Original Research Article

OCULAR DUPLEX DOPPLER SONOGRAPHY AND ITS ROLE IN EARLY DIAGNOSIS OF DIABETIC RETINOPATHY

ABSTRACT:

Diabetic retinopathy is the most common cause of vision loss among people with diabetes and a leading cause of blindness among working-age adults in India. It is a form of microangiopathy, and is the most common ocular complication seen in diabetic patients.Diabetic retinopathy progresses from non proliferative to proliferative retinopathy. Non proliferative retinopathy is a milder form, and it is reversible. With the progression to proliferative retinopathy, the damage become irreversible, and patients turn symptomatic. Vascular changes and subsequent ocular hemodynamic changes are critical events in the pathogenesis of diabetic retinopathy. Colour doppler imaging is one of the most widely used and well-established techniques for assessing ocular blood flow velocities in the retro bulbar vessels. This is a non-invasive, painless imaging method with high reproducibility. Estimation of orbital blood flow velocity from colour doppler imaging of the ophthalmic artery and central retinal artery is a technique offering great potential for the identification of early retinopathy in diabetic patients.

KEYWORDS: Diabetic retinopathy, non proliferative retinopathy, proliferative retinopathy, Colour doppler imaging, orbital blood flow velocity, ophthalmic artery, central retinal artery, ophthalmoscopy, ocular doppler,

ABBREVIATIONS: PI - Pulsatility index, RI – Resistive index, PSV – Peak systolic velocity, EDV – End diastolic velocity, NPDR – Non proliferative diabetic retinopathy, PDR - Proliferative diabetic retinopathy. T2DM – Type 2 Diabetes Mellitus.

INTRODUCTION

Diabetic retinopathy is the most common cause of vision loss among people with diabetes and a leading cause of blindness among working-age adults in India. It is a form of microangiopathy, and is the most common ocular complication seen in diabetic patients[2].

The early stages of diabetic retinopathy usually have no symptoms. Diabetic retinopathy generally appears after several years of diabetes over an average of 5–10 years; often it goes unnoticed until vision loss occurs[3-6]. Early detection, timely treatment, and appropriate follow-up care of diabetic eye disease can protect against vision loss.

Diabetic retinopathy progresses from non proliferative to proliferative retinopathy. The non proliferative retinopathy is the milder form and it is reversible. As the disease progresses to proliferative retinopathy, patients become symptomatic, and the changes become irreversible[7].

Vascular changes and subsequent ocular hemodynamic changes are critical events in the pathogenesis of diabetic retinopathy.

Prevention of diabetic retinopathy is by regular examinations, treatment and control of blood sugar levels. With strict glycemic control there is good chance for prevention of diabetic retinopathy. Definitive surgery or interventions are done only in the last /tertiary stage of management by surgery like Pars plana vitrectomy or less invasive procedures like laser photocoagulation (done as outpatient basis). These are recommended for significant macular edema in high-risk proliferative diabetic retinopathy. Laser therapy is used to seal the leaking blood vessels, reduce retinal oxygen demand and therefore reduce neovascularisation. Microsurgical procedures like vitrectomy can remove vitreous haemorrhages if present.

There are also newer developments in treating retinopathy by use of anti-vascular endothelial growth factors, useful in treating both macular edema and proliferative retinopathy.

Colour doppler imaging is one of the most widely used and well-established techniques for assessing ocular blood flow velocities in the retro bulbar vessels. This is a non-invasive, painless imaging method with highly reproducibility.

Estimation of orbital blood flow velocity from colour doppler imaging of the ophthalmic artery and central retinal artery is a technique offering great potential for the identification of early retinopathy in diabetic patients.

AIMS AND OBJECTIVES

1. To evaluate hemodynamic changes of ophthalmic artery and central retinal artery

2. To compare the hemodynamic changes of ophthalmic artery and central retinal artery of diabetic patients with non proliferative retinopathy and controls.

3. To compare the hemodynamic changes of ophthalmic artery and central retinal artery of diabetic patients with proliferative retinopathy and controls

4. To compare the hemodynamic changes of ophthalmic artery and central retinal artery of diabetic patients with non proliferative retinopathy and patients with proliferative retinopathy.

MATERIALS AND METHODS

Patients with Type 2 Diabetes Mellitus (T2DM) presenting to Saveetha Medical College and Hospital, a tertiary care hospital and teaching institute located in Thandalam, Chennai, Tamil Nadu, India were included in this cross sectional study. The diagnosis of T2DM was made using the latest ADA guidelines [8]. An institutional review board clearance was obtained. A written informed voluntary consent was obtained from all the study subjects.

A total of 15 nondiabetic healthy volunteers (30 eyes) were assessed to interpret the normal ocular hemodynamic values and fundus examinations of the eyes were done.

A further random 50 eyes of 25 diabetic patients with and without visual complaints were studied to assess the ocular hemodynamic changes in doppler imaging and fundus examination of the eyes was done for classification of the retinopathy if any. Both the eyes were taken for the study, thus accounting for 50 pathological cases. The total number of examined eye was 80.

Inclusion criteria

- Diabetic patients with and without visual complaints were included in the study.
- Diabetic retinopathy patients under follow up were included.
- Diabetics of long duration (> 10-15 yrs as diabetic retinopathy is a long term vascular complication of T2DM)

Exclusion criteria

- Cataract
- Glaucoma
- Hypertension
- Juvenile diabetes
- Previous history of eye trauma or surgery
- Total or partial blindness.
- Diabetes Mellitus induced by pregnancy.

Male and female patients with diabetes for more than 2 years and after being clinically evaluated were included in the study. The patients were referred from Department Of Medicine of our hospital for Doppler evaluation and sent to department of ophthalmology for fundus examination.

The sensitivity, range of curve, specificity, positive predictive value and negative predictive value were calculated.

Statistics: Percentage analysis, Chi Square test, ANOVA.

OCULAR DOPPLER:

An informed consent was obtained prior to the study after explaining the procedure of the examination to the patient. The examinations were carried out in a Philips affinity USG machine. The patient was asked lie down in supine position on the examination bed.

To perform the ultrasound measurement of OA and CRA, transducer with frequency range of 5-10 MHz was used for this study. A blob of gel was applied to the closed eyelid, and the probe was positioned gently with minimal pressure. The ophthalmic artery was identified as a large calibre vessel adjacent to the optic nerve and adjacent small calibre laterally placed vessel was the central retinal.

