Journal of Advances in Medical and Pharmaceutical Sciences
11(3): 1-9, 2016; Article no.JAMPS.29537
ISSN: 2394-1111

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Effect of Raw Quail Egg on Intraocular Pressure and Blood Pressure of Hypertensive Subjects

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Authors' contributions

This work was carried out in collaboration between both authors. Author GOG designed the study, performed the statistical analysis, wrote the protocol and wrote the first draft of the manuscript. Author TTO managed the literature searches. Both authors read and approved the final manuscript.

Article Information

DOI: 10.9734/JAMPS/2016/29537
Editor(s):
(1) Jinyong Peng, College of Pharmacy, Dalian Medical University, Dalian, China.
Reviewers:
(1) Fethi Ben Slama, National Institute of Public Health, Tunisia.
(2) Anonymous, Universidade Federal de Santa Catarina, Brazil.
(3) Patricia Siques, Universidad Arturo Prat, Chile.
Complete Peer review History: http://www.sciencedomain.org/review-history/17496

Original Research Article

Received 16th September 2016
Accepted 31st December 2016
Published 11th January 2017

ABSTRACT

Quail egg is a rich source of vitamins, mineral salts, enzymes and amino acids. In addition to these nutritional values, quail egg has been reported to have medicinal properties such as hypotensive property. This study investigated the effect of fresh raw quail egg on intraocular pressure (IOP) and blood pressure (BP) of hypertensive and normal subjects in a Nigerian population. One hundred and fifty newly diagnosed and untreated mild to moderate hypertensive subjects selected from the screening exercise carried out at the University of Benin Optometry Clinic, Edo State, Nigeria were recruited for this study. They comprised three groups of fifty subjects each, which were systemic hypertensives, ocular hypertensives and normotensive control subjects. IOP and BP were measured and recorded before and after oral administration of 0.6 ml/kg body weight of raw quail egg to each subject in the three study groups at 30 minutes interval for 90 minutes. Results showed that the maximum mean difference in IOP after oral administration of 0.6 ml/kg body weight of fresh raw quail egg, was 1.85 ±0.12 mmHg and 1.90 ±0.05 mmHg respectively which occurred at 90 minutes in the normotensive right and left eyes, these were statistically significant ($p<0.003$). The

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maximum mean difference in BP was 15.67 ±0.08 mmHg which occurred at 60 minutes in the normotensive subjects and it was statistically significant (*p=0.000*). The hypotensive effect of 0.6 ml/kg body weight of fresh raw quail egg was similar in the three study groups, the peak effect on IOP occurred at 90 minutes and this was preceded by the peak effect on BP which occurred at 60 minutes. The hypotensive effect on IOP may have resulted from the fall in BP. In conclusion, 0.6 ml/kg body weight of raw quail egg has significant hypotensive effect on intraocular pressure and blood pressure compared to water, when administered orally on empty stomach in ocular hypertensives, systemic hypertensives and in the normotensive control groups. Therefore it may be consumed as a form of supplement in the control of high blood pressure and raised intraocular pressure.

Keywords: Raw quail egg; intraocular pressure; blood pressure; hypertension.

1. INTRODUCTION

The prevalence and diagnosis of ocular and systemic hypertension are growing at an alarming rate especially in the Nigerian society [1]. Ocular hypertension (OHT) is defined as intraocular pressure higher than normal, in the absence of optic nerve damage or visual field loss [2]. Intraocular pressure (IOP) is controlled primarily by the rate of secretion and the rate of drainage of the aqueous humor. Whereby these two factors do not commensurate, there will be build up pressure leading to increased risk of optic nerve damage; a pathological condition called glaucoma [3]. The number of people with glaucoma worldwide is expected to rise from 64 million to 76 million in 2020 and 111 million in 2040, with Africa and Asia being affected more heavily than the rest of the world [3]. Normal IOP is between 10-20 mmHg while its average value is 15.5 mmHg with fluctuations of about 2.75 mmHg. IOP varies with the time of the day, heartbeat, respiration and blood pressure [2,4]. It can be influenced by corneal thickness and rigidity [5,6].

