

## The Maximum Color Contrast Sensitivity Test for Detecting Early Changes in Pituitary Adenomas

B. Glebauskiene<sup>1\*</sup>, R. Mazetyte<sup>2</sup>, R. Liutkevičienė<sup>1,3</sup>,  
R. Knispelis<sup>4</sup>, D. Žaliūniene<sup>1</sup>

<sup>1</sup>Ophthalmology Department, Lithuanian University of Health Sciences,  
Lithuania

<sup>2</sup>Medical Academy, Lithuanian University of Health Sciences, Lithuania

<sup>3</sup>Neuroscience Institute, Lithuanian University of Health Sciences, Medical  
Academy, Lithuania

<sup>4</sup>Endocrinology Department, Lithuanian University of Health Sciences,  
Lithuania

\*E-mail: bglebauskiene@gmail.com

**Introduction.** Pituitary adenoma (PA) is a benign neoplasm that typically arises from epithelial cells in the adenohypophysis of the pituitary gland [1-4]. The prevalence of PA ranges from 14.4% to 22.5% in pooled autopsy and radiological series, respectively [5]. Some PAs secrete one or more hormones in excess, so-called secretory pituitary adenomas, but most are clinically inactive [6]. Patients with secretory tumors are usually referred to ophthalmologists for evaluation due to hormonal imbalances that affect bodily functions [7, 8]. Not uncommonly PA's can grow large and cause neurological disorders including visual disturbances such as impaired visual acuity, visual field defects (usually bitemporal hemianopy), color vision defects, because of the compression of anterior visual pathways [9]. PA can invade into cavernous sinus causing motility problems resulting in diplopia or ophthalmoplegia [10, 11].

Several studies have shown that visual acuity assessment using the typical Snellen chart is insufficient for ophthalmological evaluation of PA patient. Very important part of neuroophthalmological evaluation is a test of contrast sensitivity, color vision tests [12 – 14], because some researchers have found impaired color vision in patients with PA despite normal visual acuity and no visual field defects [15].

To the best of our knowledge, there have been no studies that investigated the association between the color contrast sensitivity and recurrent and non-recurrent PA development.

Therefore, the aim of this study was to evaluate maximum color contrast sensitivity (MCCS) in patients with recurrent and non-recurrent PA.

**Materials and methods.** Permission (Number P2-9/2003) to undertake the study was obtained from the Biomedical Research Ethics Committee. The study was conducted in the Ophthalmology and Neurosurgery Departments of the Hospital of Lithuanian University of Health Sciences.

Study participants comprised of 63 subjects with a diagnosis of PA (126 eyes), and 99 persons from the reference group (198 eyes). The reference group

involved 99 subjects according to their age and gender, considering the PA group structure. All pituitary adenomas were analyzed based on MR imaging findings. The retrospective analysis of MRI data was conducted by an experienced radiologist. Since some of the 63 subjects had already had surgery in recent years, we categorized them by recurrence of pituitary adenoma into two groups – with PA and without recurrence.

The inclusion criteria were as follows: 1) determined and confirmed PA via MRI; 2) patient's consent to take part in the study; 3) age  $\geq 18$  years; 4) no other brain or other localization tumor; 5) no ophthalmological eye disorders found on detailed ophthalmological evaluation.

In the MCCS computer test, the subject's task was to determine the correct direction of a bar in a circle, indicated by pressing a button. If the direction was unclear, a blank button was pressed. Each time the button was pressed, a blank screen appeared, and then after one second, a circle with a randomly chosen bar direction was presented. If the direction of the bar in the circle was chosen incorrectly, its color was automatically highlighted. After the correct choice of the direction of the bar, the intensity of its color was automatically dulled; due to the change in intensity of the bar, the brightness of the background of the circle appeared to change. The first correct answer after a series of incorrect answers or the first incorrect answer after a series of correct answers was accepted as the subject's maximum sensitivity to the target color of a bar. When this maximum sensitivity was determined, the color of the bar was changed, and the test was started again. The bar was presented in a total of six colors: red, green, blue, greenish blue, violet, and yellow. Once a subject's sensitivity to all these colors had been assessed, all findings were recorded in a database, and the results of the test were presented in a result window. The luminance of the grey background of the monitor was  $350 \text{ cd/m}^2$ . The surrounding area luminance was  $400 \text{ cd/m}^2$ .

