Anterior ischemic optic neuropathy after conventional coronary artery bypass graft surgery

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Summary

Background: Perioperative optic neuropathy is a disease which can lead to serious, irreversible damage of vision. This complication could be the result of non-ocular surgery, for example, cardiac or spinal procedures.

We present a case of anterior ischemic neuropathy (AION) which occurred following a conventional coronary artery bypass graft procedure.

Case Report: A 57-year-old man, 4 days after Conventional Coronary Artery Bypass Graft surgery as result of multi-vessel stable coronary artery disease and history of anterolateral wall myocardial infarction, was admitted to the Eye Clinic due to significant loss of vision in his right eye. The patient had hypertension and was a heavy smoker. On admission, the slit lamp examination revealed a relative afferent pupillary defect in the right eye. The fundus examination showed optic disc edema with the presence of flame hemorrhages. Best corrected visual acuity (BCVA) was 0.02. The results of eye examination and fluorescein angiography confirmed the diagnosis of AION. Anti-aggregation and antithrombotic treatment was continued with steroids and vasodilators. After 7 days of this treatment we noticed the improvement of BCVA to 0.2. At 6-month follow-up, the vision was stable, and fundus examination revealed optic disc atrophy.

Conclusions: After cardiac surgical operations, such as coronary artery bypass graft procedures, anterior ischemic optic neuropathy may occur. In those cases, close cooperation between the various specialists is necessary.

key words: coronary artery bypass graft • off-pump coronary artery bypass • perioperative ischemic neuropathy • anterior ischemic optic neuropathy

Abbreviations: CCABG – conventional coronary artery bypass grafting; CABG – coronary artery bypass graft; ECC – extracorporeal circulation; CBP – cardiopulmonary bypass; OPCAB – off-pump coronary artery bypass; PON – perioperative optic neuropathy; AION – anterior ischemic neuropathy; RAPD – relative afferent pupillary defect; BCVA – best corrected visual acuity; CRVO – central retinal vein occlusion

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BACKGROUND

Perioperative optic neuropathy (PON) is a disease which can lead to serious, irreversible damage of vision. This complication could be the result of non-ocular surgery, for example cardiac [1,2] or spinal procedures [3,4]. The frequency of PON occurrence among all of surgical procedures ranges from 0.002% to 0.1% [5–7], and after coronary artery bypass graft (CABG) ranges from 0.06% to 0.113% [2,8].

Coronary Artery Bypass Graft (CABG) is a cardio-surgical procedure of by-pass implantation, passing around the place of restriction in coronary arteries. This procedure is performed in some cases of cardiac infraction and advanced coronary disease. Arteries and veins from the patient’s body are grafted to the coronary arteries to bypass atherosclerotic narrowing and improve the blood supply to the ischemic part of the heart muscle. CABG can be performed with extracorporeal circulation (ECC) with cardiopulmonary bypass (CBP) – conventional coronary artery bypass graft (CCABG) or without extracorporeal circulation – operation on beating heart or off-pump coronary artery bypass (OPCAB). The first operation on a beating heart was performed in 1964 by Kolesov [9].

Visual loss due to CABG is a rare complication. The mechanisms of this disorder are not completely understood. It may be the result of optic nerve ischemic neuropathy, although other cortical mechanisms for visual loss are considered [7,10].

We present a case of anterior ischemic optic neuropathy (AION) occurring as a consequence of a conventional coronary artery bypass graft procedure (CCABG).

CASE REPORT

A 57-year-old man was admitted to the Eye Clinic in April 2010 due to significant loss of vision in his right eye. Because of multi-vessel stable coronary artery disease and history of anterolateral wall myocardial infarction (2008), he had CCABG in extracorporeal circulation performed 4 days before. Two saphenous vein grafts and 1 arterial vein grafts were implanted, with good intraoperative graft flow and preserved left ventricular function, without any perioperative complications. After regaining consciousness following surgery, the patient complained of significant visual loss in his right eye. The consulting ophthalmologist diagnosed AION. Nothing unusual happened during the procedure, and the cardiac surgeon couldn’t indicate any cause of the eye disorder. The patient had been treated for hypertension over the past 10 years and was a heavy smoker.

On admission, the slit lamp examination revealed relative afferent pupillary defect (RAPD) in the right eye. The fundus examination showed swelling of the optic nerve head, with pale and blurred margins. Flame-shaped hemorrhages on the disc margin were visible (Figure 1). BCVA was 0.02, intraocular pressure was 17 mmHg.

We performed fluorescein angiography (Figures 2–5). These results confirmed the diagnosis of AION.

After consultation with the cardiac surgeon, anti-aggregation and anti-thrombotic treatments were continued with steroids and vasodilators.

After 7 days of these treatments we obtained improvement of BCVA to 0.2. In 6 months of follow-up the vision was stable, and fundus examination revealed optic disc atrophy which appeared as optic disc pallor.

