CASE STUDY

a division of Harvard Bioscience, Inc.

Surgical Approach: A detailed characterization of cardiovascular physiology in nonhuman primate

Introduction

Cardiovascular function can be characterized by studying the pulmonary vascular and systemic vascular circuits along with assessing cardiac output. Together, these endpoints enable the investigator to derive details about resistance indices within the vascular circuits independent of subject size. These data would provide valuable insights to pressure, resistance, and cardiac output in healthy animals as a baseline and allow detailed changes to be observed throughout various disease states. The investigator sought to capture multiple pressures across the heart to help create a detailed assessment of cardiovascular physiology in a nonhuman primate (NHP).

Challenge

Create a surgical approach to obtain numerous pressures in the heart of a nonhuman primate.

Several challenges presented when assessing the feasibility of this model. First, when determining the surgical approach, limitations of the animal size, device sizes, catheter lengths, and lead lengths all had to be considered. Second, careful and deliberate placement of the devices was critical, so the patient was comfortable and there was no strain on the catheters or anatomy during normal behaviors. Lastly and importantly, maintaining the animal's welfare was the utmost priority, especially considering the number of desired parameters. Extreme care was taken to minimize tissue trauma and painful manipulation, maintain excellent aseptic technique, and maximize efficiency throughout the procedure. Meticulous planning and a thorough understanding of the devices and endpoints were paramount to the success of this model.

Solution

Two large animal telemetry devices (DSI's PhysioTel Digital—model L21) were selected as the best solution to collect the desired parameters. The L21 allows for monitoring 2 pressures and 1 biopotential in a chronic setting. The investigator identified the pulmonary vascular and systemic vascular circuits and selected sites to acquire proximal and distal pressures for each. In the pulmonary vascular circuit, the proximal site was the pulmonary artery and the distal site was the left atrium. In the systemic vascular circuit, the proximal site was the descending aorta via the femoral artery and the distal site was the superior vena cava.

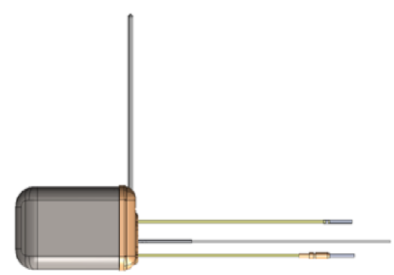

Figure 1. L21 (dual pressure, single biopotential telemetry device)

Device Placement: The first L21 device (blue, Figure 2) was placed on the back between the trapezius and latissimus dorsi muscles and both pressure catheters were routed to the chest. Biopotential leads were routed to the chest for epicardial ECG. The second L21 device (orange, Figure 2) was placed on the abdomen between the internal and external oblique muscles. One pressure catheter was routed to the chest while the other was routed to the femoral artery. Biopotential leads on the second device were placed in the leg for EMG.

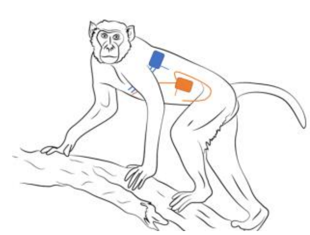

Figure 2. Device and catheter placement

Pressure Catheter Placement: The thoracic cavity was accessed through the fourth intercostal space and the structures of the heart were visualized. The pulmonary artery was identified, and the first catheter was inserted to the appropriate depth and secured with a purse string suture. The superior vena cava was catheterized using the same technique with the second catheter. The left atrium was accessed through the left auricle and the third catheter was inserted and doubly ligated in place. The femoral artery was isolated and ligated, and the fourth catheter was inserted and advanced such that the catheter tip was in the descending abdominal aorta. Signals were monitored intraoperatively to ensure optimal signal quality.

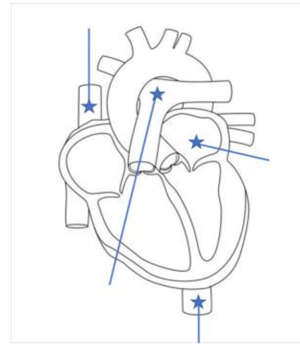

Figure 3. Catheter entry and tip locations

Results/Successes

The animals recovered from surgery without complication and resumed normal activity the following day. This demonstrates the surgical feasibility of placing multiple catheters for chronic data collection in a conscious animal model.

Figure 4. Waveforms at the end of surgery.

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