Pulsed doppler spectral analysis of the ophthalmic artery and central retinal artery allows the determination of peak systolic velocity and end-diastolic velocity.

Indices of Measurement:

(1) Resistance index

(2) Pulsatility index

(3) Peak systolic velocity

(4)End diastolic velocity

Resistive Index is not altered by the angle of doppler since it is a ratio, but V_{max}& V_{min} are altered by the angle of doppler. Resistive index is a useful measure to study the difference between various groups of patients & also avoid any interobserver bias.

The resistive index and pulsatility index are classical indices of vascular resistance. They were calculated as follows:

Resistive index (RI) = (PSV-EDV) / PSV (peak systolic velocity - end diastolic velocity) / peak systolic velocity

Pulsatility index (PI) = (PSV - EDV) / TAV (peak systolic velocity - end diastolic velocity) / time averaged velocity

FUNDUS EXAMINATION:

For the fundus examination, the pupil of the eye was first dilated. Tropicamide drops (30%) were used for dilatation and after 30 minutes the fundus study was carried out. The eyes were examined in a split lamp using 90 dioptre lens and fundus was examined for macular edema /haemorrhage / microaneurysms / cotton wool spots/ exudates / venous beading/ neovascularisation or all of the above. After examination the retinopathy was classified as either non proliferative type or proliferative type.

After documentation of the hemodynamics and the fundus imaging, a conclusion was made with the help of statistical analyses.

