



# Ascending Aorta (Cardiac Output) Measurement in the Rat, Chronic



## Application

Site: **Ascending Aorta**  
 Species: **Rat**  
 Vessel diameter: **2.5 mm**  
 Body Weight: **270 gm**  
 Duration: **Chronic**

## Probe Data

Probe style: **2.5SS** (with side exit)  
**2.5SL** (new cable configuration for lateral approach)  
 Reflector type: **J** (with slide) or **J**  
 Connector: **CA4** (micro-4-pin)  
**CM4S**  
 Cable length: **10 cm**

## 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.

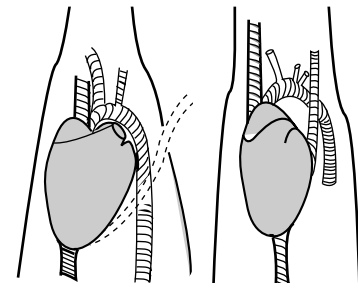


Figure 1

Figure 2

## Surgical Approach — Right Thoracotomy

Anesthetize the rat with sodium pentobarbital (60 mg/kg IP) and ventilate mechanically. Place the rat in left lateral recumbency and make an incision in the right 3rd intercostal space. Retract the ribs and the right lobe of the lung to expose the aortic arch. Insert the probe into the thoracic cavity and gently compress the aorta so that the J bracket can be passed around the vessel.

### 2.5SS Side Cable Probe (Figure 3)

Pass a trocar through the pectoral muscles and the 2nd intercostal space. Pass the CA4 connector and cable through the trocar to exteriorize it. Close the thoracotomy site routinely.

### 2.5SL Lateral Cable Probe (Figure 4)

This cable configuration allows proper positioning of the flowprobe without an additional puncture into the thoracic cavity, as above. The cable is passed through the thoracotomy and close is routine.

Create a subcutaneous tunnel with straight hemostats between the forelimbs and up to the neck. Place the animal in ventral recumbency and make a 1.5 cm mid-scapular incision. Route the connector and cable to exit between the shoulder blades. Place a patch of Dacron mesh under the skin to reinforce skin at the mid-scapular exit site. Close the skin incision and place the CA4 connector in the saddleback cuff.

Suture the saddleback cuff to the skin through Dacron mesh placed subdermally to reinforce sutures.

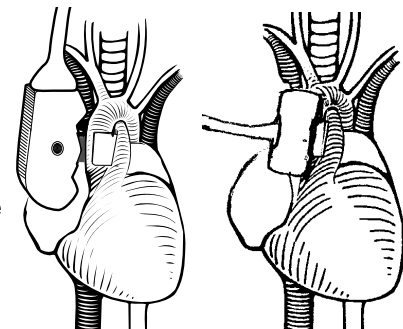


Figure 3

Figure 4

## Acknowledgement

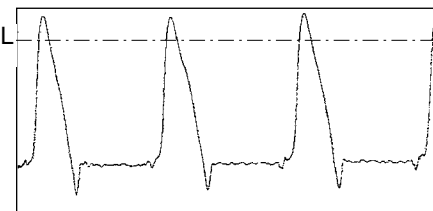
Thomas L. Smith, Ph.D., Dept. of Orthopedic Surgery, Bowman Gray School of Medicine, Wake Forest University, Winston-Salem, NC

## References

- Johnson, R.A., Lavesa, M., Askari, B., Abraham, N.G., Nasijetti, A., "A Heme Oxygenase Product, Presumably Carbon Monoxide, Mediates a Vasodepressor Function in Rats," *Hypertension* 1995; 25:166-169. (531A)  
 Greene, E.C, *Anatomy of the Rat*, Hafner Publishing Co., New York, 1963.

### Rat Surgical Video

Blood Flow Measurement in the Rat with "Implantation Techniques of the Transonic Flowprobe on the Rat Ascending Aorta," *Smith, vp-10*



Instantaneous flow in a conscious 300 gram rat peaked at 550 ml/min. Mean flow was 90 ml/min

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R.L. Dundore, Sterling Drug Co., Rensselaer, NY

## Application

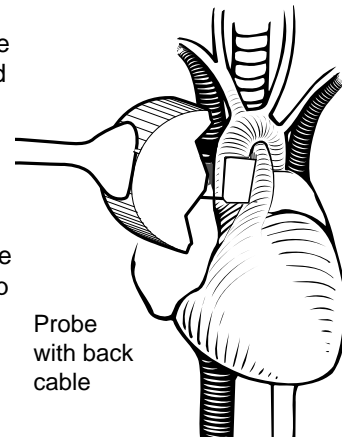
Site: **Ascending Aorta**  
Species: **Rat**  
Vessel diameter: **2.5 mm**  
Body Weight: **325 - 400 gm**  
Duration: **Chronic**

## Probe Data

Probe style: **3SB** with back exit  
Reflector type: **J**  
Connector: **CM4S**  
Cable length: **9.5 cm**

## Surgical Approach — Right Thoracotomy

Anesthetize the rat with sodium pentobarbital (50 mg/kg i.p.) and ventilate mechanically. Perform a right thoracotomy between the second and third ribs. Isolate the ascending aorta and clear of adipose and connective tissue. Position a 3 mm S-Series back cable exit probe around the aorta as close to the heart as possible. Pack the space between the body of the probe and the aorta with surgical sponge (*Meroce*). Pass the cable from the probe through the thoracotomy and tunnel it subcutaneously to the top of the skull. Close the thoracotomy, suture the muscle layers and reduce the pneumothorax. Fix the probe connector to the top of the skull with stainless steel screws and dental acrylic. Suture the wounds and treat with a topical antibiotic. Administer s.c. a suspension containing ampicillin (10 mg).



## Applications

This protocol was developed to evaluate the systemic hemodynamic effects of selective inhibitors of cyclic nucleotide phosphodiesterase in the conscious rat.

## Acknowledgements

R. Allan Buchholz, Ph.D., Pfizer Central Research Div., Groton, CT  
R.L. Dundore, Ph.D., Sterling Drug Co., Department of Pharmacology, Rensselaer, NY

## References

Dundore, R.L., Habeeb, P.G., Pratt, P.F., Becker, L.T., Clas, D.F., Buchholz, R.A., "Differential Hemodynamic Responses to Selective Inhibitors of Cyclic Nucleotide Phosphodiesterases in Conscious Rats," J of Cardiovasc Pharm, 1992; 19: 937-44.

## Note

For implantation of the Transonic flowprobe around the ascending aorta to measure cardiac output, Transonic Application Support documents several protocols depending on probe style and preferred approach.

**Thoracotomy:** As documented on the preceding page, Dr. Thomas Smith, Bowman Gray School of Medicine, prefers a right thoracotomy, entering the thoracic cavity through the third intercostal space. Upon his recommendations, the 2.5SL probe was designed, allowing exit of the probe cable directly from the entry incision. A probe with a side cable configuration may be used, but the cable must be exteriorized through the 2nd intercostal space to correctly position the probe to avoid twisting of the vessel. Dr. Ronald Dundore et al. (*Sterling Winthrop Pharmaceutical*) also uses a right thoracotomy, but enters through the 2nd intercostal space which allows him to exteriorize his aortic probe with a back exit cable directly from the entry incision.

**Sternotomy:** Preferring a sternal approach to better visualize probe placement in the thoracic cavity and to allow implants in younger rats (150 g), Dr. John Osborn and Dr. Ingegerd Keith (*Univ. of Minnesota, Univ. of Wisconsin*) have documented their protocol on the next two pages.

