Evaluation of the intraocular pressure changes after flight with warplanes

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A B S T R A C T

The effect of high altitude on the intraocular pressure (IOP) was a challenging problem for many years and the results of different studies were controversial. To determine the effect of flight with warplanes on pilot's intraocular pressure. 20 eyes of 20 pilots were studied. Intraocular pressure of all cases measured by Tonopen (Reichert Tono-Pen AVIA) before and after flight with warplanes .the difference of the pressure between these two conditions was evaluated. The mean IOP before flight was 12.70±1.97 that decreased to 11.90±1.83 after landing. Mean IOP before flight in pilots with age group of < 40 years and ≥40 years were 13.15±1.90 and 11.85±1.90 respectively that decreased to 12.15±1.77 and 11.42±1.98 after landing, none of this changes were clinically significant. the results of this study show that flight with warplanes causes only a mild decrease in the IOP level that is not clinically significant.

Introduction

The level of IOP is dependent on the rate of aqueous secretion, the aqueous outflow resistance and the level of episcleral venous pressure. The normal range of the IOP is between 11 to 21mmHg but it has a diurnal variation. Heart, blood pressure, respiration, exercise and some medications also can influence the IOP. The normal diurnal IOP fluctuation is about 5 mmHg that may be higher in the morning and lower in the afternoon and evening. It is therefore important to mention the time of day when IOP readings are measured.[1] Changes in IOP more than normal value can damage the eye and threaten ocular visual function and its safety.

Intraocular pressure (IOP) changes at high altitude have been the subject of controversy for many years and different studies were done to evaluate it.

Glaucoma determined by a progressive optic neuropathy due to axonal damage and is a main cause of blindness. Hypoxia and oxidative stress are among the risk factors for glaucomatous changes.

High altitude is usually regarded as an altitude over 2.400m (8000ft), which influences human body by various mechanisms. At high altitudes, atmospheric pressure gradually falls and the resultant hypobaric-hypoxia with an oxygen partial pressure < 60mmHg is the major factor for detrimental effects of high altitude.[2]

Most commercial airplanes are pressurized which means that they maintain a cabin pressure higher than the pressure of the surrounding atmosphere through which they fly. But, however, they don't maintain a sea level pressure during most flight operations.[3] Evaluation of the IOP changes in high altitude is complex because various stresses can influence it.[4]

The mechanism of IOP changes in high altitude in unclear but can be affected by central corneal thickness.[5] In the study done by John E.A.Somner Et al, IOP was increased in high altitude in acute codition.[6]

Also Bayer.A in a study showed that flying in an altitude 10000 feet from sea level can cause insignificant IOP changes.[7] The purpose of this study is to evaluate the IOP changes in pilots after flying with semi pressurized warplanes.

Methods

This observational study was done in AJA University of medical sciences. 20 pilots were involved. Full ophthalmologic examinations were done before inclusion. Exclusion criteria were the presence of any abnormal ophthalmologic finding.

The pilots were divided into 2 sub groups: 40 years old or more and less than 40 Y/O. In every Pilot the IOP of one eye measured by Tonopen (Reichert Tono-Pen AVIA) 3times before and exactly after the flight (after topical anesthetic drop instillation) and the mean value was documented.

The IOP of the cases in every sub group before and after flight was compared by Paired T Test.

Result and Discussion

20 eyes of 20 pilots were studied. No complication observed during study. Mean age of the cases was 37.15±5.91 (28-48), while 13 of them were under 40 years and 7 of them were over the 40. All of the cases were male. From the eyes which evaluated, 9 were right eye and 11 were left eye (this distribution is only by chance). The mean IOP time was 1.6 hours (1-2.2) and the mean Altitude from sea level was 12000ft.

The mean IOP before flight was 12.7±1.97 which decreased to 11.90±1.83 exactly after flight that was clinically insignificant (P=0.20). The mean IOP before and after flight in under 40 years old age group was 13.15±1.90 and 12.15±1.77 respectively.(P=0.40). Also IOP in over 40 age group decreased from 11.85±1.95 to 11.42±1.98 that was clinically insignificant (p=0.35)

20 Pilots were involved in this study. According to this study IOP after 1.6 hours flight with semi pressurized warplane decreased about 0.8 which was clinically insignificant. Decrease in IOP also in both

age group (under and over 40 years old) was unremarkable.

Karadag Et al in a study showed that exposure to hypobaric condition can cause significant increase in IOP.[8] In another study by Dilaver Ersanli exposure to high altitude caused a minor transient change in IOP independent of Hypoxia. [9]

In a study which done by Karadag Et al ,the results showed that changes in IOP due to hypobaric condition resolve as soon as the atmosphere pressure normalized. Karadag lso showed that hypobaric condition can increase the central corneal thickness.[10, 11]

According to Sara Von de Veire study high altitude can decrease IOP independent of temperature.[12] As the results of the previous studies shows, the pattern and significance of IOP after exposure to high altitude an hypobaric condition is the field of controversy and the findings are sometimes are completely different. One explanation for this result is the existence of a wide spectrum of confounding factors which can change the results, such as age, geometrical condition of eye, and changes in corneal thickness, rate of altitude and duration of exposure and so on.

Warplanes have some unique specificity which differ them from commercial planes. The cabin in warplanes is semi pressurized; they fly to a higher altitude than airline planes. Also acceleration and gravity, effort a force on pilot body (known as G force) which can changes aqueous flow dynamic and alter IOP.

Conclusion

According to this study flight with warplanes have no significant effect on pilot's IOP and consequent ocular damage.

The limitation of this study is the limited cases involved and the difficulty to control confounding factors like as G force, corneal thickness changes and also short follow up time after landing. Then complementary studies with more cases are recommended.

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