Effect of Coronary Artery Bypass Surgery on Central Retinal Sensitivity

Koroner Arter Bypass Cerrahisinin Santral Retina Duyarlılığı Üzerine Etkisi

Erdinç AYDIN[1], Helin Deniz DEMİR[2], Hüseyin Ayhan KAYAOĞLU[3], Erdinç NASARİ[3]

ABSTRACT

Purpose: To evaluate whether Coronary artery bypass surgery (CABS) has any effect on central retinal sensitivity.

Materials and Methods: Right eyes of 20 patients with coronary heart disease and 13 patients with thyroid disease as control were recruited in this study. Subjects were determined to be candidate by Cardiothoracic Surgery, General Surgery and Ophthalmology Departments. Standard achromatic perimetric (SAP) and Short-wavelength automated perimetric (SWAP) analyses were performed at preoperative and postoperative terms. Visual field analyses were performed using Humphrey Visual Field Analyzer 750i with full threshold, Central 24–2 program.

Results: When the results of SWAP tests were analyzed in CPBS group, mean deviation (MD) at the postoperative term were more significantly decrease than the preoperative term (p=0,027), but no significant differences were not detected in SAP tests. There were significant differences in PSD and CPSD values of TdS group at preoperative and postoperative term via SWAP tests (p=0,012, p= 0,026, respectively), but no significant changes via SAP tests.

Conclusion: Localized decrease of retinal sensitivity was detected in patients with TdS. CABS may lead loss of generalized retinal sensitivity in a subclinical manner and SWAP can be valuable to determine these early and undetectable changes over SAP.

Key words: Coronary artery disease, coronary arter bypass surgery, thyroidectomy, standard achromatic perimetry, short–wavelength automated perimetry.

ÖZ

Amaç: Koroner arter bypass cerrahisinin (KABC) santral retina duyarlığı üzerindeki etkisini değerlendirmek.

Gereç ve Yöntem: Koroner kalp hastalığı olan 20 hasta ve kontrol olarak tiroid hastalığı olan 13 hastanın sağ gözleri çalışmaya alındı. Olgular, Kardiyo Vasküler Cerrahi, Genel Cerrahi ve Göz Hastalıkları Anabilim Dalı tarafından belirlendi. Standart aromatik perimetrik (SAP) ve Kısa dalga boylu otomatize perimetri (SWAP) analizleri preoperatif ve postoperatif dönemde yapıldı. Görme alanı analizi, tam eşikli, Santral 24-2 programı ile (Humphrey Visual Field Analyzer 750i) gerçekleştirildi.

Bulgular: SWAP testlerinin sonuçları KABC grubunda analiz edildiğinde postoperatif dönemde ortalama sapma (MD) preoperatif dönemde anlamlı olarak azaldı (p = 0,027), ancak SAP testlerinde anlamlı farklılık saptanmadı. Preoperatif ve postoperatif dönemde troid hastalığı sebebi ile cerrahi yapılan (TdS) grubunun PSD ve CPSD değerlerinde SWAP testleri (sırasıyla p = 0,012, p = 0,026) ile anlamlı farklılıklar mevcut iken, SAP testleri ile anlamlı değişiklik belirlenmedi.

Sonuç: TdS'li hastalarda lokal olarak retina duyarlılığında azalma saptanmıştır. KABC ise hastalarda subklinik olarak yaygın retina duyarlılığında azalmaya neden olabilmektedir. SWAP, SAP' a göre erken ve saptanamayan değişiklikleri belirlemekte değerli olabilir.

Anahtar kelimeler: Koroner arter disease, koronar arter bypass cerrahisi, troidektomi, standart akromatik perimetri, kısa dalga boylu automatize perimetri.