Previous researchers have reported that changes in blood pressure result in changes in intraocular pressure in humans and animals studies [7-12]. The term 'blood pressure' refers to arterial blood pressure which is the lateral pressure exerted by the contained column of blood on the wall of arteries. It is expressed in four different terms: systolic blood pressure, diastolic blood pressure, pulse pressure and mean arterial blood pressure. Normal systolic pressure is 120 mmHg; it ranges between 110 to 140 mmHg, while normal diastolic pressure is 80 mmHg and varies between 60 and 80 mmHg [13]. Systemic hypertension (SHT) can be defined as a sustained rise in blood pressure, which can lead to other health complications like stroke and heart attack. A person is said to have systemic hypertension when the mean arterial pressure is greater than the upper range of the accepted normal measure of 110 mmHg or diastolic pressure greater than 90 mmHg and systolic pressure greater than 135 mmHg [14]. Adeloye et al. [15] estimated about 20.8 million cases of systemic hypertension in Nigeria among people aged at least 20 years in 2010, with a prevalence of 28.0% (24.6, 31.9) in both sexes, 30.7% (24.9, 33.7) among men and 25.2% (22.7, 31.9) among women.

Most orthodox medicines used in the treatment of ocular and systemic hypertension have unwanted adverse effects on patients suffering from these conditions. Therefore most patients prefer the use of alternative therapy such as natural food supplements to orthodox medicines. Quail egg is a universal natural food supplement with no health implications and safe to use. It is beneficial in healthy living because it has been proven to alleviate symptoms of diabetes, hypertension, high serum cholesterol, arteriosclerosis, asthma, kidney, liver, and gallbladder stones. It strengthens the immune system, promotes healthy memory, increases brain activity and stabilizes the nervous system [16-18]. Quail egg is a small speckled egg. Though the chicken egg is five times larger than quail egg, quail egg contains 7.5 times more Iron, 6 times more vitamin B2 and 5 times more phosphorus than chicken egg. The egg is a rich source of vitamins, mineral salts, enzymes, fatty acids and amino acids. Quail egg contains on the average: (per 100 g whole liquid egg), 0.12 mg of Vitamin B1, 0.85 mg of Vitamin B2, 300 IU of Vitamin A, and 0.10 mg of Niacin. 13.1 g of Protein, 11.2 g of Fat, 76 mg of cholesterol, 84 mg of omega-6-fatty acid, 4mg of omega-3-fatty acid, 59 mg of Calcium, 119 mg of potassium, 127 mg of sodium, 220 mg of Phosphorus, and 3.8 mg of Iron [19].

Quail egg works best when consumed fresh and raw. 240 eggs are needed for one course of therapy in improving the following conditions: Nervous disorders, Anemia, Migraine, Diabetes, High blood pressure, Arteriosclerosis, Bronchial asthma, and improving the memory. Instruction for use: Take the egg raw, on an empty stomach, in the morning, half an hour before breakfast, in the following manner: For adult: 1st -3rd day 3 eggs daily; 4th day on 5-6 eggs daily until completed therapy. For children: aged: 6-10 years, 4 eggs daily (90 eggs are needed for one course of therapy); 3-6 years, 3 eggs daily (60 eggs are needed for one course of therapy); 1-2 years, 2 eggs daily (60 eggs are needed for one course of therapy). 3 months-1 year, 1 egg daily (30 eggs are needed for one course of therapy). Wait for six months before repeating therapy. Two courses of therapy are recommended yearly [19].

Previous study has shown that fresh raw quail egg reduces blood glucose level when taken on empty stomach in hyperglycemia [20] and there are speculations that it lowers blood pressure in systemic hypertension, but there are no documented experimental studies on its effect on human blood pressure and intraocular pressure. Therefore this study investigated the effect of oral administration of 0.6 ml/kg body weight of fresh raw quail egg on intraocular pressure and blood pressure of fifty ocular hypertensives (OHT), fifty systemic hypertensives (SHT) and fifty normotensive (NT) control subjects; males and females selected from a screening exercise conducted at the Department of Optometry, University of Benin, Benin City, Nigeria using a purposive sampling technique.

