Ocular Complications Following **Open** Heart **Surgery**

Sameh Ibrahim sersar MBBCH a, Usama A. Hamza a MD And Ashraf I.Moawad b MD
a Cardiothoracic Surgery Department, b Opthalmology Centre, Mansoura University, Mansoura, Egypt.

Introduction: Neurologic injury following cardiac surgery with cardiopulmonary bypass is a well known sequélae and is an important cause of mortality and morbidity. The aim of this study was to evaluate the incidence and types of postoperative ocular complications which may occur following open heart surgery.

Patients and methods: This prospective study included 47 adult consecutive patients undergoing elective open heart procedures on cardiopulmonary bypass. Numerous perioperative clinical, technical and laboratory variables were analyzed. The patients included in this study were subjected to preoperative and postoperative full ophthalmological examination, fundus fluorescene angiography and visual field test.

Results: One patient had postoperative anterior ischemic optic neuropathy in one eye and two patients had postoperative variable visual field defects.

Conclusion: Ocular complications following open heart surgery are rare but devastating with poor treatment results. Prophylactic measures that are important to guard against embolization must be insisted upon.

Sameh Ibrahim

Introduction

Neurologic injury following cardiac surgery with cardiopulmonary bypass is a well known sequélae of the operation and is an important cause of mortality and morbidity(1).

Systemic embolism is a recognized complication both of cardiopulmonary bypass (CPB) and of the underlying cardiovascular diseases that require CPB for their surgical treatment(2).

Macroemboli and microemboli may contain gas bubbles (air or anesthetic gas), biologic aggregates (thrombus, platelet aggregates, or fat), or inorganic debris (fragments of polyvinyl chloride tubing exposed to the roller pump and of silicone antifoam)(3).

Visual loss (visual acuity, visual field) secondary to ischemic optic neuropathy is a rare but devastating complication of open heart surgery(4).

The development of anterior ischaemic optic neuropathy (AION) after CPB was first described in 1982 by Sweeney and associates(5).

Aim of the work

The aim of this study was to evaluate incidence and types of postoperative ocular complications which occur following open heart surgery.

Patients and methods

This prospective study included 47 adult consecutive patients undergoing elective open heart procedures (valve replacement). Cardiopulmonary bypass was conducted in all patients under moder-

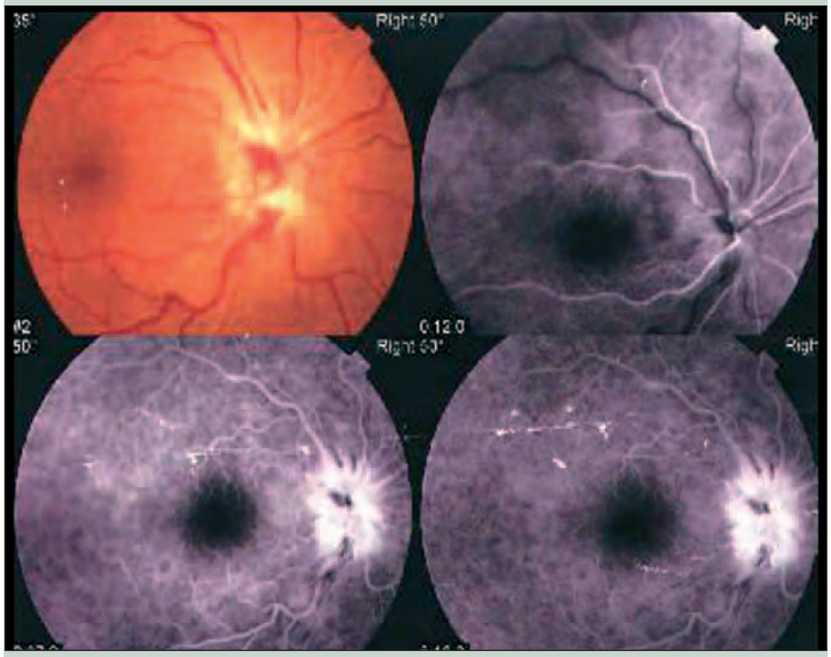

Figure 1 - *Anterior ischemic optic neuropathy.*

ate systemic hypothermia (25- 28°C).