IMAGES

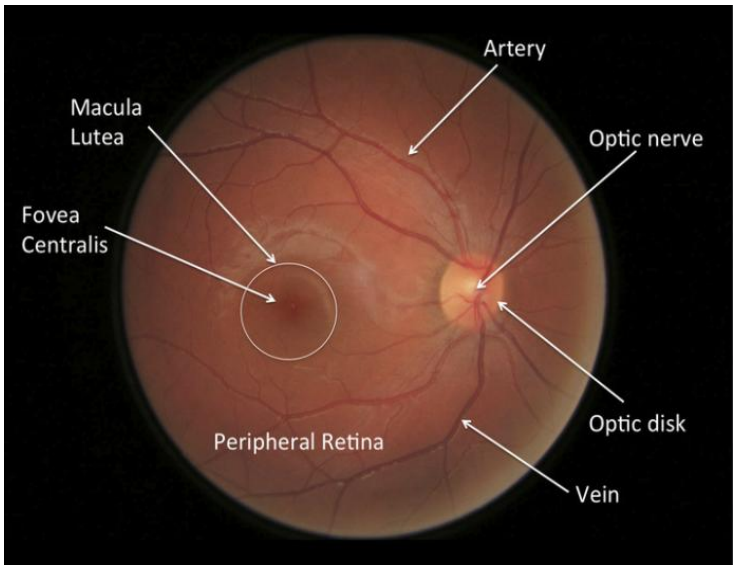


FIG 1:NORMAL FUNDUS IMAGE OF EYE

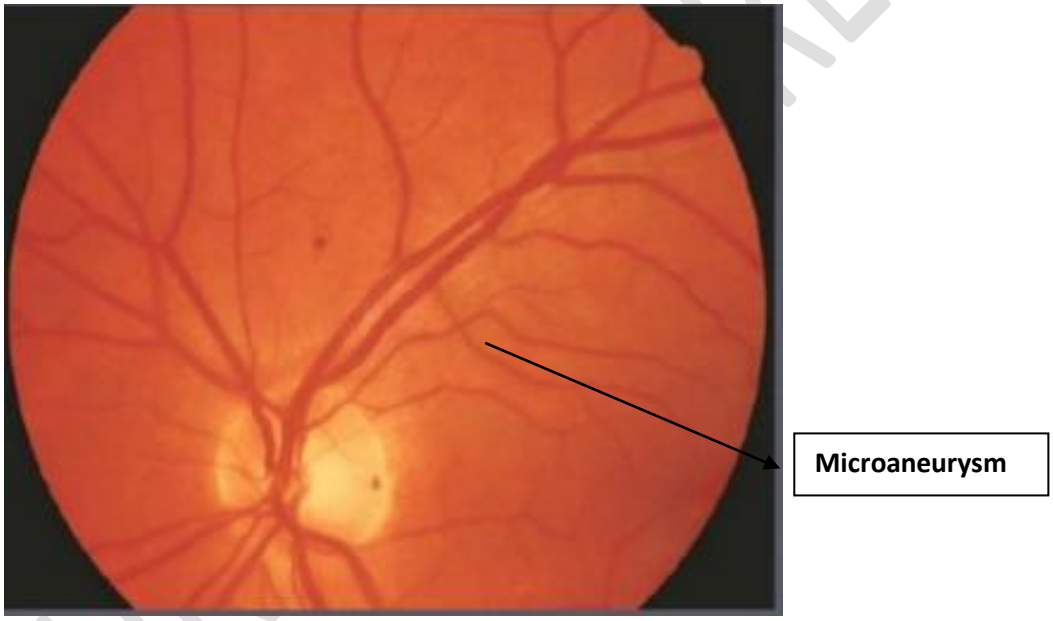


FIG 2:MICROANEURYSM IN EARLY NON PROLIFERATIVE RETINOPATHY

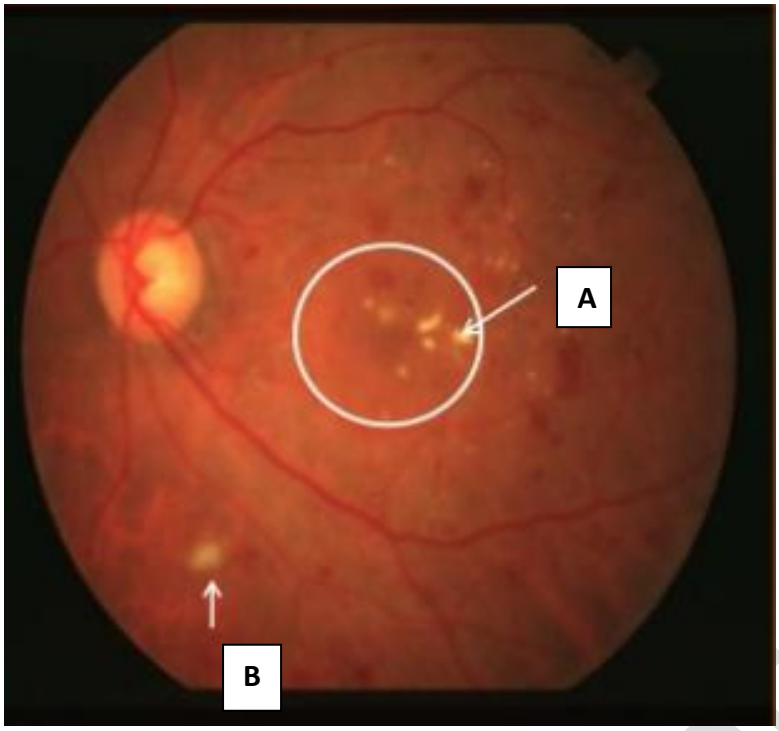


FIG 3:EXUDATES IN NON PROLIFERATIVE RETINOPATHY
A - Hard exudates
B – Soft exudates or cotton wool exudates

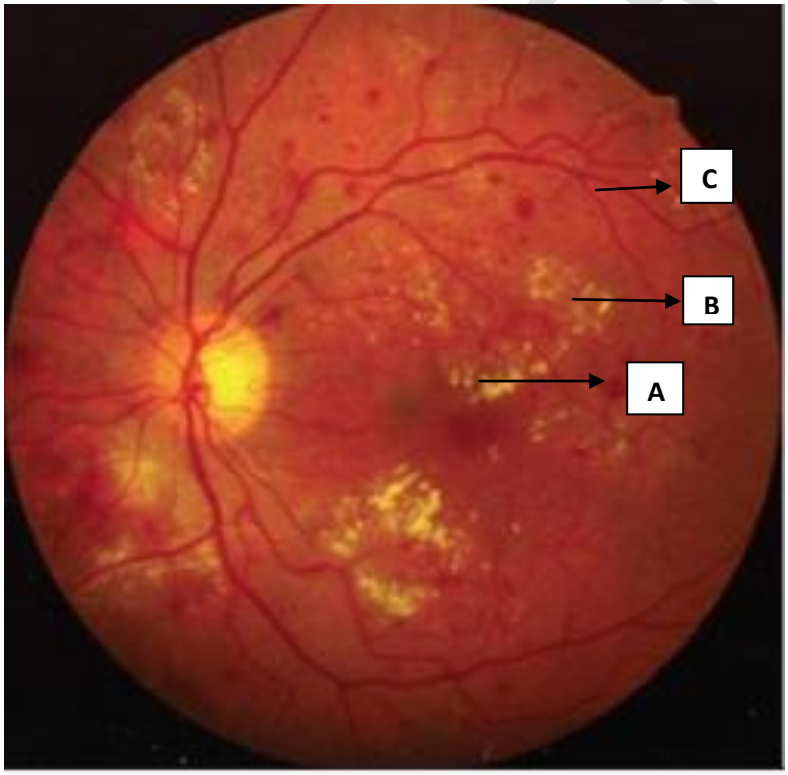


FIG 4:MACULAR EDEMA WITH EXUDATES AND HAEMORRHAGE IN NOPROLIFERATIVE DIABETIC RETINOPATHY
A - Macular edema
B – Hard exudates
C – Micro haemorrhages

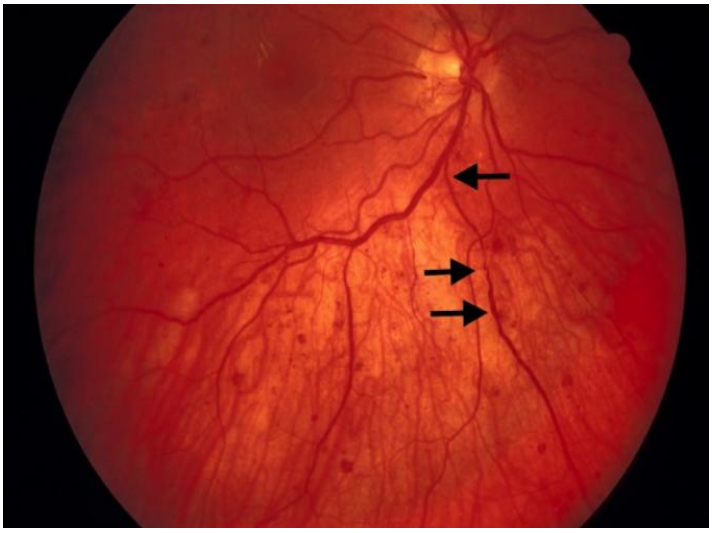


FIG 5:VENOUS BEADING IN SEVERE NON PROLIFERATIVE DIABETIC RETINOPATHY

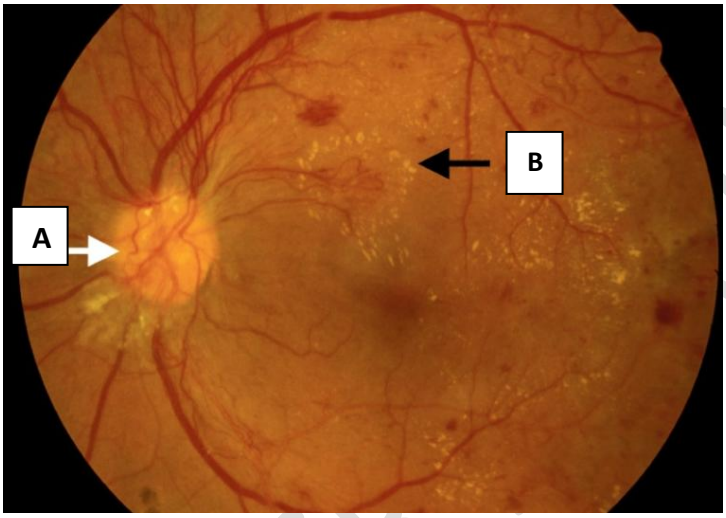
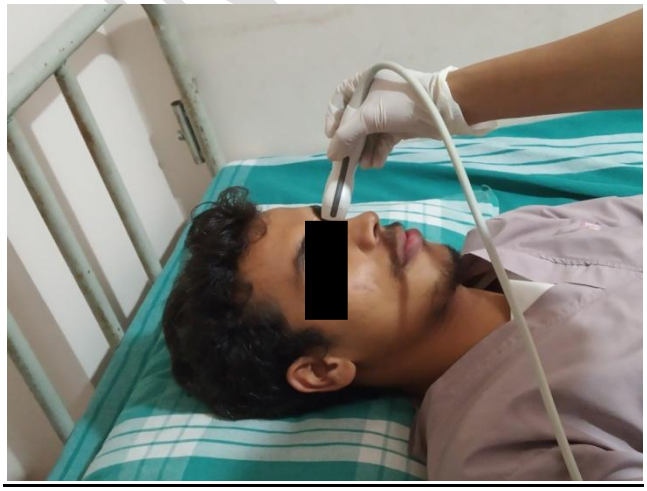


