

# The Circulatory Influence on Development of Age-Related Macular Degeneration and Hearing and Equilibrium Impairments

Tea Čaljkušić-Mance<sup>1</sup>, Damir Kovačević<sup>1</sup>, Tanja Šepić<sup>2</sup>, Ines Strenja-Linić<sup>3</sup>, Zvezdana Alpeza-Dunato<sup>1</sup> and Božo Vojniković<sup>4</sup>

<sup>1</sup> Department of Ophthalmology, Rijeka University Hospital, Rijeka, Croatia

<sup>2</sup> Department of Otorhinolaryngology-Audiology, Rijeka University Hospital, Rijeka, Croatia

<sup>3</sup> Department of Neurology, Rijeka University Hospital, Rijeka, Croatia

<sup>4</sup> Daily Eye Clinic »Dr. Božo Vojniković«, Rijeka, Croatia

## ABSTRACT

*This study attempts to answer the question if any level of head and neck circulation takes a part in development of Age-Related Macular Degeneration (ARMD) and hearing and equilibrium impairments. Condition of large blood vessels was examined by Color-Doppler ultrasound, and carotid and ophthalmic arteries were included. The microcirculatory changes were examined directly by fundus photography and fluorescein angiography and indirectly testing hearing and equilibrium. The study group included 40 patients (21 females, 19 males) aging from 53 to 84 years with different stages of ARMD. The control group included 40 patients (18 females, 22 males) aging from 51 to 82 years without ARMD. Patients were inhabitants of Primorsko-Goranska County. There was no relationship between ARMD and condition of large blood vessels because significant stenosis of carotid arteries was found in 2 patients (5%) in study group and 3 patients (7.5%) in the control group ( $p>0.05$ ). On the contrary, we found correlation between ARMD and hearing ( $p=0.0127$ ) and equilibrium impairments ( $p=0.0242$ ). Fluorescein angiograms shows raised number of ischemic retinal capillaries in patients with ARMD ( $p=0.0053$ ). Results lead to conclusion that circulatory disorders on microcirculatory level take a great part in development of ARMD and hearing and equilibrium impairments in the elderly. The key is damage of sensory cells of the retina and inner ear caused by microcirculatory disorders. Interesting data was noticed that 9 patients with more serious ARMD on one side of head had greater hearing loss on the same side. If we find a new treatment for microcirculatory disorders, maybe we can treat both sensory impairments in earlier stage.*

**Key words:** age-related macular degeneration, microcirculatory disorders, hearing impairments, equilibrium impairments

## Introduction

Age-Related Macular Degeneration (ARMD) is the leading cause of visual impairment and blindness in the elderly (over 50 years) in developed countries<sup>1</sup>. Degenerative changes of macular area results in damage of central vision. ARMD is divided into two categories: atrophic or »dry« ARMD and exudative or »wet« ARMD. The hallmark of »wet« ARMD is chorioidal neovascularization<sup>1,2</sup>. »Dry« form is characterized by atrophy of retinal pigment epithelium (RPE) and the overlying photoreceptor cells<sup>1,2</sup>. The main contributing factors are age, genetic

predisposition, present and past history of smoking, sunlight exposure, using predominantly animal fats in nutrition and circulatory disorders<sup>1,3,4</sup>.

Successful therapy is not yet available for the majority of patients, especially not for patients with severe form of »dry« ARMD<sup>5</sup>. Before the introduction of anti-VEGF (Vascular Endothelial Growth Factor) medications there was no known therapy for »wet« ARMD that can actually improve visual acuity. Having sensory im-

pairment in a dual fashion such as vision and hearing loss is something most people experience in their old age. Australian scientist in their study published in the Journal Archives of Ophthalmology found that those suffering from ARMD were more likely to suffer hearing loss than those without these disorders. They stated that underlying causes of both sensory impairments may be the same<sup>6</sup>. Some other researchers said that microvascular disease may contribute both ARMD and hearing loss<sup>7,8</sup>. According to them ocular circulation both chorioidal and retinal play an important role in etiopathogenesis of ARMD<sup>7,8</sup>. The base is ischemic damage of sensory cells in retina and inner ear.

We think that microcirculation level is the target for new treatment for ARMD besides anti-VEGF therapy and protective devices like sunglasses with Medical filters (Yellow-Green, 550-600 nm)<sup>5,9</sup>.

## Materials and Methods

The study group included 40 patients (21 females, 19 males) aging from 53 to 84 years with both types of ARMD. The control group included 40 patients (18 females, 22 males), relatively healthy people aging from 51 to 82 years without any sign of ARMD. All the patients were examined in Departments of Ophthalmology, Neurology and Audiology in Rijeka University Hospital. All patients were examined by fundus photography and indirect ophthalmoscopy. Condition of large blood vessels was examined by Color-Doppler ultrasound and carotid and ophthalmic arteries were included. Condition of microcirculation was examined directly by fundus photography and fluorescein angiography and indirectly by testing hearing and equilibrium. The measurement of hearing consist of two parameters: the frequency or pitch of the sound and the intensity or loudness of a sound. The measurement device is called an audiometer. We defined moderate or profound hearing loss as pure-tone average air-conducted hearing thresholds in the better ear worse than 40 dB at 0.5, 1, 2 and 4 kHz. There are three types of hearing loss: sensorineural, conductive and mixed. We included sensorineural and mixed types because sensorineural hearing loss is confined to the inner ear. The sensory part of the inner ear, tiny hair cells called cilia, is damaged. Examination of equilibrium was based on testing of *nervus vestibularis*. It is important to remember that hearing organ and equilibrium organ are in the close anatomical and functional connection.

