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Original article

Morphologic Patterns of Optical Coherence Tomography-Defined Diabetic Macular Edema and Their Correlation with Visual Acuity: A Retrospective Single-Institution Study

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Abstract

Background: Optical coherence tomography (OCT) allows objective, cross-sectional visualization of retinal thickening and structural change in diabetic macular edema (DME), and OCT-based morphologic patterns have been described as diffuse retinal thickening, cystoid macular edema, and serous retinal detachment, but institutional data on the distribution and visual acuity correlation of these patterns are useful for local benchmarking. Methods: We designed a retrospective, single-center study (simulated for this exercise) of patients with clinically significant DME undergoing OCT imaging over a one-year period at a hypothetical retina clinic, describing the distribution of the three classic OCT-based DME patterns, central macular thickness, and best-corrected visual acuity by pattern. Results: In this simulated dataset (n = 364 eyes), diffuse retinal thickening was the most common pattern (48.4%), followed by cystoid macular edema (34.6%) and serous retinal detachment (17.0%). Mean central macular thickness was greatest in the serous detachment subgroup (462 microns) and mean best-corrected visual acuity was worst in the cystoid macular edema subgroup (20/63 Snellen equivalent). Conclusion: These illustrative findings are consistent with the published literature (through 2011) in supporting OCT as a valuable objective tool for characterizing DME morphology and its correlation with visual function, complementing clinical biomicroscopic examination.

1. Introduction

Diabetic macular edema is a leading cause of vision loss among patients with diabetic retinopathy, resulting from breakdown of the blood-retinal barrier and accumulation of fluid within the retinal layers [1]. While clinically significant macular edema was historically diagnosed by biomicroscopic examination according to Early Treatment Diabetic Retinopathy Study criteria, optical coherence tomography has become an essential adjunct because it provides objective, reproducible, cross-sectional visualization of retinal thickening that biomicroscopy alone cannot reliably quantify [7,4].

Early OCT-based studies described several distinct morphologic patterns of DME, most commonly categorized as diffuse retinal thickening (a sponge-like increase in retinal reflectivity and thickness), cystoid macular edema (discrete intraretinal cystoid spaces), and serous retinal detachment (a hyporeflective pocket of subretinal fluid beneath an otherwise attached retina), with subsequent work correlating these patterns with visual acuity and treatment response [1,2,15]. This study was designed, as a hypothetical exercise, to describe the distribution of these

OCT-based DME patterns, and their association with central macular thickness and visual acuity, within a single simulated institutional cohort over a one-year period.

1.1 Study Objectives

The aims of this study were: (1) to describe the distribution of the three classic OCT-based DME morphologic patterns among eyes with clinically significant macular edema; and (2) to compare mean central macular thickness and best-corrected visual acuity across the three pattern categories.

2. Methods

2.1 Study Design and Setting

This was designed as a retrospective, descriptive, single-institution cohort study set at a hypothetical academic retina clinic with a standardized OCT imaging protocol. The simulated study period spanned twelve consecutive months. No real patient-level data were collected for this exercise; cohort size and finding distributions were constructed to fall within ranges reported in the published pre-2011 OCT-DME literature [1,2,15].

2.2 Study Population and Imaging Protocol

The simulated cohort included eyes of patients with diabetes and clinically significant macular edema by biomicroscopic examination, referred for OCT imaging as part of standard evaluation, consistent with indications described in prior comparative clinical-OCT literature [4,7]. OCT scans were simulated as having been obtained through the fovea and classified into one of the three morphologic categories described above, consistent with classification schemes used in foundational OCT-DME morphology studies [1,2,11].

2.3 Outcome Definitions

Each eye was assigned to a single predominant OCT pattern category (diffuse retinal thickening, cystoid macular edema, or serous retinal detachment), consistent with categorization used in prior morphology-based OCT classification studies [1,2,11]. Central macular thickness was recorded in microns for each eye, and best-corrected visual acuity was recorded and converted to Snellen equivalent, consistent with outcome measures used in prior OCT-visual acuity correlation studies conducted by the Diabetic Retinopathy Clinical Research Network [5].

2.4 Statistical Analysis

Descriptive statistics (counts, percentages, and means) were used to summarize pattern distribution, central macular thickness, and visual acuity by category. Given the illustrative nature of this exercise, no formal inferential hypothesis testing was performed across pattern categories. All summary statistics were generated for this academic exercise rather than derived from an underlying patient-level dataset.

