

# T400-Series Surgical Protocol

## Mouse Femoral Artery: Chronic Blood Flow Measurement

### APPLICATION BASICS

Site: Femoral artery  
 Species: Mouse  
 Body Weight: 17 - 30 grams  
 Duration: Chronic  
 Vessel Diameter: 0.20 - 0.40 mm

### Probe

Size: 0.5 mm  
 Reflector: J  
 Connector: 4-pin  
 Cable Length: 10 cm  
 Catalog #: MC-0.5PSS-JN-WC10-CA45-GC

**FLOWMETER** TS420 Perivascular Module

### Anatomical Landmarks

The femoral artery lies distal to the epigastric artery. The segment of the femoral artery proximal to the epigastric artery is typically isolated for acute or chronic flow measurements (Fig.1). The vessel at this point measures ~250-300  $\mu\text{m}$  in 25 g CD-1 mice. Small branches from the femoral are typically found at both locations where the 7-0 silk passes under the femoral artery.

Isolation of the artery from the vein in this position is very challenging. There is less fascia and connective tissue around the sheath of the artery and vein to manipulate the vessel free. The nerve runs immediately adjacent and is very easy to tear. Once isolated, avoid pulling up on the artery which would cause vascular spasm or putting pressure on the vein to cause occlusion.

The protocol presents an overview of steps to achieve successful femoral arterial blood flow measurement in the mouse adapted from the Considerations for Chronic Flow Measurement on the Mouse Femoral Artery PowerPoint presentation. Courtesy of Michael F. Callahan, Dept. of Orthopaedic Surgery, Wake Forest University School of Medicine, Winston-Salem, NC. For the complete photo essay PowerPoint presentation see: [www.transonic.com](http://www.transonic.com)

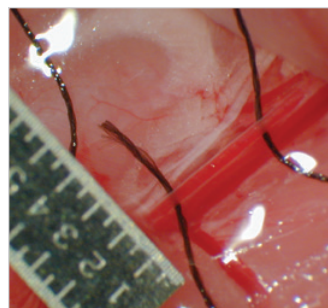


Fig. 1: The femoral artery proximal to the epigastric artery, isolated from the femoral vein, measures ~400  $\mu\text{m}$  diameter with a micrometer. Flow measurements can be made at this location fairly easily.

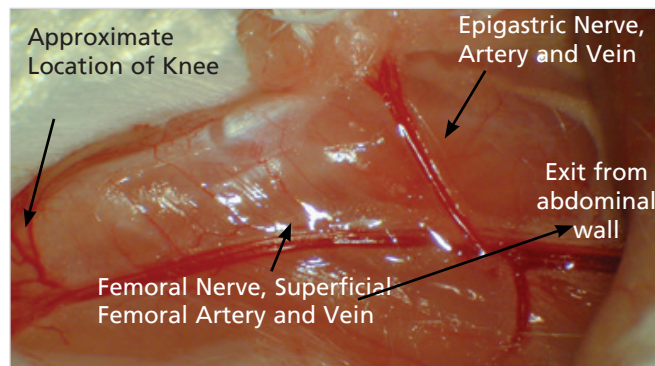


Fig. 2: Figure shows femoral nerve, superficial femoral artery and femoral vein exiting from abdominal wall and running down the leg toward the knee. Note position of epigastric nerve, artery and vein.

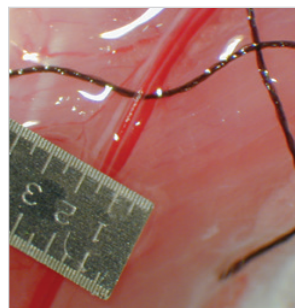


Fig. 3: The superficial femoral artery, distal to the epigastric artery, measures ~200  $\mu\text{m}$  diameter and is very challenging to isolate without damaging the nerve or the vein.



Fig. 4: A 0.5PSS Flowprobe prepared with dacron mesh attached to the underside of the Probe with silicone adhesive.

# Mouse Femoral Artery: Chronic Blood Flow Measurement Cont.

## Before Surgery

Prepare a 0.5PSS Flowprobe with a dacron mesh attached to the underside of the Probe with silicone adhesive to help stabilize the Probe position in the implant (Fig. 4).

## Chronic Measurement Protocol cont.

### 1. Femoral Artery Isolation

(Acute or Chronic Flow Measurements. Refer to Figs. 1-3)

The segment of the femoral artery proximal to the epigastric artery is typically isolated for acute or chronic flow measurements. The vessel at this point measures ~250-300  $\mu$ m in 25 g CD-1 mice. Small branches from the femoral are typically found at both locations where the 7-0 silk passes under the femoral artery.

