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PERIPAPILLARY RETINAL NERVE FIBRE LAYER THICKNESS IN PATIENTS WITH IRON DEFICIENCY ANEMIA

Ophthalmology

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ABSTRACT

Purpose: With optical coherence tomography (OCT) evaluate the effect of iron deficiency anemia (IDA) on peripapillary retinal nerve fiber layer(RNFL) thickness

Settings and Design: Prospective, Non-Randomized and Observational Study

Materials and Methods: 112 female patients who had Iron deficienyanemia(IDA) (hemoglobin less than 11 g/dl, serum transferrin saturation less than 15%, serum iron less than 50 µg/dl, and serum ferritin less than 15 µg/dl) were included in the study. Optic disc and RNFL parameters obtained by Cirrus OCT 4000 were compared with those of 47 age and sex-matched non anemic persons. The time between blood analysis and OCT measurements was 3.14 ± 5.5 (range, 0–25) days in the anemia group, and 3.5 ± 6.7 (range, 0–25) days in the control group (P=0.76).

Results: Average ages of 112 patients and 49 control subjects were 35.76 ± 10.11 (range, 18–65) years, and 36.08 ± 8.416 (range, 19–58) years (P = 0.850), respectively. The average RNFL thickness was 94.67 ± 9.39 in the anemia group, and 100.22 ± 9.12 in the control group (P = 0.001). In Nasal, temporal, and lower quadrant average RNFL thicknesses of IDA group were thinner than the control group (P = 0.001, P = 0.013, P = 0.008). Upper quadrant RNFL thicknesses in both groups were similar. Correlation analysis shows positive correlation between hemoglobin and mean RNFL thickness (r = 0.273), ferritin (r = 0.163), iron (r = 0.177), and transferrin saturations (r = 0.185), and second site a negative correlation was found between total iron binding capacity (r = −0.199) and mean RNFLthickness.

Conclusions: In adult female patients with Iron deficiency anemia(IDA) Peripapillary RNFL thickness which measured by OCT is thinner. It may have a significant effect on the management of many disorders like glaucoma and neuro ophthalmological diseases.

KEYWORDS

Iron deficiency anemia, optical coherence tomography, peripapillary retinal nerve fiber layer thickness

INTRODUCTION

Anemia is a globally public health problem, and most common cause of anemia is iron deficiency.[1] It may have harmful effects in patients with different ocular diseases through enhancement of effects of ischemia. Retina requires regular oxygen supply so to maintain its Functional and structal integrity.[2] Inner retinal layers, which receive their blood supply from deep and superficial capillary plexus of the central retinal artery, are more vulnerable to hypoxic alterations.[3] Retinal ischemia, is a significant component of many visual disorders, has a significant role in development and progression of eye diseases such as diabetic retinopathy, glaucoma, retinal vascular occlusion and retinopathy of prematurity. Hypoxia causes neuronal death. Retinal ganglion cells are known to be damaged by a reduction in normal perfusion and oxygen saturation.[4] Oligodendrocytes, require iron for the achievement of their normal functions.[5] Other cerebral cells, specifically higher concentrations of iron-containing enzymes have been found in oligodendrocytes.[6] Decrease in iron content during a certain period of rapid myelination can inhibit normal functioning of oligodendrocytes and prevent the development of myelination process. [5,7] On other side, irrespective of the iron status of the affected individuals previous studies shows that brain functions revealed with improvement of anemia in patients with chronic renal disease [8] Iron deficiency also been associated with dopaminergic dysfunction.[9] Deficiency of retinal dopaminergic dysfunction is thought to alter receptive area of axons and ganglion cells, which constitute retinal nerve fiber layer (RNFL).[10] RNFL thickness measurement provides important clinical information for determination and differential diagnosis of diseases of optic nerve.*I*n various types of ischemic retinal diseases, decreased thickness of RNFL has been demonstrated.[11-16] Reduction in RNFL thickness has been shown in diabetic patients based on optical coherence tomography (OCT) measurements.[11-14] Thinning of macular and peripapillary RNFL in central or branch retinal artery occlusions have been noticed.[15] In a study on patients with sickle cell anemia, focal macular thinning and thinner peripapillary RNFL on spectral-domain OCT (SD-OCT) was reported.[16] Thinner RNFL was also shown in pediatric patients with anemia.[17,18] In this study, our aim is to evaluate the effect of iron deficiency anemia(IDA) patients on peripapillary RNFL thickness in adults with OCT.