DISCUSSION

Anterior ischemic optic neuropathy is the result of oxygen delivery disturbance to the optic nerve head, anterior to the lamina cribrosa. These disturbances are the result of unsatisfactory blood flow in short posterior ciliary arteries (PCA) in this area [8]. Many systemic factors, including surgical procedures, may cause blood flow reduction in the PCA. Systemic, non-correlated-to-surgery risk factors of AION are: high serum cholesterol, triglycerides, hyperlipidemia, hyperfibrinogenemia, prolonged smoking history, hypertension and diabetes mellitus [11].

In spite of the fact that the patient had many risk factors contributing to AION (including hypertension, coronary disease and smoking history), time correlation with the cardiac surgical procedure and appearance of symptoms suggests that this procedure itself increased the risk for AION.

Spectacular developments in cardiac surgery have opened up new treatment possibilities for patients with coronary disease. At present, many coronary artery bypass grafts are performed. Due to the continuously rising number of procedures, the frequency of complications concomitantly increases – including eye complications.

After cardiac surgery, patients may complain about transient loss of vision, poor reading ability and altered perception of colors. Some of these symptoms are transient, but in other cases visual loss may occur [12].

Ischemic optic neuropathy is one of the serious ocular complications after cardiac surgery [13], and is the result of optic disc ischemia. The risk factors of ION due to CABG are: postoperative decrease of hemoglobin level, history of clinically severe vascular diseases, coronary angiogram within
48 hours of surgery, long duration of the CABG procedure [8], hypotension, arrhythmia and tissue edema [2].

Coronary artery bypass grafting opened-up new possibilities for widespread coronary disease treatment. At present, conventional coronary artery bypass grafts (CCABG) are performed in extracorporeal circulation with cardiopulmonary bypass. In spite of complications due to extracorporeal circulation, new methods without using cardiopulmonary bypasses are being introduced. Beginning in the mid-1990’s, off-pump coronary artery bypasses (OPCAB) without extracorporeal circulation were elaborated, referred to as “beating heart” [9]. This method has a lower risk of complications in comparison to techniques with heart-stopped procedures, which require the use of cardiopulmonary bypass [14–16]. As OPCAB cannot be performed in all cases, it cannot replace CCABG. The decision on the type of procedure is made individually by cardiac surgeons. In the patient in question, the cardiac surgeons decided to perform CCABG in extracorporeal circulation.

During operations with extracorporeal circulation, such as the present case, the aorta is cannulated and cross-clamped, and, to protect heart tissues, hypothermia is employed. Additional cardioplegic fluid is injected into coronary vessels. This causes general heart ischemia, with metabolic and water-electrolyte balance disturbance [17]. Blood contact with cardiopulmonary bypass elements during extracorporeal circulation is the cause of general inflammation, leading to activation of the complement system, monocytes, neutrophils and many proinflammatory cytokines. This process causes cellular edema, including heart muscle cells and blood vessels, which is detrimental for heart contractility and vascular tension [17,18].

These changes may lead to many postoperative complications such as early morbidity [19,20] central nervous system...
of the still rising number of cardiac surgical procedures, cardiac surgeons and ophthalmologists should consider the possibilities of serious complications leading to significant vision damage. Patients with severe vascular disorders seem to be at greater risk of these complications.

**Conclusions**

Based on the presented case and published data, we conclude that cardiac surgical operations, such as coronary artery bypass graft procedures (hypotony, hypovolemia and hypothermy) may lead to anterior ischemic optic neuropathy. In those cases, close cooperation among the various specialists is necessary.