2. MATERIALS AND METHODS

2.1 Subjects

A screening exercise was conducted at the Department of Optometry, University of Benin, Benin City, the case history of each subject was taken and each subject was made to go through general examination of blood pressure measurement and ocular examination of the anterior and posterior segments of the eyes. The inclusion criteria for the systemic hypertensives selected were those newly diagnosed from the screening exercise who had not been on any treatment. They had systolic BP of 140-160 mmHg, diastolic BP of 90-105 mmHg, and average IOP less than 21 mmHg while the normotensives selected had an average systolic BP less than 140 mmHg, diastolic BP less than 90 mmHg, and average IOP less than 21 mmHg without treatment. All the subjects had no other systemic or ocular disorders. Their blood pressure was measured three consecutive times with U-MEC mercurial sphygmomanometer manufactured in China by Medicare Instrument Ltd, and Littmann stethoscope manufactured in USA by 3M Health Care. A mean of the three readings was used in the diagnosis of those with systemic hypertension and those who have normal blood pressure, during the screening exercise. The inclusion criteria for the ocular hypertensives selected were those newly diagnosed from the screening exercise and had not been on any treatment. They had average IOP measured at the three time points greater than 21 mmHg, average systolic BP less than 140 mmHg, diastolic BP less than 90 mmHg. Their IOP was measured with CT 20 non-contact computerized tonometer manufactured by Topcon in Japan. The mean of three readings was recorded for each subject. The three readings were taken at 9 am, 3 pm, and 6 pm in order to observe the diurnal variations in the IOP of each subject before selection. Central corneal thickness (CCT) was measured for all the subjects with SW-1000P ultrasound pachymeter manufactured in China by Tianjin Electronic Technology. Ten readings were continuously taken and the average was recorded as the CCT. Each Subject's IOP was adjusted and corrected for CCT using the Ehler's formula. The subjects selected for the three groups had visual field screening using Octopus 900 manufactured in USA by Haag-streit Company and those selected had no visual field defects.

One hundred and fifty subjects, males and females were selected from the screening exercise using a purposive sampling technique. All the subjects selected were non-alcoholics and non-smokers and those on previous medication for systemic or ocular disorders were excluded from the study. They were divided into three groups of fifty each. Group 'A' comprised ocular hypertensives of twenty males and thirty females, aged 35 -52 (mean age 45 ± 3.64) years. Group 'B' comprised systemic hypertensives of twenty eight males and twenty two females, aged 45 -58 (mean age 50 ± 4.82) years, while Group 'C' comprised normal healthy subjects of twenty five males and twenty five females, used as the control group, aged 40 -55 (mean age 46 ± 4.20) years. Informed consent was obtained from each of the participant after a detailed explanation of the procedure was given to them. The study was

approved by the Ethics committee of the University of Benin Teaching Hospital, Benin City, Edo State Nigeria and was performed in accordance with the Declaration of Helsinki of 1996. All experiments were carried out at the University of Benin Optometry Clinic, Benin City, Edo State. All subjects were instructed to abstain from all medication, liquid food, water, juice and beverages in the morning before presenting for the experiment since these may affect readings. All experiments commenced at 9.00 am every morning.

2.2 Procedure

Day 1 of the experiment, each subject was weighed and body weight recorded. Baseline intraocular pressure was measured three consecutive times with CT 20 non-contact computerized tonometer. The average of three readings was recorded for each subject. Baseline blood Pressure was measured three consecutive times with U-MEC mercurial sphygmomanometer and Littmann stethoscope. The average of the three readings was recorded for each subject. Thereafter a volume of 0.6 ml/kg body weight of Eva water was administered orally on empty stomach, to each subject in the three study groups according to their body weight; and their IOP and BP were measured at 30 minutes interval for 90 minutes and the results recorded.

Day 2 of the experiment, each subject was weighed and body weight recorded. Intraocular pressure and blood pressure were measured again at baseline. Thereafter a dose of 0.6 ml/kg body weight of fresh raw quail egg was administered orally on empty stomach, to each subject in the three study groups according to their body weight; IOP and BP were measured again at 30 minutes interval for 90 minutes using the above mentioned instruments and the results recorded.

