T400-Series Surgical Protocol

Rat & Mouse Carotid Artery: Acute Blood Flow Measurement

APPLICATION BASICS

Site:	Carotid artery
Species:	Mouse
Body Weight:	20-50 grams
Duration:	Acute
Vessel Diameter:	0.55 - 0.60 mm
Length:	2.5 - 3.0 mm

PROBE

Size:	0.5 mm; 0.7 mm
Reflector:	J
Connector:	CRA10: 10-pin
Cable Length:	60 cm
Catalog #:	
Smaller mice:	MA-0.5PSB
Larger mice:	MA-0.7PSB MA-0.5VB

FLOWMETER

TS420 Perivascular Module

APPLICATION BASICS

Site:	Common carotid artery
Species:	Rat
Body Weight:	280 grams
Duration:	Acute
Vessel Diameter:	0.7 - 1.2 mm

PROBE

Size:	0.7 mm; 1 mm
Reflector:	JN / JS
Connector:	CRA10: 10-pin
Cable Length:	60 cm
Catalog #:	
Smaller rats:	MA-0.7PSB MA-0.7VB
Larger rats:	MA-1PRB w/handle

FLOWMETER

TS420 Perivascular Module

Application

The common carotid artery is an easily accessible vessel for measurements for relative cardiac output and cerebral blood flow. One advantage of the common carotid artery over the abdominal descending aorta is that the surgical approach for the common carotid artery does not require opening a major body cavity resulting in better thermoregulation and less physiological shock.

Transonic® Flowprobes are routinely used in rats and mice in standard study protocols for thrombosis formation and lysis because of their measurement precision. The recent explosion of genetic modeling techniques in mice for *in vivo* studies and the advanced technologies for bench marking results have become critical to understanding the pathophysiology of thrombosis formation and its treatment.

There are a handful of accepted methods to model arterial thrombosis in genetically altered mice. Two have been used routinely on the mouse carotid artery. The Ferric Chloride Model applies a 1 x 2 mm patch of ferric chloride-saturated paper directly on the adventitia of the isolated carotid artery. The Photochemical Model of Arterial Thrombosis uses circulating Rose Bengal that is activated by green laser illumination (545 nm wavelength) of the isolated carotid

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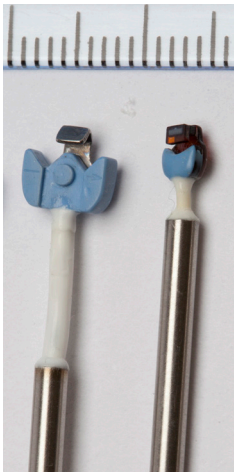

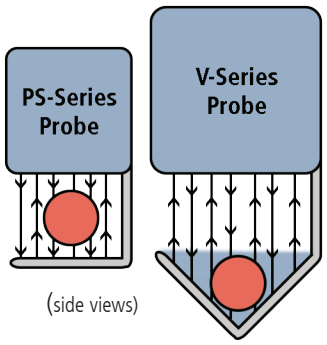

PS-Series Nanoprobe: The full height of the ultrasonic window has the same flow sensitivity, so that the vessel can be positioned anywhere within the Probe lumen.

V-Series: Only within the triangle (shaded) portion of the V will the Probe reach its full flow sensitivity

Fig. 1: Side-by-side comparison of a V-Series Flowprobe (on left) and NanoProbe (on right).

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Mouse & Rat Carotid Artery: Acute Blood Flow Measurement Cont.

Application cont.

artery to cause oxygen-radical injury to the endothelium. For results that can be interpreted across studies, these methods rely on accurate "time to occlusion" blood flow measurement using Transonic® Flowmeters.

Transonic® Nanoprobes are the method of choice for carotid artery occlusive thrombosis studies which require precision measurement of zero blood flow to discern "time to occlusion". In the literature they are often mistaken for "Doppler Probes." They are not Doppler velocity Probes. Transonic® Nanoprobes are miniaturized ultrasonic transit-time Flowprobes that loosely cradle the target vessel in the mouse and directly measure the volume flow of blood in the vessel in ml/min. They are sized for mouse-size vessels and mouse-sized flow rates. Mouse carotid flow rates average approximately 0.24 to 0.7 ml/min in sham operated pre-occluded experimental animals depending on anesthetic and protocol that includes or does not include mechanical ventilation.

Introduction

The carotid artery is a long vessel that is free of branches and very easy to locate and isolate. In a mouse, the vessel is 0.5 to 0.6 mm diameter. Transonic® 0.5PSB and 0.7PSB Nanoprobes fit the vessel very closely, thereby minimizing the amount of acoustic gel required to achieve and maintain good signal. These small bodied Probes allow best visualization of the vessel and experimental site since they occupy little space along the vessel. Nanoprobes for acute use are fitted with handles, useful in stabilizing the position of the Probes for precision experiments such as measuring the time to occlusion in thrombosis studies.

In a rat, the vessel is minimally 0.7 mm diameter to 1.2 mm diameter, depending on the age of the animal and the treatment protocol (eg. ligation of the contralateral carotid artery) A 0.7PSB Nanoprobe will fit the vessel very closely and may be used in smaller animals, thereby limiting the amount of acoustic jelly that is required to achieve good signal. However, the Nanoprobe will be constrictive on many animals. For vessels larger than 0.7 mm diameter, use a 1 mm 1PRB Flowprobe fitted with a handle.