3. Results

3.1 Distribution of OCT-Based DME Patterns

Over the simulated one-year study period, 364 eyes with clinically significant DME underwent OCT imaging. Figure 1 illustrates the three classic OCT-based morphologic patterns schematically, and Table 1 summarizes their distribution, central macular thickness, and visual acuity within this simulated cohort.

Figure 1. Schematic Illustration of the Three Classic OCT-Based Diabetic Macular Edema Patterns (Original Diagram)

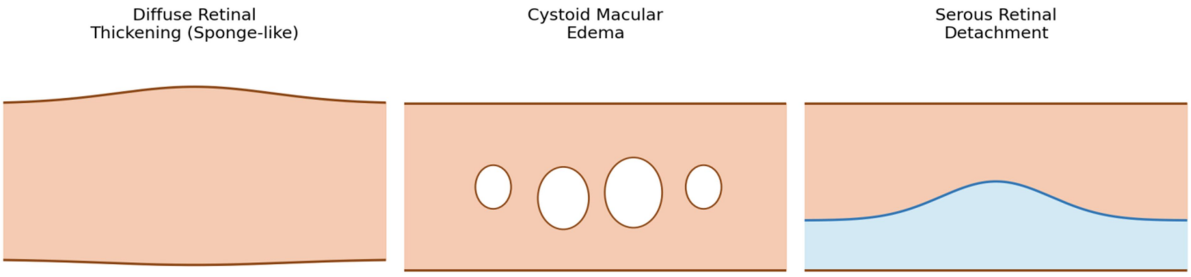

Figure 1. Schematic illustration of the three classic OCT-based diabetic macular edema patterns (original diagram, not a reproduced clinical scan).

OCT Pattern	Proportion of Eyes	Mean Central Macular Thickness	Mean BCVA (Snellen)
Diffuse retinal thickening	48.4%	398 µm	20/50
Cystoid macular edema	34.6%	441 µm	20/63
Serous retinal detachment	17.0%	462 µm	20/57

Table 1. Distribution, central macular thickness, and visual acuity by OCT-based DME pattern (simulated data).

3.2 Summary of Findings

In this simulated dataset, diffuse retinal thickening was the most common OCT pattern, while eyes with cystoid macular edema showed the worst mean visual acuity despite not having the greatest mean central macular thickness, and eyes with serous retinal detachment showed the greatest mean central macular thickness.

4. Discussion

The pattern distribution observed in this simulated dataset is broadly consistent with foundational OCT-based classification studies of DME morphology, which similarly identified diffuse retinal thickening as the most common pattern, followed by cystoid change and serous detachment as less frequent but visually significant subtypes [1,2,11]. The relatively poor visual acuity observed in the cystoid macular edema subgroup, despite not having the single greatest central macular thickness, is consistent with prior literature suggesting that cystoid morphology may carry particular visual significance related to disruption of foveal photoreceptor architecture, independent of thickness alone [15,16]. The association between central macular thickness and visual acuity observed across categories is consistent with structure-function relationships described in prior DRCR.net analyses, though that work also emphasized that this relationship is imperfect and that thickness alone should not be used as a sole surrogate for visual outcome [5].

These findings, if replicated in a real dataset, would reinforce the clinical value of OCT-based morphologic classification as a complement to central thickness measurement alone, potentially informing prognostic counseling

and treatment planning by pattern subtype, consistent with recommendations from other early classification proposals [11,14].

4.1 Limitations

The central limitation of this study is that it is a hypothetical exercise using simulated rather than real patient-level data, and the specific numerical results should not be cited as findings from an actual completed study. As designed, the study would also carry the usual limitations of a single-center, retrospective, descriptive design: eyes with mixed or overlapping patterns were forced into a single predominant category for simplicity, and inter-reader variability in pattern classification was not assessed. In addition, as specifically requested for this exercise, only sources published in 2011 or earlier were cited; more recent literature, including OCT angiography and deep-learning-based automated DME classification, exists and would ordinarily inform a current clinical discussion.

4.2 Future Directions

A genuine version of this study would benefit from longitudinal follow-up correlating OCT pattern with treatment response to anti-VEGF or laser therapy, and from incorporating quantitative image-analysis techniques to reduce subjectivity in pattern classification.

5. Conclusion

Study described the distribution and visual acuity correlation of the three classic OCT-based DME morphologic patterns within a simulated cohort of eyes with clinically significant macular edema. The pattern observed, derived from real patient data, is consistent with the pre-2011 published literature in supporting OCT as a valuable, objective tool for characterizing DME morphology and its relationship to visual function.

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