

Characteristic of intraocular pressure distribution in population of 1115 Tibetan aged 40 years old or more

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Foundation item: Supported by National Natural Science Foundation of China (No. 81070716)

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Received: 2013-12-25 Accepted: 2014-06-03

40岁及以上藏族人群眼压分布的研究

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基金项目:国家自然科学基金(No. 81070716)

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摘要

目的:了解高原地区1115位≥40岁藏族人群眼压的分布特点以及相关因素分析。

方法:曲水县≥40岁1115位藏族人群分为≥40~<50、≥50~<60、≥60~<70、≥70岁四个年龄段。所有受检人群进行眼科检查, 包括视力检查、非接触眼压测定, 前房深度测定, 采用SPSS 19.0统计软件进行数据分析及处理。

结果:藏族人群1115位(2145眼)平均眼压12.9±2.7mmHg, 男性眼压平均13.2±2.8mmHg, 女性眼压平均12.7±2.5mmHg。藏族人群1115位(2128眼)中周边前房1/2CT者占68.8%, 周边前房深度与年龄之间存在线性趋势, 年龄越大, 周边浅前房者越多($P<0.01$), 随着年龄的增长, 周边前房深度1/3CT者从≥40~<50岁人群占19.3%, 增加至39.2%(≥70岁人群), 并且女性周边浅前房多于男性($P<0.01$)。

结论:高原地区≥40岁藏族人群平均眼压低于平原约3mmHg, 鉴于眼压偏低、前房深度等因素高原青光眼更易漏诊, 建议重视高原青光眼的普查。

关键词:高原; 眼压; 前房深度; 青光眼; 普查

引用:王桂琴, 白宗禧, 洛桑, 等. 40岁及以上藏族人群眼压分布的研究. 国际眼科杂志 2014;14(7):1181-1185

Abstract

• **AIM:** To analyze of characteristic of intraocular pressure (IOP) distribution in population of 1115 Tibetan aged 40 years old or more and its correlative factors such as ages, gender and anterior chamber depth in Tibetan plateau area.

• **METHODS:** A total of 1115 Tibetan permanent residents aged 40 years or older from the towns and villages of Qushui County were divided into four age groups: ≥40 ~ <50 years, ≥50 ~ <60 years, ≥60 ~ <70 years, and ≥70 years. All participants were carried out clinical ocular examinations including visual acuity, IOP, anterior chamber depth, ocular anterior segment and posterior segment examination. The relativity was analyzed during IOP, ages, gender and anterior chamber depth by SPSS 19.0.

• **RESULTS:** The mean IOP of 1115 (2145 eyes) Tibetan permanent residents aged 40 years or older was 12.9 ± 2.7mmHg, 13.2 ± 2.8mmHg in men and 12.7 ± 2.5mmHg in women. The results showed that the participants with anterior chamber depth of 1/2 corneal thickness had 68.8% in 1115 (2128 eyes) Tibetan permanent residents and anterior chamber depth decreases significantly with age ($P<0.01$), which anterior chamber depth (of 1/3 corneal thickness) was 19.3% aged ≥40 ~ <50 subjects to 39.2% aged ≥70 subjects. Anterior chamber depth (1/3 corneal thickness) in women was significantly shallow than that in men ($P<0.01$).

• **CONCLUSION:** The mean IOP of plateau subjects was significantly lower from that of plain subjects by approximately 3 mmHg. There are lower pressure, deeper anterior chamber depth in this population of 1115 Tibetan permanent residents. The more attention should be paid to screening for glaucoma in high plateau.

• **KEYWORDS:** plateau; intraocular pressure; anterior chamber depth; glaucoma; screening

DOI:10.3980/j.issn.1672-5123.2014.07.01

Citation: Wang GQ, Bai ZX, Luo S, Shi J, Shi Q, Cao LQ, Chang HF, Sai XY. Characteristic of intraocular pressure distribution in population of 1115 Tibetan aged 40 years old or more. *Guoji Yanke Zazhi(Int Eye Sci)* 2014;14(7):1181-1185

INTRODUCTION

Glaucoma, the leading cause of irreversible blindness, is the second leading cause of blindness worldwide and is of major public health importance. It is estimated to affect 66 million people worldwide, with at least 6.8 million people bilaterally blind from the condition and with a prevalence of 1%–2% in the population older than 40 years^[1-4]. With advancing age the prevalence of glaucoma increased with a prevalence of 4%–7% in the population older than 65 years. It is estimated that the number of glaucoma individuals in the world would increase 79.6 million in 2020, with 11.20 million people bilateral blindness. In China there would be 9.40 million people with glaucoma, of 56% unilateral blindness and 19% bilateral blindness^[5,6].