2.3 Statistical Analysis

All the data in this study were analyzed with IBM SPSS version 20. Analysis of Variance (ANOVA) was used to determine if quail egg and water had significant effect on intraocular pressure and blood pressure. Least Significant Difference (LSD) was used to determine at what time the effect became significant.

3. RESULTS

The results are summarized in Tables. Table 1 showed that after oral administration of 0.6 ml/kg body weight of Eva water to the three study groups, there were no significant changes *(p>0.05)* in intraocular pressure and blood pressure at 30, 60 and 90 minutes compared to the baseline values, in systemic and ocular hypertensives as well as in normotensive control subjects.

Table 2 showed that the maximum mean difference in IOP was 0.05 ±0.01 mmHg and 0.05 ±0.04 mmHg respectively which occurred at 90 minutes in the right eye of the systemic hypertensives and the normotensive subjects and it was statistically insignificant *(p>0.05)*. The maximum mean difference in BP was 0.05 ±0.03 mmHg which occurred at 60 minutes in the ocular hypertensive subjects and it was statistically insignificant *(p>0.05)*.

Table 1. Effect of 0.6 ml/kg body weight of Eva water on mean intraocular pressure (Right and left eyes) and mean arterial blood pressure in ocular hypertensives, systemic hypertensives and normotensive subjects

	Time interval	N	Mean of pressure (mmHg) ± S.E.M. (ocular hypertensives)	Mean of pressure (mmHg) ± S.E.M. (systemic hypertensives)	Mean of pressure (mmHg) ± S.E.M. (normotensives)
Right eye	Base line	50	27.61 ±0.32	16.50 ±0.40	14.80 ±0.38
	30 minutes		27.59 ±0.31	16.45 ±0.39	14.77 ±0.35
	60 minutes		27.59 ±0.31	16.45 ±0.39	14.75 ±0.34
	90 minutes		27.58 ±0.30	16.45 ±0.39	14.75 ±0.34
Left eye	Base line	50	26.12 ±0.44	17.52 ±0.55	13.80 ±0.30
	30 minutes		26.11 ±0.43	17.50 ±0.52	13.77 ±0.28
	60 minutes		26.08 ±0.42	17.48 ±0.48	13.77 ±0.28
	90 minutes		26.08 ±0.42	17.48 ±0.48	13.77 ±0.28
Mean arterial BP	Base line	50	90.50 ±1.15	105.20 ±1.36	88.50 ±0.70
	30 minutes		90.48 ±1.13	105.17 ±1.34	88.48 ±0.67
	60 minutes		90.45 ±1.12	105.17 ±1.34	88.46 ±0.67
	90 minutes		90.46 ±1.12	105.17 ±1.34	88.48 ±0.65

Table 2. Mean difference in pressure between baseline and different time of assessment after oral administration of 0.6 ml/kg body weight of Eva water in OHT, SHT and NT subjects

	Time interval	N	Mean difference in pressure (mmHg) ± S.E.M. (ocular hypertensives) with their p-values		Mean difference in pressure (mmHg) ± S.E.M. (systemic hypertensives) with their p-values		Mean difference in pressure (mmHg) ± S.E.M. (Normotensives) with their p-values	
Right eye	30 minutes	50	0.02 ±0.01	(p=0.087)	0.05 ±0.01	(p=0.097)	0.03 ±0.03	(p=0.075)
	60 minutes		0.02 ±0.01	(p=0.087)	0.05 ±0.01	(p=0.097)	0.05 ±0.04	(p=0.085)
	90 minutes		0.03 ±0.02	(p=0.078)	0.05 ±0.01	(p=0.097)	0.05 ±0.04	(p=0.085)
Left eye	30 minutes	50	0.01 ±0.01	(p=0.070)	0.01 ±0.03	(p=0.071)	0.03 ±0.02	(p=0.078)
	60 minutes		0.04 ±0.02	(p=0.083)	0.04 ±0.05	(p=0.087)	0.03 ±0.02	(p=0.078)
	90 minutes		0.04 ±0.02	(p=0.083)	0.04 ±0.05	(p=0.087)	0.03 ±0.02	(p=0.078)
Mean arterial BP	30 minutes	50	0.02 ±0.02	(p=0.68)	0.03 ±0.02	(p=0.080)	0.02 ±0.03	(p=0.078)
	60 minutes		0.05 ±0.03	(p=0.074)	0.03 ±0.02	(p=0.080)	0.04 ±0.03	(p=0.078)
	90 minutes		0.04 ±0.03	(p=0.098)	0.03 ±0.02	(p=0.080)	0.02 ±0.05	(p=0.070)

