EXCELLENT PUBLISHERS

International Journal of Current Research and Academic Review

ISSN: 2347-3215 Volume 2 Number 8 (August-2014) pp. 217-221

www.ijcrar.com

Evaluation of the optic nerve head and peripapillary retinal nerve fiber layer changes in warplanes pilots

Mohammad Hosein Lashkari[1], Kourosh Shahraki[2]*, Amin Najafi[3], Keyvan Shirzadi[4], Saber Molaei[4] and Kianoush Shahraki[5]

[1]Associate professor of surgery, AJA University of medical sciences, Tehran, Iran
[2]Resident of Ophthalmology, Rasoul Akram Hospital, Eye research center, Iran University of medical sciences, Tehran, Iran
[3]Resident of Ophthalmology, Tabriz University of medical sciences, Tabriz, Iran
[4]Assistant professor of ophthalmology, AJA University of medical sciences, Iran
[5]Student of medicine, Mashhad University of medical sciences, Iran

***Corresponding author**

KEYWORDS

Pilot,
military aircraft,
retinal nerve fiber layer,
optic nerve,
optic nerve head

A B S T R A C T

The pilots of aircraft was predispose to various physical forces, such as hypoxia, acceleration and vibration during flight. One of the most important pressures was G force. The changes in intraocular pressure and blood supply of the eye during flight in chronic, long-term period can cause changes in the optic nerve head and retinal nerve fiber layer thickness. To determine changes in the optic nerve head and peripapillary retinal nerve fiber layer thickness in combat pilots 50 cases of military aircraft pilots complete ophthalmic examination was performed and demographic and clinical data were recorded. All samples were then examined using OCT peripapillary retinal nerve fiber layer thickness. To study the characteristics of the optic nerve head imaging was performed using HRT. The final analysis was performed on the data obtained and recorded. In this pilot study, with a mean age of 50 13/4 ± 7/43 years participated. Average years of experience of the pilots were flying combat aircraft, 46/2 ± 84/9 years. In a comparison of optic nerve head parameters measured by OCT included disc, cup, rim, cup and rim volume, cup-to-disc ratio and cup depth, there was no significant difference with normal individuals. In this study, the average RNFL thickness around the optic nerve, which was equivalent to 102.83 ± 9.76 mm, compared with the normal population is 106.59 ± 12.82, is lower, but the difference is not significant. (P = 0.45). There are no any significant side effects in optic nerve head and pri papillary retinal nerve fiber layer thickness.

Introduction

Flight with warplanes always put impacts on pilot's body physiology. Warplane pilots are exposed to various forces and pressures like pixies, acceleration and tremble while flying, that one of the most important is G force.(1) When pilot is gotten under g force, blood gets congested in a part of body according to G kind. There are 2 kinds of G force: negative G force is when pilot starts descending with high speed, blood is congested in pilot's head and brain and a condition called "red out" that happens in eyes, in this situation intraocular pressure increases. In contrast, in positive G force blood congested in legs and a little blood gets way to brain. (1,2,3)

This condition make a phenomenon of "black out" in pilots eyes. First gray out happens then environmental vision decreases and pilot gets tunnel vision. If this situation continues, pilot will lose his vision. These changes happen in intraocular pressure, and changes in blood circulation while flight in long and chronic time repetitions leads to changes in eye nerve head and retina neural fiber layers around nerve; as though, these minor traumas while flight lead to temporary intraocular pressure and this condition leads to retina ganglion cells apoptosis that shows itself by narrowing retina neural fiber layers and increasing the Cup/Disk Area ration in eye nerve head. (2,3) Therefore, in-time recognition of these changes can have its certain hygienic, social and political consequences.

Why pilot in low and high G force get unconscious?
By making positive G force and becoming relatively heavier, blood also gets heavier in human body and doesn't have ability to arrive to brain; therefore, in a situation called black out, pilot's eyes go black and if this condition continues, there will be the possibility to become unconscious.(1,4)
However, if negative G force is made, blood becomes thinner and puts pressure on brain and in a situation called red out, pilot's eyes get red and feel confused, soif warplane cracks up, this situation leads pilot to get 2 to 3 negative G force even when pilot is healthy and powerful won't be able to shift Ejection Handle.(4,5)

Regarding to all these prerequisites, if it becomes possible to prove minor and frequent traumas derived from intraocular pressure increase while flight with warplane can have long-term impacts on optic nerve head and peripapillary nerve fiber layers (it is not retrievable for harms entered to these organs), these people are classified in normal tension glaucoma, and preventive actions can be considered for this pilots group.

