

Methods for Isolated Heart Studies in the Mouse

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Since 1888, the isolated heart has been an important experimental preparation for studying heart function. In this preparation, hearts are surgically removed from animals and maintained as functioning (beating) organs by connecting them to special support systems. The support system mimics the conditions within the living body providing warm, oxygenated fluid rich in energy and nutrients to the coronary arteries.

A centerpiece of the information obtained from the isolated heart is the Frank-Starling Relationship, FSR. In the FSR, some measure of heart functional performance (i.e. generated pressure, cardiac output, work) is plotted on a graph against a measure of load put on the heart (i.e. increased volume within chamber). For instance, heart pressure generation during a heart beat increases as the heart is filled to greater volumes. The FSR is easily obtained from isolated hearts of rabbit to rat sized animals.

However, modern molecular medicine now makes use of the mouse as the preferred experimental animal. Additionally, mice are widely used to model human heart diseases. Genetic defects associated with human heart disease are introduced into the genome of the mouse. The mouse then expresses the altered heart muscle proteins that arise from these genetic defects. Ultimately, the altered proteins within the cardiac tissue influence the performance of the heart as a whole system.

The physiologic question researcher search to discover is: "How has this mutated gene with the resultant expression of the altered heart muscle protein affected the function of the mouse heart as seen by the FSR?"

To answer this question, we modified the surgical techniques and apparatus of the isolated heart protocol to allow studies of the isolated mouse heart.