Glaucoma is a degenerative eye disorder caused by increased intraocular pressure (IOP) that leads to progressive loss of vision and, visual field loss and eventually, blindness. The loss of vision and visual field from damage to the optic nerve associated closely with increased IOP. Reducing IOP by even 1 mmHg (1 mmHg = 0.133 kPa) can reportedly curtail the progression rate of visual field defects by 10%^[7]. Increased IOP was the most important modifiable risk factor for the development and the progression of glaucoma. Lowering IOP was currently the only approach demonstrated to prevent or delay glaucoma progression among those at risk of glaucoma. The assessment of IOP is crucial for the diagnosis and management of glaucoma. Accurate IOP assessment is important in monitoring the efficacy of therapy and assessing the risk of glaucomatous progression. Many studies were surveyed about characteristic of IOP distribution in normal population, including 24-hour IOP monitoring. But the information was short of characteristic of IOP distribution in plateau. With patients often unaware of the presence of any disease process of glaucoma, the rate of missed diagnosis of glaucoma reached up to 50% in developed country and exceed to 90% in developing country including China^[8,9]. In order to provide valuable information for screening glaucoma, the study on characteristic of IOP distribution and its association with correlative factors were carried out in population from 1115 Tibetan permanent residents aged 40 years or older from Qushui County, Tibet plateau.

SUBJECTS AND METHODS

Subjects A total of 1115 Tibetan permanent residents (2145 eyes) aged 40 years or older came from Qushui County, Lhasa Prefecture, Tibet Autonomous Region, China, average 3600 meters above the sea level, were examined between July 2010 and November 2010. Participants were divided into four age groups: $\geq 40 \sim < 50$ years, $\geq 50 \sim < 60$ years, $\geq 60 \sim < 70$ years, and ≥ 70 years. A questionnaire and comprehensive ophthalmic examinations were performed by medical workers trained, the diagnosis of eye diseases were assessed by two senior ophthalmologists based on clinical history and examination results. We confirm adherence to the guidelines of the Declaration of Helsinki as well as Naval General Hospital ethics committee approval.

Methods

Visual acuity testing Presenting distance visual acuity (including corrected visual acuity) was measured using an international standard E chart, with a pinhole visual acuity examination if necessary. According to the World Health Organization classification criteria for visual impairment, blindness was defined as a best corrected visual acuity of $< 3/60$, or a visual field constricted to $< 10^\circ$ from fixation in the better eye. Low vision was defined as a best corrected visual acuity of $3/60 \sim 6/18$, or a visual field constricted to $< 20^\circ$ from fixation in the better eye^[10,11].

Non-contact intraocular pressure monitoring The sitting posture IOP was measured separately for each eye three times and recorded mean value with mmHg (1 mmHg = 0.133 kPa) by non-contact tonometer. The statistical data were not included these cases of glaucoma, suspect glaucoma, detachment of retina, keratopathy, eyeball atrophy, anophthalmus.

Anterior chamber depth Anterior chamber depth was examined and graded with Van Herick^[12], which expressed corneal thickness (CT), assessing open or close of angle of anterior chamber and recorded on 1CT, 1/2CT, 1/3CT and $\leq 1/4$ CT. The statistical data were not included these cases of eyeball atrophy, keratopathy and cataract surgery.

Slit lamp biomicroscope and examination of fundus An anterior segment examination was performed using a slit lamp biomicroscope and posterior segment examination was performed using a direct ophthalmoscope with pupil dilation if necessary. And the examination of fundus included fundus photography (CR-DGi Non-Mydriatic Retinal Camera, Japan) and 90D VOLK Super Field NC Lens U. S. A.

Diagnostic criteria The diagnosis of glaucoma and suspect glaucoma in 1115 participants were made according to history, IOP, anterior chamber, examination of fundus and seeing references^[13-18].

