T400-Series Surgical Protocol

Mouse Renal Artery: Acute Blood Flow Measurement

APPLICATION BASICS

Site:	Renal artery
Species:	Mouse
Body Weight:	20 - 50 grams
Duration:	Acute
Vessel Diameter:	0.35 - 0.55 mm
Length:	0.25 mm

PROBE

Size:	0.5 mm
Reflector:	JN
Connector:	CRA10: 10-pin
Cable Length:	60 cm
Catalog #:	MA-0.5PSL MA-0.5PSB

FLOWMETER

TS420 Perivascular Module

0.5PSB Nanoprobe with handle

Flow Ranges Observed:

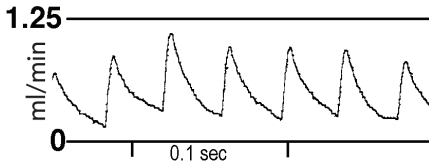

Fig. 1: Renal arterial blood flow in a 300 micron vessel in a 40 gram anesthetized mouse. Mean flow is 0.46 ml/min.

Anatomical Differences Between Mice & Rats

Size

The renal artery of the mouse is approximately 350-550 micrometers in diameter (~60% of the diameter of the renal artery of the rat). It is ~2.5 mm long somewhat shorter that the renal artery in the rat. Less space is available for dissection than is available in the rat.

Anatomic Location

In the mouse, the renal artery differs anatomically in respect to the renal vein from the rat. In the rat, the renal artery and renal vein lie almost parallel in the same plane in the back of the animal. It is, therefore, relatively easy to dissect the renal artery away from the renal vein. In the mouse, the renal artery tends to be more dorsally positioned in respect to the renal vein. Using a conventional laparotomy, the renal artery appears to lie slightly behind the renal vein and has to be dissected free from the renal vein. This poses a challenge in that the renal vein is very thin.

Application

The measurement of renal blood flow has an important role in research on hemodynamics, electrolyte regulation and pregnancy-induced hypertension. Flow-pressure relationships are essential in defining renal autoregulation. Other studies have focused on diuretics, cardiovascular drugs, and nephrotoxic agents. While average renal flow may also be obtained from the renal vein, the pulsatile waveform of the renal artery provides additional information and visual confirmation of a reliable renal arterial measurement.

Laparotomy surgical approaches to locating and isolating the vessel for measurement (typically used in the rat) are more challenging in the mouse. Anatomical differences from the mouse and anatomical variability among transgenic and knock out models require special consideration when choosing a surgical approach. The goals for obtaining stable data are to minimize the surgical preparation time and manipulation of the vessel and limit heat and fluid loss.

Advantages of Retroperitoneal Approach

A retroperitoneal approach to the renal artery has several advantages and is the preferred method for renal blood flow measurement. Approaching the kidney from the back allows easy visualization of

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Mouse Renal Artery: Acute Blood Flow Measurement Cont.

Advantages of Retroperitoneal Approach cont.

the renal artery and dissection without disturbing the delicate renal vein. By laparotomy, the renal artery lies directly under the renal vein making dissection difficult.

Retroperitoneally, there is no interference with the abdominal organs. By contrast, in laparotomy the intestines and abdominal contents are exposed and must be deflected to the side to allow access to the renal artery and vein. This lengthens the procedure and exposes the mouse's abdominal cavity for additional heat loss.

There is considerable variability in renal vascular branching among mice. In some mice, exploration of the left kidney reveal insufficient vessel length to fit the Flowprobe before the vessel branches. Because a retroperitoneal approach is quicker, it is possible to move on in the same mouse to explore the right renal artery.

Protocol: Retroperitoneal Approach, Left Renal Artery

- Anesthetize mouse and position animal in right lateral recumbency.
- Make initial skin incision 1 cm lateral to midline of back.
- Cut through skeletal muscle layer to expose the hilus of the kidney.
- Gently retract kidney to the left to expose the area between the kidney and the aorta to reveal renal artery.
- A 2 mm length of vessel without visible branching is required for Flowprobe placement.
- If the vessel is too short or bifurcates, the incision may be closed and the animal turned on its left side for exploration of the right kidney.
- Use blunt dissection along the renal artery to isolate the vessel and clear off fat for proper acoustic coupling of Probe.
- Position Probe so that the renal artery is in the lumen of the Probe.
- Use a syringe with a flexible catheter tip to deposit SurgiLube gel in air spaces of Probe and verify good transmission of the ultrasound signal by checking the Flowmeter "Test" mode.
- Stabilize Probe position with a micromanipulator for continuous measurement.

Caution: Careful Dissection Required

In general, dissections or manipulation of vessels in mice should be approached very carefully. The renal vein and renal artery may be dissected away from each other by grabbing carefully the adventitia of the renal artery and, using very fine Dumont vessel dilators (D-5az), carefully go around the renal artery and dissect it free from the renal vein. Renal artery dissections are best performed by applying slight pressure against the renal artery and allowing the D5az forceps to spread and dissect the adventitia away from the artery itself. Do not apply any kind of dissecting force against the renal vein. Instead, apply pressure toward the artery and let the instruments themselves perform the dissection by separating the adventitia from the artery. This will result in fewer misadventures with the renal vein.

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