FIG 6:PROLIFERTATIVE DIABETIC RETINOPATHY
A – Neovascularization overlying the optic disc
B – Hard exudates

<u>TRANSPALPEBRAL ULTRASOUND – COLOUR DOPPLER IMAGING OF OCULAR VESSELS IN A NORMAL SUBJECT</u>



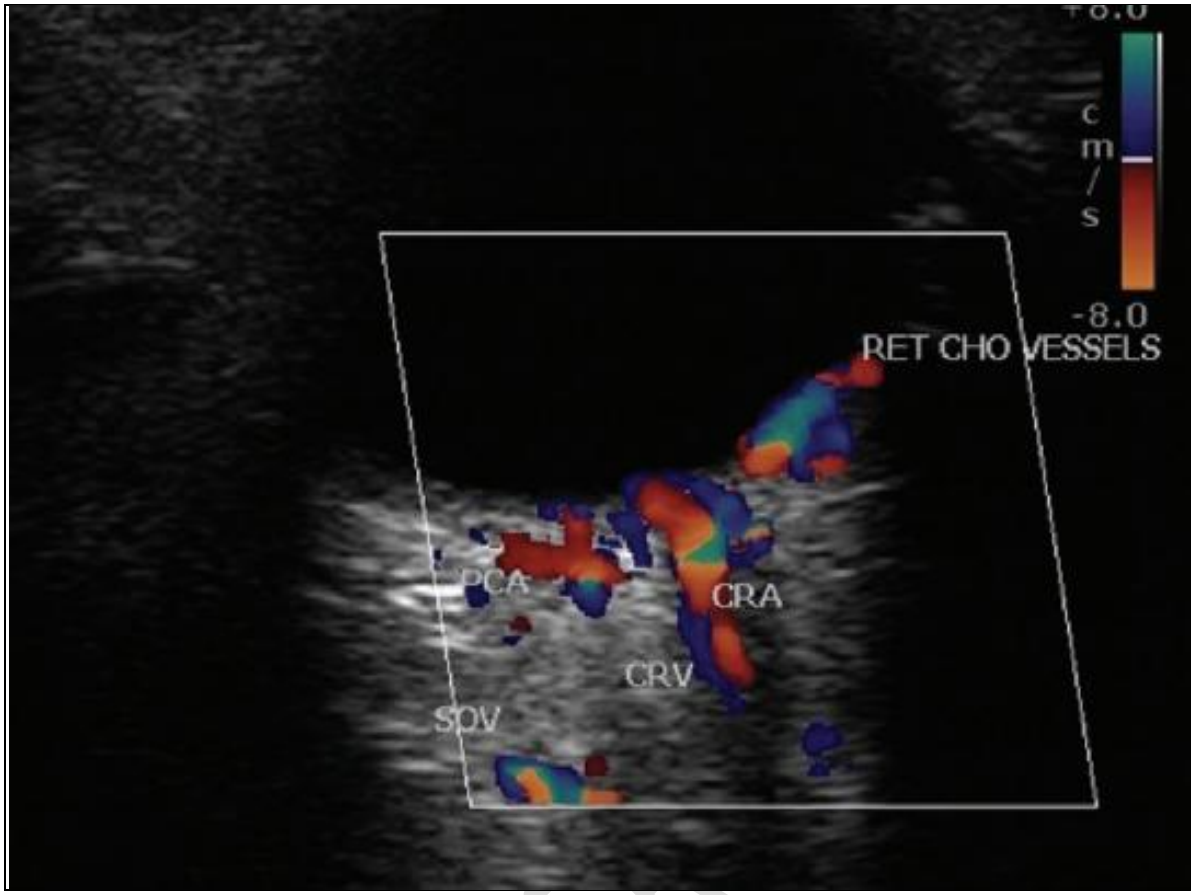


FIG 7:ANATOMIC LOCATION OF OCULAR VESSELS IN A NORMAL SUBJECT
(CRA: central retinal artery, PCA: posterior ciliary artery, CRV: Central retinal vein, SOV: Superior ophthalmic vein)

