ORIGINAL ARTICLE

Resistive index of retinal arterial blood flow in type-II diabetics without retinopathy

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Abstract

Diabetic retinopathy is a vascular disorder affecting the microvasculature of retina. It is caused by changes in the blood vessels of retina. If untreated, it may lead to blindness. Therefore if diagnosed and treated promptly, blindness is usually preventable. In ophthalmology, Colour Doppler Imaging is a new method that enables us to assess the orbital vasculature. Duplex color Doppler ultrasonography is the investigation of choice to assess retinal arterial flow velocities very quickly without any invasive procedure for qualitative and quantitative assessment of blood flow velocities. This study was performed to observe the difference between Doppler flow velocity indices of retinal artery in Type-II Diabetics subjects without retinopathy and those of normal control subjects. This case-control study was carried out in the Radiology department, BIRDEM for two years. All the selected subjects underwent Duplex Doppler ultrasonography of both eyes using 5 to 7.5 MHz linear phase transducer. Findings included spectral analysis, those were PSV, EDV and RI. Unpaired t-test was done to compare blood flow velocity indices of retinal artery in type-II diabetic patients without retinopathy and that of healthy control adult subjects and a P value <0.05 was taken as significant. Majority (42.5%) of patients were in 4th decade in diabetic subjects with male predominant, which was 58.7%. The mean duration of diabetes was 4.56 + 2.1 years. In the current study, it was found that the mean resistive index (RI) in 80 diabetic patients without retinopathy was (0.75 + 0.04) ranging 0.66-0.81. And that of 80 healthy subjects was (0.64 + 0.02) ranging 0.600.70.1n this study the mean differences of retinal arterial RI in diabetic eyes without retinopathy and healthy control eyes was statistically significant (p<0-05) in unpaired 't' test. From the result of present study it can be concluded that, there is statistically significant increased retinal arterial resistivity index of type-II diabetic patients without retinopathy. Higher RI in type-II diabetics may predict the early haemodynamic changes in the retinal artery of these patients before the clinical onset of retinopathy.

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Introduction

Diabetes mellitus, is one of the most common non-communicable diseases globally. The prevalence of diabetes for all age groups worldwide has been estimated to be 6.4%, affecting 285 million adults in 2010.1 Bangladesh is a developing country that has been facing a high prevalence of diabetes mellitus. In 2011, 8.4 millions of people with diabetes have been estimated in our country with prevalence of 8.1 % in urban and 2.3% in rural areas.[2,3]

As the prevalence of diabetes is rising, the systemic complications that include retinopathy, nephropathy. and neuropathy and involvement of cardiovascular system are also increasing. Diabetic retinopathy is a vascular disorder affecting the microvasculature of retina. It is caused by changes in the blood vessels of retina. If untreated, it may lead to blindness. Therefore if diagnosed and treated promptly, blindness is usually preventable.[5-7]

In ophthalmology, Colour Doppler Imaging is a new method that enables us to assess the orbital vasculature. It allows for simultaneous two dimentional anatomical and Doppler evaluation of haemodynamic characteristics of retinal artery.8-13 Standard ophthalmoscopy can detect retinal

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abnormalities but after the development of retinopathy and it is very much observer dependent.[14-16] On the other hand, slit-lamp biomicroscopy can assess retinal changes but it is very much time consuming and needs pupillary dilatation which causes discomfort to patient.[17,18] Retinal arterial hemodynamic changes can be also assessed by the gold standard fluorescein dye-dilution technique but accurate measurement of staining after intravenous injection of fluorescein is difficult at retinal arterial level. Therefore, Duplex color Doppler ultrasonography is the investigation of choice to assess retinal arterial flow velocities very quickly without any invasive procedure for qualitative and quantitative assessment of blood flow velocities'" and thus prevent retinopathy.

Methodology

This case-control study was attempted on 320 eyes of 160 subjects in the department of Radiology and Imaging, BIRDEM from July 2011 to June 2013. Out of them 160 eyes of 80 diabetic patients without retinopathy were considered case group and 160 eyes of 80 healthy subjects were considered as healthy control subjects. Among the 92 referred patients in preliminary selection, 12 diabetic patients were excluded, that means 24 eyes were excluded from 184 eyes. Of them 12 eyes of 6 hypertensive patients were excluded, as well as 8 eyes of 4 dyslipidaemic patients were also excluded. Four more eyes of 2 patients were also excluded, as patients refused and considered as dropout cases. 160 eyes of 80 healthy adults with normal ophthalmology examination findings (volunteers) were included as control group. At first patients with type-II Diabetes subjects without retinopathy (normal findings in slit lamp biomicroscopy) were referred from Ophthalmology OPD, BIRDEM to our department for Duplex color Doppler study of eyes. The objective of the study was discussed in details with the patients before their decision to enroll themselves into the study. Demographic information was prospectively recorded and substantiated by means of inspection of medical record. Information included the subject's age, sex, medical and surgical history, clinical history of diabetes, followed by Duplex colour Doppler study with spectral analysis. The colour Doppler study was performed first by the investigator herself and subsequently confirmed by a, radiologist of the department of Radiology and Imaging, BIRDEM, who did not know the subject's condition to eliminate bias. Peak systolic velocity, End diastolic velocity & Resistive index of retinal arteries were recorded from both right and left eyes.