1- Prof. Dr., İzmir Katip Çelebi Üniversitesi Tıp Fakültesi Göz Hastalıkları AD, İzmir, Türkiye

2- Doç. Dr., Gaziosmanpaşa Üniversitesi Tıp Fakültesi, Göz Hastalıkları AD, Tokat, Türkiye

3- Prof. Dr., Şevket Yılmaz Eğitim ve Araştırma Hastanesi, Genel Cerrahi Kliniği, Bursa, Türkiye

4- Uz. Dr., Park Hayat Hastanesi, Kalp Damar Cerrahisi Kliniği, Afyonkarahisar, Türkiye

Geliş Tarihi - Received: 16.08.2017
Kabul Tarihi - Accepted: 25.09.2017
Ret-Vit 2018; 27: 136-140

Yazışma Adresi / Correspondence Adress:
Erdinç AYDIN
İzmir Katip Çelebi Üniversitesi, Atatürk Eğitim ve Araştırma Hastanesi
Göz Kliniği, Karabaglar, İzmir, Türkiye

Phone: +90 232 244 4444
E-mail: erdincaydin@yahoo.com

INTRODUCTION

Coronary artery bypass surgery (CABS) is performed for patients with coronary artery disease (CAD) to improve quality of life and reduce cardiac-related mortality. CAD is the leading cause of mortality in the United States, Europe, and Australia.

CABS may lead to neuro-ophthalmological complications like retinal emboli or infarct, visual field defects, visual acuity reduction, and Horner's syndrome[1-3]. However, any challenge of retinal sensitivity in the patients with CABS has not been studied yet.

Thyroidectomy is one of the major indications of thyroid cancer. Beyond malignancies, thyroidectomy is also a viable option for patients with symptomatic thyroid masses or goiters. Thyroid surgery were often fraught with complications, including massive hemorrhage, infection, and injury to surrounding structures, all of which were associated with morbidity and mortality rates of nearly 40%.

Short-wavelength automated perimetry (SWAP) can detect visual field defects ten years earlier than standard automated perimetry (SAP)[4] and has also been reported to be susceptible for damage in a variety of retinal disease; where the changes are less specific for retinal nerve fibers and more confined to alterations of the inner retina [5].

In our presented study, we aim to evaluate whether CABS has any effect on central retinal sensitivity.

PATIENTS AND METHODS

Patients undergoing elective first-time coronary artery bypass grafting (CABG) with CAD was eligible. The patients, who underwent into thyroidectomy surgery (TdS), were selected as control. The study was designed and performed under the ethical standards of the Declaration of Helsinki. Informed consent was obtained from each patient prior to the study in our institution. The right eyes of all patients were randomly included in the study.

Exclusion criteria included uncontrolled diabetes with any retinopathy, previous history of cerebrovascular accident, significant carotid artery disease, hypercoagulability, estrogen replacement therapy, connective tissue vascular disorders, active smoking, previous history of ophthalmic, neurological, or peripheral vascular disease, recent myocardial infarction (1 month), or poor ejection fraction (30%), severe anemia, uncontrolled hypo or hypertension, pre and postoperative ischemic optic neuropathy, visual acuity less than 4/10, more than 1 D of cylindrical and 3 D of spherical refractive error, dense cataract (grade 3 and 4), a history of intraocular pressure readings greater than 22 mmHg, low visual field reliability criteria (fixation losses >20 %, and/or false-negative or false-positive results >33%), presence of dyschromatopsia, presence of glaucomatous visual field defects and/or optic disk changes.

Coronary artery bypass surgery

Standard anesthetic (fentanyl; 50 µg/kg, midazoram; 1–2 mg/body pancronium; 0.1 mg/kg) and monitoring techniques (electro-cardiogram, central/pulmonary and arterial pressure monitoring, urine output, bladder and skin temperature monitoring) were used in all patients. The circuit was primed with 1600 ml of Ringer's lactate solution, 45 mEq of sodium bicarbonate, and 150 ml of 20% of mannitol, 4500 U of heparin and 1 g of cefazolin. Before the institution of CAB, heparin was administered (300 IU/kg), and activated coagulation time was kept at more than 480 s. A CAB flow rate of 2.4 l/min per m^2 was maintained. During the CAB procedure, the lowest bladder temperature was kept around 30°C. The blood pressure was kept over 50 mmHg using phenylephrine. Protamine was given (300 IU/kg) at the end of CAB. After the surgery, patients were transferred to the intensive care unit and managed according to our unit protocols.

