Section: Miscellaneous

Original Research Article

ASSESSMENT OF PUPIL-TO-LIMBUS DIAMETER RATIO AND ITS CORRELATION WITH BLOOD PRESSURE AND PULSE RATE IN THE NORMOTENSIVE INDIVIDUALS

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ABSTRACT

Background: Autonomic function tests play a key role in diagnosing cardiac disorders, which are increasing worldwide in all age groups. To recommend the pupil-to-limbus diameter (PLD ratio) as an autonomic function test, the study should support with large sample size. Hence, the present study was undertaken. **Aim and objectives:** The present study was undertaken to observe the correlation between the pupil-to-limbus diameter ratio with the blood pressure and pulse rate in normotensive individuals.

Materials and Methods: A total of 80 normotensive male and female young adults were part of the study. After obtaining informed consent, the participants underwent a general physical examination where their blood pressure was recorded using a diamond sphygmomanometer, and their pulse rate was recorded manually from the radial artery. Soon after, their eye images were taken and processed to measure the PLD ratio as mentioned in the literature.

Results: A positive correlation was observed between the PLD ratio of the right eye with systolic and diastolic blood pressure and pulse rate. However, this was not statistically significant. A negative correlation was observed between the PLD ratio of the left eye with systolic blood pressure. However, this association was not statistically significant. A positive correlation was observed between the PLD ratio of the left eye and with diastolic blood pressure pulse rate. However, this association was not statistically significant.

Conclusion: The present study results support the positive correlation between the PLD ratio with systolic, and diastolic blood pressure and pulse rate except for the PLD ratio of the left eye with systolic blood pressure. There is a need for further detailed study in this area.

Keywords: Pupil diameter, Autonomic function test, Limbus diameter, Cardiac disorders.

INTRODUCTION

Autonomic function tests play a key role in diagnosing cardiac disorders, which are increasing worldwide in all age groups. Hence, continuous monitoring of the individual's autonomic functions is recommended. There exist several methods that

help to assess autonomic functions like recording the heart rate, measuring the levels of hormones of autonomic nerves, assessment of sympathetic activity. In recent years, a simple and cost-effective autonomic function test has been discussed in the literature which is the pupil-to-limbus diameter ratio. As the limbus diameter is always constant and pupil diameter varies with the activity of the sympathetic activity, the ratio was reported to have a positive correlation with blood pressure and pulse rate in different age groups of individuals and also in various clinical conditions.[1]The method to record the pupil to the limbus diameter ratio was a box method and it is manual recording and measuring using simple equipment. And hence, it is affordable to the general population.[2] Interestingly, the pupil-to-limbus ratio was reported to be correlated positively with the autonomic functions in patients with Parkinson's disease.[3] Further, a positive correlation was reported in the patients with diabetes mellitus.[4] The first study using the pupil to the limbus diameter ratio (PLD ratio) and its correlation with autonomic functions appeared in the Indian population in 2017 in the literature. However, the sample size of the study was less. To recommend the PLD ratio as an autonomic function test, the study should support with large sample size. Hence, the present study was undertaken to observe the PLD ratio and its correlation with the blood pressure and pulse rate in the normotensive population.

Aim and objectives: The present study was undertaken to observe the correlation between the pupil-to-limbus diameter ratio with the blood pressure and pulse rate in normotensive individuals.

MATERIALS AND METHODS

The present study was an observational study conducted in normotensive young adults. A total of 80 normotensive male and female young adults were part of the study after obtaining voluntary, written, informed consent. The study protocol was approved by the institutional human ethics committee. Willing, normotensive males and females within the age group of 18-24 were part of the study. Individuals with any complications, under any kind of treatment or therapy, and individuals with eye disorders were excluded from the study. After obtaining informed consent, the participants underwent a general physical examination where their blood pressure was recorded using a diamond sphygmomanometer, and their pulse rate was recorded manually from the radial artery. Soon after they were taken to the room designed with constant illuminance (measured and fixed using the lux meter). They were explained about the procedure and pictures of the eye were obtained using a Samsung S 24 mobile camera. Later the images were processed as suggested in the literature.

