Reduce Early Graft Failure Following CABG Surgery

- Improve patient outcomes
- Verify graft patency
- Reduce bring-backs
Coronary Flowprobes take the guesswork out of knowing bypass flow

Transonic® Cardiovascular Flowprobes work with the Transonic® Optima Flowmeter to measure volume flow in vessels or grafts from 1.3 - 36 mm diameter. The non-constrictive perivascular Flowprobes use transit-time ultrasound technology to measure volume blood flow directly, quickly and easily, even in the low-flow range.

The surgeon now has a quantitative tool with which to objectively assess the quality of the anastomosis. Unseen blood flow obstructions can be detected intraoperatively and repaired before closing the patient. This ability to correct otherwise undetectable flow restrictions gives the surgeon with a unique opportunity to improve patient outcomes.

**European Revascularization Guidelines**

“Graft flow measurement, related to graft type, vessel size, degree of stenosis, quality of anastomosis, and outflow area, is useful at the end of surgery. Flow <20 mL/min and pulsatility index >5 predict technically inadequate grafts, mandating graft revision before leaving the operating theatre.”

1 The Task Force on Myocardial Revascularization of the European Society of Cardiology (ESC) and the European Association for Cardio-Thoracic Surgery (EACTS) “Guidelines on Myocardial Revascularization,” Eur J Cardiothorac Surg 2010; 38, S1 S52

“TTFM predicts graft failure within six months after CABG.”

“TTFM is a reliable method to verify intraoperative graft patency.”


“The intraoperative use of flow measurements provide invaluable information in a timely, accurate, cost-effective manner allowing for the surgical correction of a surgical problem. This has significantly reduced the complication related to early technically induced graft failure.”

Mindich B, MD

**TRANSIT-TIME ULTRASOUND TECHNOLOGY**

MEASURES VOLUME FLOW, NOT VELOCITY

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.
Flow-based Patency Assurance: Illustrative CABG Case Reports

“The intraoperative use of flow measurements provides invaluable information in a timely, accurate, cost-effective manner allowing for the surgical correction of a surgical problem. This has significantly reduced the complications related to early technically induced graft failure ... and provides documentation of the *sine qua non* of the operation: patency.”

Two LIMA-LAD Cases Demonstrate that PIs <5 Can Be Misleading; Acceptable Mean Flow Is Key

A 76-year-old male patient underwent coronary artery bypass grafting (CABG) surgery to bypass a lesion in the left anterior descending (LAD) artery utilizing a left internal mammary artery (LIMA) graft. Initial LIMA-LAD mean flow measured 8.8 mL/min (PI: 3.8) (top waveform).

The graft was revised. Following revision, LIMA-LAD mean flow improved to 60 mL/min (PI: 0.8) and was accompanied by a classic, diastolic dominant waveform profile (bottom waveform).

In the second case, a 67-year-old male patient with single-vessel coronary artery disease underwent off-pump CABB. LIMA-LAD graft flow first measured 5.2 mL/min (PI: 3.4). The patient’s pulse and pressure appeared normal and the graft appeared functional, but the waveform exhibited a damped profile and atypical diastolization (top waveform). The surgeon decided to revise the graft.

After revision, LIMA-LAD graft flow improved to 50 mL/min (PI: 3). The flow waveform (bottom) exhibited a classic LIMA-LAD profile. Note that the first PI was 3.4, the revised PI was 3.

Zero Mean Flow Demands Revision of LIMA-Cx Graft

A 78-year-old female patient underwent single coronary bypass grafting to bypass a blocked circumflex (Cx) coronary artery with the LIMA. Flow first measured 0 mL/min (PI: 91) following anastomosis of the LIMA to the Cx. The flow waveform had a spiky systolic profile (top waveform). Revision was demanded.

Following revision of the graft, mean graft flow improved to 30 mL/min (PI: 2), and the waveform exhibited a balanced systolic/diastolic profile (bottom waveform). Zero mean flow was the determining factor in the decision to revise the graft.
Zero Flow in SVG-Cx Graft Reveals Clot

An 81-year-old male patient underwent CABG surgery to bypass a blocked circumflex (Cx) coronary artery. A harvested saphenous vein graft (SVG) was used to connect the aorta to the Cx distal to the lesion (top waveform).