MATERIALS AND METHODS

Study setting:

This study was conducted in Department of Ophthalmology, Dhiraj Hospital SBKS MI&RC,Piparia,Vadodara from August 2020 to November 2020

Study selection Criteria:

INCLUSION CRITERIA:

- Female patients
- Subject with IDA
- Willing to participate in study

EXCLUSION CRITERIA:

- Patients having lenticular or other ocular media opacities
- History of ocular trauma or intraocular operation
- Glaucoma,uveitis,myopia or hyperopia over 4.0 diopters, amblyopia retinal disorders
- Intraocular pressure higher than 20 mmHg

Study design:

Prospective, Non-Randomized and Observational Study

This study was conducted in Department of Ophthalmology, Dhiraj Hospital SBKS MI&RC,Piparia,Vadodara. The study has been conducted according with the principles of the Helsinki Declaration Consecutive patients who presented to the outpatient clinic were evaluated, and 112 female patients who fulfilledthe inclusion criteria were enrolled in the study. Iron deficiency anemia(IDA) was

diagnosed when serum hemoglobin was less than 12 g/dl, serum transferrin saturation less than 15%, serum iron less than 50 µg/dl, and serum ferritin less than 15 µg/dl. Patients with BCVA, lenticular or other ocular media opacities, history of ocular trauma or intraocular operation, glaucoma,uveitis,myopia or hyperopia over 4.0 diopters, amblyopia, retinal disorders,or intraocularpressure higher than 20 mmHg were excluded. The control group was composed of age 48 and sex-matched nonanemic patients. The time between blood analysis and OCT measurements was 3.14 ± 5.6 (range, 0–27) days in the anemia group, and 3.5 ± 6.8 (range, 0–28) days in the control group (*P* = 0.76).

After obtaining ethics approval from the institutional ethics committee, the patients were enrolled in our study

Outcome parameters

RNFL thickness was obtained with optic disc cube 200 × 200 scan Protocol. Best scan with a signal strength more than 7 was used for the analysis. Average, Nasal,temporal, superior and inferior quadrant RNFL measurements were noted. Right eye values of the participants were used for statistical analysis.

Statistical analysis

Data were decided using the Statistical Package for Social Sciences 21.0 for windows. Independent samples t-test was used for data with normal distribution, and Mann–Whitney U-test was employed for those without normal distribution.

Correlation analysis was performed with Spearman's correlation test. All differences linked with a chance probability of 0.04 or less were considered statistically significant.

RESULTS

Among patients screened,112 cases with Iron deficiency anemia(IDA) were included in the study. No attempt was madeto determine the duration of iron deficiency anemia(IDA) asreliable information was not provided by the majority of the patients. Average ages of 112 patients, and 49 control subjects were 35.76 ± 10.112 (range, 18–65) years, and 36.08 ± 8.42 (range, 19–58) years (P = 0.850), respectively. Mean IOP of iron deficiency anemia(IDA) and the control groups were 14.97 ±2.47 mm/Hg and 15.16 ± 2.45 mm/Hg (P = 0.654), respectively. The average C/D ratio, rim and disc area, and cup volumewere similar in both IDA and the control groups. The average RNFL thickness was 94.67 ± 9.38 in the anemia group, and 100.22 ± 9.12 in the control group (P = 0.001).Temporal, nasal, and lower quadrant average RNFL thicknesses of IDA group were thinner compare to the control group (P = 0.001,P= 0.013, P = 0.008). Difference between the upper quadrant RNFL thicknesses of the IDA and control group didn't reach statistical significance; 116.63 ± 14.39 µm and 121.71 ± 15.19 µm(*P* = 0.114), respectively. RNFL thickness values are presentedin Table 3. Correlation analysis revealed positive association between mean RNFL thickness and hemoglobin, iron, ferritin andtransferrin saturations, while a negative association was found between TIBC and mean RNFL thickness