Patients with known peripheral vascular disease or patients going to have coronary artery bypass graft operation are excluded from this study.

Patients included in this study were subjected to complete ophthalmologic examination, which included assessment of visual acuity, measurement of intraocular pressure, slit-lamp examination of the anterior segment, dilated fundus examination with indirect ophthalmoscope.

Visual field-testing by automated perimetry, retinal photography and fluorescein angiography were done for all patients included in the study.

Numerous clinical, technical and laboratory variables were analyzed:

Preoperative variables included age, sex, history of hypertension, diabetes mellitus, obesity, smoking, history of renal insufficiency, and transient ischaemic attacks.

Perioperative variables included the type of surgical procedure, cardio-pulmonary bypass time, highest and lowest flow rate, highest and lowest perfusion pressure, carbon dioxide tension (Pco2) and the use of inotropic or vasopressor medications.

Postoperative variables included the use of intra-aortic balloon pump, early postoperative weight gain, incidence of myocardial infarction, development of transient or permanent neurologic deficit (other than AION), postoperative atrial fibrillation, and acute renal failure. Follow up of these patients was 8:13 months.

Statistical analysis of data was done and expressed as means+ standard deviation and student T. test with $P < 0.05$ is considered significant.

Results

This study included, 47 patients underwent elective valve replacement procedures on CPB.

With regards to the surgical procedure, 15 patients (31.9%) had mitral valve replacement (MVR), 9 (19.1%) patients had MVR plus tricuspid valve repair (TR), 12 (25.5%) patients had aortic valve replacement (AVR), 8 (17.1%) patients had double valve replacement (DVR), and 3 (6.4%) patients had DVR plus TR. Out of them 3 patients (6.3%) had postoperative ocular complications. Patients were classified into 2 groups, group I where patients had postoperative ocular complications and group II where no postoperative ocular complications occurred.

There was no significant difference between both groups with regards to age, sex, and the frequency of preoperative risk factors (table 1).

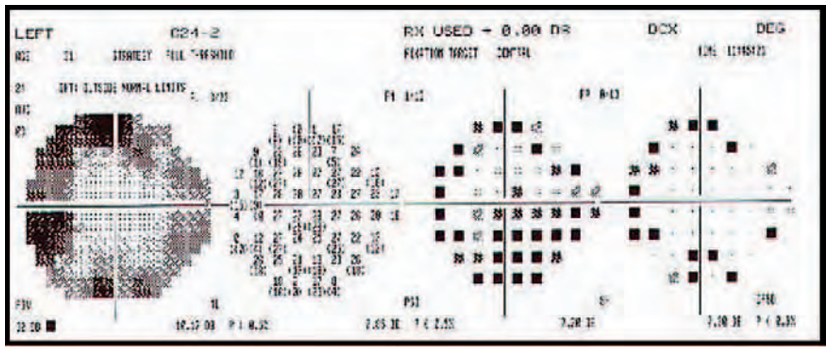

Figure 2 - *Multiple patchy field defects*

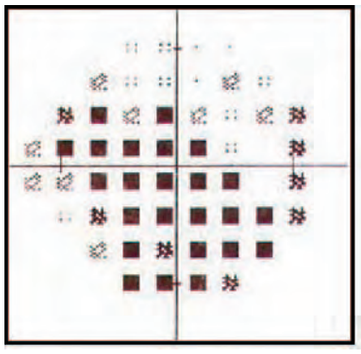

Figure 3 - *Inferior and nasal field defects*

Clinical Characteristics	Group (I) n.3	Group (II) n. 44	P. Value
Age (years)	34.2-1.2	28.8-4.1	0.752
Sex (male/female)	2/1	24/20	0.826
Body weight	78.4-3.1	78.1-5.2	0.542
Diabetes mellitus	1	8	0.973
Hypertension	2	12	0.862
Obesity	2	11	0.294
Smoking	2	20	0.317
Renal insufficiency	0	2	1.000
Previous stroke	0	0	-

