

COLOR DOPPLER EXAMINATION OF OPHTHALMIC ARTERY IN NORMAL TENSION GLAUCOMA.

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Abstract:

Glaucoma can be defined as an optic nerve disease with typical morphological and functional changes. There are many risk factors associated with this neuropathy. The best known factor is an increased intraocular pressure there are however many other risk factors. Among them, vascular factors play a major role. Although such vascular factors have been postulated more than hundred years ago, it is only recently that the physiology and pathophysiology optic nerve head circulation is , to some extent, understood. Blood flow velocity in the extra-ocular vessels are reduced in patient with glaucoma. Reduced blood flow velocity may be secondary as well as contributory to glaucomatous damage. New instruments have been developed to measure ocular blood flow including blood flow in optic nerve head. Although most of the studies indicate that circulation is changed in glaucoma patients, there is little association between glaucoma seems rather to be a vascular deregulation leading to local vasospasm and to systemic hypotension.

Aim

In confirmed cases of normal tension glaucoma by disc and field changes were subjected to (1) measurement of peak systolic volume, end diastolic volume, systolic/diastolic ratio, resistance index, pulsitivity index of ophthalmic artery to know about perfusion of disc (2) measurement of blood pressure (3) measurement of blood sugar (4) refer to physician to rule out any, cardiac, vascular central nervous system and any other etiological problem.

Introduction to subject

Definition of normal tension glaucoma (1) mean IOP without treatment consistently less than 21 mm of Hg on diurnal variation test with no single measurement greater than 24 mm of Hg.(2) open drainage angle on gonioscopy (3) absence of secondary cause of a glaucomatous optic neuropathy e.g. trauma, steroid instillation(4) typical optic disc damage with glaucomatous cupping or loss of neuroretinal rim (5) vascular field defect compatible with glaucomatous cupping. Normal tension glaucoma is divided into two types (1) progressive (2) non progressive. No treatment is required in normal tension glaucoma patient who are stable. Treatment options: should be considered in patients who have progressive field defects or disc changes. Different authors have reported various rate of progression over various years: 40% - 10.5 years, 53% - at 3years, 62% - at 5 years. Prevalence of

normal tension glaucoma increased from 0.2% in 43-54 years age group to 1.6% in those over 75 years.

Etiological factors:

- (1) Role of abnormal blood flow: optic nerve blood vessels diameters may be affected by vasospastic element, which explains mechanism of damage in normal tension glaucoma in migraine, raynaud's phenomenon. Improvement in vasospasm by Ca^{++} channel blocker nifedipine give clues to improvement of visual field in some patients.
- (2) Role of systemic hypotension: decreased perfusion of disc in hypoglycemia.

Pathophysiology

Pathophysiology of normal tension glaucoma is still incompletely defined. Although height of IOP remains? mark for glaucomatous – optic nerve damage and field defects can virtually at any level of intra ocular pressure. Intra ocular pressure in normal tension glaucoma lies within normal limits, there is still suggestive factor that is a major ' risk factor ' for development of progression of disease.

Damage increases in increase IOP with in normal limits.

Vascular theory

Vasospasm causes inadequate perfusion of critical neural tissue leading to tissue death at optic nerve level based largely on circumstantial evidence including association of normal tension glaucoma with migraine. Does the pattern of optic disc cupping differ between normal tension glaucoma and POAG? Tezel's group looked at large number of patients with normal tension glaucoma and POAG found increased peripapillary atrophy but they acknowledged that this was probably due to relatively late presentation of this group of patient. Hemorrhage at disc was found more commonly with normal tension glaucoma group. Pit like changes were found in normal tension glaucoma group. Are visual field defect different in normal tension glaucoma and POAG? Levence considered that frequency of dense defect extending within 5 degree of fixation was higher in normal tension glaucoma group than POAG. Neurological evaluation is routinely not indicated in normal tension glaucoma group unless some neurological cause suspected producing optic disc cupping.

Color Doppler introduction

It is a variation on a standard Doppler technique called color flow Doppler or color Doppler ultrasound or color Doppler imaging. This technology combines a real time gray scale ultrasound image of anatomic structures with a super imposed color coded vascular flow. The results of this computer generated photographs of hemodynamic of small vessels. But at this stage of development smaller vessels cannot be measured. Color Doppler is usually used in ophthalmology for measuring flow in ophthalmic artery.