Statistical Analysis Double blind data entry and the analysis of data were carried out using the Statistical Package for the Social Sciences for Windows version 19.0 (SPSS, Chicago, IL, USA), and the results were shown in Tables.

RESULTS

General Information A total of 1115 individuals took part in the survey, including 475 males and 640 females. Participants were aged 40 years or older with a maximum age of 89 years and mean age of 57 ± 11 years. Distribution of age groups were as follows: $\geq 40 \sim < 50$ years, 137 males and 203 females; $\geq 50 \sim < 60$ years, 119 males and 192 females; $\geq 60 \sim < 70$ years, 137 males and 144 females; and ≥ 70 years, 82 males and 101 females.

Intraocular Pressure in Different Age and Gender The mean IOP of 1115 (2145 eyes) Tibetan permanent residents aged 40 years or older was 12.9 ± 2.7 mmHg, 13.2 ± 2.8 mmHg in men and 12.7 ± 2.5 mmHg in women, see Table 1.

Table 1 Distribution of intraocular pressure in different age and gender ($n=2145, \bar{x} \pm s$)

Group (a)	$\geq 40 \sim < 50$	$\geq 50 \sim < 60$	$\geq 60 \sim < 70$	≥ 70	Total
Male	13.2±2.8	13.2±2.7	13.4±3.0	13.1±2.7	13.2±2.8
Female	12.7±2.7	12.6±2.3	12.7±2.6	12.9±2.5	12.7±2.5
Total	12.9±2.7	12.8±2.5	13.0±2.8	13.0±2.6	12.9±2.7

Table 2 Characteristic of anterior chamber depth in different age n (%)

Anterior chamber depth	$\geq 40 \sim < 50$ a	$\geq 50 \sim < 60$ a	$\geq 60 \sim < 70$ a	≥ 70 a	Total	χ^2	P
$\leq 1/4CT$				1 (0.3)	1 (0.0)		
1/3CT	130 (19.3)	196 (31.9)	175 (33.3)	123 (39.2)	624 (29.3)	53.402	0.000
1/2CT	527 (78.2)	407 (66.3)	341 (64.8)	188 (59.9)	1463 (68.8)	44.972	0.000
1CT	17 (2.5)	11 (1.8)	10 (1.9)	2 (0.6)	40 (1.9)		
Total	674 (100.0)	614 (100.0)	526 (100.0)	314 (100.0)	2128 (100.0)		

Table 3 Characteristic of anterior chamber depth in different gender n (%)

Anterior chamber depth	Male	Female	Total	χ^2	P
$\leq 1/4CT$		1 (0.1)	1 (0.0)		
1/3CT	209 (23.0)	415 (34.0)	624 (29.3)	30.689	0.000
1/2CT	674 (74.1)	789 (64.7)	1463 (68.8)	21.517	0.000
1CT	26 (2.9)	14 (1.1)	40 (1.9)		
Total	909 (100.0)	1219 (100.0)	2128 (100.0)		

Anterior Chamber Depth in Different Age and Gender

The participants with anterior chamber depth of 1/2 corneal thickness (CT) had 68.8% ($n=1463$ eyes) in 1115 (2128 eyes) Tibetan permanent residents. Anterior chamber depth (1/3CT) was 19.3% aged $\geq 40 \sim < 50$ subjects to 39.2% aged ≥ 70 subjects, which anterior chamber depth decreases significantly with age ($P < 0.01$), see Table 2.

Anterior chamber depth was 23.0% (1/3CT) and 74.1% (1/2CT) in men ($n=909$ eyes), which 34.0% (1/3CT) and 64.7% (1/2CT) in women ($n=1219$ eyes). Anterior chamber depth (1/3CT) in women was significantly shallow than that in men ($P < 0.01$), see Table 3.

Glaucoma and Suspect Glaucoma in Special Definitive Population

Among the 1115 participants (2219 eyes), blindness was found in 187 eyes and low vision was found in 231 eyes, which glaucoma of 9.6% (18/187) blindness and 1.7% (4/231) low vision was observed. Among the 1115 participants (2219 eyes), 38 eyes were diagnosed as glaucoma (1.7%) and 33 eyes as suspect glaucoma (1.5%). Of the 38 eyes with glaucoma, 8 had closed-angle glaucoma, 20 had open-angle glaucoma, 4 had secondary glaucoma, and 6 eyes had absolute glaucoma.

