

Quantitative MRI analysis of lacrimal glands in patients with sickle cell disease

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Introduction: Sickle cell disease (SCD) is a systemic disease affecting all organs of the body, including the eyes and orbits. The literature regarding orbital pathology in SCD focuses on ocular complications, orbital bone infarctions and orbital compression syndrome (Ref. 1-3). However, a recent case report describes specific SCD-related lacrimal gland pathology (Ref. 4).

Purpose: The purpose of this study is to identify and characterize lacrimal gland pathology in SCD patients using characteristics of multispectral quantitative MRI (qMRI) parameters (T1, T2, and secular-T2) and volumetry.

Materials and Methods: 15 SCD patients (age = 19.8-43.6 yrs, mean = 30.14 yrs.) and 23 controls (age: 23-64 yrs, mean 40.9 yrs.) were imaged with the mixed turbo spin-echo (TSE) pulse sequence at 1.5T (Ref. 5, 6). Lacrimal glands were segmented manually on axial 3mm thick proton density-weighted images using 3D Slicer (<http://www.slicer.org>) (Fig.1). qMRI algorithms were programmed by MathCAD 2001 (PTC, Needham, MA). T1, T2, and secular-T2 relaxation time histograms of lacrimal glands were modeled with Gaussian functions; peak values were plotted as a function of age. Glandular volumes were calculated by virtual segmental volumetry. In order to monitor the severity of SCD in each patient medical records from 2000 through 2009 were analyzed to determine the number of SCD-induced hospitalizations and blood transfusions received.

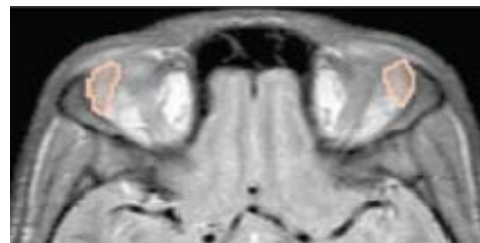


Fig. 1: Lacrimal gland segmentation.

Results: T2 and secular-T2 relaxation times were significantly shortened in SCD patients compared to normal subjects (80.0 ± 5.3 ms and 89.4 ± 4.9 , $p < 0.0001$, and 85.0 ± 4.9 ms and 95.0 ± 6.0 , $p < 0.0001$) (Fig.2). No difference was seen in T1 peak relaxation times in comparing the two groups. There was no correlation between the number units of packed red blood cells transfused and qMRI parameters (volume, T1, T2, and secular-T2). Volumetry revealed an increased size of lacrimal glands in comparing SCD patients compared to control subjects (1.97 ± 0.57 cm³ and 1.31 ± 0.49 cm³, $p < 0.001$) (Fig.3).

Conclusion: Patients with SCD exhibited glandular changes specific to the lacrimal glands that can be observed with qMRI relaxometry and volumetry. These observed changes support specific underlying pathology in the lacrimal glands. The microvascular component of these glands may predispose them to be targets for vasoocclusion, chronic inflammation, fibrosis, and iron deposition, all potential complications of SCD; all of which may be detected by q-MRI.

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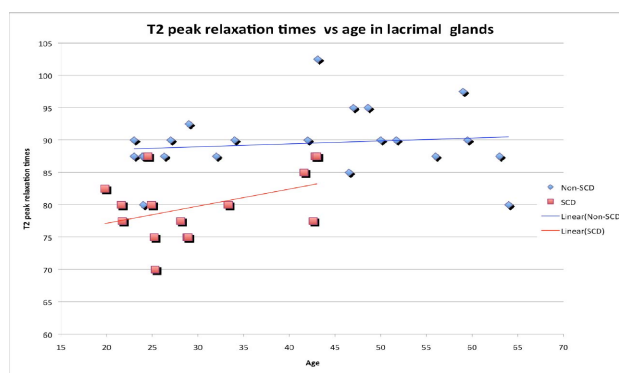


Fig. 2: T2 peak relaxation times of lacrimal glands. T2 peak values were shortened in SCD patients compared to control subjects.

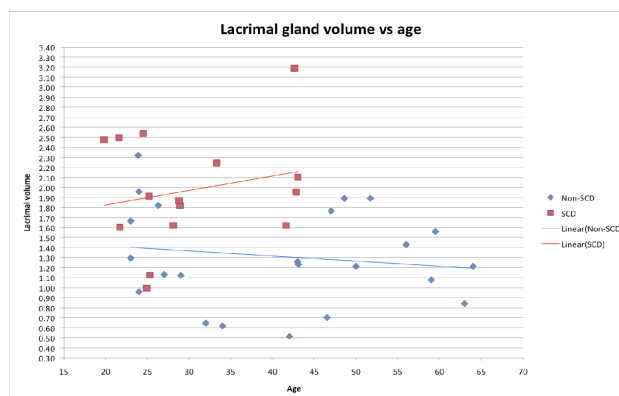


Fig. 3: Lacrimal gland volumes. Volumes for SCD patients were increased when compared to control subjects.