Methods and materials

32 eyes diagnosed as normal tension glaucoma on parameter for clinical diagnosis tonometry, disc changes, field changes, having mean age of 54 years are compared to same mean age group 10 eyes of controls with similar gender distribution and similar baseline intra ocular pressure and who are free of any disease. Criterias : PSV – peak systolic volume (meter/second), EDV – End diastolic volume (meter/second), S/D ratio, RI- Resistance index, PI- Pulsitivity index. Comparision of values were done among NTG and normal group. To examine the ophthalmic artery the sample volume segment along transmitted beam chosen for analysis was oriented nasally and superior to the optic nerve. Just lateral to and avoiding the visible hyporefective stripe representing the nerve. The sample volume marker lay about 25 mm posterior to the globe. Strong signals are routinely detectable at this site.

Results: Total : 32 eyes, NTG group: 22 eyes, Control group: 10 eyes.

(A) Sex distribution:

Sex	NTG group (no. of patients)	Percentage	Control group (no. of patients)	Percentage
Male	7	64	3	60
Female	4	36	2	40

(B) Age distribution:

Age (years)	NTG Group (no. of patients)	Percentage	Control group (no. of patients)	Percentage
45-55	3	27	1	20
56-65	4	36	2	40
66-75	4	36	2	40

(C) IOP distribution in study group (no. of eyes) (IOP taken by applanation tonometry):

IOP (mmHg)	NTG group (no. of Eyes)	Percentage	Control group (no. of Eyes)	Percentage
12.0	4	18	2	20
14.0	6	27	3	30
18.0	8	36	3	30
20.0	4	18	2	20

(D) C:D ratio changes among NTG group:

C:D ratio	NTG group (no. of eyes)	Percentage
0.5	6	27
0.6	4	18
0.7	6	27
0.8	3	14
0.9	2	09
Full cup	1	05

(E) Field defects among NTG group (no. of patients):

Type of field defect	No. of eyes	Percentage
Few absolute /relative scotomas	8	36

Superior zone defect	8	36
Both zone defects	2	09
Inferior zone defects	3	14
Temporal island	1	05

(F) NTG group predisposing factors:

Condition	No. of patients
Hypotension	5
Hypertension	2
Hypoglycemia	3
Sudden blood loss	1
Cardiac problems	1
DM	0

(G) Distribution of Doppler values in study groups (no. of eyes):

(A) Peak systolic velocity(PSV) (meter/second)

PSV (M/S)	NTG group (no. of eyes)	Percentage	Control group (no. of eyes)	Percentage
<0.10	2	09	0	0
0.10-15	6	27	0	0
0.16-20	4	18	0	0
0.21-25	6	27	3	30
0.26-30	2	09	4	40
>0.30	2	09	3	30

(B) End diastolic velocity (meter/second) (EDV):

EDV (M/S)	NTG group (no. of eyes)	Percentage	Control group (no. of eyes)	Percentage
0.03-0.06	12	55	0	0
0.07-0.09	6	27	0	0
0.10-0.12	2	09	5	50
0.13-0.15	2	09	5	50

(C) Resistance index (RI)

RI	NTG group (no. of eyes)	Percentage	Control group (no. of eyes)	Percentage
<0.50	1	05	0	0
0.51-60	3	14	7	70
0.61-70	8	36	3	30
0.71-80	8	36	0	0
0.81-90	2	09	0	0

(D) Mean values of Doppler study

Doppler criteria	NTG group	Control group	P value
PSV (M/S)	0.19 (M/S)	0.28(M/S)	>0.1
EDV(M/S)	0.06(M/S)	0.12(M/S)	>0.1
RI	0.68	0.55	>0.1
PI	1.21	1.41	>0.1

The 22 eyes in normal tension glaucoma group and 10 eyes in the control group were tested for significance by 'z' test. Both group had similar age and gender distribution. Baseline intraocular pressure was also similar in two groups. Color Doppler imaging of ophthalmic artery showed significantly reduced peak systolic velocity($P>0.1$) at baseline in normal tension glaucoma group. The end diastolic velocity was significantly reduced ($p>0.1$) at baseline in the ophthalmic artery in the normal tension glaucoma group. The calculated resistance index was significantly higher ($p>0.1$) in the ophthalmic artery in the normal tension glaucoma group at baseline. The pulsitivity index was significantly lower ($p>0.1$) in the ophthalmic artery in the normal tension glaucoma group at baseline.

Conclusion

- (A) We conclude that increased resistance index, decreased peak systolic velocity, end diastolic velocity and pulsitivity index of ophthalmic artery in NTG group proves vascular theory of NTG.
- (B) This indirect evidence of vasospasm in the orbital vascular bed in patients with normal tension glaucoma, may have implications for treatment of this disease. For example interventions that directly provoke vasodilatation or limit vasospasm, might conceivably be therapeutic.

(C) In some cases such as hypotension, hypoglycemia and sudden blood loss may play role in development of normal tension glaucoma which produces temporary lowering of blood perfusion in optic nerve which remains as a non- progressive damage to disc and field. That is why normal tension glaucoma is divided into progressive and non- progressive group.

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