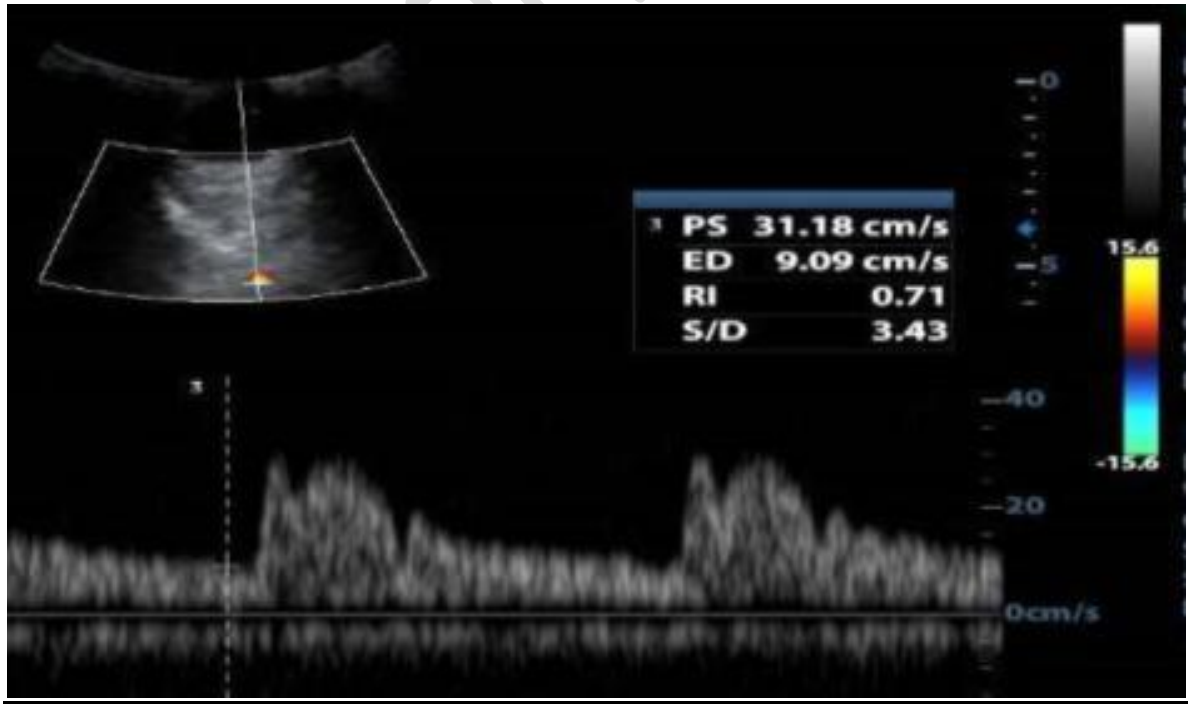


FIG 8:OPHTHALMIC ARTERY - NORMAL

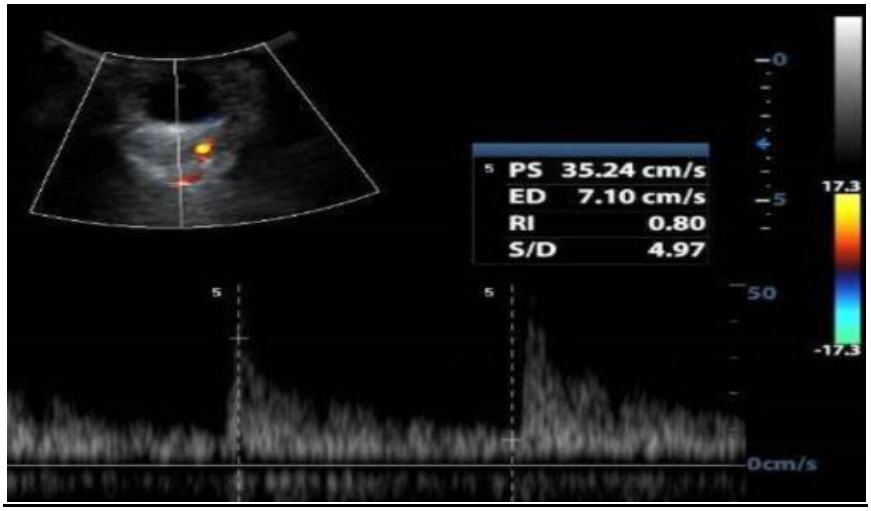


FIG 9:OPHTHALMIC ARTERY – DIABETIC RETINOPATHY

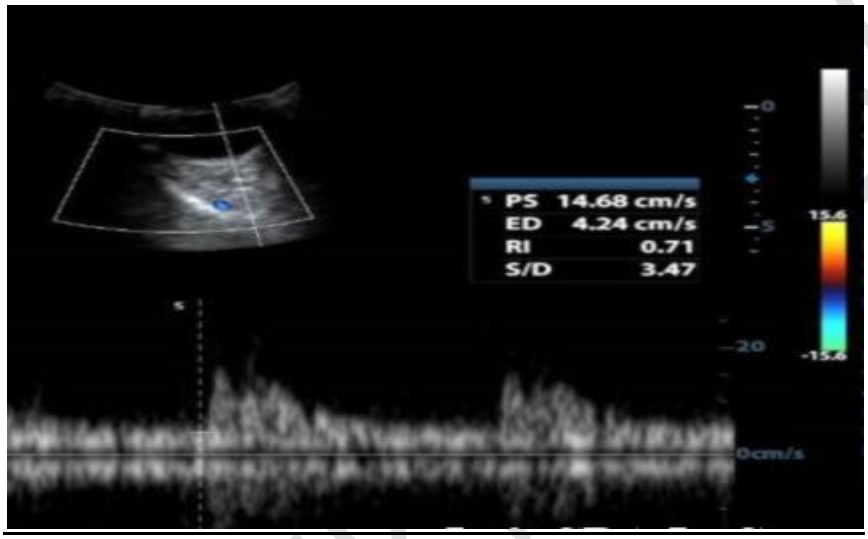


FIG 10:CENTRAL RETINAL ARTERY - NORMAL

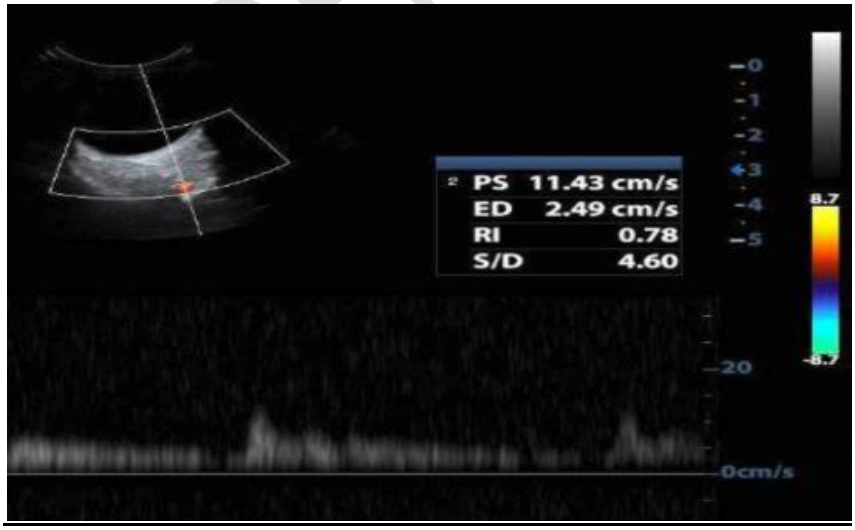


FIG 11:CENTRAL RETINAL ARTERY – DIABETIC RETINOPATHY

OBSERVATIONS AND RESULTS:

Table 1: Age Distribution

Age in years	No. of Cases	Percentage
30-50 years	12	24%
>50 years	38	76%
Total	50	100%

Most of patients were more than >50 years (76%). 24% of patients were between 30-50 years old.