Thyroidectomy surgery

After making a slightly curved and symmetrical transverse incision, superior and inferior flaps were dissected medially beneath the platysmal layer. Than the midline raphe was divided from the thyroid cartilage superiorly to the sternal notch inferiorly. After blunt finger dissection of the thyroid capsule, lobes of the gland were mobilized following superior and inferior pole vessels entering the thyroid were ligated and divided. The parathyroid glands and recurrent laryngeal nerves were identified and protected bilaterally. Berry's ligament and than the attachment of the thyroid medially on the trachea was divided.

Detection of Visual Acuity

Corrected visual acuity (VA) for both eyes of each patient was measured with a Snellen chart at preoperative and postoperative 1th week. Patients' visual fields were also assessed by a Humphrey visual-field analyzer before and after the surgery between 1th weeks.

Static perimetry was performed using the 24-2 program of a modified Humphrey Field Analyzer 750i (Humphrey Instruments, San Leandro, CA). The test was performed in both eyes. All subjects underwent baseline standard achromatic (white-on white) perimetric analysis once before the study and a complete ocular examination including the best-corrected visual acuity, refractive error, biomicroscopy, optic disc and fundus examination with a 78-D lens, Goldman applanation tonometry, color vision test using Ishiara's

color test booklet, and keratometry. All examinations were performed under the same room conditions. Anterior and posterior segments were normal in all subjects in the pre and postoperative examination. Two experienced observers (EA and HD) masked to the cases, assessed the optic nerve head to rule out the presence of probable glaucomatous changes.

Parametric tests were performed using a Humphrey visual field analyzer (Model 750i, Humphrey instruments, San Leandro, CA, USA) with full threshold strategy and central 24-2 program. Tests were carried out according to the Humphrey perimetry manual. SWAP test was performed on yellow background with a luminance of 100cd/m^2 and a narrow-band 440 nm blue stimulus. A minimum of 4 min of adaptation was allowed for SWAP tests. The efficiency of fixation of the subjects was constantly monitored by an experienced perimetrist. At pre and postoperative period, all subjects underwent perimetric examinations at least twice and the second tests were used for the analysis to prevent a learning effect on the visual field data. The pupil diameter of each subject was measured under same room conditions before all perimetric tests.

Regarding interpretation of visual fields, global indices, including mean deviation (MD), pattern standard deviation (PSD), corrected pattern standard deviation (CPSD), short-term fluctuation (SF) and test duration of each field analysis were noted.

Statistical Analysis

The preoperative characteristics of the patients and their postoperative clinical outcomes were summarized by descriptive statistics. All data are presented as means ± SD. For statistical analysis, the values in the right eyes of the subjects was evaluated. Statistical analysis was performed using the paired t-test and Student's t test. Statistical significance was set as $P<0.05$.

RESULTS

All patients received their allocated type of surgery. At the postoperative term, except the two patients with atrial fibrillation, none of the patients had problem such as bleeding, hypotension and atrial fibrillation was taken under control in these two subjects. The preoperative characteristics of patients are summarized in the Table 1. The mean ages of the patients with CABS and TdS were 57.1±11.4 (M (male) /F(female): 16/4) and 48.4±7.6 (M/F: 6/7), respectively. The best corrected visual acuity of the patients with CABS and TdS were 0.89±0.14 in the right eyes and 0.85±0.18 in the left eyes and 0.96±0.07 in the right eyes, 0.97±0.04 in the left eyes, respectively (Table 2).

