intraocular lenses are considered most appropriate because of their minimum adherence of silicone oil, which ensures best transparency during the vitreoretinal intervention. Silicone lenses are therefore not suitable due to poor ocular

background transparency during vitreoretinal interventions. (30,31)

10 Postoperative patient management

In patients with diabetes, vigilant follow-up monitoring is required in the early postoperative period because of the greater probability of DR or CMO occurrence after the cataract surgery. Patients whose ocular background was not transparent before the procedure should have their ocular background assessed after two to three days, and their treatment recommendations adhered to. Long-lasting inflammation after the procedure is common in patients with DM. Therefore all patients with DM receive a 2-week therapy with topical corticosteroids. Topical NSAIDs are administered to patients without DR for two months and to those with DR for three months. However, we must not forget the appropriate precautionary measures due to changes in the occular surface. (20,34)

11 Conclusion

A cataract surgery in patients with DM is associated with a higher risk of complications and frequently a much lower postoperative visual acuity due to diabetes-related eye changes. Therefore, in order to ensure a good surgical result, patients with DM require careful preoperative preparation, optimal surgery and vigilant postoperative follow-up.

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