Many studies also reference high sensitivity 0.5VB mouse and 0.7VB rat Flowprobes for thrombosis applications. These may be used in this vessel location since the carotid is a long vessel and affords the space for the larger bodied Probe. If using the V-series, make certain that the vessel is fully within the sensitive "V" area of the Probe reflector and fill the remaining space with acoustic gel (Fig. 5). Only the "V" area of the Probe is sensitive to total flow. Flow outside this "V" position will be underestimated.

Flow Ranges Observed

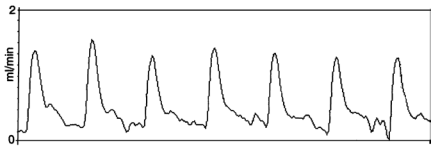

Fig. 2: Instantaneous flow in the common carotid artery ranged from 0 to 2 ml/min in a deeply anesthetized 200 gram rat.

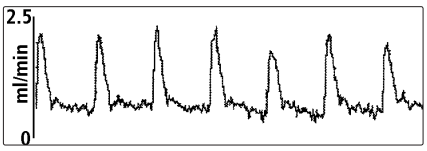

Fig. 3: Acute carotid arterial flow in a 31.2 gram mouse with a 0.7 mm V-Series Flowprobe.

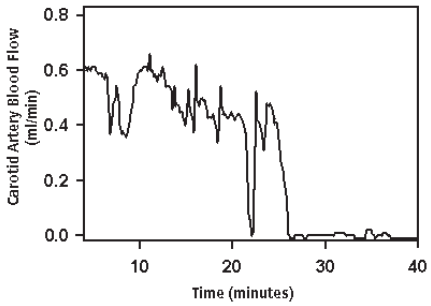

Fig. 4. Photochemical-induced injury set-up: Green laser light illumination on isolated mouse carotid artery proximal to Transonic Systems 0.5PSB Flowprobe. Sustained zero blood flow measured by the Flowprobe indicates carotid artery occlusion from thrombosis.

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Surgical Approach

Mice are anesthetized with sodium pentobarbital (70-90 mg/kg intraperitoneally) and secured in a supine position under a dissecting microscope. A heating pad is used to maintain body temperature at 36-37 °C. Supplemental anesthesia is administered as needed. A midline cervical incision is made and the trachea and right common carotid are dissected free, Mice are ventilated mechanically with room air and supplemental oxygen (80 breaths per minute, stroke volume 0.5 ml) using a Harvard rodent respirator modified with a 1.0 ml cylinder and piston assembly. Carotid artery blood flow is measured with a 0.5 PSB Flowprobe.

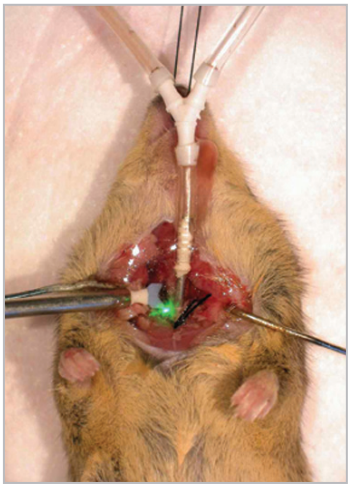

Fig. 5: Ventilated mouse undergoing photochemical thrombosis in the carotid artery.

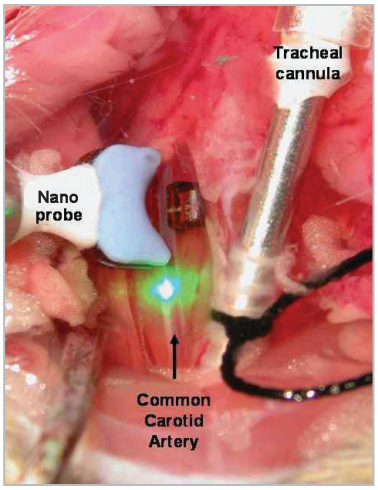

Fig. 6: Close-up of 0.5PSB Nanoprobe measuring carotid arterial blood flow in the mouse.

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AMERICAS
Transonic Systems Inc.
34 Dutch Mill Rd
Ithaca, NY 14850
U.S.A.
Tel: +1 607-257-5300
Fax: +1 607-257-7256
support@transonic.com

EUROPE
Transonic Europe B.V.
Business Park Stein 205
6181 MB Elsloo
The Netherlands
Tel: +31 43-407-7200
Fax: +31 43-407-7201
europe@transonic.com

ASIA/PACIFIC
Transonic Asia Inc.
6F-3 No 5 Hangsiang Rd
Dayuan, Taoyuan County
33747 Taiwan, R.O.C.
Tel: +886 3399-5806
Fax: +886 3399-5805
support@transonicasia.com

JAPAN
Transonic Japan Inc.
KS Bldg 201, 735-4 Kita-Akitsu
Tokorozawa Saitama
359-0038 Japan
Tel: +81 04-2946-8541
Fax: +81 04-2946-8542
info@transonic.jp