Result

In this current study it was observed that the mean age of diabetic patients was 46.05 ± 9.78 years with range from 27 to 68 years and most of the patients (42.5%) were found in 4th decade, where 58.7% and 41.3% were male and female respectively. On the other hand, the mean age of healthy control subjects was 42.78 ± 7.31 years with range from 30 to 59 years and majority (47.5%) were found in 4th decade, out of which 53.7% were male and 46.3% were female.

The mean duration of diabetes was 4.56 ± 2-1 years. The study also revealed that there was no difference (p>0.05) in retinal arterial mean peak systolic velocity (PSV),mean end diastolic velocity (EDV) and mean resistive index (RI) between right and left eyes of diabetic patients without retinopathy and also in control subjects.

In the current study, it was found that the mean peak systolic velocity (PSV) in 160 eyes of 80 diabetic patients without retinopathy was (10.70 + 1.50 cm/sec) ranging 5.30-16.10. And the mean peak systolic velocity (PSV) measured in 160 eyes of 80 healthy subjects was (11.27 + 0.98 cm/sec) ranging 09-00-13.10.

Table 1

Comparison of retinal arterial mean resistive index

RI	Mean + SD	Range	t value	p value*
Control group (n=160)	0.64 ± 0.02	0.60-0.70		
			13.41	0.001
Diabetic group (n=160)	0.75±0.04	0-66-0.81		

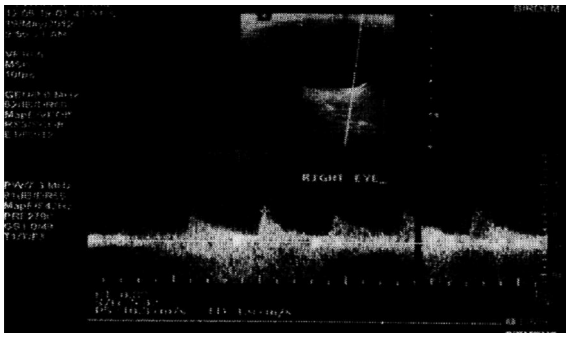
* P value was achieved from unpaired t-test.

In the present study, it was also found that the mean end diastolic velocity (EDV) in 160 eyes of 80 diabetic patients without retinopathy was (2.58 ± 0.67 cm/sec) ranging 1-00-5.10. And the mean end diastolic velocity (EDV) measured in 160 eyes of 80 healthy subjects was (4.11 ± 2.7 cm/sec) 3.00-4.60.

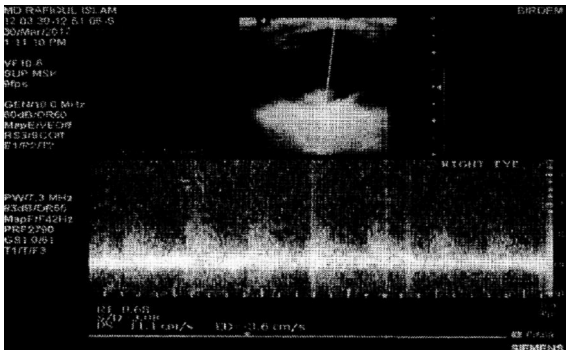
In this study the mean differences of retinal arterial peak systolic velocity and end diastolic velocity in diabetic eyes without retinopathy and healthy control eyes was statistically significant (p<0.05) in unpaired 't' test.

In the current study, it was found that the mean resistive index (RI) in 160 eyes of 80 diabetic patients without retinopathy was (0.75 ± 0.04) ranging 0.66-0.81. And the mean resistive index (RI) value measured in 160 eyes of 80 healthy subjects was (0.64 ± 0.02) ranging 0.60-0.70. The

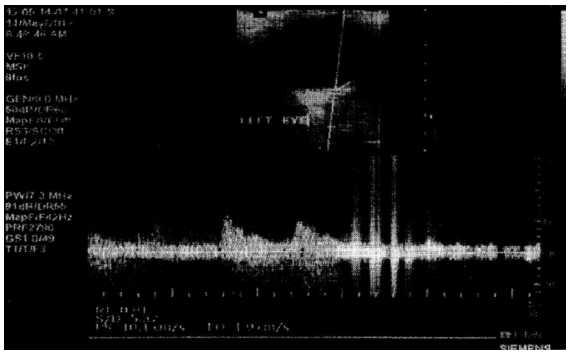
mean difference was statistically (P<0-05) between two groups (Table I)