Table 1 - *Preoperative demographic data and risk factors*

Variable	Group (I) n.3	Group (II) n.44	P. Value
Surgical procedure: (Number of patients)			
MVR	0	15	
MVR + TR	0	9	**0,041***
AVR	0	12	
DVR	2	6	
DVR + TR	1	2	
CPB time (min.)	164-6.5	100.2-12.4	**0.001***
Lowest flow index (L.m-2 .Min –1)	1.7-0.2	1.5-0.4	0.462
Hematocrit (%)	19.4-2.2	22.6-2.5	**0.037***
Lowest PCO_2 (mmHg)	31.0-1.6	31.6-2.9	0.862
Highest PCO_2 (mmHg)	42.1-3.2	39.8-3.6	0.572
Lowest perfusion pressure (mmHg)	52.1-4.8	56.6-5.9	0.967
Highest perfusion pressure (mmHg)	75.2-6.3	78.2-6.4	0.379
Medications:			
• Epinephrine	3	25	**0,0052***
• Dopamine	2	20	0,397
• Dobutamine	0	8	0,726
• Nitroglycerine	3	35	0,375
• Nitroprusside	1	12	0,128

MVR: Mitral valve replacement, TR: Tricuspid valve repair, AVR: Aortic valve replacement, DVR: Double valve replacement, CPB: Cardio-pulmonary Bypass.

Table 2 - *Perioperative data*

Preioperative technical and laboratory data are summarized in table (2). Ocular complications (group I) occurred in two patients who had DVR and one patient who had DVR plus TR with statistical significance.

CPB time was significantly longer in group (I) than in group (II), also hematocrit value was significantly lower in group (I). There was no significant difference between both groups with regards to the flow indices, perfusion pressures and (Pco2) levels. There was significantly more use of epinephrine intraoperatively in group (I) than in group (II), but the use of other medications was not significantly different in both groups.

As for the postoperative clinical data, no significant difference was noted in the use of the intra-aortic balloon pump or other postoperative complications, including myocardial infarction, atrial fibrillation, transient ischemic attacks, stroke, or acute renal failure. This is shown in table (3).

Table (4) shows the ophthalmologic findings in group (I) . One patient had postoperative anterior ischemic optic neuropathy (AION) in one eye and the other eye was normal (Fig1). The second patient had multiple patchy field defects in one eye (Fig2) and superior field defect in the other eye. The third patient had nasal field defect in one eye and the other eye was normal (Fig3). Visual acuity ranged between PL 1-0 6/9.

Intraocular pressures measured at variable times were not elevated. Optic disc examination ranged between normal appearance, mild edema and marked edema associated with nerve fiber layer haemorrhage and retinal ischaemia.

The patient with AION received a course of corticosteroids with CAI and hyperosmotic medication but no improvement was noticed, Follow up of these patients was 8:13 months and the visual deficit remained unchanged.

Discussion

Neuro-ophthalmic complications associated with open heart operations have been will recognized but rarely reported(6,7). Post-operative reported visual complications included retinal emboli, retinal infarcts, visual field deficits, Horner's syndrome and ischemic optic neuropathy(7). AION is now the most commonly reported cause of postoperative loss of vision for all surgical procedures(8).

Results in this study are in agreement with this hypothesis because patients with postoperative ocular complications had significantly longer CPB time than other patients

In this study, postoperative ocular complications occurred in 6.3% of patients. This incidence in agreement with Shapira and others(2), however, Show

and associates (7) reported an incidence of 25.6% in patients undergoing coronary artery bypass grafting and this high incidence was due to screening of all asymptomatic patients.