### 2. Thigh Incision

Prepare the medial thigh and a 2 cm area on the back for surgery. A 1.5 cm incision is made into the medial aspect of the thigh near the body wall (Fig. 5). Care should be taken to avoid the epigastric artery which exits the femoral about 7-8 mm from the body wall and travels rostrally in a fat pad attached to the skin.

### 3. Positioning Probe Connector

Make an incision in the back to place the Flowprobe connector and then tunnel subcutaneously from the back to the posterior aspect of the thigh (Fig. 6). With a pair of forceps pull the Probe connector from the back of the thigh to the exit on the back. The length of the cable was short in this prototype Probe and prevented placement in the preferred midscapulae position. Therefore, the connector was placed on the small of the back.

### 4. Isolation of the Femoral Artery

Open the sheath covering the femoral artery, vein and nerve with a pair of 45° microblunted Dumont forceps parallel to the vessel. Typically, one small branch is located between the abdominal wall and the epigastric artery. When the fascia is removed, a 3-4 mm section of the artery between the small branch and the epigastric will appear (Fig. 7).

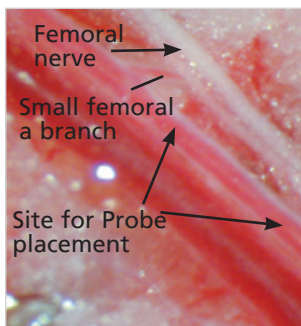


Fig. 8: Nerve isolated from the femoral vessels.

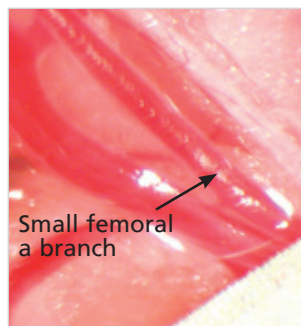


Fig. 9: A small branch of the femoral exiting caudally on the femoral a. proximal to the epigastric a.

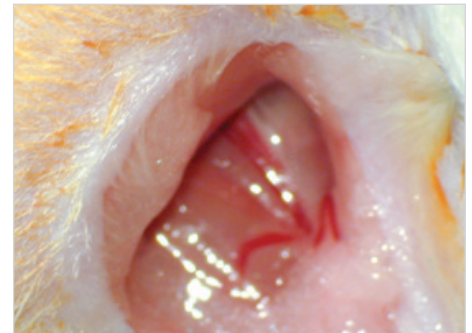


Fig. 5: Incision in medial aspect of thigh.

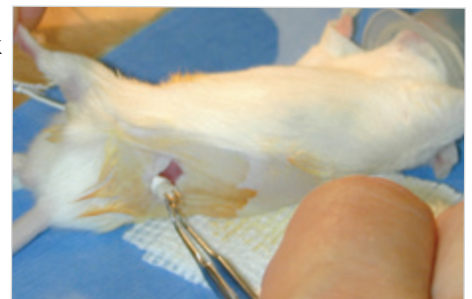


Fig. 6: An incision is made in the back to place the Flowprobe connector.

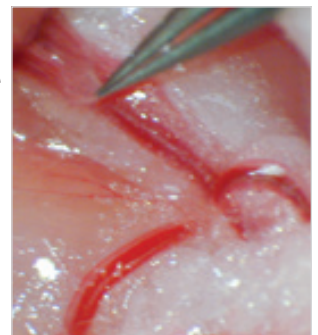


Fig. 7: Femoral artery isolated.

Clear this section to place the Flowprobe. Grasp the fat/fascia located rostral to the vessels and pull it rostrally. The nerve can then be isolated from the vessels with a 45° Dumont without touching or damaging it (Fig. 8). Pulling on the fascia caudal to the vein allows it to be separated from the artery. A small branch of the femoral can usually be seen exiting caudally on the femoral artery immediately proximal to the epigastric artery (Fig. 9).

## Mouse Femoral Artery: Chronic Blood Flow Measurement Cont.

### Chronic Measurement Protocol cont.

#### 5. Placement and Securing of the Flowprobe

Gently place the Probe in position over the vessels and pull the dacron mesh under the artery (Fig. 10). The Probe cable and or mesh can be anchored to the muscle with 7-0 silk suture prior to passing the mesh under the vessel but these anchor points should be placed before positioning the Probe.

After passing the mesh, gently lift the femoral artery and place it into the lumen of the Probe. Place a section of dacron mesh over the Probe and secure the two pieces of mesh with silk (Fig. 11). Place acoustic coupling gel or lidocaine gel into the lumen of the Probe to displace air bubbles. The gel acts as a barrier to prevent the Kwik-Sil from entering the lumen of the Probe. Check the signal of the Flowprobe on the Flowmeter.

Inject 2-part Kwik-Sil or Kwik-Cast (shown) around the Flowprobe and cable (Fig. 12). The vessel can be visualized under the mesh, exiting the lumen of the Probe. Do not inject the casting material into the lumen of the Probe. This will block the ultrasound signal, and prevent flow measurement. Allow the cast to become hardened before closing wounds. Prepare skin button as previously indicated.