But in Tables 3 and 4, with oral administration of 0.6 ml/kg body weight of fresh raw quail egg, ANOVA showed that 0.6 ml/kg body weight of fresh raw quail egg had significant effect *(p<0.05)* on intraocular pressure and blood pressure in systemic and ocular hypertensives as well as in normotensive control subjects. LSD showed that the peak effect on mean IOP occurred at 90 minutes and this was statistically significant (*p=0.000*) in the three study groups. It was preceded by the peak effect on mean arterial blood pressure which occurred at 60 minutes of ingesting 0.6 ml/kg body weight of fresh raw quail egg, this effect was also statistically significant *(p=0.000)* in the three study groups. The peak effect on blood pressure occurred 30 minutes before the peak effect on intraocular pressure. Thereafter the blood pressure started rising gradually.

The maximum mean difference in IOP for the right eye in OHT, SHT and NT subjects after oral administration of 0.6 ml/kg body weight of fresh raw quail egg, was 1.73 ±0.13, 1.82 ±0.06 and 1.85 ±0.12 mmHg respectively. Likewise the maximum mean difference in IOP for the left eye in OHT, SHT and NT subjects were 1.81 ±0.11, 1.76 ±0.05 and 1.90 ±0.05 mmHg respectively which occurred at 90 minutes and these were statistically significant (p<0.003). The maximum mean difference in BP in OHT, SHT and NT subjects were 15.54 ±0.08 mmHg, 12.35 ±0.16 mmHg, 15.67 ±0.05 mmHg which occurred at 60 minutes and they were statistically significant (p=0.000). The maximum mean difference in IOP and BP after oral administration of 0.6 ml/kg body weight of fresh raw quail egg was similar in the three study groups. This showed that 0.6 ml/kg body weight of fresh raw quail egg has similar hypotensive effects on IOP and BP of ocular and systemic hypertensives as well as the normotensive control subjects.

4. DISCUSSION

The mechanism of action of the hypotensive effects of fresh raw quail egg on intraocular pressure and blood pressure has not been fully understood, but numerous possibilities have been proposed. Many of the proposals have attempted to relate the effect of dietary calcium on vascular smooth muscle of blood vessels and how it alters vascular tone to reduce blood pressure [21]. Potassium supplements have also been shown to have blood pressure–lowering effect in persons with low dietary intake. The study of Frank et al. [22] and George et al. [10] further showed the importance of potassium in lowering blood pressure in the general population. Therefore the high potassium and calcium content in the quail egg may have played a role in lowering blood pressure. Hoshi et al. [23] in their study concluded that Omega-3 fatty acids also lower blood pressure by directly activating large-conductance calcium-dependent potassium channels. Hence, Omega-3 fatty acids present in quail egg may have facilitated this mechanism to decrease the blood pressure.

Table 3. Effect of 0.6 ml/kg body weight of raw quail egg on mean intraocular pressure (Right and left eyes) and mean arterial blood pressure in OHT, SHT and NT subjects