Peripapillary retinal nerve fiber layer thicknesses of the groups

Peripapillary RNFL thickness in micro Meter	Anemic group (n = 112)	Control group (n=49)	P
Average	94.67+/-9.37	100.22+/-9.12	0.001
Temporal	64.61+/-10.98	70.31+/- 10.14	0.001
Superior	116.63+/- 14.39	121.71+/- 15.19	0.114
Nasal	72.17+/- 11.56	77.73+/-12.36	0.013
Inferior	125.06+/-16.44	132.57+/-15.67	0.008

DISCUSSION

Worldwide among the various type of anemia IDA is the most frequently seen type of anemia.[19] The prevalence of IDA is estimated to be 3–5% in women, and <1% in men.

Lippincott Williams & Wilkins et al. study done in Philadelphia, USA reported that average RNFL, temporal, nasal, and lower quadrant RNFL thicknesses were thinner when compared to the nonanemic group.[1]

OncelAcir et al. study has reported that peripapillary RNFL is thinner in the nasal-inferior quadrant in patients with IDA.[20]In this study weak correlation was detected between serum ferritin level and peripapillary RNFL thickness in the temporal superior area.

Aksoy et al. used spectral domain OCT (Spectralis, Heidelberg Engineering, Heidelberg, Germany) to investigate pediatric control subjects , patients with thalassemia major, and IDA .[21] They found lower RNFL thickness in the inferior quadrant in IDA group and detected a correlation between RNFL thickness and hemoglobin level. In the thalassemia major group, RNFL was thinner in all four quadrants compared to the control and IDA group.

Main limitations of our study is that we did not know duration of the anemia in patients. It is, however, not possible to know the duration of anemia as reliable information was not provided by majority of patients.Another drawback of this study is patients group, which is composed of female patients.This approach fail to know the effects of RNFL thickness in anemia in male patients and elderly. As this study was conducted in developing countries, like India there were many limitations regarding patiets education and awareness so there were many patients who did not participated in the study and there were many taboo and religious barriers making patients uncompliant for treatments

The analysis of RNFL has a significant role in diagnosis and follow-up of many disorders like glaucoma. Thinning of peripapillary RNFL seen in patients with IDA; it is; however, not known whether peripapillary RNFL thinning is along with iron deficiency, anemic hypoxia or both. So this Prospective, randomized studies will contribute to better characterization of the changes imposed on RNFL thickness in IDA patients, and to determination of potential effects of management.

CONCLUSION

In adult female patients with IDA, Peripapillary RNFL thickness measured by OCT is thinner in adult female patients with IDA. It may have a significant influence on the management of many disorders such as glaucoma and neuro-ophthalmological diseases.

