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Radiology

COMPARATIVE STUDY OF ORBITAL DOPPLER PARAMETERS IN DIABETICS WITH RETINOPATHY AND DIABETICS/ HEALTHY CONTROLS WITHOUT RETINOPATHY

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ABSTRACT

AIM: To compare orbital vessel doppler indices in diabetics with retinopathy and diabetics/healthy controls without retinopathy using the color doppler sonography.

METHODOLOGY: This prospective study includes the study population as diabetic without retinopathy (non-DR), diabetics with retinopathy (DR) and healthy controls who come to diabetology outpatient department after categorizing by fundoscopy. The final population enrolled in this study composed of 55 patients with non-proliferative diabetic retinopathy, 68 diabetic patients without retinopathy, 90 healthy controls without diabetic retinopathy. Patients to be in supine position. Sterile gel will be placed in closed eyelid and Colour Doppler imaging (CDI) done. Measurements include Peak Systolic Velocity (PSV), End Diastolic Velocity (EDV), Resistive Index (RI) and Pulsatile Index (PI) in ophthalmic arteries (OA), central retinal artery (CRA) and central retinal vein (CRV). These doppler parameters are compared in these three groups.

RESULTS: In Ophthalmic artery, PSV showed no statistically significant difference across the groups. EDV was lowest in DR group, followed by non-DR group and was higher in healthy controls. The PI and RI was highest in DR group, followed by non-DR group and least among healthy controls.

In Central Retinal artery, PSV did not show any statistically significant difference. EDV of Central Retinal artery was much lower in DR group, as compared to non-DR group and healthy controls. PI and RI of CRA also showed declining trend from DR group to non-DR group and healthy controls.

In Central retinal vein, PI and RI values were highest in DR group, followed by non-DR group and lowest in healthy controls.

CONCLUSION: Ocular blood flow velocity was decreased with increased RI and PI in diabetic retinopathy group. This study concludes that Orbital Colour Doppler Imaging has the potential to provide useful information related to altered ocular blood flow even before the appearance of Diabetic retinopathy thereby enabling early diagnosis of diabetic retinopathy and early intervention.

KEYWORDS : Colour Doppler Imaging, Peak systolic velocity, End diastolic velocity, Pulsatility Index, Resistivity Index, Diabetic retinopathy.

INTRODUCTION:

Diabetes mellitus is one of the most common non-communicable diseases globally. The prevalence of diabetes in our country is increasing. 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 caused by changes in the retinal blood vessels. If untreated, it may lead to blindness. Therefore, if diagnosed and treated promptly, blindness is usually preventable. Colour Doppler imaging is a new method that enables us to assess the orbital vasculature. It allows for simultaneous two dimensional anatomical and Doppler evaluation of hemodynamic characteristics of retinal artery. For diagnosis of early changes in retinal blood flow in diabetes mellitus without retinopathy duplex colour Doppler ultrasonography is the investigation of choice to assess the problem very quickly without any invasive procedures.

AIM:

The Aim of this study is to compare orbital vessel Doppler indices in diabetics with retinopathy and diabetics/healthy controls without retinopathy using the colour Doppler sonography. The Peak Systolic Velocity, End Diastolic Velocity, Pulsatility Index and Resistivity Index are measured in Ophthalmic artery, Central retinal artery and Central retinal vein in the three groups and compared.

SUBJECTS

This prospective study was performed after obtaining clearance from our Institutional Ethics Committee and institutional informed consent guidelines were observed. The study population included diabetic patients without retinopathy, with retinopathy, non-diabetic healthy controls who came to diabetology outpatient department after fasting and post prandial blood investigation based on the following criteria.

INCLUSION CRITERIA:

- Age between 20 and 80 years, both sexes.
- Cases with non-proliferative diabetic retinopathy.
- Diabetics without retinopathy
- Non-diabetic healthy controls were included in the study.

EXCLUSION CRITERIA:

- Previous laser photocoagulation
- Proliferative diabetic retinopathy
- Any disease or anomaly of the eye, which may affect blood flow velocity, such as ocular inflammation, systemic diseases like hypertension, Non-diabetic vascular disease.
- Trauma
- Lactating and pregnant females whatever the gestational age.