Although numerous etiologic theories have been proposed, it is now believed that interruption of the oxygen supply to the optic nerve head anterior the lamina cribrosa and to the retina is the cause of ocular complications postoperatively which follow a critical reduction in blood supply or oxygen carrying capacity(9).

Results in this study are in agreement with this hypothesis because patients with postoperative ocular complications had significantly longer CPB time than other patients. Shapira and others(2) also had the same relation between CPB time and postoperative ocular complications. It has been shown that long CPB time is associated with high levels of circulating endogenous vasoactive amines(10).

We excluded from this study patients with known peripheral vascular disease or going to have coronary artery disease in an attempt to stress on the CPB and the studied other variables effect.

In this study the three cases with ocular complications occurred in patients who had either double valve replacement (two patients), or double valve replacement with tricuspid repair (one patient). These procedures require longer CPB time and more tissue trauma than the single valve replacement that may be the incremental risk factor.

Also, hematocrit value was significantly lower in ocular complications

Clinical variable	Group (I) n.3	Group (II) n.44	P.value
Intra-aortic balloon pump	0	1	1.000
Complications:	0	2	1.000
Myocardial infarction	1	8	1.000
Atrial fibrillation	0	0	1.000
Transient ischaemic attack	0	2	1.000
Stroke	1	3	1.000

Table 3 - postoperative clinical data:

Patient no.	Visual acuity		Intraocular Pressure		V.F.	Optic nerve		Retina		F.A.	
	OD	OS	OD	OS	OD	OS	OD	OS	OD	OS	OD	OS
1	PL	6/18	17.0	15.0		NAD	Oedema with N.F.L hge	NAD	Ischae-mic	NAD	AION	NAD
2	6/9	6/12	16.0	15.0	Patchy defects	Superior fieldDefect	Mild oedema	NAD	NAD	NAD	NAD	NAD
3	6/18	6/9	13.0	14.0	Nasal defect	NAD	Mild oedema	NAD	NAD	NAD	NAD	NAD

OS=left eye. OD = right eye;

Table 4 - Ophthalmological findings (Group I)

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group than the other group without ocular complications. Epinephrine was also used more frequently in patients with postoperative ocular complications. Thus a combination of exogenous vasoactive drugs, anemia and prolonged exposure to endogenous amines stimulated by CPB may have acted synergistically to produce vasoconstriction and ischaemia in the posterior ciliary circulation(12). Katz and colleagues(13), have demonstrated higher levels of intraocular pressure in patients with postoperative ocular ischaemia, although this finding was not confirmed in a subsequent study by Shapira and associates (2) or in this study.

Embolization to the optic nerve and retinal vessels may be an etiologic factor in some patients(8), and evidence of retinal embolization during CPB has been well documented using intraoperative fluorescien angiography(11).

Numerous techniques have been studied to detect and minimize the risk of intraoperative embolization including the use of transesophageal echocardiography, epiaortic echo by the surgeon, and the use of arterial line filtration(3).

None of our patients had progression of symptoms or improvement, and this is in agreement with results of Shapira and colleagues(2).

Conclusion

Ocular complications following open heart surgery are rare but devastating and because of poor treatment results, prophylactic measures are important particularly in patients with potential predisposing factors, such as high hyperopia, small cup/disc ratio or high intraocular pressure. Intraoperative monitoring and adjustment of intraocular pressure in high risk patients (such as preoperative high intraocular pressure) is advised.

Surgical strategy has to focus on avoidance of major embolism of air, intracardiac thrombus, and calcific debris from diseased heart valves.

Prophylactic measures include, brief duration of CPB, careful tissue manipulation, adequate deairing after valve replacement, maintenance of adequate levels of hematocrit and hemoglobin, and judicious use of exogenous inotropic and vasoconstricting agents.

More studies including larger number of patients are encouraged to for full understanding of these complications.