REFERENCES

1. Fairbanks VF. Iron-deficiency anemia. In: Mazza JJ, editor.Manual of Clinical Hematology. Philadelphia, USA: Lippincott Williams & Wilkins; 2002. p.17-38.
2. Kaur C, Foulds WS, Ling EA. Hypoxia-ischemia and retinal ganglion cell damage. Clin Ophthalmol2008;2:879-89.
3. Janáky M, Grósz A, Tóth E, Benedek K, Benedek G. Hypobaric hypoxia reduces the amplitude of oscillatory potentials in the human ERG. Doc Ophthalmol2007;114:45-51.
4. Kergoat H, Hérard ME, Lemay M. RGC sensitivity to mild systemic hypoxia. Invest Ophthalmol Vis Sci2006;47:5423-7.
5. Connor JR, Menzies SL. Relationship of iron to oligodendrocytes and myelination. Glia1996;17:83-93.
6. DeMaman AS, Melo P, Homem JM, Tavares MA, Lachat JJ. Effectiveness of iron repletion in the diet for the optic nerve development of anaemic rats. Eye (Lond)2010;24:901-8.
7. Bartlett WP, Li XS, Connor JR. Expression of transferrin mRNAin the CNS of normal and jimpy mice. J Neurochem1991;57:318-22.
8. Singh NP, Sahni V, Wadhwa A, Garg S, Bajaj SK, Kohli R, et al. Effect of improvement in anemia on electroneurophysiological markers (P300) of cognitive dysfunction in chronic kidney disease. Hemodial Int2006;10:267-73.
9. Lozoff B. Early iron deficiency has brain and behavioreffects consistent with dopaminergic dysfunction. J Nutr2011;141:740S-6S.
10. Djamgoz MB, Hankins MW, Hirano J, Archer SN.Neurobiology of retinal dopamine in relation to degenerative states of the tissue. Vision Res1997;37:3509-29.
11. Lonneville YH, Ozdek SC, Onol M, Yetkin I, Gürelik G, Hasanreisoglu B. The effect of blood glucose regulation onretinal nerve fiber layer thickness in diabetic patients. Ophthalmologica2003;217:347-50.
12. Ozdek S, Lonneville YH, Onol M, Yetkin I, Hasanreisoglu BB. Assessment of nerve fiber layer in diabetic patients withscanning laser polarimetry. Eye (Lond)2002;16:761-5.
13. Lopes de Faria JM, Russ H, Costa VP. Retinal nerve fibre layerloss in patients with type 1 diabetes mellitus without retinopathy. Br J Ophthalmol2002;86:725-8.
14. Lim MC, Tanimoto SA, Furlani BA, Lum B, Pinto LM, EliasonD, et al. Effect of diabetic retinopathy and panretinal photocoagulation on retinal nerve fiber layer and optic nerve appearance. Arch Ophthalmol2009;127:857-62.
15. Leung CK, Tham CC, Mohammed S, Li EY, Leung KS, ChanWM, et al. In vivo measurements of macular and nerve fibre layer thickness in retinal arterial occlusion. Eye (Lond)2007;21:1464-8.
16. Chow CC, Shah RJ, Lim JI, Chau FY, Hallak JA, VajaranantTS. Peripapillary retinal nerve fiber layer thickness in sickle-cell hemoglobinopathies using spectral-domain optical coherence tomography. Am J Ophthalmol2013;155:456-64.e2.
17. Özkasap S, Türkyilmaz K, Dereci S, Öner V, Calapoglu T, CüreMC, et al. Assessment of peripapillary retinal nerve fiber layer thickness in children with Vitamin B12 deficiency. Childs Nerv Syst 2013;29:2281-6.
18. Türkyilmaz K, Oner V, Ozkasap S, Sekeryapan B, DereciS, Durmus M. Peripapillary retinal nerve fiber layer thickness in children with iron deficiency anemia. Eur J Ophthalmol2013;23:217-22.
19. McLean E, Cogswell M, Egli I, Wojdyla D, de Benoist B. Worldwide prevalence of anaemia, WHO Vitamin and mineral nutrition information system, 1993-2005. Public Health Nutr. 2009;12:444–54.
20. OncelAcir N, Dadaci Z, Cetiner F, Yildiz M, Alptekin H, Borazan M. Evaluation of the peripapillary retinal nerve fiber layer and ganglion cell-inner plexiform layer measurements in patients with iron deficiency anemia with optical coherence tomography. CutanOculToxicol. 2015;21:1–6.
21. Aksoy A, Aslan L, Aslankurt M, Eser O, Garipardic M, Okumus S, et al. Retinal fiber layer thickness in children with thalessemia major and iron deficiency anemia. Semin Ophthalmol. 2014;29:22–6.