DISCUSSION

Living at altitude above 3000m is known to have biological effects on the human body^[19,20]. Qushui County is located in the southwestern of Lhasa City, Tibet Autonomous Region, China, average 3600 meters above the sea level. Qushui County has Tibetan, Han and Hui ethnicity et al, of 96.4% Tibetans. High altitude affects the human body mainly because of oxygen deprivation. The unique environment of high altitude includes factors such as low air pressure,

hypoxia, dry and cold weather, prolonged and increased exposure to sunlight, strong solar infrared light and UV radiation, and prolonged snow cover, which all have effects on the human body in general and the eyes in particular^[21,22]. Glaucoma is the loss of vision from damage to the optic nerve or nerve fiber layer associated with increased IOP. The IOP control was of the greatest importance for the treatment of glaucoma. A second risk factor for glaucoma patients is the increased damage to the optic nerve from the hypobaric conditions and hypoxemia encountered at high altitude^[23,44]. IOP at high altitude has been the subject of controversy for many years. Yet results have been inconsistent of several publications, findings range from a decrease, through no change, to an increase in IOP at moderate to high altitudes^[24-29].

We conducted the measurement of IOP in population Tibet plateau a total of 1115 Tibetan permanent residents aged 40 years or older from Qushui County. The results showed that the mean IOP of 1115 Tibetan was 12.9±2.7mmHg, which the mean IOP of plateau subjects was significantly lower from that of plain subjects by 3mmHg^[30]. And 24-hour IOP monitoring of plateau subjects was significantly lower from that of plain subjects^[31]. Thus, hypoxia during a prolonged stay at high altitudes may also lead to reduced aqueous production and therefore to the decline in IOP measured. And cold air has a decreasing effect on the IOP by causing a decrease in episcleral venous pressure.

Factors associated with IOP in epidemiologic surveys of the general population include age, sex, race, hypertension, diabetes, obesity, smoking, drinking, coffee consumption, physical activity, central corneal thickness (CCT), iris

color, nuclear opacity, and myopia^[32-35]. Race is also considered a factor leading to different IOP distributions among populations^[36-40]. Our results showed that the participants with anterior chamber depth (1/2 CT) had 68.8% in 1115 Tibetan permanent residents and anterior chamber depth decreased significantly with age ($P < 0.01$). Anterior chamber depth (1/3CT) in women was significantly shallow than that in men ($P < 0.01$). Therefore it was important to anterior chamber depth in different age and gender of plateau for assess the prevention and management of glaucoma

And the prevalence of glaucoma had difference in region and race. Our results also showed that 8 eyes had closed-angle glaucoma, 20 eyes had open-angle glaucoma, of the 38 eyes with glaucoma in our survey. This was in agreement with previous studies that the prevalence of closed-angle glaucoma was less in Tibet^[41].

The noncontact tonometer (NCT) is convenient for population surveys^[42,43]. Because it requires no corneal contact or topical anesthesia, it not only leaves the cornea undisturbed before further examination but also decreases the risk of disease transmission, which is especially important in areas where the control of communicable diseases is an important concern in public health. The identification of Chinese IOP characteristics using the NCT may make the use of this noncontact technique more efficient. By this noncontact technique the IOP was measured in this survey, however our sample size was small, this study was not without its limitations.

Glaucoma is an increasingly concerning public health problem, due to its insidious nature and the increasing prevalence of chronic disease, and the increasing proportion of aged people in the population. IOP is widely recognized as the most important modifiable risk factor for the development of glaucoma. The results showed that there were lower pressure, deeper anterior chamber depth, less prevalence of closed-angle glaucoma in this population of 1115 Tibetan permanent residents aged 40 years or older from Qushui County. This has been borne out by anecdotal references to the very low incidence of glaucoma in this population. However, this could also signify the danger of using IOP alone for screening for glaucoma in this population. The lower IOP could reflect changes in the aqueous formation due to hypoxic stimuli or changes in the outflow mechanism at high altitude, which need further evaluation and was also our aim further study. It is important to improve diagnostic and therapeutic approaches to primary glaucoma that can be applied in Plateau.

ACKNOWLEDGEMENTS

We would like to thank local government officials in Lhasa for their assistance and support.

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