When the scores of SWAP and SAP of the patients with CABS were analyzed, the mean MD of SWAP was significantly decreased at the postoperative term than at the preoperative term (p=0,027), but no significant differences were not detected via SAP tests.

Table 1. *Clinical demographic characteristics of groups.*

Groups	CPBS	TdS	P-value
Age at surgery	57.1± 11.4	52.6±6.46	0.205
Duration of surgery (Hour)	2.97±0.73	1.69±0.52	0.0001
Sex, (Male/Female)	16/4	6/7	0.97
Intraocular pressure, mmHg			
Preoperative	16.0±1.5	16.3±2.1	0.836
Postoperative	15.7±1.1	15.6±1.4	0.765
BCVA (Right/Left)	0.89±0.14 / 0.85±0.18	0.96±0.07/0.97±0.04	
Triple-vessel disease	6		
Two-vessel disease	10		
One-vessel disease	4		
Smoking history			
Never smoked	1	3	
Past smoker	19	8	
Current smoker	-	2	
DM without retinopathy	9	4	
Hypertension	8	5	
Hypercholesteremia	13	2	

BCVA: Best corrected visual acuity, CPB: Cardiopulmonary bypass surgery TdS:Thyroidectomy surgery, DM: Diabetes Mellitus

Table 2. *Changes in visual field indices of SAP and SWAP at the preoperative and postoperative term of the patients with coronary artery bypass surgery (CABS) and Thyroidectomy surgery (TdS).*

Groups	Preoperative term (SAP/SWAP)	Postoperative term (SAP/SWAP)	P-value (SAP/SWAP)
CPBS			
MD, dB	4.19±2.49/9.29±4.68	3.86±2.42/6.99±5.47	0.248/0.027
PSD, dB	3.02±1.64/4.09±1.29	2.68±1.25/3.70±0.80	0.395/0.028
CPSD, dB	1.97±1.58/2.52±1.77	1.70±1.43/2.03±1.15	0.349/0.274
SF	1.92±1.06/2.69±0.97	1.79±0.56/2.37±0.81	0.535/0.112
TdS			
MD, dB	5.03±5.84/8.26±4.38	2.99±2.62/7.2±5.45	0.123/0.194
PSD, dB	3.45±2.86/3.34±0.88	2.66±2.30/2.90±0.93	0.088/0.012
CPSD, dB	1.26±2.02/2.32±0.90	1.73±2.44/1.73±1.07	0.197/0.026
SF	2.92±2.23/2.18±0.67	2.02±0.73/2.13±0.59	0.086/0.843
P-Value MD PSD CPSD SF	 0.633/0.524 0.631/0.059 0.294/0.670 0.149/0.087	 0.207/0.917 0.974/0.248 0.962/0.444 0.769/0.356	

MS: mean Sensitivity; MD: mean deviation; PSD: pattern standard deviation; CPSD: corrected pattern standard deviation; SF: short-term fluctuation, SAP: standard acromatic perimetry; SWAP: short-wave automatized perimetry.

SWAP scores of TdS group showed significantly localized retinal sensitivity changes (PSD and CPSD) between at the preoperative term and at postoperative term (p=0,012, p=0,026, respectively), but there was no significant changes at SAP scores (Figure 1 and 2).

DISCUSSION

Patients with CABS sometimes may complain of postoperative transient loss of vision, poor reading, altered perception of colors, and reduced VA for both near and distance[6]. Levy and Rawitscher reported that systemic hypotension during CABS lead to reduce transiently intraocular pressure but