Following anastomosis of the SVG to the Cx, graft flow measured 0 mL/min, clearly indicating that there was a problem. Investigation revealed a clot in the graft. The patient was placed on IABP support. The graft was declotted and flow was remeasured with the patient still on IABP support. Flow measured 86 mL/min (middle waveform).

When the IABP support was removed, graft flow measured 76 mL/min (PI: 2) indicating that the presence of an IABP did not significantly affect graft flow (bottom waveform).

Three waveforms above show a progression from a clotted graft with zero mean flow (top waveform) to a declotted graft on IABP (mean flow, 86 mL/min) to the declotted graft with IABP removed (mean flow, 76 mL/min, bottom waveform).

RIMA-RCA Graft Flow Suppressed by Competitive RCA Flow

A 60-year-old male underwent CABG to bypass a blockage in his right coronary artery (RCA) with a right internal mammary artery graft (RIMA).

Following the RIMA-RCA anastomosis distal to the blockage, flow measured 4.8 mL/min (PI: 6). Low mean flow, a high PI and a systolic dominant waveform profile indicated the need for graft revision.

After revision, flow improved to 20 mL/min (PI: 3.2), but this flow was not as high as the surgeon expected given the size of the patient. Suspecting the presence of competitive flow from the native RCA, the surgeon occluded the native RCA proximal to the anastomosis of the graft. Mean graft flow increased to 64 mL/min (PI: 2). Another graft was added, placed more distally on the RCA. Runoff improved, competitive flow decreased and graft flow was > 40 mL/min.

The significant increase in mean graft flow supported the surgeon’s suspicion that competitive flow was suppressing graft flow.

Three waveforms show the systolic dominant profile of the RIMA-RCA graft before revision (top), the systolic/diastolic flow waveform profile following revision of the graft (middle), and the similar graft waveform with the proximal RCA occluded (bottom).
Flow-based Patency Assurance

Poor Rad-LAD Graft Flow Triggers Graft Revision

A 71-year-old male with single-vessel coronary artery disease underwent CABG surgery. A segment of the radial artery (Rad) was harvested and grafted proximally to the aorta and distally to the LAD. Initial Rad-LAD mean flow measured 1.8 mL/min (PI: 29) indicating that revision of the graft was warranted (top waveform).

After revision, graft flow improved to 77.5 mL/min (PI: 3). The flow was accompanied by a repetitive systolic/diastolic waveform profile (bottom waveform).

Low Mean Flow Spurs Rad-OM\textsubscript{1} Graft Revision

A 48-year old male patient with multi-vessel coronary artery disease underwent quadruple CABG. Four grafts including a LIMA-LAD, SVG-OM, SVG-Dx and Rad-OM\textsubscript{1} were constructed to deliver flow to the distal myocardium. Mean flows in the LIMA-LAD, SVG-OM and SVG-Dx grafts were acceptable.

However, mean Rad-OM\textsubscript{1} graft flow measured 3.6 mL/min (PI: 12.7) signaling the need for revision of the graft. Following Rad-OM\textsubscript{1} graft revision, mean graft flow improved to 18.3 mL/min (PI, 1.7) and was accompanied by a systolic/diastolic waveform.

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.
CABG Medical Protocol

Intraoperative Graft Patency Assessment during CABG Surgery

Measuring Graft Flow

Accurate measurements are technique dependent.
- Select a Flowprobe sized so that the graft will fill at least 75% of the lumen of the Probe without compressing the graft.
- Fill Probe window with ultrasound gel.
- Position Probe on graft (not over metal clips or fascia).
- Occlude native coronary artery and measure graft flow to establish maximum flow for the graft.
- When flow reading is stable (10-15 seconds), press PRINT, take snapshot or record on AureFlo®.

Does Mean Flow Confirm Graft Patency?
- Acceptable Mean Flow > 30 mL/min
- Medium Range Mean Flows (5 - 30mL/min)
  Does flow exhibit the expected pattern?
  Evaluate other factors that may lower flow such as vasospasm of arterial grafts; small target vessel or small patient; small graft capacity, poor runoff, or low mean arterial pressure.

Is Pulsatility Index (PI) between 1 & 5?
A PI greater than 5 is generally associated with low mean flow and systolic-dominant flow pattern indicating that the graft should be reexamined.