METHODS:

Fundoscopy was performed by expert ophthalmologist Patients with retinopathy and no retinopathy was categorized based on International disease severity scale for Diabetic Retinopathy by Wilkinson into five levels as:

1. None,
2. Mild non-proliferative diabetic retinopathy,
3. Moderate non-proliferative diabetic retinopathy,
4. Severe non-proliferative diabetic retinopathy or

5.Proliferative diabetic retinopathy.

COLOUR DOPPLER IMAGING:

Patients to be in supine position and sterile gel will be placed in closed eyelid. Gray-scale imaging is performed first to obtain an overview of the anatomy in the orbit. Signals from the ophthalmic artery can be located in the medial section of an eyeball, superior to the optic nerve, just lateral to and abutting the visible hypo echoic stripe representing the nerve.

The central retinal artery originates from the ophthalmic artery and can be found anterior to the optic nerve, around 7.5 mm behind the ocular bulb.

A specific finding of the blood flow in the central retinal vein is its pulsatile character.

Measurements include Peak Systolic Velocity (PSV), End Diastolic Velocity (EDV) in ophthalmic arteries, central retinal artery and central retinal vein.

Resistive Index (RI) and Pulsatile Index (PI) will be measured by the following formula.
Resistive Index (RI) = PSV-EDV/PSV;
Pulsatile Index (PI) = PSV-EDV/V mean;
V mean=1/3(PSV-EDV) + EDV.

RESULTS:

Among, ophthalmic artery doppler parameters, PSV had shown no statistically significant difference across the groups (P value 0.347). EDV was lowest in DR group, followed by non-DR group and was higher in healthy controls (P value <0.001). The PI was highest in DR group, followed by no DR group and least among healthy controls (P value <0.001). The RI of ophthalmic artery was also highest among DR group and showed declining trend in non-DR and healthy controls (P value <0.001).

Among Central Retinal artery parameters, PSV did not show any statistically significant difference. EDV of Central Retinal artery was much lower in DR group, as compared to non-DR group and healthy controls. PI and RI of Central Retinal artery also showed declining trend from DR group to non-DR group and healthy controls (P value <0.001).

Among central retinal vein parameters, PSV was highest in DR group and showed declining trend in non-DR group and healthy controls. (P value <0.001). EDV of both DR and non-DR groups was similar and even though, it was slightly lower in control group, the difference was statistically not significant (P value 0.727). The PI and RI values of central retinal vein were highest in DR group, followed by non-DR group and lowest in healthy controls (P value <0.05).

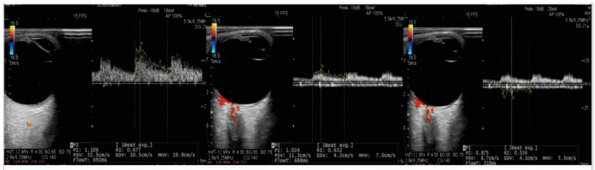
CONCLUSION:

Orbital Colour Doppler Imaging has the potential to provide useful information related to altered ocular blood flow even before the appearance of Diabetic retinopathy thereby enabling early diagnosis of diabetic retinopathy and early intervention.

The findings of our study suggest a need for large-scale studies to derive a cut off value in the Doppler indices to identify the Diabetics who are at risk of developing retinopathy. Further the study of association of ocular blood flow parameters with other micro and macro vascular complications in diabetics may help in identifying subjects with high risk of developing complications.

REPRESENTATIVE CASES:

CASE:1- NORMAL HEALTHY CONTROL

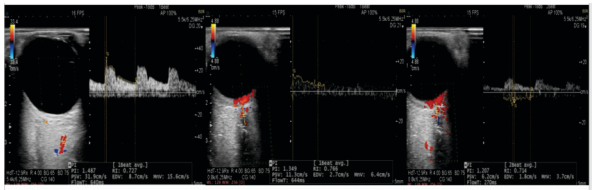


Opthalmic Artery in a normal healthy control showing systolic peak, dicrotic incisura, slightly diastolic flow declination noted.
PSV: 32.5cm/s
EDV: 10.5 cm/s
PI: 1.106
RI:0.677