In Mader et al. study in 1993 they explored intraocular pressure and retina vessels diameter in 11 people during 20 seconds of making microgravity in flight with KC-135 plane that intraocular pressure increases 58% and retinal circulation vessels diameter increases 4%. This study showed that this situation impacts make fast changes in eyes during 20 seconds.(3)

In Horng et al. study in 2008, visual field changes were evaluated after facing with height. 15 male pilots 26-39 years old were explored. This study results showed that after ascending to7620 meter visual field sensitivity reduced significantly that this reduction was more in visual field environmental parts than central parts.(4)

In Ersanli et al. study in 2006, the exploration on 34 male pilots with average age of 32 showed that intraocular pressure was a temporal increase in Hypoxic and normoxic (Oxygen 100%) in 9000 height. (5)

In Marsell et al. study in 2013 which was published from NASA space research centers, they reported changes in space shuttle pilots' eyes consequences of intracranial pressure increase and vascular blocking caused from Cephalic liquid. These changes include eye nerve peripapillary homo, globe flatting, eye nerve thickness, hyperopic shifts and changes in retina. (6)

In John E.A.Somner et al. done in 2007, intraocular pressure in sea level and 3700 meters height were explored that indicate intraocular pressure was keen in height.(6,7) In another study by Bayer et al. in 2008, exploration of 25 volunteers on earth level and 1760 feet altitude height indicated significant reduction of intraocular pressure during the second hour after usual flight that this change continues after landing.(7,8)

In another study by Bayer A et al., intraocular pressure of 20 volunteers were explored on earth and in height of 10000 feet while flight that indicated statistical insignificant reduction in intraocular pressure.(7,8)

There have not been any studies done about long-term impacts of warplane flights on eye nerve features and retinal neural fiber layers' thicknesses around nerves yet.

Materials and methods

Sample Volume: Regarding to nonexistence of similar study in this field, sample volume was calculated like pilot after starting study. Based on statistical counselling with statistics specialist and epidemiology with type 1 error was 5% and D=0.15 sample volume was estimated about 85 eyes. In this study we used 50 patients and 100 eyes.

After that all sample were studied by ophthalmologist, and demographic and clinical information were recorded. Then in all samples photograph was taken from peripapillary part in order to explore retina neural fiber layers thickness by Optical coherence Tomography (Heidelberg Spectralis (Heidelberg Engineering, Inc, Carlsbad, California, USA)), and photograph was taken to explore optic nerve head features by HRT (Heidelberg Retina Tomograph) device. In order to compare with normal population, data base information of device was used that is in device print out, and to compare retinal nerve fiber layers around optic disc with Iranian normal popularity from retrieved information resulted from Dr. Pakravan et al. study (2) was used which was obtained from our study mentioned variables' sizes in Iranian population.

Data related to samples were classified after registration in forms then entered into software spss(Ver 16.1). If data distribution was normal, it was analyzed by paired test; otherwise, it was analyzed by Wilcoxon. P-value was considered less than 0.05.

Result and Discussion

Totally, in this study 50 pilots of Military. Pilots' average age was 43.7 ± 4.13 (between 35 and 54). As it is seen, Rim average area in right eye is 1.51. No statistical difference is seen in 2 eyes, and in comparison to normal people, there is no significant statistical difference, too. (p=0.2). As it is seen, cup/Disc area ratio in left and right eyes is 0.31 that there is no significant statistical difference seen; in comparison to normal people, there is no significant statistical difference, too. (p=0.6 & p=0.8).

As it is seen, cup volume in left and right eyes is 0.22 that there is no significant statistical difference seen; in comparison to normal people, there is no significant statistical difference, too. (p=0.2).

As it is seen, mean cup depth in left and right eyes is 0.27 that there is no significant statistical difference seen; in comparison to normal people, there is no significant statistical difference, too. ($p=0.09$ & $p=0.06$) Therefore, according to results obtained from HRT and OCT, it is concluded that flight with warplane doesn't have harmful impact on eye nerve head features and retinal neural fiber layers around nerve and results of comparison to normal people don't show significant changes in them.

Conclusion and Suggestion

According to achieved results from OCT and HRT of optic nerve head and peripapillary nerve fiber layer in this study, it can concluded that flight with warplane doesn't cause changes in optic nerve and doesn't have harmful impacts on optic nerve head features and retinal neural fiber layer around the nerve, and results from comparison to normal people didn't show significant change in them. In other words, optic nerve head features and peripapillary retinal nerve fiber layer are not different in warplane pilots and normal people.