	Time interval	N	Mean of pressure (mmHg) ± S.E.M. (ocular hypertensives)	Mean of pressure (mmHg) ± S.E.M. (systemic hypertensives)	Mean of pressure (mmHg) ± S.E.M. (Normotensives)
Right eye	Base line	50	28.61 ±0.29	15.41 ±0.39	13.68 ±0.26
	30 minutes		27.90 ±0.27	14.82 ±0.38	12.91 ±0.25
	60 minutes		27.34 ±0.28	14.23 ±0.36	12.39 ±0.24
	90 minutes		26.88 ±0.26	13.59 ±0.33	11.83 ±0.24
Left eye	Base line	50	27.72 ±0.33	16.62 ±0.43	13.53 ±0.23
	30 minutes		26.92 ±0.31	15.90 ±0.41	12.87 ±0.22
	60 minutes		26.39 ±0.30	15.38 ±0.40	12.30 ±0.22
	90 minutes		25.91 ±0.31	14.86 ±0.38	11.63 ±0.20
Mean arterial BP	Base line	50	92.87 ±1.05	107.92 ±1.37	89.21 ±0.91
	30 minutes		88.06 ±1.01	104.65 ±1.26	84.21 ±0.87
	60 minutes		77.33 ±0.97	95.57 ±1.21	73.54 ±0.78
	90 minutes		82.60 ±0.92	98.17 ±1.23	79.16 ±0.83

Table 4. Mean difference in pressure between baseline and different time of assessment after oral administration of 0.6 ml/kg body weight of raw quail egg in OHT, SHT and NT subjects

	Time interval	N	Mean difference in pressure (mmHg) ± S.E.M. (ocular hypertensives) with their p-values		Mean difference in pressure (mmHg) ± S.E.M. (systemic hypertensives) with their p-values		Mean difference in pressure (mmHg) ± S.E.M. (Normotensives) with their p-values	
Right eye	30 minutes	50	0.71 ±0.02	(p=0.072)	0.58 ±0.01	(p=0.092)	0.77 ±0.01	(p=0.063)
	60 minutes		1.27 ±0.01	(p=0.001)	1.18 ±0.03	(p=0.008)	1.29 ±0.02	(p=0.000)
	90 minutes		1.73 ±0.13	(p=0.000)	1.82 ±0.06	(p=0.001)	1.85 ±0.12	(p=0.000)
Left eye	30 minutes	50	0.80 ±0.01	(p=0.070)	0.72 ±0.02	(p=0.071)	0.66 ±0.01	(p=0.068)
	60 minutes		1.33 ±0.01	(p=0.003)	1.24 ±0.03	(p=0.048)	1.23 ±0.01	(p=0.005)
	90 minutes		1.81 ±0.11	(p=0.000)	1.76 ±0.05	(p=0.002)	1.90 ±0.03	(p=0.000)
Mean arterial BP	30 minutes	50	4.81 ±0.04	(p=0.001)	3.27 ±0.11	(p=0.008)	5.00 ±0.04	(p=0.000)
	60 minutes		15.54 ±0.08	(p=0.000)	12.35 ±0.16	(p=0.000)	15.67 ±0.05	(p=0.000)
	90 minutes		10.27 ±0.13	(p=0.000)	9.75 ±0.14	(p=0.000)	10.05 ±0.04	(p=0.000)

Finally, as long as the aqueous humour drains into the episcleral venous system either by way of the intrascleral plexus or more directly along the aqueous veins, intraocular pressure varies directly with the venous pressure [24]. Decrease in episcleral venous pressure will therefore result in an increased outflow of aqueous causing a fall in intraocular pressure. Previous studies have shown that intraocular pressure is significantly correlated with systemic blood pressure. There are significant direct correlations between changes in systemic blood pressure and changes in intraocular pressure in humans and animals studies [7-12]. Therefore the fall in blood pressure may have consequently resulted in a fall in intraocular pressure.

5. CONCLUSION

0.6 ml/kg body weight of raw quail egg has significant hypotensive effect on intraocular pressure and blood pressure compared to water, when administered orally on empty stomach in ocular hypertensives, systemic hypertensives and in the normotensive control groups. The hypotensive effects in the three study groups are similar therefore it may be consumed as a form of supplement in the control of high blood pressure and raised intraocular pressure since the quail egg is innocuous. Toxicological studies including acute and repeated oral administration on rats as well as in vitro studies demonstrated good tolerability of the product without mutagenic or genotoxic effects [18]. Nevertheless further investigations may be required to determine the safety dose of the quail egg as well as its long term effects if used as a supplement in the management of ocular and systemic hypertension.

COMPETING INTERESTS

Authors have declared that there is no conflict of interest associated with this work.

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Peer-review history:
The peer review history for this paper can be accessed here:
http://sciencedomain.org/review-history/17496