Optical Coherence Tomography as a Diagnostic Tool of Ischemic Macular Edema of Diabetic Retinopathy

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Abstract

Background: Diabetic Macular Ischemia (DMI) is recognized as an important cause of visual disability, it is considered as an important clinical feature of Diabetic Retinopathy (DR). Disorganization of Retinal Inner Layer (DRIL) is defined as the horizontal extent in microns for which any boundaries between the ganglion cell-inner plexiform layer complex, inner nuclear layer, and outer plexiform layer could not be identified and considered as a feature of capillary non perfusion.

Aim of Study: To study the rule of DRIL assessed by Optical Coherence Tomography (OCT) in differentiation between the ischemic and non-ischemic diabetic maculopathy.

Patients and Methods: 66 eyes of 66 patients were enrolled in prospective study and divided into 3 equal subgroups; control normal patients, patients with ischemic diabetic maculopathy and patients with non-ischemic diabetic maculopathy diagnosed by FFA. All patients underwent full ophthalmological examination and OCT macula was done to assess the DRIL.

Results: We found that there was highly statistically significant difference \( p=0.000 \) between non ischemic and ischemic groups as regard presence or absence of DRIL.

Sensitivity of DRIL (by OCT) is 86.36%, specificity is 81.82%, positive predictive value is 82.61% and negative predictive value is 85.71%.

Conclusion: There was a statistically significant difference in presence or absence of DRIL between ischemic and non-ischemic diabetic retinopathy.

Key Words: Diabetic maculopathy – DRIL – OCT.

Introduction

DIABETIC retinopathy is a major complication in diabetic patients and considered as the principle cause of visual disability in the working age group in developed countries [1].

Disorganization of Retinal Inner Layer (DRIL) is defined as the horizontal extent in microns for which any boundaries between the ganglion cell-inner plexiform layer complex, inner nuclear layer, and outer plexiform layer could not be identified [2]. DRIL affecting 50% or more of the central 1-mm-wide zone centered on the fovea (foveal DRIL) is associated with worse VA [3]. The finding of DRIL is assessed independently and is not graded differently in the presence of retinal edema, intra-retinal cysts, or any other SD-OCT-evident pathology [2].

Aim of study:

To detect if DRIL assessed by macular OCT can differentiate between ischemic and non-ischemic diabetic maculopathy.

Patients and Methods

A prospective study was carried on 66 eyes of 66 diabetic patients, with age ranged between 30-50 years; divided into 3 equal subgroups; control group, diabetic ischemic and diabetic non-ischemic maculopathy diagnosed by FFA. The study was done on Ain Shams University Hospital outpatients from September, 2018 till August, 2019.

We included all patients with diabetic ischemic maculopathy diagnosed with FFA graded by using standard photographs from ETDRS. Briefly, patients were given a score of absent (no disruption of the FAZ), questionable (outline is not smooth or oval, but changes are not clearly pathologic), mild (outline of the FAZ is destroyed for less than half the original circumference), moderate (outline of the FAZ is destroyed for greater than half the original circumference), severe (outline of the FAZ is completely destroyed).

We excluded all patients with pathological conditions that may affect the retina such as high myopia, Glaucoma, ocular trauma and artery occlusion.
The protocol of this study was approved by the Medical and Ethical Committee of Ain Shams University. The patients were informed about the procedure and written consent was obtained.

All the patients underwent complete ophthalmological examination including best corrected visual acuity, complete anterior segment examination using slit-lamp bio-microscopy, as well as IOP measurement using Goldmann applanation tonometer and posterior segment examination using Volk lens +90D. FFA and Macular OCT using OCT RS-3000 NIDEK.

Results

The current prospective study was carried on 66 eyes from 66 patients, with age ranged between 30-50 years.

1- The logmar was not normally distributed the most appropriate statistically test was Mann-whitney u test. (Value of logmar was statistically significant difference) (Table 1).

Mann-whitney test was used to compare age and log mar, between 3 groups control, non ischemic and ischemic.

Table (1): Comparison between the three groups regarding the studied groups.

