

T400-Series Surgical Protocol

Sheep Simultaneous Coronary Flow & NMR Spectroscopy: Acute Blood Flow Measurement

APPLICATION BASICS

Site:	Coronary sinus shunt
Species:	Sheep: 5 - 90 days old
Weight:	5 - 14 kg
Duration:	Acute

SENSOR

Size:	3 mm (Inline)
Cable Length:	1 meter
Extension Cable:	4 meter
Catalog #:	ME-3PXN (non-magnetic)

FLOWMETER

TS410 Tubing Module

Application

This protocol was developed to correlate the traditional technique of measuring oxygen consumption (ie, the product of concentration and flow) with ATP utilization as measured with NMR spectroscopy. The simultaneous measurement of blood flow with NMR presents some unique challenges. First, the Flowsensor must be completely constructed from non-magnetic materials. Special care must also be taken to minimize the noise introduced into the NMR signal by the flow system. In this protocol, both spatial isolation and electrical filtering were used to increase the signal-to-noise ratio. Finally, the signal-to-noise ratio is increased by gating data acquisition to the initial inspiratory phase of the respiratory cycle and summing 60 acquisitions. In two animals, this concept was taken even further and the heart was paced at a precise harmonic of the ventilation rate.

Surgical Approach

Induce anesthesia with ketamine (10 mg/kg IM) and xylazine (0.2 mg/kg IM). Intubate and ventilate with oxygen and halothane at a rate of 30 cycles per minute. Perform a left thoracotomy with rib removal to expose the left ventricle.

Identify the left azygous vein draining into the coronary sinus, and ligate it as shown in Fig. 3 to keep it from contributing to apparent coronary flow. Make a shallow skin incision over each jugular vein and catheterize each vein with 1/8 inch Tygon tubing. Advance one catheter into the right atrium and the other into the coronary sinus as shown in Fig. 4. Place a suture around the coronary sinus so that all coronary drainage must pass through the catheter.

Connect one of the jugular catheters to the cannulating Flowsensor. Connect a plastic T connector to other end of the

(Continued on next page.)

Flow Ranges Observed

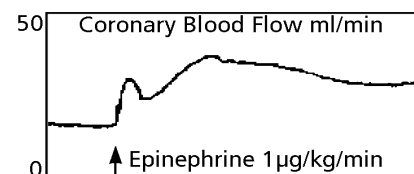


Fig. 1: Typical recording of hemodynamic parameter (coronary bf) obtained while acquiring ^{31}P NMR spectra.

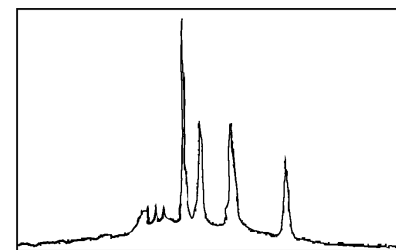
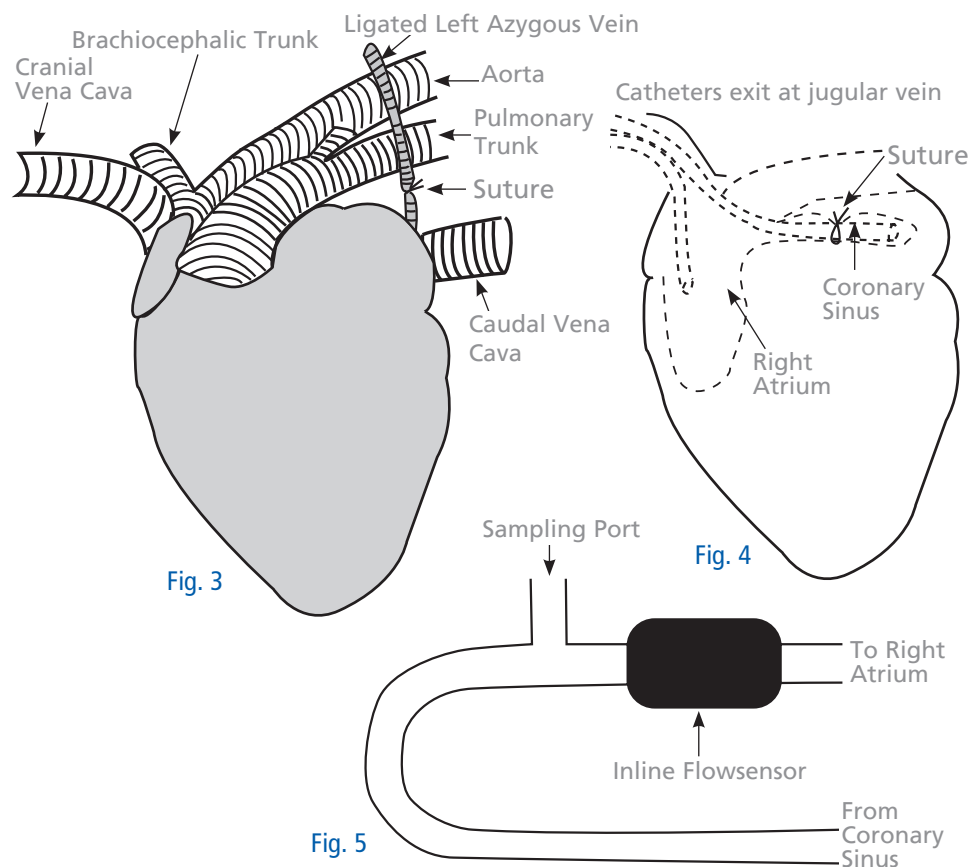


Fig. 2: ^{31}P (81 MHz) spectrum of a lamb left ventricle (age, 70 days) *in vivo*. The spectrum represents the sum of 300 acquisitions which were respiratory gated resulting in an interpulse delay of 2 sec.

Sheep Simultaneous Coronary Flow & NMR Spectroscopy: Acute Blood Flow Measurement Cont.

Surgical Approach cont.

Flowsensor and the other jugular catheter to other port of the T connector as shown in Fig. 5. The stem of the T connector can be used for blood sampling or heparin flushing of the shunt.



ACKNOWLEDGEMENT

Dr. R.S. Balaban and F.W. Heineman, Laboratory of Cardiac Energetics, National Heart, Lung and Blood Institute, National Institutes of Health, Bethesda, MD, 20892

REFERENCES

Portman MA, James S, Heineman FW, Balaban RS, "Simultaneous Monitoring of Coronary Blood Flow and ^{31}P NMR Detected by Myocardial Metabolites," *Magnetic Resonance in Medicine* 1988; 7: 243-247.

Portman MA, Heineman FW, Balaban RS, "Metabolic Control of Oxygen Consumption in the Developing Heart in Vivo: A ^{31}P NMR Study," *JACC* 1988; 11(2): 9A.



Transonic Systems Inc. is a global manufacturer of innovative biomedical measurement equipment. Founded in 1983, Transonic sells "gold standard" transit-time ultrasound flowmeters and monitors for surgical, hemodialysis, pediatric critical care, perfusion, interventional radiology and research applications. In addition, Transonic provides pressure and pressure volume systems, laser Doppler flowmeters and telemetry systems.

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