Examine Graft
- With Probe on the graft, turn on FlowSound® and listen for pitch increases as adjustments are made to the graft (1 octave pitch ‘K’ = 4 ‘xK’ in flow).
- Look for kinks/twists in the graft, low MAP, dampened waveform
- Redo anastomosis if technical error is indicated.

Flow Waveform Analysis

Diastolic-Dominant Pattern

For grafts to the left ventricle, the shorter waveform peak is usually systolic, and the higher, broader peak is diastolic (Fig. 1) except in the presence of severe tachycardia where diastole is shortened. An acceptable left ventricular waveform is “diastolic dominant” where the delivered diastolic blood volume (i.e., area under diastolic curve) exceeds delivered systolic blood volume.

Balanced Systolic/Diastolic Pattern

In grafts to the right ventricle, flow is more equally distributed between the systolic and diastolic phases. This produces a flow waveform where the systolic peak may dominate but is followed by a proportionally strong diastolic flow producing a systolic/diastolic balanced waveform (Fig. 2).

Questionable Flows

For questionable mean graft flows (5 - 30 mL/min), the graft is evaluated through systolic/diastolic waveform properties, using FlowSound®, a printout or snapshot to examine the graft. A rule of thumb is that systole lasts one-third of a heart beat and diastole lasts two-thirds.

Stenotic Pattern

In stenotic grafts, the systolic peak dominates the flow profile and is associated with low or zero-mean flow. Often, systolic charge flow flows backwards as a negative flow during diastole (Fig. 3).

Diastolic-Dominant Pattern cont.

Fig. 1: LIMA-LAD: mean = 147 mL/min; diastolic dominant; PI =2.

Diastolic-Dominant Pattern cont.

Fig. 2: RIMA - RCA: mean is 19 mL/min. systolic/diastolic balanced; PI=2.

Fig. 3: The RIMA - RCA graft exemplifies a graft with a stenotic flow profile. The flow waveform dips below zero and indicates the presence of competitive flow.
Coronary Graft Patency Assessment Protocol Cont.

Measure Graft Flow

Evaluate Mean Flow Reading (per mean flow chart)

- **Good Flow**: > 20 mL/min or > 30 mL/min (depending on a patient’s size and physiology)

  - Examine Graft (spasm/kinks/twists/soft BP)

    - Remeasure Graft Flow with native coronary artery occluded (mean flow reading & waveform printout)

    - Reevaluate Mean Flow Reading (per mean flow chart)

    - **Flow Waveform Analysis**
      - Acceptable Flow Profile:
        - Diastolic Dominant (left ventricle)
        - Systolic/Diastolic balanced (right ventricle)
        - Acceptable Pulsatility Index (1 - 5)

    - Analyze Other Factors
      - Small patient/small target vessel?
      - Physiologic factors (MI, vasospasm, low MAP)?
      - Poor runoff?
      - Quality of myocardium?

  - **Questionable or Poor Flow**

    - Patent Graft
      - Proceed to measure flow in next graft

- **Questionable Flow**

  - Acceptable Pulsatility Index (1 - 5)
  - Analyze Other Factors
  - Suspect Graft
   - Examine Graft for Anastomotic Error
    - Revise graft

  - **Poor Flow**
    - Proceed to measure flow in next graft

  - **Good Flow**
    - Patent Graft
      - Proceed to measure flow in next graft

  - **Questionable Flow**
    - Acceptable Flow Profile
    - Analyze Other Factors
    - Suspect Graft
     - Examine Graft for Anastomotic Error
      - Revise graft
Cardiac Surgery Flowprobes

Transonic® Cardiac Surgery Flowprobes and HT300-Series Flowmeters measure volume flow in blood vessels or grafts from 0.5 to 36.0 mm outer diameter. Measurements help the surgeon correct otherwise undetectable flow restrictions and guide surgical decisions to ensure the best outcome for the patient.

Coronary Flowprobes for Coronary Artery Bypass (CABG) Surgery

Pictured, from left to right, are 1.5 mm, 2 mm, 3 mm and 4 mm coronary Flowprobes showing their blue Probe bodies, J-style reflectors and ultrasonic sensing windows.

The Coronary Flowprobe’s elongated handle allows for easy positioning of the Probe around coronary artery bypass grafts behind the heart. As shown above, the Flowprobe’s flexible neck can be bent so that the Flowprobe can easily encircle a coronary graft or vessel.