Central retinal Artery shows the rounded systolic peak and the continuous flow during diastole in the arterial waveform.
PSV: 11.3cm/s
EDV:4.2 cm/s
PI:1.024
RI:0.632

Central retinal vein shows
PSV: 8.7cm/s
EDV:4.1 cm/s
PI:0.875
RI:0.534

CASE:2-DIABETIC WITHOUT RETINOPATHY

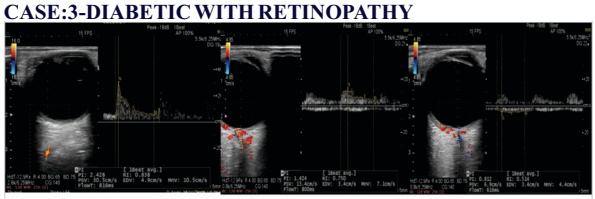


Opthalmic artery shows
PSV:31.9.9 cm/sec
EDV:8.7cm/sec
PI:1.487
RI:0.727

Central retinal artery shows
PSV:11.3 cm/sec
EDV:2.7 cm/sec
PI:1.349
RI:0.766

Central retinal vein shows
PSV:6.2cm/sec
EDV:1.8 cm/sec
PI:1.207
RI:0.714

CASE:3-DIABETIC WITH RETINOPATHY



Opthalmic artery in a patient with diabetic retinopathy
PSV:30.5 cm/sec
EDV:4.9 cm/sec
PI:2.428
RI:0.838

Central retinal artery in a diabetic patient with retinopathy
PSV :13.4 cm/sec
EDV :3.4 cm/sec
PI :1.424
RI :0.750

Central retinal vein in a diabetic patient with retinopathy
PSV:6.9 cm/sec
EDV:3.4 cm/sec
PI:0.812
RI:0.514

Comparison of ophthalmic artery parameters across the study group:

Ophthalmic artery	Diabetic retinopathy Median (IQR)	Diabetic without retinopathy Median (IQR)	Non diabetic Median (IQR)	Kruskal Wallis test (P value)
PSV	32.90 (27.80 to 40.50)	31.25 (25.92 to 34.57)	30.90(29.67 to32.52)	0.347
EDV	5.20(4.10 to 7.40)	6.85(5.12 to8.47)	7.50(7.05 to 8.90)	<0.001
PI	2.04(1.73 to 2.30)	1.65 (1.45 to 1.87)	1.52 (1.36 to 1.55)	<0.001
RI	0.83 (0.79 to 0.87)	0.77(0.73 to 0.80)	0.75 (0.72 to 0.76)	<0.001

Comparison of central retinal artery parameters across the study group:

Central retinal artery	Diabetic retinopathy Median (IQR)	Diabetic without retinopathy Median (IQR)	Non diabetic Median (IQR)	Kruskal Wallis test (P value)
PSV	11.70 (7.97 to 15.45)	10.15 (8.57 to 14.05)	11(10.10 to 11.85)	0.343
EDV	2.20(1.80 to 3.23)	2.60 (2 to 3.63)	3.50 (2.80 to 4.02)	<0.001
PI	1.48(1.33 to 1.74)	1.46 (1.30 to 1.74)	1.35 (1.22 to 1.55)	<0.001
RI	0.77 (0.73 to 0.84)	0.76(0.71 to 0.82)	0.67 (0.63 to 0.73)	<0.001

Comparison of median values in central retinal vein across the study group:

Central retinal vein	Diabetic retinopathy Median (IQR)	Diabetic without retinopathy Median (IQR)	Non diabetic Median (IQR)	Kruskal Wallis test (P value)
PSV	8 (6 to 10.10)	7.60 (5.60 to 9.22)	5.50(5 to 8.52)	<0.001
EDV	3.90 (2.90 to 5.20)	3.90 (3 to 4.77)	3.55 (3.17 to 4.32)	0.727
PI	0.74 (0.49 to 0.98)	0.60 (0.43 to 0.88)	0.47 (0.38 to 0.75)	0.001
RI	0.50 (0.39 to 0.60)	0.46(0.35 to 0.58)	0.37 (0.30 to 0.54)	0.002

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