Statistical Analysis: The data was analyzed using SPSS 21.0. The Pearson correlation coefficient was applied to test the correlation between the variables. A probability value of less than 0.05 was considered significant.

RESULTS

Table 1 presents the demographic data of the participants. Table 2 presents the correlation between the PLD ratio of the right eye with blood pressure and pulse rate. A positive correlation was observed between the PLD ratio of the right eye with systolic and diastolic blood pressure and pulse rate. However, this was not statistically significant. Table 3 presents the correlation between the PLD ratio of the left eye with blood pressure and pulse rate. A negative correlation was observed between the PLD ratio of the left eye with systolic blood pressure. However, this association was not statistically significant. A positive correlation was observed between the PLD ratio of the left eye and with diastolic blood pressure pulse rate. However, this association was not statistically significant.

Table 1: Demographic data of the participants

Parameter	(n=80)
Age (years)	21.38 ± 2.03
Height (cm)	173.86±2.75
Weight (kg)	68.24 ± 5.98

Data was mentioned as mean and SD

Table 2: Correlation between PLD ratio of the right eye with blood pressure and pulse rate

PLD ratio	Systolic blood pressure (mmHg)	Diastolic blood pressure (mmHg)	Pulse rate
0.5333 ± 0.0889	116.63 ± 9.82	76.27 ± 6.29	87.52 ± 9.85
	R =0.0453	R=0.0397	R = 0.0708
	P=0.6898	P = 0.7266	P = 0.5325

Data was mentioned as mean and SD

Table 3: Correlation between PLD ratio of the left eye with blood pressure and pulse rate

PLD ratio	Systolic blood pressure (mmHg)	Diastolic blood pressure (mmHg)	Pulse rate
0.54 ± 0.08463	116.63 ± 9.82	76.27 ± 6.29	87.52 ± 9.85
	R = -0.055	R=0.0738	R = 0.0333
	P=0.6279	P = 0.5153	P = 0.7693

Data was mentioned as mean and SD

DISCUSSIONS

The present study was undertaken to observe the correlation between the PLD ratio and the autonomic parameters, blood pressure, and pulse rate. There was a positive correlation between these parameters, but it was not statistically significant. India has the highest number of cardiovascular diseases compared to the rest of the world.[6] As the prevalence of cardiovascular diseases is high it is very essential to diagnose them at the earliest. Hence, there is a great role for the autonomic function tests. The autonomic nervous system has two important components that is sympathetic and parasympathetic nervous systems. The balance between these two systems ensures homeostasis. The diameter of the limbus stays constant and the diameter of the pupil changes with the activity of autonomic functions. When there is stimulation of the sympathetic nervous system, it causes dilation of the pupil which ensures an increased field of vision. During the parasympathetic stimulation, the pupil is constricted. Changes in the blood pressure are also regulated by autonomic activity. Earlier studies explained the existence of a correlation between blood pressure pulse rate and the PLD ratio.[7] Another study observed variations in the pupil-to-limbus diameter ratio among the healthy and diabetic populations and concluded that there was no variation in the pupil-to-limbus diameter ratio among these two groups.[8] An experimental study conducted in long-term yoga-practicing individuals reported a significant decrease in the PLD ratio in both the eyes along with a reduction in the pulse rate and respiratory rate.[9] Interestingly, the pupil-to-limbus diameter ratio was assessed in different phases of the menstrual cycle. There was a significant variation in the PLD ratio in the follicular and luteal phases of the menstrual cycle. A correlation between the blood pressure and pulse rate with PLD ratio was reported in Parkinson's patients.[3] A study observed the blood pressure pulse rate and PLD ratio in normotensive and hypertensive subjects. Blood pressure and pulse rate were significantly higher in hypertensive subjects. Also, the PLD ratio was significantly different in the normotensives and hypertensive individuals.[11] As the PLD ratio assessment is easy and cost-effective, this can be used in the evaluation of autonomic functions. However, a study with a large population must be conducted to implement the PLD ratio as an autonomic function test.

CONCLUSION

The present study results support the positive correlation between the PLD ratio with systolic, and diastolic blood pressure and pulse rate except for the PLD ratio of the left eye with systolic blood pressure. There is a need for further detailed study in this area.

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