COnfidence Flowprobes® for Continuous CO Measurements

COnfidence Flowprobes® provide highly accurate measurements in vessels with turbulent flows such as the ascending aorta. A novel four-transducer concept for ultrasonic signal coupling enables immediate, accurate beat-to-beat flow measurements.

COnfidence Flowprobes consist of a form-fitting liner that cushions and protects the vessel during flow measurement and a reusable shell that encircles the vessel. Probes may be left in place for extended cardiac output measurements and then easily removed.

COnfidence Flowprobes are available in 17 sizes ranging from miniature 4 mm and 6 mm flowprobes for pediatric and neonatal ascending aortas and pulmonary arteries to 36 mm for large turbulent vessels in adults.
Port Access Flowprobes

Transonic’s Port Access Flowprobes enable volume flow measurements during minimally invasive robotic CABG surgeries to allow surgeons to confirm adequate flow, especially critical in procedures where there is no other method to accurately assess flow or where it is not possible to directly visualize the vessel or anastomosis.

The Flowprobes feature a long endoscopic handle that can be inserted through ports for access to the measurement site. The Probe handle is grooved to hold a disposable, sterile, gel-filled tube attached to a syringe in order to simplify the application of couplant to ensure the best possible measurement.

This innovative probe is CE marked; FDA clearance is pending.

FD-Series Port Access Flowprobes feature a blue probe body with J-style reflector, ultrasonic sensing windows and a long endoscopic handle with a groove on the bottom side to hold tubing through which acoustic couplant is injected by a syringe into the measurement site.

FD-Series Port Access Flowprobes: shown from top to bottom are 1.5 mm, 2 mm, 3 mm and 4 mm diameter Flowprobes.

<table>
<thead>
<tr>
<th>PROBE SIZE</th>
<th>CATALOG #</th>
<th>VESSEL OUTER DIAMETER OD (mm)</th>
<th>MINIMUM TROCAR SIZE (mm)</th>
</tr>
</thead>
<tbody>
<tr>
<td>1.5 mm</td>
<td>HQx 1.5FD</td>
<td>1.3 - 2.3</td>
<td>8</td>
</tr>
<tr>
<td>2.0 mm</td>
<td>HQx 2FD</td>
<td>1.8 - 3.0</td>
<td>8</td>
</tr>
<tr>
<td>3.0 mm</td>
<td>HQx 3FD</td>
<td>2.4 - 4.0</td>
<td>12</td>
</tr>
<tr>
<td>4.0 mm</td>
<td>HQx 4FD</td>
<td>3.2 - 5.3</td>
<td>12</td>
</tr>
</tbody>
</table>

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.
# Flowprobe Selection Guide

## Perivascular Flowprobe Series & Available Sizes

<table>
<thead>
<tr>
<th>Suffix</th>
<th>Description</th>
<th>Sizes (mm)</th>
</tr>
</thead>
<tbody>
<tr>
<td>-FMC</td>
<td>Coronary (J-reflector, extended neck)</td>
<td>1.5, 2, 3, 4</td>
</tr>
<tr>
<td>-FMV</td>
<td>Vascular (J-reflector, standard handle)</td>
<td>1.5, 2, 3, 4, 6, 8, 10, 12, 14</td>
</tr>
<tr>
<td>-FME</td>
<td>Carotid (L-reflector, standard handle)</td>
<td>4, 6, 8, 10</td>
</tr>
<tr>
<td>-FTV</td>
<td>OptiMax® (J-reflector, hands-free butterfly wings)</td>
<td>4, 6, 8, 10, 12</td>
</tr>
<tr>
<td>-FTE</td>
<td>OptiMax® (L-reflector, hands-free butterfly wings)</td>
<td>4, 6, 8, 10, 12</td>
</tr>
<tr>
<td>-MU</td>
<td>Microvascular (L-reflector, standard handle)</td>
<td>0.7, 1, 1.5, 2, 3</td>
</tr>
<tr>
<td>-AU</td>
<td>Cardiac Output Confidence Flowprobe® (C-shaped design, no handle)</td>
<td>4, 6, 8, 10, 12, 14, 16, 18, 20, 22, 24, 26, 28, 30, 32, 34, 36</td>
</tr>
<tr>
<td>-MB;</td>
<td>Intracranial Charbel Micro-Flowprobe® (L-reflector, long bayonet handle)</td>
<td>-MB: single use; -MR: resposable</td>
</tr>
<tr>
<td>-MR</td>
<td></td>
<td>1.5, 2, 3</td>
</tr>
<tr>
<td>-MB-S</td>
<td>Extracranial EC-IC Bypass: Micro-Flowprobe (L-reflector, short bayonet handle): -MB-S: single use; -MR-S: resposable</td>
<td>3, 4, 6</td>
</tr>
<tr>
<td>-MR-R</td>
<td></td>
<td></td>
</tr>
<tr>
<td>-FSB</td>
<td>Basic (L-reflector with sliding cover, no handle)</td>
<td>1.5, 2, 3, 4, 6, 8, 10, 12, 14</td>
</tr>
<tr>
<td>-P</td>
<td>Port Access (J-reflector, long port-access handle)</td>
<td>Port Access (J-reflector, long port-access handle)</td>
</tr>
<tr>
<td>-FD</td>
<td></td>
<td>2, 3, 4</td>
</tr>
<tr>
<td></td>
<td></td>
<td>1.5, 2, 3, 4</td>
</tr>
</tbody>
</table>