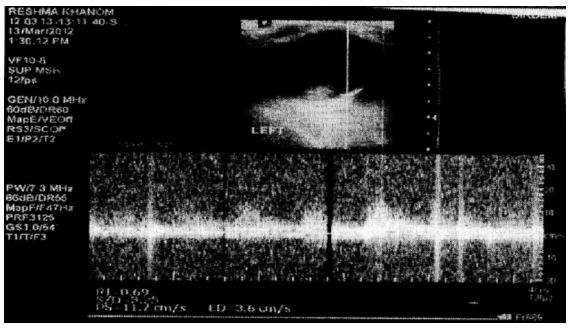
Picture-1. Spectral Doppler flow patterns of retinal artery of right eye in type-II diabetic subject



Picture-2. Spectral Doppler flow patterns of retinal artery of right eye in normal control subject



Picture-3. Spectral Doppler flow patterns of retinal artery of Left eye in type-II diabetic subject



Picture-4. Spectral Doppler flow patterns of retinal artery of Left eye in normal control subject

Discussion

As the prevalence of diabetes is rising, the systemic complications that include retinopathy, nephropathy and neuropathy and involvement of cardiovascular system are also increasing. Diabetic retinopathy is the leading cause of blindness in the world. Therefore prevention of retinopathy needs early diagnosis.[21] Despite the improvements in ophthalmoscopic examination in out patient department (OPD) in ophthalmology, in order to diagnose early changes in retinal arterial flow velocity, a newer imaging modality may be used for diagnosis of early changes in retinal artery before clinical manifestation of retinopathy.

Colour Doppler imaging is the most promising modality that produce conventional gray-scale ultrasound images along with information regarding the direction and velocity of blood flow.[22] The present study was attempted to evaluate clinically diagnosed diabetic patients without retinopathy by measuring the retinal arterial RI and compare the result with normal healthy controls by Duplex colour Doppler study.

184 eyes of 92 diabetics without retinopathy assesed by slit lamp biomicroscopy examination were recruited prospectively from the ophthalmology OPD, BIRDEM and have been taken as cases. Among the 92 referred patients in preliminary selection, 12 diabetic patients were excluded; that means 24 eyes were excluded. Of them 12 eyes of 6 hypertensive patients were excluded, as well as 8 eyes of 4 dyslipidaemic patients were also excluded. Four more eyes of 2 patients were also excluded, as patients refuse to be included in the study and considered as dropout cases. Ultimately a total of 160 eyes of 80 Type-II diabetic patients were included in the study.

In this study 80 patients were divided into five age groups. The ages of the patients ranged from 27 to 68 years with the number of cases found in the 40-49 years age group. Observation revealed no statistically Significant (p<0.05) mean age differences in study and control group. A similar study showed no significant difference between the study and reference groups with respect of age.[23]

For control group, age-matched 160 eyes of 80 healthy control subjects were recruited from hospital personnel and voluntary workers, whose slit lamp biomicroscopic findings were normal. In this study, comparison between mean peak systolic velocity (MV), mean end diastolic velocity (EDV) and mean resistivity index(RI) of right and left eyes of type-II diabetic patients and control subjects were evaluated but no significant (p>0.05) difference were found.

In this study the mean differences of retinal arterial peak systolic velocity in diabetic eyes without retinopathy and control eyes was statistically significant ($p<0.05$) in unpaired T test- The previous study compared the mean PSV of retinal artery in diabetic patients without retinopathy and healthy subjects and found there was significant difference in retinal arterial PSV in study and control group.[24]

The mean end diastolic velocity (EDV) of 160 diabetic eyes without retinopathy and 160 control eyes was statistically significant ($p<0.05$) in unpaired 't' test. The observation is supported by a study who has compared the mean end diastolic velocity of diabetic patients and control group and discovered that there was statistically significant differences of mean retinal arterial EDV among case and control groups.[25]

In this study the resistive index (RI) measured in 160 eyes of 80 diabetic patients without retinopathy, the mean RI value was found (0.75± 0.04) ranging 0.66-0.81 and the previous investigator who found the mean RI value of (0.70 ± 0.005).[23] Mean resistive index (RI) value measured in 160 eyes of 80 healthy subjects was (0.64 ± 0.02) ranging 0.60-0.70 and the previous investigator discovered the mean RI value of (0.65+0.05).[23]

So, the result of present study coincides with those of the previous studies. The mean resistive index (RI) value of diabetic patients without retinopathy is significantly higher than that found in control group.

Conclusion

From the result of present study it can be concluded that, there is statistically significant increased retinal arterial resistivity index M of type-II diabetic patients without retinopathy. Higher RI in type-II diabetics may predict the early haemodynamic changes in the retinal artery of these patients before the clinical onset of retinopathy. Duplex colour Doppler sonography can be routinely used in type-II diabetic patients for early detection of flow abnormalities.

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