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QUANTITATIVE ASSESSMENT OF HYPER-REFLECTIVE DOT DISTRIBUTION AND SUBRETINAL FLUID TEXTURE IN REGULATED AND DYSREGULATED RHEGMATOGENOUS RETINAL DETACHMENT

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Rhegmatogenous retinal detachment (RRD) is a retinal emergency with an incidence ranging from 6.3 to 17.9 per 100,000 individuals globally. Prompt surgical intervention is essential to preserve anatomical integrity and optimize visual outcomes. While clinical examination remains the cornerstone of diagnosis, optical coherence tomography (OCT) has emerged as a critical tool for detailed evaluation of retinal morphology and subretinal fluid (SRF) characteristics.

Hyperreflective dots (HRDs) on OCT are small, punctate lesions with increased reflectivity, observed within various retinal layers and in the SRF. HRDs have been described in numerous retinal pathologies, including diabetic macular edema and age-related macular degeneration, where their histological correlates vary from activated microglia and macrophages to degenerated photoreceptor elements and lipoproteinaceous debris. Notably, HRD presence has been linked to both disease activity and treatment response, particularly in diabetic macular edema, where increased HRD burden correlates with worse visual prognosis.

In the context of RRD, the biological significance of HRDs remains poorly understood, though emerging evidence suggests a potential inflammatory component. This retrospective study aims to quantitatively compare the characteristics of subretinal fluid (SRF) in patients with regulated versus dysregulated rhegmatogenous retinal detachment (RRD) both in baseline and 3 months postoperatively. We focused on analyzing hyperreflective dots within the SRF to explore differences in particle density and texture, hypothesizing that the chronicity of regulated RRD leads to a denser, more heterogeneous SRF.

Sixty eight patients from St. Michael's Hospital were retrospectively reviewed, including 24 with regulated
RRD and 44 eyes with dysregulated RRD, all of whom had high-quality baseline swept-source OCT (SSOCT)
or SD-OCT images. Custom-developed MATLAB codes were employed to select the region of interest (ROI) in each OCT image and to count hyper reflective dots within the SRF. The software further categorized these dots into four groups based on size and intensity: large + high intensity, large + low intensity, small + high intensity, and small + low intensity. Additionally, texture analysis was performed by
plotting the ROI histogram and calculating its standard deviation (SD) and full width at half maximum (FWHM), with higher values indicating a more heterogeneous texture.

The regulated group had a lower mean age of 43.3 years, with an equal male and female distribution (12
each), whereas the dysregulated group had an average age of 63.6 years, with 27 males and 17 females.
Phakic eyes were more prevalent in the regulated group (83%, 20/24) compared to the dysregulated

group (59%, 26/44). The regulated group had a significantly higher total count of hyperreflective dots (14
vs. 2; p = 0.0004) and greater density per square millimeter (3.48 vs. 0.64; p = 0.0046). Large, highintensity
dots were most prevalent in the regulated group (36.2%), whereas small, low-intensity dots
dominated in the dysregulated group (48%, p = 0.02). The regulated group also showed significantly
higher SD and FWHM values (p = 0.0002 and p < 0.0001, respectively), indicating greater SRF
heterogeneity.
At 3 months postoperatively, 80% (17/21) of the regulated group still had SRF, compared to 37% (15/40)
in the dysregulated group. Over time, SD increased significantly in the dysregulated group (8 vs. 4.35, p <
0.0001), as well as FWHM (11.9 vs. 9, p = 0.001). The dominant dot type also changed, with small, lowintensity
dots becoming more prevalent in both groups.

Our findings indicate that regulated RRD, representing a more chronic condition, is associated with a
denser SRF containing a higher number of hyper reflective particles and a more heterogeneous texture
compared to dysregulated RRD preoperativly. The increased particle density in regulated RRD may reflect
prolonged duration with continuous absorption of fluid by the retinal pigment epithelium (RPE), leading
to a SRF that is less liquid and more particulate, as particulate matter may take longer to be removed
from the subretinal space. In contrast, dysregulated RRD is more acute, with fewer particles and a more
homogeneous SRF. Also, when comparing pre-operative and post-operative images, our findings suggest
that SRF in dysregulated patients becomes more heterogeneous over time, with distinct dot evolution
patterns between groups.This study not only elucidates the distinct baseline and longitudinal SRF
characteristics between regulated and dysregulated RRD, but also demonstrates the utility of quantitative
OCT image analysis using custom MATLAB code as an objective tool to asess subretinal fluid in RRD.