MCCS test results were estimated separately for each eye. Statistical analysis was performed using the computer program SPSS ver. 13.0 (SPSS Inc., Chicago, IL, USA). A statistically significant difference was considered if  $p < 0.05$ .

**Results.** A total of 162 participants were enrolled in the study. Sixty three patients were diagnosed with PA. Nine patients were diagnosed with recurrent PA. The average error score of MCCS test was  $1.33 \pm 0.649$  in the control group, and  $3,806 \pm 3,425$  in the group with PA. Test results range from 0,26 to 3,5 in the healthy patients, and from 0,66 to 18,36 in the patients with PA. In the healthy persons results of MCCS test were significantly higher than in the participants with PA ( $p < 0,001$ ). The research showed that there is no significant difference between the group with recurrent PA and the group with non-recurrent PA group (63,03 vs 66,33 (mean rank), respectively;  $p = 0,72$ ).

**Discussion.** PA is a significant cause of visual disturbances, so it is very important to carefully examine visual functions. In the present study, we demonstrate that MCCS test is important part of neuroophthalmological

evaluation of patients with PA. In our study the results of MCCA test were significantly higher in the healthy people than in the participants with PA ( $p < 0,001$ ). In our previous study, which comprised of 40 persons with PA, we have reported that the error score of MCCA test was 1,9 times higher in patients with optic chiasm compressions than in the patients without optic chiasm compression ( $p < 0,001$ ). Although visual acuity of patients was 1,0, their error score of MCCA was 2,35 times higher than in the healthy people ( $p < 0,001$ ) [13]. In our previous research which comprised of 41 persons with PA, we have found the error score of MCCA test 1,9 times higher in the patients with PA bigger than 1 cm than in the patients with PA smaller than 1 cm ( $p < 0,01$ ) [14]. We believe this is the first study to evaluate MCCA in patients with recurrent and non-recurrent PAs. Due to the limited number of patients in this study further investigation with a larger number of patients is needed.

**Conclusions.** The results of MCCA test were significantly higher in the healthy people than in the participants with PA ( $p < 0,001$ ), but there was no significant difference between the group with recurrent PA and the group with non-recurrent PA group ( $p = 0,72$ ).

**Financial support:** This research was funded by a grant (No. MIP-008/2014) from the Research Council of Lithuania.

### References

1. Al-Brahim NY, Asa SL. My approach to pathology of the pituitary gland. *J. Clin. Pathol.* 2006;59(12):1245–1253.
2. Asa SL, Ezzat S. The cytogenesis and pathogenesis of pituitary adenomas. *Endocr. Rev.* 1998;19(6):798–827.
3. Asa SL, Ezzat S. The pathogenesis of pituitary tumours. *Nat. Rev. Cancer.* 2002;2(11):836–849.
4. Melmed S. Pathogenesis of pituitary tumors. *Nat. Rev. Endocrinol.* 2011;7(5):257–266.
5. Ezzat S, Asa SL, Couldwell WT, Barr CE, Dodge WE, et al. Vance, M. L. The prevalence of pituitary adenomas. *Cancer.* 2014;101:613–619.
6. Fernandez-Balsells MM, Murad MH, Barwise A, et al. Natural history of nonfunctioning pituitary adenomas and incidentalomas: a systematic review and metaanalysis. *J Clin Endocrinol Metab.* 2011;96(4):905–912.
7. Abouaf L, Vighetto A, Lebas M. Neuro-ophthalmologic exploration in non-functioning pituitary adenoma. *Ann Endocrinol (Paris).* 2015;76(3):210–219.
8. Cooper O, Melmed S. Subclinical hyperfunctioning pituitary adenomas: the silent tumors. *Best Pract Res Clin Endocrinol Metab.* 2012;26(4):447–460.
9. Asa SL. Tumors of the pituitary gland. *Atlas of Tumor Pathology.* 1998
10. Ferrante E, Ferraroni M, Castrignanò T, Menicatti L, Anagni M, Reimondo G, et al. Non-functioning pituitary adenoma database: a useful resource to improve the clinical management of pituitary tumours. *European Journal of Endocrinology.* 2006;155:823–829.
11. Ahmadi J, North CM, Segall HD, Zee CS, Weiss MH. Cavernous sinus invasion by pituitary adenomas. *AJNR Am J Neuroradiol.* 1985;6:893-898.
12. Ginsburg AP. Contrast sensitivity and functional test. *Int Ophthalmol Clin* 2003;43:5-15