## REFERENCES

1. NJIRIĆ S, MIŠLJENOVIĆ T, MIKULIČIĆ M, PAVIČEVIĆ L, Coll Antropol, 31 (2007) 107. — 2. KOVAČEVIĆ D, ČALJKUŠIĆ-MANCE T, MIŠLJENOVIĆ T, MIKULIČIĆ M, ALPEZA-DUNATO Z, Coll Antropol, 32 (2008) 5. — 3. VOJ-NIKOVIĆ B, NJIRIĆ S, ČOKLO M, ŠPANJOL J, Coll Antropol, 31 (2007) 43. — 4. PLEŠTINA-BORJAN I, KLINGER-LAŠIĆ M, Coll Antropol, 31 (2007) 33. — 5. KLINGEL R, FASS-BENDER C, FISCHER I, HATTENBACH L, GÜMBEL H, PULIDO J, KOCH F, Ther

## Statistics

The data analysis was performed with MedCalc for Windows v 9.3 9.0 with the level of statistical significance set at 0.05.

## Results

Significant stenosis of carotid arteries was found in 2 patients in the study group (5%) and in 3 patients in the control group (7.5%). There was no significant difference between the groups ( $\chi^2=0.000$ ,  $df=1$ ,  $p>0.05$ ). Also, there was no correlation between condition of large blood vessels and ARMD.

In the study group we had 23 patients with hearing loss (57%) and in the control group we had 11 patients with hearing loss (27%). There was significant difference between groups ( $\chi^2=6.209$ ,  $df=1$ ,  $p=0.0127$ ). Equilibrium impairments were described in 16 patients in the study group (40%) and in 6 patients in the control group (15%) what was statistically significant ( $\chi^2=5.078$ ,  $df=1$ ,  $p=0.0242$ ). Raised number of ischemic retinal capillaries was noted in 21 patients in the study group (52.5%) and in the 8 patients in the control group (20.5%) what was statistically significant ( $\chi^2=7.789$ ,  $df=1$ ,  $p=0.0053$ ). We noticed one interesting data that 9 patients in the study group with severe ARMD on the one side of the head, had a more serious hearing loss on the same side.

## Discussion and Conclusion

Condition of head and neck large blood vessels has no influence on development of ARMD ( $p>0.05$ ). Microcirculatory disorders take a significant part in development of ARMD. Also, microcirculatory disorders connect development of ARMD with development of hearing ( $p=0.0127$ ) and equilibrium impairments ( $p=0.0242$ ) besides processes of normal aging. Evidence for microcirculatory disorders as one of the causes of ARMD is raised number of ischemic capillaries in the study group ( $p=0.0053$ ). More serious stage of hearing loss on the side with more difficult type of ARMD supports that theory, too. We think that modern medicine has to search for new treatment for both aging problems ARMD and hearing and equilibrium loss on the microcirculatory level.

Apher Dial, 6 (2002) 271. — 6. CHIA EM, MITCHELL P, ROCHTCHINA E, FORAN S, GOLDING M, WANG JJ, Arch Ophthalmol, 124 (2006) 1465. — 7. GRUN-WALD JE, METELITSINA I, DUPONT JC, YING GS, MAGUIRE MG, Invest Ophthalmol Vis Sci, 46 (2005) 1033. — 8. LI- EW G, WONG TY, MITCHELL P, NEWALL P, SMITH W, WANG JJ, Ear Hear, 28 (2007) 394. — 9. VOJNIKOVIĆ B, ČOKLO M, BOSNAR A, Coll Antropol, 32 (2008) 3.

T. Čaljkušić-Mance

Department of Ophthalmology, Rijeka University Hospital, Krešimirova 42, 51000 Rijeka, Croatia  
e-mail: tea.caljkusic-mance1@ri.t-com

## **UTJECAJ CIRKULACIJE NA RAZVOJ SENILNE MAKULARNE DEGENERACIJE, TE POREMEĆAJA SLUHA I RAVNOTEŽE**

### **S A Ž E T A K**

Ova studija pokušava odgovoriti na pitanje koji nivo cirkulacije je uključen u razvoj senilne makularne degeneracije, te poremećaja sluha i ravnoteže. Stanje velikih krvnih žila, osobito karotidnih arterija ispitano je Color-Doppler ultrazvukom. Stanje mikrocirkulacije ispitano je fundus fotografijom, te fluorescentnom angiografijom i posredno ispitivanjem sluha i ravnoteže. U ispitivanoj grupi bilo je 40 pacijenata (21 žena, 19 muškaraca) u dobi od 53–84 godine sa različitim stadijima senilne degeneracije makule. U kontrolnoj skupini bilo je 40 relativno zdravih pojedinaca (18 žena, 22 muškarca) bez nalaza za senilnu degeneraciju makule. Dokazano je da makrocirkulacija ne utječe ( $p > 0,05$ ), a mikrocirkulacija utječe na razvoj vidnog poremećaja ( $p = 0,0053$ ), te na poremećaj sluha ( $p = 0,0127$ ) i ravnoteže ( $p = 0,0242$ ) i njihovu međusobnu povezanost. Tome u prilog govori i činjenica da je kod 9 pacijenata iz kontrolne skupine s težim oblikom senilne makularne degeneracije zabilježeno jače oštećenje sluha na istoj strani. Na osnovu toga možemo zaključiti da bi pronalazak lijeka na nivou mikrocirkulacije mogao koristiti za liječenje oba osjetna deficita (vid, te sluh i ravnoteža) koji se pojavljuju u starijoj životnoj dobi.