Table 2: Sex Distribution

Sex	No. of Cases	Percentage
Male	30	60%
Female	20	40%
Total	50	100%

Most of patients were males (60%). 40% of patients were females.

Table 3: Duration of Diabetes

Duration of Diabetes	No. of Cases	Percentage
<10 years	24	48%
>=10 years	26	52%
Total	50	100%

In our study, 52% of patients had diabetes more than 10 years and 48% of patients had diabetes less than 10 years.

Table 4: Visual Complaints

Visual Complaints	No. of Cases	Percentage
Yes	24	48%
No	26	52%
Total	50	100%

48% of patients had visual complaints and 52% of patients didn't have visual complaints.

Table 5: Examined Side

Examined Side	No. of Cases	Percentage
Left	25	50%
Right	25	50%
Total	50	100%

Half of the patients were examined on left side and other half of the patients were examined on right side.

Table 6: Fundus examination results of diabetic patients.

Fundoscopy	No. of Cases	Percentage
Normal	2	4%
Non proliferative retinopathy	36	72%
Proliferative retinopathy	12	24%
Total	50	100%

The result shows that most of patients had non proliferative diabetic retinopathy. (72%). 4% of diabetic patients had no diabetic retinopathy and 24% of patients had proliferative retinopathy.

Fig. 12 : Fundus examination results of diabetic patients

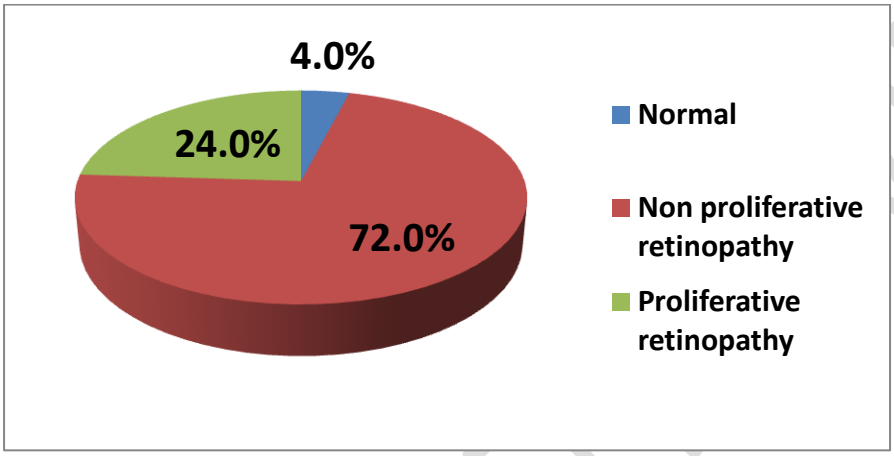


Table 7: Comparison of clinical parameters between ophthalmic artery and central retinal artery groups

Clinical Parameters		Mean±SD	't' value	P value
Peak systolic velocity (cm/sec)	Ophthalmic Artery	33.3394±0.7686	210.619	<0.001*
	Central Retinal Artery	11.8042±0.4698		
End diastolic velocity (cm/sec)	Ophthalmic Artery	6.4762±0.5927	37.023	<0.001
	Central Retinal Artery	3.3602±0.1871		
Resistivity index	Ophthalmic Artery	0.8055±0.0197	28.744	<0.001*
	Central Retinal Artery	0.71±0.019		
Pulsatility index	Ophthalmic Artery	1.7525±0.0904	30.781	<0.001*
	Central Retinal Artery	1.3738±0.0701		

***-Significant**

The paired 't' test result showed that peak systolic velocity, end diastolic velocity, resistivity index and pulsatility index values were significantly lower in central retinal artery group when comparing to ophthalmic artery group (p<0.001*).

Table 8: Correlation between age and fundoscopy results of patients with diabetes

			Fundoscopy			Total
			Normal	Non proliferative retinopathy	Proliferative retinopathy	
Age in years	30-50 years	Count	0	10	2	12
		% within Age in years	.0%	83.3%	16.7%	100.0%
	>50 years	Count	2	26	10	38
		% within Age in years	5.3%	68.4%	26.3%	100.0%
Total		Count	2	36	12	50
		% within Age in years	4.0%	72.0%	24.0%	100.0%

Chi-Square Value = 1.267 P value = 0.531 Not Significant

The chi-square test shows that there is no significant correlation between age in years and fundoscopy results in patients with diabetes (p=0.531). The inference is that age does not affect the progress of retinopathy.

Table 9: Correlation between sex and fundoscopy results of patients with diabetes

			Fundoscopy			Total
			Normal	Non proliferative retinopathy	Proliferative retinopathy	
Sex	Male	Count	2	21	7	30
		% within Sex	6.7%	70.0%	23.3%	100.0%
	Female	Count	0	15	5	20
		% within Sex	.0%	75.0%	25.0%	100.0%
Total		Count	2	36	12	50
		% within Sex	4.0%	72.0%	24.0%	100.0%

Chi-Square Value = 1.389 P value = 0.499 Not Significant

The chi-square test shows that there is no significant correlation between sex and fundoscopy in patients with diabetes (p=0.499). Sex does not play a role in severity or progression of retinopathy.

Table 10: Correlation between examined side and fundoscopy results of patients with diabetes

			Fundoscopy			Total
			Normal	Non proliferative retinopathy	Proliferative retinopathy	
Examined Side	Left	Count	1	19	5	25
		% within Examined Side	4.0%	76.0%	20.0%	100.0%
	Right	Count	1	17	7	25
		% within Examined Side	4.0%	68.0%	28.0%	100.0%
Total		Count	2	36	12	50
		% within Examined Side	4.0%	72.0%	24.0%	100.0%

Chi-Square Value = 0.444 P value = 0.801 Not Significant

The chi-square test shows that there is no significant correlation between examined side and fundoscopy in patients with diabetes (p=0.801).