13. Kriauciuniene L., Slatkeviciene G., Liutkeviciene R., Zaliuniene D., Bernotas G., Glebauskiene B. and Tamasauskas A. The application of Colour Contrast Sensitivity test to the early prediction of chiasm damage in cases of pituitary adenoma. *Acta Ophthalmologica*, (2014) 92: 0. doi:10.1111/j.1755-3768.2014.T102.x

14. G.Slatkeviciene, R.Liutkeviciene, B. Glebauskiene, D. Zaliuniene, L. Kriauciuniene, G. Bernotas, A. Tamasauskas. The Application of a New Maximum Color Contrast Sensitivity Test to the Early Prediction of Chiasma Damage in Cases of Pituitary Adenoma: The Pilot Study. *Korean J Ophthalmol* 2016;30(4):295-301 <http://dx.doi.org/10.3341/kjo.2016.30.4.295>.

15. Sinkunas K. In: Factors influencing an effect on the results of surgery for pituitary adenomas [dissertation]. Kaunas: Kaunas University of Medicine; 2008.

#### **The Maximum Color Contrast Sensitivity Test for Detecting Early Changes in Pituitary Adenomas**

**B. Glebauskienė<sup>1\*</sup>, R. Mazetytė<sup>2</sup>, R. Liutkevicienė<sup>1,3</sup>, R. Knispelis<sup>4</sup>, D. Žaliūnienė<sup>1</sup>**

<sup>1</sup>*Ophthalmology Department, Lithuanian University of Health Sciences, Lithuania*

<sup>2</sup>*Medical Academy, Lithuanian University of Health Sciences, Lithuania*

<sup>3</sup>*Neuroscience Institute, Lithuanian University of Health Sciences, Medical Academy, Lithuania*

<sup>4</sup>*Endocrinology Department, Lithuanian University of Health Sciences, Lithuania*

**Purpose.** To evaluate maximum color contrast sensitivity (MCCS) in patients with recurrent and non-recurrent PA.

**Materials and methods.** 126 eyes of 63 patients with PA were included in the study. Color contrast sensitivity was analysed with the MCCS test.

**Results.** A total of 162 participants were enrolled in the study. Sixty three patients were diagnosed with PA. Nine patients were diagnosed with recurrent PA. The average error score of MCCS test was  $1.33 \pm 0.649$  in the control group, and  $3,806 \pm 3,425$  in the group with PA. Test results range from 0,26 to 3,5 in the healthy patients, and from 0,66 to 18,36 in the patients with PA. There was no significant difference between the group with recurrent PA and the group with non-recurrent PA group (63,03 vs 66,33 (mean rank), respectively;  $p=0,72$ ).

**Conclusion.** The results of MCCS test were significantly higher in the healthy people than in the participants with PA ( $p<0,001$ ), but there was no significant difference between the group with recurrent PA and the group with non-recurrent PA group ( $p=0,72$ ).