## Recommended Sizes and/or Flowprobe Series for Specific Vessels or Applications

### Cardiac Surgery

<table>
<thead>
<tr>
<th>CABG: On or Off Pump</th>
<th>Probe Size (mm)</th>
<th>Probe Series</th>
</tr>
</thead>
<tbody>
<tr>
<td>Arterial conduits</td>
<td>1.5, 2, 3, 4</td>
<td>-FMC</td>
</tr>
<tr>
<td>Saphenous vein</td>
<td>2, 3, 4</td>
<td>-FMC</td>
</tr>
<tr>
<td>Port access - coronary arteries</td>
<td>1.5, 2, 3, 4</td>
<td>-FD</td>
</tr>
</tbody>
</table>

### Cardiac Output

<table>
<thead>
<tr>
<th>Vessels</th>
<th>Probe Sizes (mm)</th>
<th>Probe Series</th>
</tr>
</thead>
<tbody>
<tr>
<td>Ascending aorta</td>
<td>28, 32, 36</td>
<td>-AU</td>
</tr>
<tr>
<td>Pulmonary artery</td>
<td>24, 28, 32</td>
<td>-AU</td>
</tr>
<tr>
<td>Pediatric heart</td>
<td>4, 6, 8, 10, 12, 14, 16, 20</td>
<td>-AU</td>
</tr>
</tbody>
</table>

### Transplant Surgery

<table>
<thead>
<tr>
<th>Vessels</th>
<th>Probe Sizes (mm)</th>
<th>Probe Series</th>
</tr>
</thead>
<tbody>
<tr>
<td>Liver</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Hepatic artery</td>
<td>4, 6, 8</td>
<td>-FMV, -AU</td>
</tr>
<tr>
<td>Portal vein</td>
<td>10, 12, 14</td>
<td>-FMV, -AU</td>
</tr>
<tr>
<td>Kidney</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Renal artery</td>
<td>4, 6</td>
<td>-FMV, -FSB</td>
</tr>
<tr>
<td>Renal vein</td>
<td>10</td>
<td>-FMV, -FSB</td>
</tr>
<tr>
<td>External iliac artery</td>
<td>6, 8</td>
<td>-FMV, -FSB</td>
</tr>
<tr>
<td>Hypogastric artery</td>
<td>4, 6</td>
<td>-FMV, -FSB</td>
</tr>
</tbody>
</table>

### Pancreas

<table>
<thead>
<tr>
<th>Vessels</th>
<th>Probe Sizes (mm)</th>
<th>Probe Series</th>
</tr>
</thead>
<tbody>
<tr>
<td>Common iliac artery</td>
<td>8</td>
<td>-FMV, -FSB</td>
</tr>
</tbody>
</table>

### Cerebrovascular Surgery

<table>
<thead>
<tr>
<th>Vessels</th>
<th>Probe Sizes (mm)</th>
<th>Probe Series</th>
</tr>
</thead>
<tbody>
<tr>
<td>Aneurysm clipping</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Cerebral arteries</td>
<td>1.5, 2, 3</td>
<td>-MB; -MR</td>
</tr>
<tr>
<td>EC-IC Bypass</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Extracranial</td>
<td>3, 4, 6</td>
<td>-MB-S, MR-S</td>
</tr>
<tr>
<td>Intracranial</td>
<td>1.5, 2, 3</td>
<td>-MB, -MR</td>
</tr>
<tr>
<td>AVM, Tumor Resection, Dural Fistula</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Outflows</td>
<td></td>
<td>-MB, -MR</td>
</tr>
</tbody>
</table>