**References:**

1. Busch T, Sirius H, Aleckic I et al: Anterior ischemic optic neuropathy: a complication after extracorporeal circulation. Ann Thorac Cardiovasc Surg, 1998; 4: 354–58
2. Kalyani, S.D., N.R. Miller, L.M. Dong, W.A. Baumgartner, D.E. Alejo, and T.B. Gilbert, Incidence of and risk factors for perioperative optic neuropathy after cardiac surgery. Ann Thorac Surg, 2004; 78: 34–37
3. Alexandrakis G, Lam BL: Bilateral posterior ischemic optic neuropathy after spinal surgery. Ann J Ophthalmol, 1999; 127: 354–55
4. Dilger JA, Tetzlaff JE, Bell RG et al: Ischaemic optic neuropathy after spinal fusion. Can J Anaesth, 1998; 45: 635–66
5. Brown RH, Schausch JF, Miller NR: Anemia and hypotension as contributors to perioperative loss of vision. Anesthesia, 1994; 80: 222–26
6. Roth S, Thisted RA, Erickson JP et al: Eye injuries after nonocular surgery. A study of 60,965 anesthesiologies from 1988 to 1992. Anesthesiology, 1996; 85: 1029–27
7. Williams EL, Hart WM Jr, Tempelhoff R: Postoperative ischemic optic neuropathy. Anesth Analg, 1995; 80: 1018–29
8. Nuttall GA, Garrin JA, Dearani JA et al: Risk factors for ischemic optic neuropathy after cardiopulmonary bypass: a matched case/control study. Anesth Analg, 2001; 93: 1410–16, table of contents
9. Kolesov VI: Mammary artery-coronary artery anastomosis as method of treatment for angina pectoris. J Thorac Cardiovasc Surg, 1967; 54: 535–44
10. Shapira OM, Kimmel WA, Lindsey PS, Shahian DM: Anterior ischemic optic neuropathy after open heart operations. Ann Thorac Surg, 1996; 61: 660–66
11. Jacobson DM, Vierkant RA, Belongia EA: Nonarteritic anterior ischemic optic neuropathy: A case-control study of potential risk factors. Arch Ophthalmol, 1997; 115: 1403–7
12. Machida S, Gotoh Y, Tanaka M, Tazawa Y: Predominant loss of the photopic negative response in central retinal artery occlusion. Arch Ophthalmol, 1998; 161: 660–66
13. Shalan RN, Asfour VM: Visual loss after coronary artery bypass surgery. Saudi Med J, 2000; 21: 90–92
14. Angelini GD, Taylor FC, Reeves BC, Asicone R: Early and mid-term outcome after off-pump and on-pump surgery in Beating Heart Against Cardioplegic Arrest Studies (BHACAS 1 and 2): a pooled analysis of two randomised controlled trials. Lancet, 2002; 359: 1194–99
15. Mage R, Jabsolinski KA, Stamsou SC et al: Elimination of cardiopulmonary bypass improves early survival for multivessel coronary artery bypass patients. Ann Thorac Surg, 2002; 73: 1196–202, discussion 1202–3
16. Sergeant P, Wouters P, Meyns B et al: OPCAB versus early mortality and morbidity: an issue between clinical relevance and statistical significance. Eur J Cardiothorac Surg, 2004; 25: 779–85
17. Chojecki HP, Grysko L, Szałasiński P et al: Pomostowanie aortalowo-więńcowe bez użycia krążenia pozaustrojowego. Pol. Merk. Lek., XXII, 61: 660–66
18. Edmunds LH Jr, Taylor FC, Reeves BC, Asicone R: Early and mid-term outcome after off-pump and on-pump surgery in Beating Heart Against Cardioplegic Arrest Studies (BHACAS 1 and 2): a pooled analysis of two randomised controlled trials. Lancet, 2002; 359: 1194–99
19. Mack MJ, Pfister A, Bachand D et al: Comparison of coronary bypass surgery with and without cardiopulmonary bypass in patients with multivessel disease. J Thorac Cardiovasc Surg, 2004; 127: 167–73
20. Reston JT, Tregear SJ, Turkelson CM: Meta-analysis of short-term and mid-term outcomes following off-pump coronary artery bypass grafting. Ann Thorac Surg, 2005; 76: 1530–15
21. Hernandez F, Cohn WE, Bazileau RV et al: In-hospital outcomes of off-pump versus on-pump coronary artery bypass procedures: a multicenter experience. Ann Thorac Surg, 2001; 72: 1528–33, discussion 1533–34.

22. Magee MJ, Coombs LP, Peterson ED, Mack MJ: Patient selection and current practice strategy for off-pump coronary artery bypass surgery. Circulation, 2003; 108(Suppl.1): 119–14.

23. Gerritsen WB, van Boven WJ, Driessen AH et al: Aarts, Off-pump versus on-pump coronary artery bypass grafting: oxidative stress and renal function. Eur J Cardiothorac Surg, 2001; 20: 923–29.

24. Puskas JD, Williams WH, Duke PG et al: Off-pump coronary artery bypass grafting provides complete revascularization with reduced myocardial injury, transfusion requirements, and length of stay: a prospective randomized comparison of two hundred unselected patients undergoing off-pump versus conventional coronary artery bypass grafting. J Thorac Cardiovasc Surg, 2003; 125: 797–808.

25. Reuler JR: Hypothermia: pathophysiology, clinical settings, and management. Ann Intern Med, 1978; 89: 519–27.

26. Emmrich P, Hahn J, Ogunlade V et al: Neuropathological findings after cardiac surgery: retrospective study over 6 years. Z Kardiol, 2003; 92: 925–37.

27. Williams IM: Intravascular changes in the retina during open-heart surgery. Lancet, 1971; 2: 688–91.

28. Ascione R, Ghosh A, Reeves BC et al: Retinal and cerebral microembolization during coronary artery bypass surgery: a randomized, controlled trial. Circulation, 2005; 112: 3835–38.

29. Fosnot J, Glazer-Hockstein C, Tolentino MJ: Central retinal vein occlusion immediately following cardiac surgery. Ophthalmic Surg Lasers Imaging, 2003; 34: 215–16.