Table 11: Mean and SD of clinical parameters with respect to fundoscopy results in patients with diabetes

OPHTHALMIC ARTERY		n	Mean	Std. Deviation	Std. Error
Peak systolic velocity (cm/sec)	Normal	2	34.8200	0.42426	0.30000
	Non proliferative retinopathy	36	32.1064	0.58479	0.09746
	Proliferative retinopathy	12	31.1250	0.79215	0.22867
	Total	50	33.3394	0.76867	0.10871
End diastolic velocity (cm/sec)	Normal	2	7.0750	0.26163	0.18500
	Non proliferative retinopathy	36	6.5964	0.60357	0.10060
	Proliferative retinopathy	12	6.0158	0.23608	0.06815
	Total	50	6.4762	0.59268	0.08382
Resistive index	Normal	2	.784361	0.0107592	0.0076079
	Non proliferative retinopathy	36	.800678	0.0188383	0.0031397
	Proliferative retinopathy	12	.823594	0.0087210	0.0025175
	Total	50	.805525	0.0197086	0.0027872
Pulsatility index	Normal	2	1.653464	0.0477967	0.0337974
	Non proliferative retinopathy	36	1.729528	0.0846688	0.0141115
	Proliferative retinopathy	12	1.838115	0.0437201	0.0126209
	Total	50	1.752546	0.0904402	0.0127902

The hemodynamic values of ophthalmic artery are obtained. The above table shows that the peak systolic velocity and pulsatility index resistive index are increased in retinopathy. The mean cut off value of resistive index in proliferative diabetic retinopathy being more than 0.82. There is decrease in end diastolic velocity and peak systolic velocity, normal end diastolic velocity being 7cm/sec, non proliferative retinopathy is 6.5cm/sec and proliferative diabetic retinopathy being 6cm/sec.

Table 12: Association between ophthalmic artery clinical parameters and fundoscopy result in patients with diabetes

OPTHALMIC ARTERY		Sum of Squares	DF	Mean Square	F	Sig.
Peak systolic velocity (cm/sec)	Between Groups	9.900	2	4.950	12.212	0.000*
	Within Groups	19.052	47	0.405		
	Total	28.952	49			
End diastolic velocity (cm/sec)	Between Groups	3.780	2	1.890	6.614	0.003*
	Within Groups	13.432	47	0.286		
	Total	17.212	49			
Resistive index	Between Groups	0.006	2	0.003	9.945	0.000*
	Within Groups	0.013	47	0.000		
	Total	0.019	49			
Pulsatility index	Between Groups	0.127	2	0.063	10.847	0.000*
	Within Groups	0.274	47	0.006		
	Total	0.401	49			

***-Significant**

Between groups- between diabetic and non diabetic patients

Within groups – between non proliferative and proliferative diabetic retinopathy

The ANOVA test results shows that there is a significant difference in mean values of ophthalmic artery with respect to the fundoscopy results in patients with diabetes ($p<0.001$*). There is evidence of mean increase in pulsatility index and resistive index of ophthalmic artery and decrease in end diastolic velocity and peak systolic velocity.

Table 13: Mean and SD of clinical parameters with respect to fundoscopy results in patients with diabetes

CENTRAL RETINAL ARTERY		n	Mean	Std. Deviation	Std. Error
PSV (cm/sec)	Normal	2	12.3800	0.09899	0.07000
	Non proliferative retinopathy	36	11.6675	0.40005	0.06668
	Proliferative Retinopathy	12	11.2017	0.30337	0.08758
	Total	50	11.8042	0.46982	0.06644
EDV (cm/sec)	Normal	2	3.3250	0.02121	0.01500
	Non proliferative retinopathy	36	3.2239	0.17508	0.02918
	Proliferative retinopathy	12	3.1750	0.08660	0.02500
	Total	50	3.3602	0.18713	0.02646
Resistive index	Normal	2	0.70	0.000	0.000
	Non proliferative retinopathy	36	0.710	0.013	0.002
	Proliferative retinopathy	12	0.720	0.024	0.007
	Total	50	0.715	0.019	0.003
Pulsatility index	Normal	2	1.336916	0.0160558	0.0113532
	Non proliferative retinopathy	36	1.342211	0.0426490	0.0071082
	Proliferative retinopathy	12	1.475052	0.0372234	0.0107455
	Total	50	1.373881	0.0701062	0.0099145

The hemodynamic values of central retinal artery are obtained. The hemodynamic changes were similar to that of ophthalmic artery in retinopathy. The peak systolic velocity and pulsatility index resistive index are increased in retinopathy. The mean cut off value of resistive index in proliferative diabetic retinopathy being more than 0.72, where the normal is 0.7 and non-proliferative retinopathy showed mean value of 0.71. There is decrease in end diastolic velocity and peak systolic velocity, normal end diastolic velocity being 3.3cm/sec, non proliferative retinopathy is 3.2cm/sec and proliferative diabetic retinopathy being 3.1cm/sec.

Table 14: Association between central retinal artery clinical parameters and fundoscopy result in patients with diabetes

CENTRAL RETINAL ARTERY		Sum of Squares	df	Mean Square	F	Sig.
PSV (cm/sec)	Between Groups	4.192	2	2.096	14.873	0.000*
	Within Groups	6.624	47	0.141		
	Total	10.816	49			
EDV (cm/sec)	Between Groups	0.560	2	0.280	11.388	0.000*
	Within Groups	1.156	47	0.025		
	Total	1.716	49			
Resistive index	Between Groups	0.005	2	0.002	9.107	0.000*
	Within Groups	0.013	47	0.000		
	Total	0.017	49			
Pulsatility index	Between Groups	0.162	2	0.081	47.993	0.000*
	Within Groups	0.079	47	0.002		
	Total	0.241	49			

***-Significant**

The ANOVA test results shows that there is a significant difference in mean values of central retinal artery with respect to the fundoscopy results in patients with diabetes ($p<0.001$*). There is evidence of mean increase in pulsatility index and resistive index of central retinal artery and decrease in end diastolic velocity and peak systolic velocity.

Table 15: The cut off values between non proliferative and proliferative retinopathy are as follows:

	RESISTIVE INDEX		**PULSATALITY INDEX**	
	OA	**CRA**	**OA**	**CRA**
NORMAL	**0.78**	**0.70**	**1.6**	**1.33**
NON PROLIFERATIVE RETINOPATHY	**0.80**	**0.71**	**1.7**	**1.34**
PROLIFERATIVE RETINOPATHY	**0.82**	**0.72**	**1.8**	**1.47**

DISCUSSION:

Using colour doppler imaging, the resistive indices of orbital vessels were measured in patients with diabetes mellitus and were found to be significantly greater than those of normal subjects and to be further increased in the presence of proliferative diabetic retinopathy. The resistive index has been used as a measure of vascular resistance in the artery as elucidated by Kanagaraju V, Divya K, Raajaganesh M, Devanand B et al [8]. The value of calculating the resistive Index has previously been highlighted by Khatri, M., Saxena, S., Kaur, A. *et al* [9], helping to give a more accurate and non-angle dependent measurement.

