Research Data Management Case: Regeneration of Functional Heart Tissue in Rats

Unlike other organs and tissues which regenerate themselves, the heart does not have the ability to regenerate. The goal of the study is to try to regenerate functional heart tissue that has been starved of oxygen in a rat by delivering stem cells to the heart.

Two days before operating on the rat, we take adult stem cells and incubate them for 24 hours with a fluorescent nanoparticle marker. We then place these marked stem cells into solution and inject them into a tube that has a biological suture in it, so that the cells sit down on the outside of the biological suture. After allowing the suture to incubate for 24 hours, we carry out the surgery. We open up the thoracic cavity of the rat and induce a heart attack by occluding the left anterior descending coronary artery. This restricts blood flow to the heart tissue. After restricting blood flow for 1 hour, we remove the occlusion and allow the blood to flow freely. After 10 minutes, we place the biological suture with marked stem cells through the region of the heart that was deprived of oxygen. The rat is allowed to recuperate for a week after which we reopen the thoracic cavity and use our camera system to acquire images of the heart. The camera system consists of two cameras that take images simultaneously and a pressure transducer that syncs automatically with the cameras to measure left ventricle pressure as pictures are taken. We repeat this process 4 to 5 times in different locations in and around the area of the heart where tissue death occurred due to lack of oxygen.

At this point, we euthanize the animal, isolate the heart, place it in a fixative, and put it in the freezer for about 24 hours. We then cut sections of the heart and place them onto slides – about 3 sections of the rat heart per slide. Approximately 200 slides are generated per rat heart. At any time there might be heart tissue in various stages of processing throughout the lab. Every sample should be entered into an excel spreadsheet that documents the sample number, what has been done to the sample, who did the work, the current location of the sample, etc., but that doesn’t always happen. At varying points after the samples are stained, a second stain that highlights the marked stem cells is applied. This tells us what tissue, if any, is dead.

We take initial images of the samples using an epifluorescent microscope. Images that are deemed acceptable are further imaged using a confocal microscope that takes higher resolution pictures. We examine the data using a home-grown custom software that tracks particles on the surface of the heart to see how far and how fast those particles are moving and analyzes the optical images of the heart. These results tell us what the function of that region of the heart was like when the sample was taken. This software was written in C and MATLAB.

This is an edited case study from the New England Collaborative Data Management Curriculum, a Joint Initiative of the University of Massachusetts Medical School & the National Network of Libraries of Medicine, New England Region
http://library.umassmed.edu/necdmc/research_cases
1. Types of Data Produced

2. Data & Metadata Standards

3. Policies for Access & Sharing
4. Policies for Re-Use & Distribution

5. Plans for Archiving & Preservation

6. Roles & Responsibilities

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