Retinal Nerve Fiber layer (RNFL) average thickness in different studies was between 100 and 140 micron. In Dr. Nilforushan study on Iranian healthy population RFNL average thickness was about 137.56 ± 16.79 using OCT II that Dr. Pakravan study's similar results was 144.10 ± 33.32. (2)

In this study average thickness of RNFL around optic nerve head was 102.83 ± 9.76 micrometer that its being less reason is using Spectralis SD OCT device. These results are similar to Hee et al. ones who used this device, too. (9,10) Moreover, in Budenz et al; study in 2007 on 328 normal samples using OCT-III device, RNFL average thickness was reported 100.1 ± 11.6 micrometer.(10,11)

Leung et al study in China in 2004 on 107 normal samples using OCT-II device, RNFL average thickness of 105 ± 11 micro meter was reported.(10,11)

According to pathology in Jones study, ordinal OCT may show peripapillary nerve fiber layer less than of 37% real range in average.(12,13)

In present study and according to achieved results from HRT and Spectralis SD OCT, RNFL thickness obeys from ISNT rule that other studies refer to this agreement, too. This constant finding can be justified according to eye structure; an arcade fiber are ended to upper and beneath poles of optic nerve head, and this fact leads RNFL to be thicker than nasal and temporal in this part.

In our study, there was no different between right and left eyes that this finding is similar to Bundez study results. According to achieved results from OCT and HRT of optic nerve head in present study, it can be concluded that flight with warplane doesn't make change in optic nerve and doesn't have harmful impact on optic nerve head features and peripapillary retinal nerve fiber layers.

Research results of comparison to normal people don't show significant difference in them. In other words, optic nerve head features and retinal nerve fiber layers around the disc in warplane pilots are not different with other people. However, we need more studies and exploring this data changes lapse in order to prove these findings.

References

1. The Pull of Hyper Gravity - A NASA researcher is studying the strange effects of artificial gravity on humans.". NASA. Retrieved 11 March 2012.
2. Pakravan et al ,Peripapillary Retinal Nerve Fiber Layer Thickness Measurement by Three-Dimensional Optical Coherence Tomography in a Normal Population .J Ophthalmic Vis Res 2009; 4 (4): 220-227.
3. Mader, T.H., Gibson, C.R., Caputo, M., Intraocular pressure and retinal vascular changes during transient exposure to microgravity. ican Journal of Ophthalmology .Vol 115, 1993, 347-350
4. Horng CT, Liu CC, Wu DM,Visual fields during acute exposure to a simulated altitude of 7620 m.Aviat Space Environ Med. 2008 Jul;79(7):666-9.
5. Ersanli D, Akin T, Yildiz S, The effect of hyperbaric oxygen on intraocular pressure. Undersea Hyperb Med. 2006 Jan-Feb;33(1):1-4.
6. Marshall-Bowman, K.ab , Barratt, M.R.a , Gibson, C.R.c Ophthalmic changes and increased intracranial pressure associated with long duration spaceflight: An emerging understanding .Vol 87, 2013, 77-87.
7. Thomas H. Mader, C. Robert Gibson,et al. Optic Disc Edema, Globe Flattening,Choroidal Folds, and Hyperopic ShiftsObserved in Astronauts after Long-durationSpace Flight. Ophthalmology 2011;118:2058–2069.
8. Kerrigan-Baumrind LA, Quigley HA, Pease ME, et al. Number of ganglion cells in glaucoma eyes compared with threshold visual field tests in the same persons.Invest Ophthalmol Vis Sci.2000;41:741–748.
9. Quigley HA, Katz J, Derick RJ, et al. An evaluation of optic disc and nerve fiber layer examinations in monitoring progression of early glaucoma damage. Ophthalmology.1992;99:19–28.
10. Harwerth RS, Carter-Dawson L, Shen F, et al. Ganglion cell losses underlying visual field defects from experimental glaucoma.Invest Ophthalmol Vis Sci.1999;40:2242–2250.
11. Hee MR, Izatt JA, Swanson EA, et al. Optical coherence tomography of the human retina. Arch Ophthalmol.1995;113:325–332.
12. Greaney MJ, Hoffman DC, Garway-Heath DF, Nakla M, Coleman AL, Caprioli J. Comparison of optic nerve imaging methods to distinguish normal eyes from those with glaucoma. Invest Ophthalmol Vis Sci2002;43:140-145.
13. Savini G, Zanini M, Carelli V, Sadun AA, Ross-Cisneros FN, Barboni P. Correlation between retinal nerve fiber layer thickness and optic nerve head size: an optical coherence tomography study. Br J Ophthalmol 2005;89:489-492.