#### 6. Experimental Exercise Setup

The mouse is connected to a Flowmeter via an electronic swivel connected to the skin button (Fig. 13). Femoral arterial blood flow is recorded by the Flowmeter as the mouse, implanted with a Nanoprobe on the femoral artery, runs on the treadmill.

#### 7. Flowprobe Recovery After 5 Weeks Implantation

Connective tissue and blood vessels overlie the Kwik-Cast but have not infiltrated it (Fig. 16). Tissue has infiltrated the mesh but this can be cut away (Fig. 17) to visualize the intact blood vessel exiting the Probe lumen (right). At this point one can check for "zero" flow by occluding the vessel.

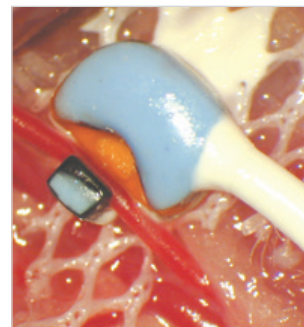


Fig. 10: Dacron mesh pulled under the artery.



Fig. 11: Upper and lower pieces of Dacron mesh secured with two pieces of silk.



Fig. 12: Kwik-Sil or Kwik-Cast injected around the Probe and cable.

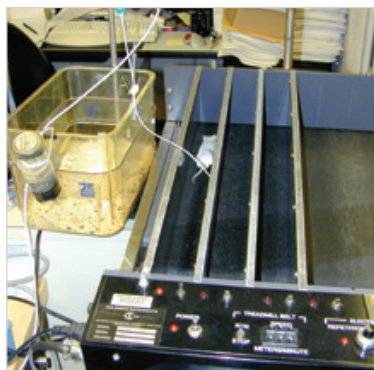


Fig. 13: Three station treadmill for rodents by Columbus Instruments.

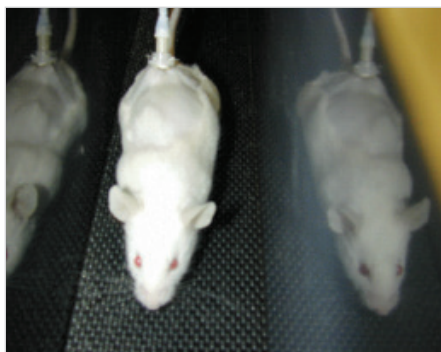


Fig. 14: Mouse with femoral Nanoprobe implant running on treadmill.



# Mouse Femoral Artery: Chronic Blood Flow Measurement Cont.

## Chronic Measurement Protocol cont.

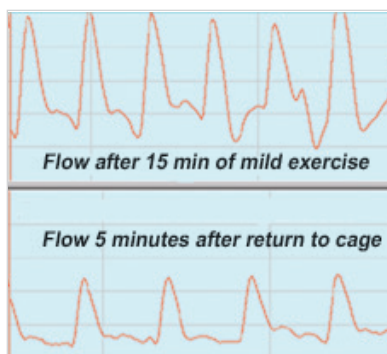


Fig. 15: Effect of brief exercise on femoral artery blood flow. Mean Flows: Top: 1.9 ml/min during treadmill exercise; Bottom: 0.8 ml/min returned to home cage.

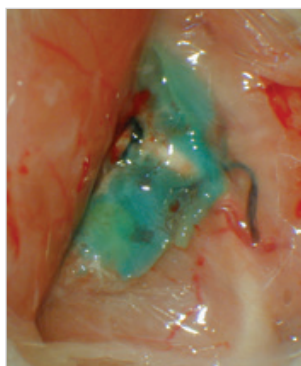


Fig. 16: Kwik-Cast with connective tissue and blood vessels.

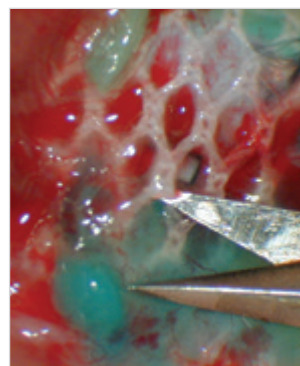


Fig. 17: Cutting away tissues from the Dacron mesh.

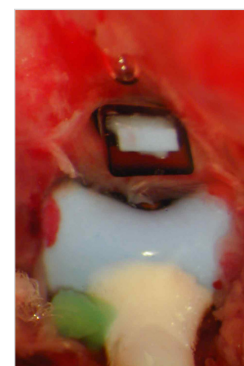


Fig. 18: Probe removed.



Fig. 19: Typical mouse chronic femoral artery flowtrace.

### ACKNOWLEDGEMENTS

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