### Vascular Surgery

<table>
<thead>
<tr>
<th>Vessels</th>
<th>Probe Sizes (mm)</th>
<th>Probe Series</th>
</tr>
</thead>
<tbody>
<tr>
<td>Common carotid artery</td>
<td>8, 10</td>
<td>-FTE, -FME, -FSB</td>
</tr>
<tr>
<td>External carotid artery</td>
<td>6</td>
<td>-FTE, -FME, -FSB</td>
</tr>
<tr>
<td>Internal carotid artery</td>
<td>6</td>
<td>-FTE, -FME, -FSB</td>
</tr>
<tr>
<td>AV Fistulas &amp; Grafts</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Radial artery</td>
<td>2, 3</td>
<td>-FMV, -FSB</td>
</tr>
<tr>
<td>Brachial artery</td>
<td>3, 4, 6</td>
<td>-FMV, -FTV, -FSB</td>
</tr>
<tr>
<td>Graft venous outflow</td>
<td>4, 6</td>
<td>-FMV, -FTV, -FSB</td>
</tr>
</tbody>
</table>

### Abdominal

<table>
<thead>
<tr>
<th>Vessels</th>
<th>Probe Sizes (mm)</th>
<th>Probe Series</th>
</tr>
</thead>
<tbody>
<tr>
<td>Renal bypass</td>
<td>4, 6</td>
<td>-FMV, -FTV, -FSB</td>
</tr>
<tr>
<td>Aorta</td>
<td>16, 20</td>
<td>-AU, -FSB</td>
</tr>
<tr>
<td>Common iliac artery</td>
<td>10, 12</td>
<td>-FMV, -AU, -FSB</td>
</tr>
<tr>
<td>Portocaval shunt</td>
<td>10, 12, 14</td>
<td>-FMV, -AU, -FSB</td>
</tr>
<tr>
<td>Splenorenal shunt</td>
<td>10, 12, 14</td>
<td>-FMV, -FTV, -AU, -FSB</td>
</tr>
</tbody>
</table>

### Lower Extremity Bypass

<table>
<thead>
<tr>
<th>Vessels</th>
<th>Probe Sizes (mm)</th>
<th>Probe Series</th>
</tr>
</thead>
<tbody>
<tr>
<td>Profunda femoris</td>
<td>8</td>
<td>-FMV, -FTV, -AU, -FSB</td>
</tr>
<tr>
<td>Common femoral</td>
<td>8, 10</td>
<td>-FMV, -FTV, -AU, -FSB</td>
</tr>
<tr>
<td>Popliteal</td>
<td>4, 6</td>
<td>-FMV, -FTV, -FSB</td>
</tr>
<tr>
<td>Tibial</td>
<td>3, 4</td>
<td>-FMV, -FTV, -FSB</td>
</tr>
</tbody>
</table>

### Microvascular Surgery

<table>
<thead>
<tr>
<th>Vessels</th>
<th>Probe Sizes (mm)</th>
<th>Probe Series</th>
</tr>
</thead>
<tbody>
<tr>
<td>Microvessels in hand, wrist</td>
<td>0.7, 1, 1.5, 2, 3</td>
<td>-MU</td>
</tr>
</tbody>
</table>

Transonic is the measure of better results.
Transonic® Flowmeters
Versatile Systems to Optimize Flow

Choose the Flowmeter That Best Fits Your Needs

Establishing adequate blood flow is a prime objective of any cardiovascular procedure. But without definitive measurements, one really doesn’t know exact flow. Transonic’s Flowmeters give you this information.

Moreover, you can choose the flowmeter that best fits your needs. They include:

- **Single-channel** Optima Flowmeters (key-activated or non key-activated)
- **Dual-channel** Optima Flowmeters (key-activated or non key-activated)
- An Optima Flowmeter integrated into the state-of-the-art Aureflo
Optima Flowmeters®

Transonic Optima® Flowmeters provide immediate, quantitative flow measurements to ensure vessel and graft patency with unsurpassed accuracy and resolution.