<table>
<thead>
<tr>
<th></th>
<th>Control</th>
<th>Non Ischemic</th>
<th>Ischemic</th>
<th>Kruskal-Wallis Test</th>
<th>Mann-Whitney Test</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Median</td>
<td>Perc. 25</td>
<td>Perc. 75</td>
<td>Median 25</td>
<td>p-value</td>
</tr>
<tr>
<td>Age</td>
<td>45.00</td>
<td>40.00</td>
<td>49.00</td>
<td>49.00 47.00 50.00</td>
<td>8.497 0.014*</td>
</tr>
<tr>
<td>Log mar</td>
<td>0.00</td>
<td>0.00</td>
<td>0.17</td>
<td>0.17 0.30</td>
<td>40.286 &lt;0.001 *</td>
</tr>
</tbody>
</table>

2- We compare OCT of non ischemic and ischemic groups as regard presence or absence of Dril. 4/22 patients of non ischemic group had Dril while 19/22 patients of ischemic group had Dril, we found that there was highly statistically significant difference (p 0.000) (Table 3).

Table (2): Comparison between non ischemic and ischemic groups in presence of dril or not by OCT.

<table>
<thead>
<tr>
<th></th>
<th>Non Ischemic</th>
<th>Ischemic</th>
<th>p-value</th>
</tr>
</thead>
<tbody>
<tr>
<td>No drill:</td>
<td>Count 18</td>
<td>3</td>
<td>0.000</td>
</tr>
<tr>
<td></td>
<td>% within OCT 85.7%</td>
<td>14.3%</td>
<td></td>
</tr>
<tr>
<td></td>
<td>% within group 81.8%</td>
<td>13.6%</td>
<td></td>
</tr>
<tr>
<td>Drill:</td>
<td>Count 4</td>
<td>19</td>
<td></td>
</tr>
<tr>
<td></td>
<td>% within OCT 17.4%</td>
<td>82.6%</td>
<td></td>
</tr>
<tr>
<td></td>
<td>% within group 18.2%</td>
<td>86.4%</td>
<td></td>
</tr>
</tbody>
</table>

Sensitivity of dril (by OCT) is 86.36%, specificity is 81.82%, positive predictive value is 82.61% and negative predictive value is 85.71%.

Case from group 2:

Fig. (1): OCT of diabetic ischemic maculopathy patient and presence of dril.

Case from group 2:

Fig. (2): OCT of diabetic ischemic maculopathy patient and presence of dril.
Disorganization of the inner retinal layers (DRIL) is an OCT-derived biomarker that has been shown to be predictive of baseline VA as well as the VA after resolution of macular edema in both diabetes and uveitis (Grewal et al., 2017) [6] and (Sun et al., 2014) [8]. Sun and his colleagues showed that the presence of foveal DRIL was associated with worse baseline visual acuity in patients with Diabetic Macular Edema (DME) (Sun et al., 2014) [3].

DRIL was associated with nonperfusion and thus foveal DRIL may in fact be related to an enlarged foveal avascular zone or macular ischemia. Notably, DRIL was the only OCT feature that was associated with worse VA at final follow-up (Nicholson et al., 2015) [10].

In the present study, on applying ROC curve to assess the diagnostic accuracy of DRIL, we found that DRIL has sensitivity of 86.36%, specificity of 81.82%, positive predictive value of 82.61%, negative predictive value of 85.71% and accuracy of 84.09%. Nicholson and his colleagues found that DRIL can be used to detect macular CNP in patients with diabetic retinopathy. The diagnostic sensitivity was 84.4% and specificity was 100%. From a clinical perspective, the presence of DRIL is a very useful alternative to performing FA to identify CNP as DRIL is a definite indicator of nonperfused retina. There were no false positives. However, it is useful to consider the clinical implications of absence of DRIL in the presence of angiographic evidence of CNP (false negatives). With regard to false negatives, 7/45 (25.6%) angiographic evidence of CNP did not manifest as DRIL. Therefore, the absence of DRIL does not rule out CNP. This may suggest that the disorganization of retinal layers may only occur after a period of CNP or it is a sequelae of CNP (Nicholson et al., 2015) [10].

Conclusion:
Our study we can differentiate between ischemic and non ischemic diabetic maculopathy by presence or absence of Disorganization of Retinal Inner Layer (DRIL), assessed by OCT.

Macular ischemia and an enlarged foveal avascular zone may contribute to foveal DRIL and reduced visual acuity.

References