Khatri M, Saxena S, Kumar M, Chabbra AK et al [10] in their study proved that resistive index of central retinal artery is a bioimaging biomarker for severity of diabetic retinopathy. In the present study, the resistive index of ophthalmic and central retinal arteries in patients with diabetic retinopathy was significantly greater compared to normal subjects and was higher in proliferative diabetic retinopathy when comparted to non-proliferative diabetic retinopathy.

There is a significant difference in the end diastolic velocity and peak systolic velocity of ophthalmic artery and central retinal artery between patients with and without diabetic retinopathy. In patients with diabetic retinopathy it is seen that both end diastolic velocity and peak systolic velocity were statistically reduced. This was similar to the results of the study by Tamaki Y, Nagahara M, Yamashita H, Kikuchi M et al [11] .The end diastolic velocity and peak systolic velocity of central retinal artery in patients without diabetic retinopathy were higher in comparison to those with diabetic retinopathy. Goebel et al [12] in his study has proved that the resistive index of ocular arteries was increased in patients with diabetes when compared to the normal individuals. Our results agreed with this author.

In our study, the resistive index was increased in patients with diabetic retinopathy which was in concordance with the findings by Dimitrova et al [13] who also found significant increase of RI in patients with diabetic retinopathy when compared to the controls.

Mendívil, Antonio, Victoria Cuartero and Maria P. Mendívil et al [14] in their study have reported ocular colour doppler imaging findings of a mixed group of type I and type II diabetics with proliferative diabetic retinopathy after laser photocoagulation. Pan retinal photocoagulation resulted in reduction of the peak systolic velocity in ophthalmic artery when compared to values before laser treatment. This parameter could not be assessed in the current study as patients undergoing photocoagulation were not included in the study.

In the study conducted by Dimitrova et al [13], there was a reduction of blood flow velocity both in non-proliferative and proliferative retinopathy and the increase in resistive index was evident in central retinal artery and ophthalmic artery. The finding of the present study showed that the RI of CRA and OA in patients with and without retinopathy were significantly greater than those of normal individuals agrees with the results by Akal A, Ulas T, Goncu T et al in their study [15].

Diabetes Mellitus is a chronic multisystem endocrine disease with short- and long-term complications. One of the main long term complications causing significant reduction in quality of living is diabetic retinopathy and its spectrum, the others being nephropathy and neuropathy. As proved these vascular complications based on endothelial injury by glycation products start 5-10 years before someone is labelled diabetic as per the latest diagnostic criteria. Routine testing for the presence of nephropathy, retinopathy and neuropathy at the time of diabetes diagnosis is advocated. Retinopathy screening routinely employs fundoscopic and slit lamp examination which are quick, inexpensive and available in most facilities, whereas nephropathy screening usually involves a baseline sonography of abdomen to see renal anatomical status.

Though fundoscopy is cheap and effective, it can only detect anatomical changes in the blood vessels after it has occurred which are permanent and irreversible. They also cannot assess the functional status or real time blood flow within these vessels which can be done by ocular doppler. Colour doppler indices like PI and RI changes occur before definite anatomical changes. Also, Ocular sonography has the added advantage of diagnosing other posterior chamber pathologies associated with diabetes like retinal detachment, dense vitreous haemorrhage, choroidal neovascularisation, glaucoma and optic nerve head changes.

Though Ocular sonography needs expensive equipment and operator expertise, the benefit it offers should encourage more widespread use of it. Moreover, any tertiary care hospital offering holistic diabetes management will be equipped with necessary sonographic machinery for abdominal and vascular screening. In such cases, Ocular doppler and sonography needs only training of sonographers, radiologists and more patronage from referral departments.

These doppler imaging findings can predict the progression of diabetic retinopathy and proper lifestyle modifications and medications can be instituted early prevent the manifestation of disabling proliferative retinopathy.

LIMITATIONS:

Some limitations of the present study should be considered:
Sample size was relatively small.
Type 1 diabetics in whom retinopathy occurs in a much younger age were not be studied.
Posterior ciliary artery and superior ophthalmic vein were not imaged or studied.
Another potential limitation was operator-dependent nature of ultrasonography which makes it difficult for standardisation and universal use without training.
We have ruled out most of (but not all) the conditions like glaucoma and hypertension, previous intraocular surgeries which are etiopatholgical factors in causing ocular vasculopathy.

CONCLUSION:

The aim of this study is to evaluate hemodynamic changes of ophthalmic artery and central retinal artery in diabetic patients with diabetic retinopathy by comparing it with normal individuals and to find the cut off value between the non-proliferative diabetic retinopathy and proliferative diabetic retinopathy groups.

Using colour doppler imaging, blood flow velocities i.e., peak systolic velocity, end diastolic velocity, resistive index and pulsatility index were found in ophthalmic artery and central retinal artery for 80 eyes (30 controls and 50 tests). In this study, it is found that resistive index and pulsatility index is increased in both the vessels of patients with diabetic retinopathy. Peak systolic velocity and end diastolic velocity is decreased in both the orbital vessels in patients with diabetic retinopathy. Colour Doppler imaging can be used in evaluating the hemodynamic circulation in orbital vessels and is a useful modality to assess the progression of diabetic retinopathy when other techniques are inaccessible to these vessels. Measurements give reliable information on blood flow velocities at the sites of complex vasculature. Focussed training in ocular sonography and using it widespread screening of diabetic retinopathy will help in translating the results of the research into well timed therapeutic benefit.

COMPETING INTERESTS DISCLAIMER:

Authors have declared that no competing interests exist. The products used for this research are commonly and predominantly use products in our area of research and country. There is absolutely no conflict of interest between the authors and producers of the products because we do not intend to use these products as an avenue for any litigation but for the advancement of knowledge. Also, the research was not funded by the producing company rather it was funded by personal efforts of the authors.

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