The Optima Flowmeter complements a full line of Perivascular Flowprobes for vessels from 0.5 mm to 36 mm in diameter and our Tubing Flowsensors for tubing with 1/8 to 1 1/4 inch outer diameters.

Key-activated and Keyless Systems

- Key-activated HT354 single-channel and HT364 dual-channel Flowmeters for US and Canada placement. An Optima Key is required for each use.

The AureFlo®

AureFlo® display of recorded LIMA-LAD volume flow waveform (systolic flow volume in red; diastolic in blue). Also displayed are mean flow in mL/min, pulsatility index, D/S Ratio, ECG tracing and heart rate.

Case Portfolios: Record, Display, Create

- Recordings and snapshots can be labeled for identification before and after the procedure
- Select 8-second snapshots from recorded measurements for review or documentation
- Generous memory space allows storage of many cases
Versatile Display
- Touch-screen PC uploaded with FlowTrace® software
- Easy to read, high contrast display
- Display can be connected to an OR monitor

Intuitive Operation
- Quick and easy data entry
- Measure, capture, store and retrieve flow information

Archive & Retrieve
- Enhance operative notes and referral feedback
- Review case recordings remotely
- Print selected waveforms for reference, analyzing, teaching or documenting into the patient record

Convenient & Portable
- Small footprint, easy mobility
- Stable cart that securely holds Flowmeter, Monitor & printer
- Convenient writing surface and storage drawer

Why rely on guesswork and intuition, and wait until postoperative conditions determine surgical success? Make intraoperative flow measurements with a Transonic Flowmeter part of your routine to verify establishment of adequate blood flow before closing your patient.
Transonic®: The Flow Pioneer

Transonic, the recognized leader in clinical and research blood Flowmeters, is rooted in university research. The company was founded in 1983 by its current President Cornelis Drost and fellow collaborators at Cornell University’s College of Veterinary Medicine to commercialize the transit-time ultrasound flowmetry devices pioneered by the group.

From its initial animal research market niche, Transonic evolved into the market leader for innovative medical flow measurement instrumentation. Examples include:

- Transonic’s transit-time non-constrictive Perivascular Flowprobes, now the intraoperative quality assurance standard for beating-heart coronary bypass surgery.
- Its intraoperative bayonet-style Flowprobes help avert intraoperative stroke encountered during aneurysm clipping procedures, EC/IC bypass and other cerebrovascular procedures.
- Transonic’s Clamp-on Tubing Sensors are an integral component of ventricular assist devices, organ preservation units, ECMO and cardiopulmonary bypass circuits.

“Accurate flow measurements can be of great assistance during vascular reconstructive surgery. The primary aim with these intraoperative measurements is to obtain information on the immediate result of the reconstruction, where a technical failure may jeopardize an otherwise successful operation.”

A Lundell, MD, FACS

“Not a day goes by that these flow measurements don’t solve a problem for me.”

B. Mindich, MD

“...at the Medical Center here, we use the flowprobe as part of our routine monitoring the post-bypass patient. It gives us intraoperatively information about what’s transpiring with each individual graft. It’s not information that you could get any other way.”

E. Grossi, MD

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 Hangsien 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

**European Revascularization Guidelines**
“Graft flow measurement, related to graft type, vessel size, degree of stenosis, quality of anastomosis, and outflow area, is useful at the end of surgery. Flow <20 mL/min and pulsatility index >5 predict technically inadequate grafts, mandating graft revision before leaving the operating theatre.”

1 The Task Force on Myocardial Revascularization of the European Society of Cardiology (ESC) and the European Association for Cardio-Thoracic Surgery (EACTS) “Guidelines on Myocardial Revascularization,” Eur J CardiothoracSurg 2010; 38, S1 S52

“Transonic Flow-QC® provides a measurable improvement in the quality of care you can extend to your patients. You can: improve patient outcomes; reduce or delay the need for future interventions and document surgical results.”

T. Wolvos, MD, FACS

TRANSIT-TIME ULTRASOUND TECHNOLOGY
MEASURES VOLUME FLOW, NOT VELOCITY

Two transducers pass ultrasonic signals through the vessel, alternately intersecting the vessel in upstream and downstream directions. The difference between the two transit times yields a measure of volume flow.