Acute Cardiac Output Measurement in the Rat

Application

Site: **ASCENDING AORTA**
Species: **RAT**
Vessel diameter: **2.0 mm**

Body Weight: **330 gm.**
Duration: **ACUTE**

Probe Data

400-Series: **MA2SPB** or **MA2.5BPB**

TX06-Series: **2SB-JS-MC100-CH10-Acute**
2.5SB-JS-MC100-CH10-Acute

Recommendation: **2 mm for rats < 300 gm**

Comparative Anatomy

The anatomy of the rat may be initially disorienting to the surgeon familiar with larger animals. The normal rat has a persistent left anterior vena cava and an prominent aortic arch that is slightly rotated to the right. The following mental exercise may aid orientation; visualize grafting an additional vessel to the caudal vena cava of the canine heart in figure 1. Mentally pull the vessel cranially, then merge and move the common carotid arteries from brachiocephalic trunk to the aorta. The result is the remarkably rat-like presentation shown in figure 2.

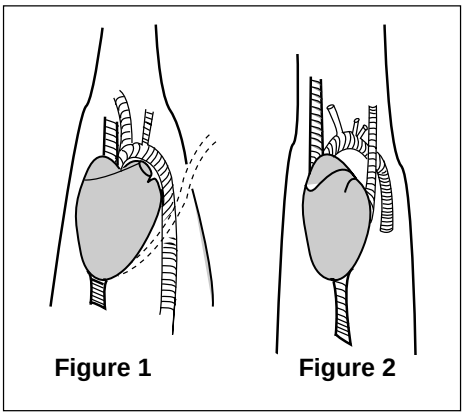


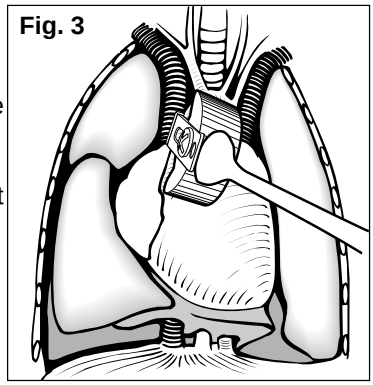
Figure 1 **Figure 2**

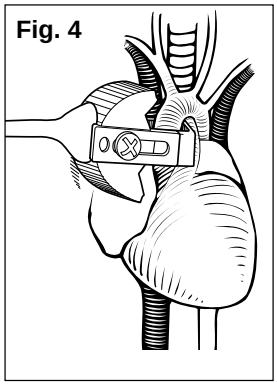
Surgical Approach

Anaesthetize the rat with ketamine hydrochloride (70 mg/kg IP) and mechanically ventilate. Perform a median sternotomy and open the pericardium taking care to avoid the vagus nerve. Accuracy is greatest when the flowprobe fits the vessel very closely and a minimum of acoustic gel is needed.

Place the bracket around the ascending aorta just above the coronary arteries. If you are using one with a slide, close the slide. Position the flowprobe as shown in Figure 3. In this location, the flowprobe is perpendicular to the curvature of the arch. Incorrect placement is shown in figure 4. In figure 4, the sound beam of the flowprobe is parallel to the arch and flow may be significantly underestimated.

We recommend SurgiLube or HR lubricating jelly as a couplant because its acoustical velocity is within 30m/sec of blood. Most ultrasonic coupling gels have an acoustical velocity different than blood and tend to lower sensitivity. Remove the plunger of a 30 cc syringe and load the syringe with sterile lubricating jelly, taking care to prevent the formation of air bubbles. Place a flexible catheter on the tip of the syringe. Insert the flexible catheter through the probe's acoustic window adjacent to the artery and deposit the jelly while withdrawing the syringe. The lubricating jelly must replace all air space to be effective as a acoustical couplant. Press the test mode button on the meter to verify that signal amplitude is close to 1 Volt. A low signal or an acoustic error can usually be traced to an insufficient amount of lubricating jelly or an air bubble.





Transonic Systems Inc.
Excellence in Quantitative Hemodynamics
34 Dutch Mill Road, Ithaca, NY 14850 USA; Tel: 800-353-3569, 607-257-5300;
Fax: 607-257-7256; Internet: www.transonic.com

Acute Cardiac Output Measurement in the Rat

Flow Ranges Observed

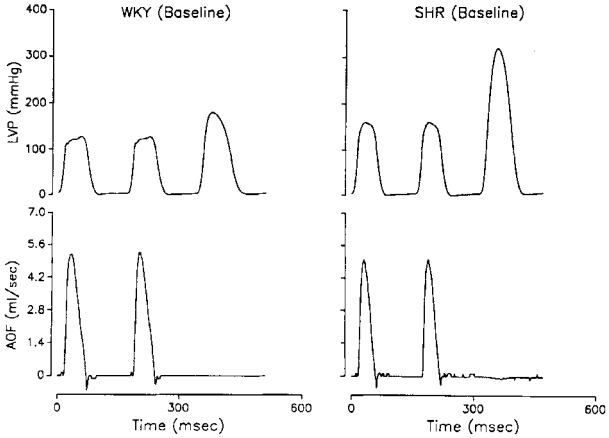


Fig. 1. A typical example of left ventricular pressure (LVP) and aortic flow (AOF) data from in-situ experiment. Base-line data are depicted for 2 steady-state contractions followed by an isovolumetric contraction obtained by occluding ascending aorta in diastole. Left and right panels correspond to data for Wistar-Kyoto (WKY) and spontaneous hypertensive rat (SHR), respectively.

Instantaneous flow in a ketamine anesthetized rat peaked at over 300 ml/min. Cardiac index was 166 ml/kg/min. These values are substantially higher than those in rats anaesthetized with pentobarbital.

Applications

Measurement of cardiac output has many applications, one researcher studies vasoconstrictors by combining CO with pressure and flow measurements in peripheral vessels. Another studies the effect of altering isomyosin composition on left ventricular resistance. This application requires high speed (1000 hz) data acquisition and sophisticated digital signal processing.

References

1. Shroff, S.G., Ivanhoe, R.J., Clark, W.A., and Janicki, J.S., “Isomyosin and Systolic Mechanical Properties of the Intact Hypertrophied Left Ventricle”, Circulation, Vol. 76, No. 4, p. IV-334, 1987.
2. Shroff, S.G., Motz, W., “Left Ventricular Systolic Resistance in Rats with Hypertension and Hypertrophy “, American Journal of Physiology, Vol. 257, pp. H386-394, 1989.
3. Shroff, S.G., Naegelen D., Clark, W.A., “Relation Between Left Ventricular Systolic Resistance and Contractile Rate Processes”, American Journal of Physiology, Vol. 257, 1989.
4. Hoffman, A., Grossman, E., Ohman, K.P., Marks, E., Keiser, H.R., “Endothelin Induces An Initial Increase in Cardiac Output Associated with Selective Vasodilation in Rats”, Life Sciences, Vol. 45, No. 3, p. 249-255, 1989.

Rev. C 6-04

Surgical Methods Protocol #34

Transonic Systems Inc.
Excellence in Quantitative Hemodynamics
34 Dutch Mill Road, Ithaca, NY 14850 USA; Tel: 800-353-3569, 607-257-5300;
Fax: 607-257-7256; Internet: www.transonic.com