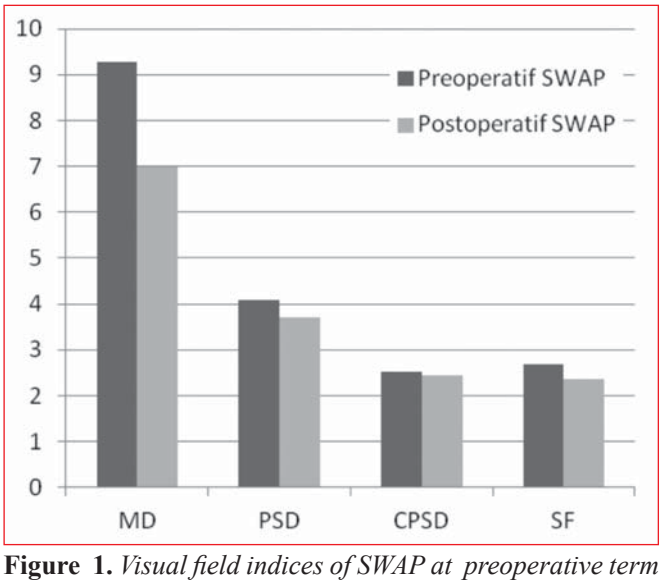

Figure 1. *Visual field indices of SWAP at preoperative term of the patients with Coronary artery bypass surgery (CABS) and Thyroidectomy surgery (TdS).*

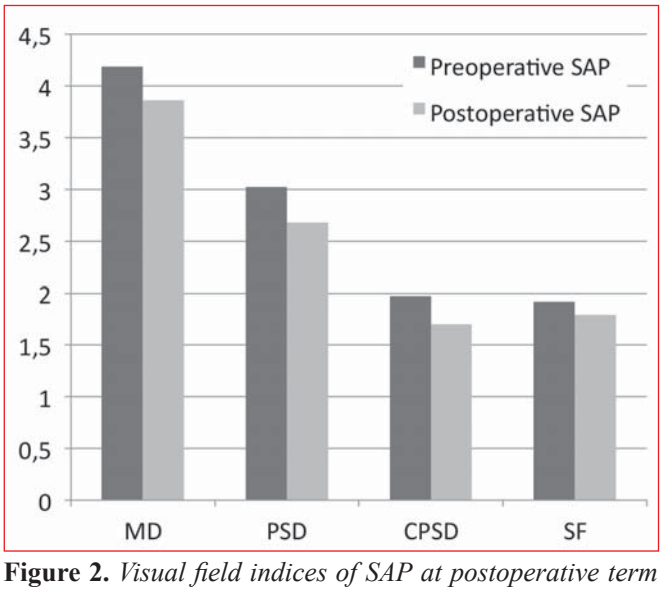

Figure 2. *Visual field indices of SAP at postoperative term of the patients with Coronary artery bypass surgery (CABS) and Thyroidectomy surgery (TdS)*

not affect any functional or morphologic change in eye [7]. In the literature, few cases were presented who underwent off-pump cardiac surgery and developed an AION postoperatively[8,9]. Some case reports related with posterior optic neuropathy following general surgery have been declared[2,10,11]. Ischemic optic neuropathy may present as an early and extremely serious intraoperative complication that can involve both optic nerves simultaneously[12]. It was suggested that prolonged controlled hypotension and intraoperative anemia could increase the risk of ischemic optic neuropathy in patients with predisposing factors[13].

Recent reports indicate that SWAP can reveal visual field defects earlier and larger in extent than SAP [15-18]. Moreover, SWAP may determine the functional abnormality earlier than structural abnormality of the optic nerve head or retina [18]. SWAP is known to be more effective since it also tests the function of an isolated subset of ganglion cells[16].

Therefore, in postoperative term, the patients with CABS demonstrate generalized retinal sensitivity decrease in visual field threshold sensitivity. On the other hand, localized retinal sensitivity decrease was postoperatively detected in the patients with TdS. In the present study, all patients underwent prolonged controlled hypotension and intraoperative relative anemia due to routine over hydration during CABS so; this might result in transient and subclinical ocular ischemia and a decrease in retinal sensitivity as a result of this.

