Compositional Changes in Inflammatory Cardiomyopathy

Beamline:
U10B

Technique:
Infrared Microspectroscopy

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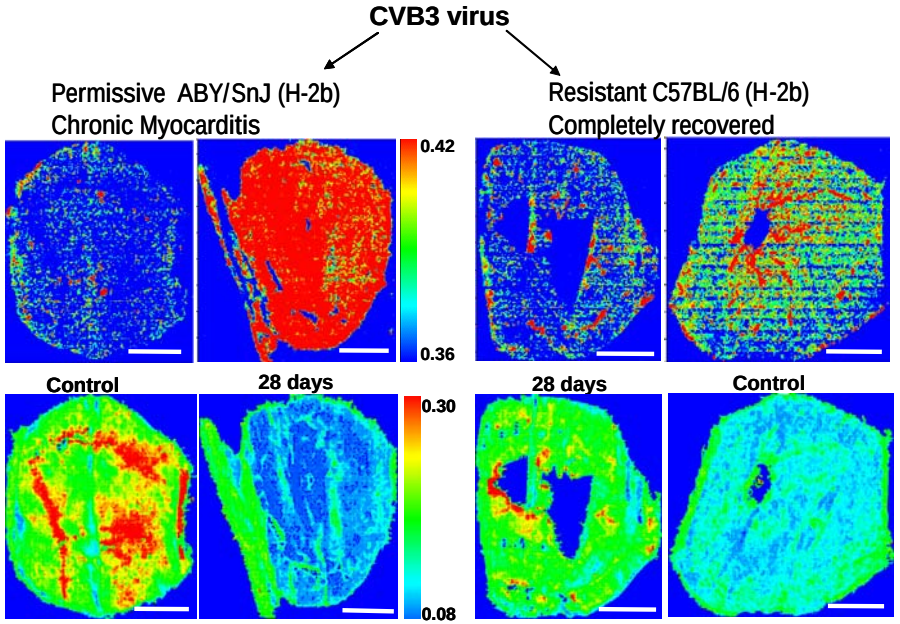
Motivation: Myocarditis is an inflammatory disorder that affects heart muscle cells and results in their dysfunction. The group B coxsackieviruses (CVB3) are the most common agents of myocarditis. In most cases the disease is self-limiting; however, idiopathic dilated cardiomyopathy may in many instances represent the end stage of an immunologically mediated disease initiated by an episode of enteroviral myocarditis. In early studies, fibrillar collagen was observed to be elevated in pathological myocardium and extracellular matrix remodeling has been suggested to play a significant role in the cardiac dysfunction. The aim of this study is to investigate the chemical composition of the myocardium in an immuno-resistant (C57BL/6) and an immuno-permissive (ABY/SnJ) mouse model of inflammatory cardiomyopathy, using Fourier Transform InfraRed Imaging (FTIRI).



(Top) Collagen correlation images and (Bottom) Lipid / Protein ratio images of heart tissue from (Left) ABY/SnJ mouse model and (Right) C57BL/6 mouse model at later disease stages: 28 dpi, compared to control tissue. The data from early stage (4 dpi) and acute stage (8 dpi) of diseases are not shown.

Results: The composition and distribution of proteins and lipids were obtained at a pixel resolution of 6.25 microns. The lipid/protein ratio (area ratio of 3000 – 2800 cm^{-1} / 1700 – 1600 cm^{-1}) and the collagen content (correlation analysis from 1400 – 1000 cm^{-1}) were determined. Results from both mouse models showed that the lipid/protein ratio decreased as the collagen content increased, suggesting extracellular matrix remodeling. In the permissive model (ABY/SnJ), the lipid/protein ratio decreased and the collagen content increased continuously as the disease progressed. However in the resistant model (C57BL/6), the lipid/protein ratio decreased and the collagen content increased in the earlier stages of the disease (4 and 8 days), but then reversed in the later stages (28 days), suggesting a recovery from the disease. These results demonstrate chemical differences between the inflammatory responses in these two mouse models, providing insight into why the disease can be self-limiting in some cases while fatal in others. The FTIRI results also show that the two strains have different compositions in the uninfected state, which may also provide an insight into the mechanism for the different responses. In addition, this research demonstrated that FTIRI brings a new dimension to understanding the composition of heart tissue in myocarditis, and has the potential to become a reliable tool for monitoring the disease *in situ*.