CABS may lead the decrease of generalized retinal sensitivity in a subclinical manner and SWAP can be valuable to determine these early and undetectable changes over SAP. We conclude that further clinical trials are necessary to define the effect of CABS on retinal sensitivity changes with SWAP in larger series with a longer follow-up.

Acknowledgements

The authors had no separate source of funding for this study. We owe special thanks to Unal Erkorkmaz PhD, Department of Biostatistics for helping with statistically evaluation of the study.

REFERENCES / KAYNAKLAR

1. Shaw PJ, Bates D, Cartlidge NE et al : Neuro-ophthalmological complications of coronary artery bypass graft surgery. Acta Neurol Scand 1987; 76(1):1-7.
2. Gaillard MC, Zambaz BD, Borruat FX: Posterior ischemic optic neuropathy: case report of a rare complication after general surgery. Klin Monatsbl Augenheilkd 2004 ;221(5):421-3
3. Mansour AM, Awwad ST, Najjar DM et al: Anterior ischaemic optic neuropathies after coronary artery bypass graft: the role of anemia in diabetics. Eye 2006; 20, 706–711.
4. Sit AJ, Medeiros FA, Weinreb RN: Short-wavelength automated perimetry can predict glaucomatous standard visual field loss by ten years, Semin Ophthalmol. 2004; 19(3-4): 122-4
5. Remky A, Arend O, Hendricks S. Short-wavelength automated perimetry and capillary density in early diabetic maculopathy Invest Ophthalmol Vis Sci. 2000; 41:274-281
6. Machida S, Gotoh Y, Tanaka M, Tazawa Y. Predominant loss of the photopic negative response in central retinal artery occlusion Am J Ophthalmol. 2004; 137:938 –940.
7. Levy NS and Rawitscher R. The effect of systemic hypotension during cardiopulmonary bypass on intraocular pressure and visual function in humans Ann Ophthalmol. 1977; 9:1547-52.
8. Tidow-Kebritchi S and Jay WM. Anterior ischemic optic neuropathy following off-pump cardiac bypass surgery Seminars in Ophthalmology 2003;18(4):166
9. Frey ME, Schwartz HW. Bilateral anterior ischemic optic neuropathy after an off-pump bypass: a case report Am J Phys Med Rehabil. 2000;79(2):206
10. Murphy MA. Bilateral posterior ischemic optic neuropathy after lumbar spine surgery Ophthalmology 2003 ;110(7):1454-7
11. Sadaba LM, Garcia-Layana A, Maldonado MJ, Berian JM.Bilateral ischemic optic neuropathy after transurethral prostatic resection: a case report, BMC Ophthalmol 2006; 11;6:32
12. Hayreh SS. Anterior ischemic optic neuropathy. VIII. Clinical features and pathogenesis of post-hemorrhagic amaurosis Ophthalmology 1987, 94:1488-1502.
13. Stevens WR, Glazer PA, Kelley SD, Lietman TM, Bradford DS. Ophthalmic complications after spinal surgery. Spine 1997; 22, 1319-24.
14. Nomura R. Blue-on-Yellow Perimetry to Evaluate S Cone Sensitivity in Diabetics Ophthalmic Res. 2000; 32(2-3):69-72
15. Hart WM Jr, Silverman SE, Trick GL, Nesher R, Gordon MO. Glaucomatous visual field damage. Luminance and color-contrast sensitivities Invest Ophthalmol Vis Sci. 1990; 31(2):359-67.
16. Johnson CA. Diagnostic value of short-wavelength automated perimetry Curr Opin Ophthalmol. 1996; 7(2):54-8.
17. Sample PA, Weinreb RN. Progressive color visual field loss in glaucoma Invest Ophthalmol Vis Sci. 1992; 33(6):2068-71.
18. Wild JM. Short wavelength automated perimetry Acta Ophthalmol Scand. 2001; 79(6):546-59.